



Steven A. Hunt & Associates

HEYWOOD CIVIC CENTRE

ELECTRICAL SERVICES SPECIFICATION



REF: 4026
DATE: APRIL 2024

Harnessing all **elements** of Mechanical and Electrical Engineering





Steven A Hunt & Associates

Issue Status

Preliminary Issue – P1	February 2024
Preliminary Issue – P2	February 2024
Preliminary Issue – P3	March 2024
Tender Issue – T1	April 2024

AUTHOR:

VERIFIED BY:

CONTENTS	PAGE NO.
SECTION 1 - TECHNICAL DESCRIPTION OF WORKS	8
1.0 SCOPE OF WORKS	8
1.1.1 General	8
1.1.2 Description of the Project	8
1.1.3 Definitions	10
1.1.4 Drawings	11
1.1.5 Site Visits	12
1.1.6 Submissions with Tender	12
1.1.7 Specialist Quotations	12
1.1.7 Builderswork	13
1.1.9 Removal of Existing	13
1.2 LV DISTRIBUTION	14
1.2.1 Sub Mains Distribution	14
1.2.2 Sub Mains Distribution Boards	14
1.2.3 Sub Mains Distribution Cable	15
1.2.4 General Installation Works	16
1.2.5 Distribution Cable Tray & Basket Systems	16
1.2.6 Distribution Cable Trunking Systems	18
1.2.7 System Earthing and Equipotential Bonding	19
1.3 GENERAL EQUIPMENT	19
1.3.1 Conduit	19
1.3.2 Conduit Boxes	19
1.3.3 PVCu Conduit	20
1.3.4 PVCu Conduit Boxes	20
1.3.5 Uni-Channel	20
1.3.6 Cabling	20
1.3.7 Putty Pads	21
1.3.8 Flexible Conduit	21
1.3.9 Dado Trunking Systems	22
1.3.10 Equipment Safety & Accessories	23
1.4 LIGHTING	23
1.4.1 General Lighting Installation	23
1.4.2 Lighting Controls	26
1.5 EMERGENCY LIGHTING	26

1.6	SMALL POWER, MECHANICAL SYSTEMS & EQUIPMENT POWER SUPPLIES	27
1.6.1	General	27
1.6.2	Supplies to Specialist Systems	27
1.7	MECHANICAL PLANT WIRING	28
1.8	FIRE ALARM SYSTEM	29
1.9	INTRUDER ALARM SYSTEM	31
1.10	ACCESS CONTROL & ENTRY SYSTEMS	31
1.11	CCTV INSTALLATION	33
1.12	PUBLIC ADDRESS INSTALLATION	35
1.13	STRUCTURED WIRING SYSTEM	35
1.14	PV SYSTEM	39
1.15	SPECIALIST LIGHTING/SOUND SYSTEMS	41
1.16	LIGHTNING PROTECTION	41
1.17	TESTING & COMMISSIONING	42
	SECTION TWO - GENERAL CONDITIONS / PREAMBLES	43
2.1	TENDER INSTRUCTIONS	43
2.2	CONTRACT DUTIES	51
2.3	FORM OF CONTRACT	52
2.4	DUTIES OF THE CONTRACTOR	52
2.5	CONSTRUCTION (DESIGN & MANAGEMENT) REGULATIONS 2015	53
2.5.1	Health & Safety Information	54
2.5.2	Risks to Health & Safety	54
2.6	DEFINITIONS	54
2.6.1	Technical Definitions	54
2.6.2	Drawing Definitions	55
2.7	SITE CONDITIONS	59
2.8	INFORMATION PROVIDED BY THE EMPLOYER TO SITE AND OTHER CONDITIONS	60
2.9	MATERIALS AND WORKMANSHIP	60
2.10	DELETERIOUS (PROHIBITED) MATERIALS	61
2.11	PROGRAMME	62
2.12	PROCUREMENT, PLANT AND MATERIALS	63
2.12.1	Specialist Contractors	63
2.12.2	Responsibility for Suppliers	63
2.12.3	Samples	64
2.12.4	Site Delivery	64
2.12.5	Name Plates & Labels	64

2.12.6	Handling & Storing Materials & Products	64
2.12.7	Erection of Plant	65
2.12.8	Quality of Services	65
2.12.9	Standardisation	65
2.12.10	Plant and System Selection	65
2.12.11	Recommended Spare Parts:	67
2.13	DRAWINGS	67
2.13.1	Tender Drawings	67
2.13.2	Contract Drawings	68
2.13.3	Installation Drawings (Working Drawings)	68
2.13.4	Manufacturer's Drawings	69
2.13.5	Builderswork Drawings	69
2.13.6	Examination of Drawings/Information	69
2.14	BUILDERSWORK	69
2.15	INSTALLATION	70
2.15.1	Co-Ordination	70
2.15.2	Progress and Monitoring	70
2.15.3	Attendance	71
2.15.4	Labour & Supervision	71
2.15.5	Painting & Anti-Corrosion Treatment	72
2.15.6	Fixing To Building Fabric	72
2.15.7	Room Terminal Locations	73
2.15.8	Positions of electrical outlet points on drawings	73
2.15.9	Final Connections	74
2.15.10	Interruption of Existing Services	74
2.15.11	Connecting To Existing Services	75
2.15.12	Public & Private Services	75
2.15.13	Existing Services – Connections and Utilisation in the Project	75
2.15.14	Notice Prior To Cover	75
2.15.15	Protection of the Installation	76
2.15.16	Removal of Rubbish & Cleaning	76
2.15.17	Notices & Labels	76
2.15.18	Materials	77
2.15.19	Fire Precautions	77
2.15.20	Electric Supply	77
2.15.21	Design Intent	77
2.15.22	Access to Plant	77
2.15.23	Acoustic Control of Plant	78

2.15.24	Electromagnetic Compatibility	78
2.15.25	Software	78
2.15.26	Rotating Plant	78
2.15.27	Testing and Commissioning of Services	78
2.16	SUPPLY CONNECTIONS AND LOCAL AUTHORITIES	80
2.17	PRACTICAL COMPLETION OF WORKS	81
2.17.1	Systems Used Before Practical Completion	81
2.17.2	Training of Employer's Staff	81
2.17.3	Proposals for Annual Maintenance Contract	82
2.18	12 MONTHS DEFECTS LIABILITY PERIOD	82
2.18.1	Obligations during Defects Liability Period	83
2.19	OVERTIME	83
2.20	TEMPORARY POWER, LIGHTING AND WELFARE	84
2.21	VARIATIONS	84
2.22	VALUE ADDED TAX	84
2.23	PROVISION OF RECORD DOCUMENTS	84
2.23.1	General	84
2.23.2	Operating & Maintenance Instructions	85
2.23.3	Record Drawings	88
2.23.4	Plant Room and Switch Room Record Drawings, Schedules and Schematics	90
2.23.5	Electronic Operating and Maintenance Manuals	90
2.23.6	Building Log Book	91
2.24	BUILDING USER GUIDE	91
2.25	PATENT	94
SECTION THREE – ELECTRICAL STANDARD SPECIFICATION		95
3.1	GENERAL	95
3.2	STANDARD INSTALLATION REQUIREMENTS	95
3.3	ARRANGEMENT OF ELECTRICAL SERVICES	95
3.4	PROTECTIVE PAINTING	95
3.5	FIXINGS	97
3.6	EARTHING	100
3.7	EQUIPOTENTIAL BONDING	103
3.8	LIGHTNING PROTECTION	104
3.9	CIRCUIT PROTECTIVE CONDUCTORS	107
3.10	ACCESSORIES	108
3.11	SWITCHES AND SWITCH SOCKETS	115
3.12	COOKER CONTROL UNITS	116

3.13	MOUNTING HEIGHTS	116
3.14	LUMINAIRES	117
3.15	CABLE GROUPING AND ROUTING	123
3.16	CONDUIT	124
3.17	PVCu CONDUIT	129
3.18	FLEXIBLE METALLIC CONDUIT	130
3.19	ADAPTABLE BOXES	131
3.20	CABLE TRAY & BASKET SYSTEMS	131
3.21	LADDER RACK	136
3.22	CABLE TRUNKING	136
3.23	PVCu TRUNKING	139
3.24	DADO TRUNKING	140
3.25	CABLE INSTALLATIONS GENERALLY	141
3.26	CABLES IN CONDUIT AND TRUNKING	147
3.27	ARMOURED CABLES	148
3.28	FP 200 CABLES	149
3.29	XLPE INSULATED/ LSZH SHEATHING CABLES	150
3.30	FLEXIBLE CABLES	151
3.31	SPECIAL CABLE	151
3.32	SWITCHBOARDS AND PANELS	152
3.33	DISTRIBUTION GEAR	159
3.35	MOTOR TERMINATIONS	164
3.36	LABELLING	165
3.37	TESTING AT ELECTRICAL SUB-CONTRACTORS WORKS	170
3.38	TESTING & COMMISSIONING OF ELECTRICAL SERVICES	171
3.39	APPLICATION FORMS AND TEST NOTICES	173
3.40	INSTRUCTIONS ON OPERATION	173
3.41	COMPLETION PROCEDURE	174
	SECTION FOUR - TENDER SUMMARY	175
4.1	TENDER BREAKDOWN	175
4.2	DAYWORK RATES	177
4.3	COLLUSION	178
4.4	SUB-CONTRACTORS	179

SECTION 1 - TECHNICAL DESCRIPTION OF WORKS

1.0 SCOPE OF WORKS

1.1.1 General

This specification and associated tender drawings have been prepared by:

Steven A. Hunt & Associates
Hangar 9
De Havilland Drive
Speke
Liverpool
L24 8RN
Tel: 0151 427 8009
Contact for this scheme: Edward Raven

The Contractor shall read this specification in conjunction with all other tender documents.

1.1.2 Description of the Project

The project involves the refurbishment and extension of the existing Heywood Civic Centre building which includes for the stripping out and remodelling of the of the existing buildings layout. The purpose of the work is to reinvigorate and reenergise the Heywood Civic Centre building which serves vital purposes in bringing the local community together. Upgrades shall be made to the interior design to make it both comfortable and community-centred all while maintaining its functionality for the buildings purposes. The building shall consist of 3 main areas with 3 level changes. These include the front of house with a lower middle and upper ground floors, back of house with a lower middle and upper ground floors and a generous double height multipurpose auditorium.

The front of house area shall show off the entrance to the building which is the middle ground floor this consists of a generous double height extension with floor to ceiling glass windows. This then leads through into the new bar and lobby area. The lobby has a general seating area which shall be multi-purpose to facilitate the use of the bar, café, flexible working and waiting area. Also on this floor there is the new kitchen area which serves the café an accessible toilet with shower facilities and an additional toilet space.

The upper ground floor spaces on the left hand side consist of a creche, multifaith room and toilet space which are all accessible via a staircase or platform lift. The right hand side upper ground floor spaces consist of a rehearsal room and specialist equipment space, this is accessible via a staircase.

The lower ground floor spaces on the left hand side consist of storage space and toilet facilities this is also mirrored on the lower ground floor right hand side spaces.

Leading on from the front of house is the middle of the building which houses the main room the auditorium/multipurpose space. This shall be the heart of the building for multipurpose activities and performances. This room shall be complete with an upgraded viewing room and storage space to utilise all areas.

The back of house area shall be the main area for staff and performers and also a rear entrance for Cartwheel arts to gain access to the building. On the middle ground floor the rooms shall consist of a changing space and a toilet room.

The upper ground floor spaces on the left hand side consist of a flexible working area for the Cartwheel arts office and a small quaint meeting room, these spaces are accessible via the auditorium and a platform lift. The right hand side upper ground floor spaces consist of a changing room and accessible toilet space this is accessible via a staircase or platform lift.

The lower ground floor spaces on the left hand side consist of storage space and the main plant room for the building. The lower ground floor right hand side spaces facilitate another changing space which leads to a toilet area and the server room for the building.

The electrical contractor is responsible for the supply of all labour, supervision, transportation, materials and supply of plant and equipment necessary to install and test a complete and functioning installation as outlined below.

- LV Distribution
- General and Emergency Lighting installation
- Small Power installation
- Mechanical Plant Wiring
- Fire Alarm installation
- Intruder Alarm installation
- Access Control installation
- Structured Wiring installation
- PV installation
- Containment installation
- Commissioning and testing.

The sub-contractor is to prepare a tender for supplying, installing and commissioning the services as detailed within this Specification and as per the accompanying drawings the Architect's drawings and the Structural Engineers drawings.

This specification MUST be read in conjunction with all other tender information and drawings issued under this contract. If any anomalies exist, the Contractor must clarify these during the tender period. No claims will be considered after the tender period due to lack of information.

The Contractor shall carry out the supply and installation of all services described herein in accordance with the general, technical, and specific material requirements, and as required by the following:

- Statutory Authority Requirements
- Local Authority Regulations
- Building Regulations including Fire Officers Requirements
- The Health & Safety Regulations (1974)
- Electricity, Water Authority Regulations or Byelaws
- Latest IEE Regulations for Electrical Installations (18th edition)
- Relevant British Standards
- CDM Regulations
- CIBSE Design Manuals, Technical Memoranda and Recommendations
- ILE Guidance Note on reduction of unobtrusive light
- Requirements of Legionella Prevention in Buildings
- Water Regulations

Any clarification required in relation to the meaning or importance of the Tender Documents shall be dealt with during the tender period and a full financial allowance shall be incorporated into the tender submission.

The tender must include documents without exclusions in any respect. The substance and conclusion relating to any clarification of the tender shall be circulated to all Tenderers.

Upon completion the entire installation is to be tested and left in full working order allowing the client immediate use of all facilities following practical completion.

1.1.3 Definitions

The term 'Works' shall mean the whole of the engineering services, and associated builder's work, described in this Specification and detailed on the drawings enumerated hereinafter.

The term 'Employer' or 'Client' shall mean;

Rochdale Development Agency
Number One Riverside
Smith Street
Rochdale
OL16 1XU

The term 'Architect' shall mean;

K2 Architects
1st Floor, Compton House
18 School Lane
Liverpool
L1 3BT

The term 'Main Contractor' shall mean;

TBC

The term 'Quantity Surveyor' shall mean;

Identity Consult
3 Caxton Rd
Fulwood
Preston
PR2 9ZZ

The term 'Structural Engineer' shall mean;

Sutcliffe
18-20 Harrington Street
Liverpool
L2 9QA

The term 'Services Engineer' shall mean;

Steven A. Hunt & Associates Ltd.
Hangar 9
De Havilland Drive
Speke
Liverpool
L24 8RN

Tel: 0151 427 8009

The term 'Main Contractor' shall mean the contractor engaged to carry on the complete works for the project.

The term 'Mechanical Contractor' shall mean the Sub Contractor engaged to carry out the Works described in this Mechanical Specification.

The term 'Electrical Contractor' shall mean the Sub-Contractor engaged to carry out the electrical Section of Works described in the electrical Specification.

The term 'Designer' shall mean the design engineer engaged by the Employer to carry out the Section of Works described in this Specification.

The term 'Specialist Sub-Contractor' shall mean the Contractor engaged by the Sub Contractor to carry out certain works under Domestic Sub-Contract Agreements, having first gained the approval of the Employer, which will not be unreasonably withheld.

The Main Contractor shall ensure that all Contractors comply with all parts detailed in this Specification.

1.1.4 Drawings

The drawings accompanying this Specification are full design drawings. The contractor shall prepare their own working, fabrication and builders work drawings based on the design drawings.

The contractor shall allow within their programme for the production of the same and submission for approval prior to any works commencing on site. They shall allow a period of 10 Days for approval of the drawing following which, comments shall be incorporated and the drawings issued a fully coordinated working drawings.

The contractor shall allow for the issue of all drawings in electronic format (PDF and AutoCAD) and for 2 paper copies of the same to be issued to the main contractor, Architect and Engineer for comment and approval.

These shall be updated throughout the duration of the contract in line with any variations that take place.

Please refer to the Drawing Issue Sheet for the drawings accompanying this specification.

1.1.5 Site Visits

The sub-contractor is **strongly** recommended to visit the site as no claim will be accepted by the Consulting Engineer with respect to the lack of knowledge of the building and the constraints within it as well as the extent of existing services.

Without this visit the electrical sub-contractor will not be able to provide a tender bid that provides a true reflection of the works required and as such any additional claims for costs after the tender submission shall not be accepted.

1.1.6 Submissions with Tender

The electrical sub-contractor shall submit with the tender the following information:

- a) The completed tender breakdown. It should be noted that there is strict control on the funding of this project and it is extremely important that the cost breakdowns indicated in the tender are adhered to.
- b) A covering letter with any discrepancies and exclusions.
- c) Notification of any variations to the Specification and explanations for a change required.
- d) Notification of any extended delivery periods, i.e. any items of equipment over six weeks.
- e) All sub-contractors proposed for the project shall be declared within the tender package.
- f) Project risk assessments.
- g) Material procurement schedules.

All of the above information shall be submitted with the tender and within the specified date and time. Failure to comply with this requirement may disqualify the tender.

1.1.7 Specialist Quotations

Within this Specification reference may be made to specialist suppliers and sub-contractors' quotation references. It is the electrical sub-contractor's responsibility to ensure these quotations include for all works, quantities and details as specified herein and shown upon the accompanying drawings. The Design team shall not be responsible for the verification of such quotes. **The tender drawings and specification represent the final design intent.**

The Main Contractor will accept no claim by the electrical sub-contractor for any misinterpreted details or quantities derived from a quotation.

1.1.7 Builderswork

Holes through walls/floors for Trunking/Traywork and chases for Conduit drops shall generally be marked on site. However, if any part of the works requires a more detailed builders work provision, builders work drawings shall be issued to the main contractor as necessary.

All builders work shall be submitted to satisfy the main contractor's programme of works.

Should it not be possible to exactly define a builder's work requirement for any reason within the agreed programme this must clearly be stated to the Consulting Engineer within good time to enable suitable action to be taken.

Should any builders work requirement not be defined on the drawings or should a detail be incorrectly shown any alterations that may arise as a result may be subject to a charge by the main contractor.

1.1.9 Removal of Existing

The Electrical Contractor, Structured Wiring, Fire Alarm and Security specialists shall include within their works for the removal of all existing redundant equipment to accommodate the new installation. This shall include all redundant wiring and containment systems.

The electrical sub-contractor shall include within his offer the inclusion of any necessary temporary wiring or fixtures required to allow the revamp works to progress and to maintain the day-to-day protection to the building.

In order to assess the requirements of this section of works the contractor is to visit site and familiarise himself with the existing services. No claim will be accepted by the Client with respect to lack of knowledge of the building structure and the extent of the existing services.

Only a site visit will provide a true reflection as to the extent of the existing services and the requirements with regards to the removal works. We would expect this to be carried out during the tender period.

The electrical sub-contractor shall include for all necessary costs associated with the safe and correct removal and disposal of all redundant equipment off site.

The electrical sub-contractor shall also ensure when removing services that all the correct shutdown procedures and notices are carried out in line with Standard HSE procedures. Before any isolations or disconnections are carried out the contractor shall check to ensure that the respective system isolated is not linked to any services that are required to remain operational during the contract period.

The Fire Alarm & Security systems will be required to be maintained within all areas throughout to ensure the building is afforded protection during the out of hours periods throughout the construction period. Protection covers or exchanging the existing smoke detectors to heat will be required during working hours to ensure there are no false alarms.

The electrical sub-contractor shall include for any necessary out of hours working to carry out any of the removal or reconnection works of any of the associated Electrical Services or Specialist systems or for working in areas that are not accessible during normal working hours.

The Electrical Sub Contractor will consult with the main contractor with regards to the proposed programme of works so he can make the necessary allowances within his tender bid for works that are to be carried out during out of hours working.

1.2 LV DISTRIBUTION

1.2.1 Sub Mains Distribution

The mains incoming cable is to be upgraded to a system with a supply load of 300kVA. The contractor is to coordinate with the client and Electricity north west for the timely installation and supply of this system.

Within the basement plant room the electrical contractor shall strip out the existing main panel board and replace with a Schneider Electric form 3b type 2 630A 18-way panel board as cat No MG6C18. The new panel board shall have sub metering for each outgoing sub main.

The electrical contractor shall allow for installing new sub mains cable/tails and trunking from the utilities service head to the new switchboard.

The existing supply cable shall be retained up until the utility company has finalised their works. When the switchover takes place the Rochdale council shall need to be informed as the existing server houses the CCTV network for the area which needs to remain energised during the installation.

Electricity North West
Energy Solutions
Frederick Road
Salford
M6 6QH

1.2.2 Sub Mains Distribution Boards

Distribution boards shall take the form of metal clad surface mounted MCB Units with integral main isolator and hinged lockable, front cover to conform to BS EN61439-3 2012. They shall include a fully shrouded and insulated main busbar assembly; the shrouding over line conductors must be non-removable.

The number and rating of MCB's and combined MCB/RCD's or blanking plates shall be as shown in the circuit design data and upon the accompanying drawings. Each shall be left upon completion with the facility of a 25% spare capacity so as to accommodate future services.

Manufactured and supplied by:
Schneider Electric Ltd
Low Voltage Devices
Ford house Road
Wolverhampton
WV10 9ED
T: 01952 290029
Contact – Paul Richards
Tel – 07815 425390

Distribution board shall be Acti 9 Isobar B type 3 phase
With 125A and 250A switch disconnectors and ways to suit
125A switch disconnector – SEA91253N
250A switch disconnector – SEA9N12503

All boards shall come with Power Logic Multimeters as MET SEPM5111
Metering enclosures as SEA 9BNMETE including CT's.

Combined MCB/RCD's shall be of the single module type to minimize the space taken within the distribution boards. All MCB's shall be of the minimum 10KA rating and of the type 'C' range for lighting and motor circuits and of the type 'B' for general power circuits.

Contactors will also form part of the associated distribution arrangement and will be enclosed within a housing attached to the bottom of the distribution board as per the manufacturer's recommendations. These items shall be clearly labelled and cabling to the equipment will be 'boot lace' ferruled and marked to indicate its circuitry.

Contactors will be of the anti-chatter type suitable for excessive operation and of minimal rating 40A. Connection and dressing of the cabling within each distribution board shall be in a neat and unobstructive manner so as to facilitate future installations, cable marked to identify each leg of each circuit.

Provision is to be made on the inside of the doors for numbering and describing the various outgoing circuits.

This is to be completed at the termination of the contract in clear type black printing ink or similar permanent marking on white card.

Identity labelling shall be on the external front face of the distribution board identifying source and description.

The distribution board shall be positioned and fed as indicated upon the accompanying drawings at a height as detailed with the maximum height of the highest MCB shall not exceed 1900mm.

Trunking connecting to the distribution board shall be run to the top and bottom of the boards for the entirety of their width. It shall be slotted as per the distribution board to accept incoming and outgoing cabling, and correctly insulated and grommited to prevent damage to the cables.

1.2.3 Sub Mains Distribution Cable

Cables shall be installed upon galvanised steel type MDRF & HDRF type galvanised steel cable trays.

This cabling shall have shaped copper conductors; XLPE compound insulated taped steel wire armouring and LSZH compound over sheath. They shall be suitable for 600/1000-volt grade and complete with manufacturers recommended and approved indoor type cable terminations to be manufactured in accordance with BS6346.

Earth type rings shall be installed with each termination and bolted to the panel accordingly accepting and extending the same size earth cable to the local earth bar within the distribution board as per that running with the boards supply cable.

Means of fixing to the cable tray will be via heavy duty LSZH cable ties suitably sized to accommodate the cabling. They should be spaced at a maximum of 500mm with cabling of diameter of 25mm or over being individually tied.

These cables will be routed upon the containment systems in sequential order so as correctly exiting the traywork at key positions so as maintaining a neat & unobtrusive installation.

Untidy systems will not be accepted, and cabling installed in this fashion will be removed and replaced by the Electrical Sub-contractor at his own expense.

Where cabling is not installed upon traywork, one-piece heavy duty non-corrosive cleats of high impact LSZH plastic, system grouped as required and of a size and pattern recommended by the manufacturer are to be used.

Manufacturer: Prysmian Cables Limited or AEI Cables Limited.

Accessories: Prysmian Cables Limited or AEI Cables Limited.

1.2.4 General Installation Works

The methods of installation of services to accommodate the General Lighting, Emergency Lighting, Small Power, Mechanical Plant Wiring and Specialist Plant supplies shall be by a fully contained rewirable system.

The installation shall be as far as is practical contained within the fabric and as such the Electrical sub-contractor shall carefully plan his cabling routes to each of the areas considering all of the building structure and fabric restraints.

Wiring systems within all areas shall comprise of LSF twin and earth cabling installed within surface mounted galvanised steel tray systems and surface or recessed mounted galvanised steel conduit systems.

Careful consideration of all conduit runs is required by the electrical sub-contractor to ensure co-ordination with the other services and to overcome the restraints within the building structure.

Installation of services will generally be exposed within the ground floor workshop area and careful planning and consideration will be required to ensure the installation is as aesthetic pleasing as possible.

Fire rated type 'Putty Pads' shall be incorporated to all flush accessory boxes positioned within fire rated party and partition walls. The M&E contractor will refer to the Architect drawings for specific wall types.#

1.2.5 Distribution Cable Tray & Basket Systems

The electrical sub-contractor shall supply and install various & separate distribution cable tray & cable basket systems to accommodate Sub Mains distribution cabling, Telecom, Data services cabling, Fire Alarm cabling and ELV services cabling.

The general indicative dispositions of the distribution routes are indicated upon the accompanying drawings. However, it should be noted that only main routes are indicated on these drawings and no claim will be accepted by the Consulting Engineer for additional routes that the contractor may deem required to complete or assist his installation.

Final positioning of all tray work routes will be developed within the production of the co-ordinated design working and installation drawings which are to be produced by the Electrical Sub-contractor

The Sub Mains systems will be of the galvanised Steel, MDRF & HDRF type cable tray.

Fire Alarm, ELV, Data systems will be of the galvanised steel basket tray type.

These systems in the main will be exposed as there will be limited suspended ceilings. As such the electrical sub-contractor will need to carefully plan all routes ensuring all installed systems are provided to a high-quality neat finish.

The Sub-mains tray will be of perforated sheet steel type compliant with BS EN 61537 and Hot-Dip Pre-Galvanised to BS EN 10346, self-coloured galvanized finished complete with steel angle supports, brackets and external earth bonding straps as recommended by the manufacturer. Heavy duty return flanged type cable tray is to be used for the distribution system for trays of sizes of 225mm and above, but below this size, medium duty return flanged cable tray is to be used.

On heavy duty tray the return flange shall be of a minimum height of 50mm and to the medium duty tray it shall be of minimum height of 25mm.

The cable basket will be of perforated hot dipped galvanised C4D steel rod compliant with BS EN 61537 & Hot-Dip Pre-Galvanised to BS EN 10244 with brackets and external earth bonding straps as recommended by the manufacturer.

The Fire Alarm, ELV & Data systems will follow similar routes to those identified above for the Sub Mains containment. In general, the Fire Alarm, ELV & Data containment will be a singular Basket tray suitably sized and equipped in their entirety with segregation plates required for each service.

The electrical sub-contractor shall carefully manage each of his specialist sub-contractors ensuring cabling installed by each sub-contractor is correctly and neatly installed to the Basket traywork systems.

Bracketry supporting the tray work systems shall be purpose made utilising 41 x 41 Steel channel and associated accessories complete with 10mm stud iron and specialist manufacturers steel framework fixings, e.g., Erco, Furse, Unistrut etc. Within any risers 21x41mm Unistrut may be used due to the minimal space available within these areas. Spacing of bracketry shall be as per manufacturers recommendations to provide a minimum deflection of 2mm. Prior to installation, design proposals with respect to the positioning and forming of all bracketry shall be submitted to the Consulting Engineer and Structural Engineer for approval. The tray work shall be securely fixed down to each of the brackets.

Installation of tray work systems shall be in close liaison with other trades to ensure co-ordination of services. The electrical sub-contractor shall carefully examine the Architects and Structural Engineers detailed section drawings as no claim will be accepted by the Consulting Engineer with respect to lack of knowledge of the building structure.

All required necessary bends, tees and sets shall be included for by the electrical sub-contractor as deemed necessary to complete his installation whilst maintaining co-ordination with all other services and the restraints of the building structure and its proposed finishes.

The electrical sub-contractor shall make the necessary allowance for these provisions within his tender offer.

Fire barrier protection shall be inclusive where passing through a barrier wall or fire blanket within the ceiling void. Reference to all Fire compartmentation shall be as per detailed on the Architects drawings

All traywork systems used throughout for this project will be of the same type & manufacturer. Traywork systems to be utilised by the Electrical sub-contractor will be approved by the Consulting Engineer

1.2.6 Distribution Cable Trunking Systems

The electrical sub-contractor shall supply and install a distribution cable trunking system to accommodate sub-main cabling, specialist power services cabling, general lighting and small power services throughout the building.

The general indicative dispositions of the distribution routes are indicated upon the accompanying drawings. However, it should be noted that only main routes are indicated on these drawings and no claim will be accepted by the Consulting Engineer for additional routes that the contractor may deem required to complete or assist his installation.

Final positioning of all trunking routes will be developed within the production of the co-ordinated design working and installation drawings which are to be produced by the Electrical Sub-contractor

The main extent of these trunking systems will be from each of the distribution units and control panels to distribute cabling to all of the field equipment.

These systems in the main will be exposed as there will be limited suspended ceilings. As such the electrical sub-contractor will need to carefully plan all routes ensuring all installed systems of provided to a high-quality neat finish.

The electrical sub-contractor shall carefully examine the Architects and Structural Engineers detailed section drawings as no claim will be accepted by the Consulting Engineer with respect to lack of knowledge of the building structure. The electrical sub-contractor shall make the necessary allowance for these provisions within his tender offer.

The trunking will be of standard section, in accordance with the drawings or as elsewhere specified. It will be manufactured from heavy gauge sheet steel to BS EN 10142:1993, compliant with BS EN 50085 & Hot-Dip Pre-Galvanised to BS EN 10346. It will be of the surface mounting pattern type with snap fit or MS overlapping cover plates secured by counter-sunk screws at regular intervals. Finish to be self-coloured galvanised.

All elbow, offsets, tees and other accessories etc. for the trunking systems will be as recommended and supplied by the manufacturer and each connection complete with external earth bonding straps (for equipotential bonding). The electrical contractor shall also include for manufacturers recommended fire barrier protection where trunking passes through fire barrier protection walls, floors or ceiling void fire curtains.

Where trunking drops to the distribution board positions, the electrical sub-contractor shall ensure that enough cable capacity is provided within the trunking so as not to exceed the cable grouping factors. In these instances, the sub-contractor shall provide a larger section of trunking than identified to drop to the distribution board and configure the trunking so that it runs along the whole top and bottom edges of the distribution boards and slotted and insulated accordingly.

Bracketry details to be as per described within the tray work section of this Specification where the bracketry is to be designed to accommodate power, LV and Data tray work systems as well as the trunking systems. Where the bracket is solely used for the trunking, it shall be installed as a maximum spacing of 1500mm. All trunking shall be securely fixed to each bracket.

Installation of all trunking systems shall be in close liaison with other trades to ensure co-ordination of services. All required necessary bends, tees and sets shall be included for by the electrical sub-contractor as deemed necessary to complete his installation whilst maintaining co-ordination with all other services and the restraints of the building structure and its proposed finishes.

The electrical sub-contractor shall make the necessary allowance for this provision within his tender offer.

Fire barrier protection shall be inclusive where passing through a barrier wall or fire blanket within the ceiling void. Reference to all Fire compartmentation shall be as per detailed on the Architects drawings

All trunking systems used throughout for this project will be of the same type & manufacturer. Trunking systems to be utilised by the Electrical sub-contractor will be approved by the Consulting Engineer.

1.2.7 System Earthing and Equipotential Bonding

The electrical installation is to be earthed in accordance with the 18th Edition of the IEE Regulations for Electrical Installations.

The electrical sub-contractor shall ensure that joints in the trunking and conduit are mechanically sound and electrically continuous by providing copper links to ensure equipotential bonding between these points. Links are to be in accordance with the manufacturers recommendations and are to be visible at all times.

Earth cabling to all socket outlet circuits shall be in compliance with regulation 543.7. of BS7671 IEE wiring regulations providing a dual earth facility to each outlet as well as earthing the accompanying back box.

The effectiveness of each of the earthing system shall be tested and the results recorded on a Test Certificate particular to the building to which it is installed.

1.3 GENERAL EQUIPMENT

1.3.1 Conduit

Shall comply in all respects with BS EN 61386. To be heavy gauge welded screwed galvanised steel type. All conduits to be free from internal burrs. The ends of all conduit lengths are to be reamed to a smooth finish. No conduit of a smaller diameter overall than 20mm to be used.

Manufacturer: Walsall Conduits Limited (Legrand Electrical), Barton Conduits (Hub Le Bas) or equivalent and approved.

1.3.2 Conduit Boxes

All boxes to be galvanised. Unless used in association with direct fixed equipment, all boxes are to be fitted with a steel cover lid fixed with brass screws and, where there is a possibility of moisture entering the boxes, they shall be provided with suitable watertight gaskets.

Standard circular conduit boxes shall be of malleable iron for all surface work or pressed steel where concealed in the building fabric. Male brass bushes and couplings shall be used for all adaptable or switch box entries.

Manufacturer: Walsall Conduits Limited (Legrand Electrical), Barton Conduits (Hub Le Bas) or equivalent and approved.

1.3.3 PVCu Conduit

Shall be manufactured in accordance with BS4607 and BS EN 61386-21 To be high impact, heavy gauge PVCu type.

The ends of all conduits are to be reamed to a smooth finish.

No conduit of a smaller diameter overall than 20mm to be used. Appropriate vinyl solvent of the water resistant type to be used on all connections. All surface installed conduits are to be securely fixed by means of spacer bar type saddle.

Bends shall be formed on site. No inspection junctions will be acceptable.

Manufacturer: Caradon MK Limited - Type/Range – HIP Manufacturer, Mita Trunkings Ltd, Marshall Tufflex Ltd or equivalent and approved.

1.3.4 PVCu Conduit Boxes

To be of the standard PVCu circular box. Unless used in association with direct fixed equipment, all boxes are to be fitted with a PVCu circular lid fixed with brass screws, and where there is a possibility of moisture entering the boxes they shall be provided with suitable water tight gaskets.

Female thread bush adapters are to be used for all switch box entries.

Appropriate vinyl solvent or the water resistant type to be used on all connections.

Manufacturer: Caradon MK Ltd, Mita Trunkings Ltd, Marshall Tufflex Ltd or equivalent and approved.

1.3.5 Uni-Channel

Shall comply to BS6949. pre-galvanised finished in standard lengths of 3 metre or 6 metre. Channel sizes to be either 41mm x 41mm or 21mm x 21mm section.

All fixings and accessories to be as per manufacturers recommendations.

Manufacturer: Unistrut Ltd or equivalent and approved.

1.3.6 Cabling

A LSZH Insulated, Non Sheathed (Mains and Final Circuit wiring)

Single core LSZH insulated only 450/750-volt grade cables having copper conductors of cross section as indicated on the drawings.

Ref - 6491B Cable (H07Z-R) LSZH (Low smoke Zero Halogen) manufactured to BS7211/BS EN 50525-3-41. The cable will be of the stranded plain annealed compacted circular copper conductor, low smoke and zero halogen (LSZH) outer sheath. 450/750 volts grade to BS7211/BS EN 50525-3-41. Acid gas emission to BS EN 50267 (IEC60754), smoke emission to BS EN 50268 (IEC 61034) and flame propagation to BS EN 50265 (IEC 60332), low smoke and zero halogen (LSZH). BASEC/LPCB or HAR approved

Manufacturer: Prysmain cables Ltd or AEI cables – No alternatives accepted

B XPLE/SWA/LSZH Steel Wire Armoured (Sub-main wiring)

Ref -: Mains LSZH manufactured to BS6724. The cable features stranded plain annealed copper conductors, XLPE insulated, low smoke and zero halogen (LSZH) extruded bedding,

galvanised steel wire armour, low smoke and zero halogen (LSZH) outer sheath. Black. 600/1000 volts grade to BS6724. Acid gas emission to BS EN 50267 (IEC 60754-1), smoke emission to BS EN 50268 (IEC 61034) and flame propagation to IEC 60332-1, IEC 60332-3, BS EN50265, Category C; BS EN 50266, low smoke and zero halogen (LSZH). BASEC/LPCB or HAR approved

They shall be c/w manufacturers recommended and approved indoor & outdoor type cable terminations to be manufactured in accordance with BS6346. Earth type rings shall be installed with each termination and bolted to the termination point accordingly accepting and extending the same size earth cable to the earth connection point within the equipment. Manufacturer: Prysmian cables Ltd or AEI cables Ltd to BS6724. (New harmonised coloured conductors).– No alternatives accepted

C FP Plus Cabling (Fire Alarm & Final Circuit Cabling).

300 to 500v rated LSF insulated, flame/electrostatic aluminium tape screened and robust thermoplastic LSOH sheathed cable coloured red. Fire resistant in compliance with BS6387 category CWZ and BS8434-4 **120min**. Conductors to be of minimum size 1.5mm², 2 core with separate CPC. (New harmonised coloured conductors)

Cabling to be BASEC and LPCB approved in accordance with the requirements of BS5839-1:2002 for enhanced applications

Accessories to be of the same range and matching colour.
Reference: FP Plus Gold

Manufacturer: Prysmian Cables.

D Flexible Cabling

Ref: 3183B (New harmonised coloured conductors)

Cable Specification: 3183B Cables, Zero Halogen Flexible Cords (HO5 ZIFI-F)- manufactured to BS EN50525-3-11. The cable will have plain annealed copper conductors, Low smoke and zero halogen (LSZH) insulated, low smoke and zero halogen (LSZH) outer sheath. Black or white. 300/500 volts grade BS EN 50525-3-11 Harmonised code HO5 ZIFI-F. Acid gas emission to BS EN 50267-2(IEC 60754-2), smoke emission to BS EN50268 (IEC 61034) and flame propagation to BS EN 50265 (IEC 60332-1). BASEC/LPCB or HAR approved

Note: *Where the luminaire's thermal temperature exceeds cable 85°C, silicon runner glass braided flexibles ref: 2793D to BS 6500 shall be used.*

Manufacturer: Prysmian Ltd or AEI Ltd (only)

1.3.7 Putty Pads

The Electrical contractor shall install Firestop putty pads into all back boxes to be installed within fire rated walls, sub compartment and compartment walls.

Manufacturer: Hilti CP 617 range or equivalent and approved.

1.3.8 Flexible Conduit

Galvanised steel flexible, liquid tight type tubing, having low acid, LSZH covering overall, complete with externally threaded clamp pattern brass adapters.

Manufacturer: Kopex type **LT-T-LFH**
or equivalent and approved

1.3.9 Dado Trunking Systems

As identified upon the accompanying drawings the electrical sub-contractor is to supply and install a cat 6a compliant 3-compartment 167 x 50mm dado trunking.

The dado trunking systems will have a curved top and bottom lid section as manufactured by Marshall Tufflex Ltd
Europa Trading Estate,
Stoneclough Rd,
Radcliffe,
Manchester M26 1GG

Contact : Des Tully

Tel: 077138 77243

Type: 167 x 50mm Dado trunking – **Sterling curve** c/w accessories to suit. (UPVC) installed in Tech room – RO-03

Type: 167 x 50mm Dado trunking – **Sterling curve Silver Grey** c/w accessories to suit. (Aluminium) installed in office areas

Standard white logic, twin socket outlet fascia's shall be fixed to these trunkings and single gang and twin gang outlet boxes shall be included to facilitate the installation of the Structured cabling system and their respective fascia plates.

The electrical sub-contractor shall allow for the supply and installation of Part M/DDA by including for a grey back box lip section to accommodate each of the socket outlets

Consideration of the furniture details must be included for when installing these trunkings systems as the consultant will accept no claim for lack of knowledge with respect to these instructions.

The electrical sub-contractor is to liaise with the furniture installer/main contractor to ensure the trunking system corresponds with his layout and that it is installed at the correct height to serve the various items of equipment.

Allocation of services to these trunkings systems shall be so that power services are located within the top section of the trunking. The bottom section is to be utilised for the provision of data cabling. All Accessory plates be positioned in the top section of the Trunking. Accessory boxes shall maintain segregation of the services.

Cabling to these trunking systems shall be by riser section of same specification or suitably numbered recessed 25mm heavy duty PVCu conduits, one for power, two for data and one spare complete with draw wires to facilitate any future cabling that may be required. These conduits shall be extended from the adjacent ceiling void trunking systems to connect rear to the trunking system.

The electrical sub-contractor shall ensure that all his cables and any specialist cabling are installed within the trunking system prior to the completion of the covers.

1.3.10 Equipment Safety & Accessories

In order to comply with the IEE Regulations, any equipment providing the source of supply to any sub-main or sub-circuit, if not already provided with a means of 'locked' isolation as standard, is to have this facility added by the electrical sub-contractor. Simple brackets of appropriate design and quality which, when required, will allow the fixing of a padlock by authorised persons, for the duration that the circuit(s) require isolation are considered suitable.

Accessories within the building are generally to be of the Honeywell MK White Logic Range. Metal clad shall be used within the ground floor workshop, with any external outlets being of the MK Master seal range.

All Data outlets will need to match the above criteria.

Isolator Units

Shall be of IP65 weatherproof type isolators:

Manufacturer MEM Limited

20A TPN - 207151

32A TPN - 207202

63A TPN - 207349

20A SPN - 207074

Or equivalent & approved

13a, twin, switched IP56 Weatherproof socket outlet

Manufacturer: Caradon MK Ltd

List No: - Masterseal Plus - 56482GRY

Or equivalent & approved

1.4 LIGHTING

1.4.1 General Lighting Installation

Luminaires to the identified areas are to be supplied and installed by the electrical sub-contractor. They will be of the make and pattern as scheduled upon the accompanying drawing. Each luminaire shown on the accompanying drawings has an inset letter or number making it identifiable by referring it back to the schedule.

The positions given for luminaires on the drawings are approximate only and the electrical sub-contractor is to verify these positions on site with the Consulting Engineer & the interior designer before the installation commences. The electrical sub-contractor shall be responsible for the height and alignment of all fittings and accessories in accordance with the instructions of the Consulting Engineer. All metalwork must be adequately earthed.

All luminaires are to match the performance specification listed below and **MUST** be approved by the Services Engineer before a manufacturer is to be selected:

5 years Onsite warranty (access equipment, parts, labour included)

Minimum 60,000 hours rated fittings

TPA rated materials in our products which can go into Government Buildings

UK Manufacturer

Supported by design and energy reports

3 steps McAdam Eclipse 4000k colour consistency across the site

LED chip consistency with chip for back up.

7- 10 Day delivery lead times.

British manufactured

Own Transport used (no couriers unless it is really necessary)

Offer a recycling scheme

Lighting levels to the areas that are to be remodelled and refurbished shall generally be as per CIBSE LG2 recommendations in the areas specified:-

Auditorium	500 lux @ ffl	Recessed downlighters and 600x600 luminaires controlled by DALI system with a scene setting plate and switch input for overriding setting
Kitchen	500 lux @ ffl	600 x 600 layin modular luminaires controlled with 2 way on off switches
Lobby/Communal Areas	200 lux @ ffl	Circular pendants and track lighting controlled by scene setting switch
Toilets	150 lux @ ffl	Recessed downlights PIR controlled
Office	500 lux @ ffl	LED luminaires controlled via PIR sensors
Creche	500 lux @ ffl	LED luminaires controlled via PIR sensors
Corridors / Circulation	200 lux @ ffl	Recessed LED luminaires controlled via PIR
Multifaith room	200 lux @ ffl	Recessed LED luminaires controlled via PIR
Plantrooms	200 lux @ ffl	Surface mounted linear luminaires light switch controlled
Changing Rooms	300 lux @ ffl	Surface mounted linear luminaires PIR controlled
Store Rooms	150 lux @ ffl	Recessed LED luminaires controlled via PIR

The installation shall be as far as practical contained within the fabric and as such the electrical sub-contractor shall carefully plan his cabling routes to each of the areas considering all of the building structure and fabric restraints.

However, parts of the Installation of services will be exposed, and careful planning and consideration will be required to ensure the works carefully consider and work within with the restrictions whilst maintaining an aesthetic pleasing installation.

Careful consideration of all conduit runs is required by the electrical sub-contractor to ensure co-ordination with the other services and to overcome the restraints within the building structure.

In general, all conduit systems to switch positions and to wall mounted luminaires shall be extended from the ceiling void mounted trunking systems and recessed within the building fabric.

All wall finishes and the extent of both the floor and ceiling void areas will be as per detailed on the architects detailed design drawings.

Power and lighting cabling shall not be contained within the same conduit wire way system. All conduits will be sized appropriately to ensure that cabling can be removed easily at a future date.

All cabling will be protected throughout to minimise potential damage and shall be installed in line with the main programme to ensure installation at the correct construction stage.

Protection of all lighting circuitry shall be by combined MCB/RCBO units all rated accordingly with 30mA protection.

Final connections to luminaires will be via heat resisting 3 core flexible cords terminating at plug in ceiling type roses or Lighting Control Modules.

Conduit boxes supporting luminaries are to be rigidly and separately supported to take the weight of the luminaries when mounted on the box and leave no gap between the luminaries back plate and the ceiling tiles or plaster board.

When handling the satin aluminium louvres, the contractor shall ensure that cotton gloves are worn in all instances. Louvres found to have greasy finger marks within their cells shall be replaced by the sub-contractor at his own cost.

The integrity of all appropriately IP rated luminaires shall be maintained at all times with the electrical sub-contractor ensuring all compliant cable connections and fixings.

All luminaires and associated diffusers shall be left in a clean, fully working A1 condition upon completion of the works. The contractor at his own cost shall replace any luminaire found not to be in this condition.

The electrical sub-contractor shall include for a separate End Users Demonstration to show the operation and maintenance requirement of all the lighting systems, their associated luminaires and the control system.

1.4.2 Lighting Controls

Most areas throughout the building shall utilise a ceiling mounted 240v motion sensor style detection method located strategically so immediate illumination operation from all possible entrance and exit points as well as keeping illumination during the occupancy of the space in use. These detectors will be of range 7mts - 360° with adjustable delay timer from 1-35mins. Each detector shall also have daylight-override facility with adjustable settings from 10 to 1000lux. Switch output rating shall be 10A.

Operation of the movement detector will be set to a maximum run on time of 20 minutes after activation and a lighting level of 300lux. Key switches associated with the testing of the emergency lighting shall be located adjacent to mains distribution arrangement or local to each room. Other areas of the building shall use motion sensors in line with dimmer switches to set the lighting for the required use at that time. The main auditorium shall have the ability to scene set and have switch input alongside motion sensors by adopting a DALI mesh system.

Positions and heights of all switches shall be **in compliance with part M of the building regulations AT 1000mm affl**

1.5 EMERGENCY LIGHTING

Emergency lighting levels to all areas shall generally be as per CIBSE recommendations to provide a minimum & average illumination level of 1lux to the designated escape routes, 5 lux adjacent to Fire Services and 15 lux to all high-risk areas.

Emergency lighting shall be designed, installed, tested and commissioned in accordance with BS5266 and CIBSE requirements. Generally emergency lighting shall be of the self-contained LED type with integral batteries within the luminaires as well as separate standalone emergency lighting within areas of high risk to achieve the required 15 lux.

All emergency luminaires shall be of the 3-hour duration.

All emergency luminaires shall be connected to the local lighting circuits so that if a sub-circuit failure should occur, then the emergency luminaires are automatically activated. Testing the emergency luminaires shall not affect the general lighting operation.

Each maintained plug-in luminaire shall be connected to its lighting circuit using a 4 pin 'plug in' type ceiling rose mounted on the trunking, one per emergency luminaire. Emergency exit luminaires shall be hard wired to the rear of the luminaire via recessed conduit installed in accordance with the area of installation.

Testing of the emergency lighting shall be by means of a fully automatic self-test system. As detailed in the lighting controls section above.

Installation methods to emergency lighting shall be as per that described for the general lighting appertaining to the area of installation.

Operation and maintenance of the emergency lighting shall form part of the separate end user's demonstrations.

1.6 SMALL POWER, MECHANICAL SYSTEMS & EQUIPMENT

POWER SUPPLIES

1.6.1 General

Small power shall be provided in the form of wall mounted single and twin switched socket outlets, dado trunking mounted twin switched socket outlets, premade furniture bench units within the basement, Commando outlets feeding comms cabinet, Isolators feeding mechanical equipment both internally and externally.

Wiring will generally be LSF twin + CPC type. All Cabling will be fed from local MCB distribution boards in the form of radial and ring main circuits. Installation methods will be as per that detailed within the general installation methods section of this specification all installed in accordance with their area of installation.

Power and lighting cabling shall not be contained within the same conduit wireway system. Protection of the circuitry throughout will be via combined MCB/RCBO units all rated accordingly with 30mA protection.

General positions and heights of all outlets are as required and as detailed within of this Specification, upon the accompanying drawings and to correspond with the specialist furniture and building structure. Positions and heights of all outlets shall also be in compliance with **part M** of the building regulations.

The Electrical sub-Contractor shall always refer to the detailed architect's drawings for particular layouts within each room prior to commencement of any works. Failure to carry out these instructions and to seek clarity to any ambiguities may result in the electrical sub-contractor correcting the works at his own cost.

Fire barrier intumescent mouldable putty pads are required in all socket outlet back boxes which form part of a fire wall.

1.6.2 Supplies to Specialist Systems

The Electrical sub-contractor as required shall supply and install the necessary supplies to facilitate his specialist sub-contractor installations. These shall generally extend to the Fire Alarm, Access Control, Intruder Alarm, CCTV and PV system although this list is not exhaustive, and the M&E sub contractor will be required to verify quantity and location of all supply requirements prior to commencement of his installation works:

All shall be wired from the respective local distribution board each on their own dedicated radial circuit.

Cabling will be of the minimum 2.5mm² installed in accordance with the area of installation. Local isolation to shall be in the form of switched/unswitched, neon indicated, type fused spur units fused as required. The spur units shall be complete with traffolyte type self-adhesive labelling identifying the use and circuitry of the spur unit. The M&E sub contractors appointed specialist will carry out final connections from the spur units to the equipment.

The electrical contractor shall allow include for wiring from all **isolators to final equipment throughout**. For example all kitchen equipment plus all mechanical plant.

1.7 MECHANICAL PLANT WIRING

The electrical sub-contractor works associated with this system will extend to providing full main header containment, installing the wiring and isolators to all equipment detailed on the small power & data drawings. These include but not limited to the following.

- Air Handling Unit
- Mechanical Control Panel
- AC Units
- Heat Pumps
- Fan Convectors
- Sump Pump
- Fan Coil Units

These units will all be supplied and installed by the Mechanical sub-contractor but wired to and connected by the Electrical Sub-contractor. Local Isolation devices will be installed as required.

This list and the specifics relating to each item of Plant will be verified by the Mechanical sub-contractor and issued during the contract period.

Installation methods to serve this equipment will be as described above under General Installation Methods. Cabling will generally be of the 6491B type LSF twin cabling installed within surface mounted galvanised steel trunking systems and galvanized steel conduit systems.

Power supplies to Heat Pumps & AHU will be of the XLPE/SWA/LSZH run on the proposed new Sub Mains distribution Tray work system. Termination of this cabling will be by weatherproof CW type glands. Isolation devices will be of the minimum IP65 rated.

Indication of all equipment served shall be provided to each isolation device utilised via self-adhesive or screw fixed Traffolyte type labels identifying equipment supplied, source and circuitry.

Final positions of all equipment will be as detailed by the mechanical contractor.

The Electrical sub-contractor is to ensure that he is in receipt of all the specialist wiring diagrams prior to commencing works on site.

The electrical sub-contractor shall also include for attendance upon the Mechanical sub-Contractor and his appointed specialist controls sub-contractor to assist with all final testing & commissioning of the Mechanical services systems. Commissioning will be scheduled to accommodate the staged completion of the works.

A separate comprehensive end user demonstration shall be included for upon completion of the works.

1.8 FIRE ALARM SYSTEM

The electrical sub-contractor shall employ specialist sub-contractor for the supply, installation, testing and commissioning of an open protocol type, fully digital addressable, 24V DC Fire Alarm system installed in accordance with BS 5839 Part 1 2017 L1 complete with associated equipment in compliance with BS EN 54-4:1998, BS EN 54-2:1997+A1:2006

The fire alarm Panel will be a Morley IAS-MAX type and all protection devices shall be the Apollo range.

The existing fire alarm detection system shall be fully stripped and rewired. Whilst works are being complete a temporary system shall be installed or the existing system shall be maintained and have the smoke heads changes for heat heads.

Protection devices will include smoke and heat sensors, combined smoke sounder sensors / heat sounder sensors, combined smoke sounder beacon / heat sounder beacon, wall mounted sounders with flashing beacons and manual call points to provide notification and warning of the detection of a fire within the building. All call points will be supplemented with self-powered 'screecher' units to alert of misuse. The fire alarm is to have remote monitoring for out of hours alarms. Within the auditorium there shall be a system in place which can be isolated during theatre performances as there will be use of pyrotechnics and smoke mimicking devices this is to prevent false detection and activation during performances.

Detectors will be of the Apollo addressable type, slimline profile mounted upon common bases. Each unit shall have LED indication and shall be labelled with its zone address number. All smoke detectors shall be of the photo-electric type and heat detectors will be of the fixed high temperature type. All detectors shall be installed in a level, horizontal manner and in strict accordance with the manufacturer's recommendations. Termination of cabling to detectors shall be via galvanised type 'U' or 'end' BESA boxes which shall be fixed to the building fabric or to proprietary timber supports where installed within the false ceiling. Connection of the detection bases shall be subsequently to this box.

Break glass units shall be of the addressable type, red and complete with flush recessing bezels or mounting boxes where applicable. They shall have LED indication and shall be labelled to identify zone and address. Test keys shall be provided for each unit.

The system shall also incorporate loop monitored interface relay module units (I/O). These will be utilised to activate/isolate, mechanical services, door access control system upon activation of an alarm condition. They will be programmed accordingly.

Cabling to serve all devices will be of the red FP Plus Enhanced zoned and looped as required to comply with BS 5839-1

The units adjacent to the Stairwells shall be adjusted so as the output noise does not impact on the operation of the Outstations.

The Installation shall be totally concealed within the building fabric, with the cabling run in the main, within the ceiling void areas fire alarm basket tray system or clipped direct to the building fabric using one piece all round screwed clips. It shall be protected by galvanised steel capping were installed behind plasterwork and devices shall be installed upon the

appropriate flush mounted steel boxes with flush mounting bezels being installed to break glass units.

Cabling shall be fixed and terminated using manufacturers recommended accessories. cable clips shall be LSOH coated coloured red type. They shall be installed at distances equal to or less than those guidelines given in the IET Regulations. Cabling fixed to the cable trays shall be dressed using steel type cable ties installed at equal distances of no more than 300mm. Terminations shall be of the standard externally nylon threaded gland with suitable locknuts.

The electrical sub-contractor shall liaise with the specialist contractor regarding the installation and ensure co-ordination with respect to other specialist sub-contractors and building conditions.

The electrical sub-contractor will also carefully need to manage his sub-contractor to ensure that they are correctly programmed.

A full Cause & Effect schedule for the building shall be produced by the Electrical sub-Contractor and his specialist prior to the commencement of the Commissioning works. This schedule will be in line with the recommendations and guidance given in the Fire Engineers report with final approval obtained from the Fire Officer.

The system shall be fully tested and commissioned upon completion of the works by the specialist sub-contractor. Final configuration and address data will be compiled by the electrical sub-contractor and submitted to the Consulting Engineer for approval.

All necessary certifications shall be included as part of the O & M Manuals. The sub-contractor shall ensure that the system complies fully with the requirements of the Fire Officer.

The zonal diagram shall be altered to suit any changes necessary.

A separate comprehensive end user demonstration shall be included for upon completion of the works.

1.9 INTRUDER ALARM SYSTEM

The electrical sub-contractor shall employ specialist sub-contractor for the supply, installation and commissioning of a grade 3 intruder alarm system to protect the complete external envelope of the building at the Ground Floor and Basement levels. This will generally extend to the provision of 24 hour monitored external envelope doors.

The specialist contractor shall install a new security system.

The security system shall be of the Honeywell Galaxy Control Panel Series and a grade 2 system.

A new intruder alarm is required for the building. This shall feature impact sensors to doors and motion sensors within rooms. The alarm shall be Grade 3 for intruders and Grade 4 for signalling. A response is required within 20 minutes on activation of the alarm. The alarm shall be able to separate so that the Cartwheel Arts office can be in use while the front of house area is still alarmed. The alarm signal shall be via GPRS and monitored from the present alarm receiving centre.

Cabling will be of the standard 8core 0.22mm AWG LSZH alarm type cabling installed discretely within the building structure. The cabling will be run upon the ELV basket tray work systems. All cabling to remote devices off the main tray work system shall be contained within heavy duty UPVC conduit.

All cabling run on the ELV cable basket shall be tie wrapped at neat regular intervals of no more than 200mm. Cabling clipped to the building fabric will be fixed at regular interval of also 200mm using all round screw fixed white type clips or one piece nailed type white clips. Cabling will not be tie wrapped to the ceiling systems or laid to rest on the ceiling without any form of fixings. Cabling installed in a poor manner will not be accepted by the employer and shall be replaced in full by the specialist sub-contractor at his own expense.

The electrical sub-contractor shall liaise with his specialist contractor regarding the installation and ensure co-ordination with respect to other specialist sub-contractors and building conditions.

The electrical sub-contractor shall also ensure that the specialist sub-contractor is correctly programmed with regards to the installation of their works to ensure cabling is concealed and that full requirements are incorporated upon the builders work drawing including installations to specialist doors.

1.10 ACCESS CONTROL & ENTRY SYSTEMS

The electrical sub-contractor shall employ Your Trusts approved security specialist for the supply, installation and commissioning of a new door access control systems to accommodate all the areas associated with the project all as identified upon the accompanying drawings.

A Paxton Net 2 Access Control System shall be installed and programmed to allow different access permissions for staff and members of the public respectively. Equipment will extend to reader units, electromagnetic locks, release buttons and emergency green break glass units.

Each door will be interfaced as part of the main fire alarm system so as to maintain fail safe operation in an alarm condition.

The door access controller will be complete with suitably rated power supply unit and 8hr battery backup. The status of each door and associated emergency release break glass will be indicated at the central server position

The Controller/PSU will be fed locally via dedicated individual circuit isolated locally via an un-switched fused spur unit.

The Paxton P50 proximity readers shall be programmed by the security specialist to match the buildings current access control programme.

Door mechanism devices will generally of the surface mounted magnetic lock type or equivalent and approved and of type suitable to suit their door of installation. Mechanism devices will be supplied and installed as part of the main contractors works but wired connected and fully tested & commissioned by the M&E specialist contractor.

Details of each of the doors will be provided on a detailed schedule drawn up by the Main Contractors specialist supplier and approved by the Architect. This will be issued during the contract to enable final arrangements to be drawn.

A 'Push to Exit' and 'Fail Safe Break glass' button will be located internally adjacent to the door. The 'Push to Exit' button will be a flush mounted unit of stainless-steel finish with a centrally located push button. The 'Fail Safe Break glass' button will of the standard break glass type, green in colour and double pole for additional status monitoring.

The complete door access control system shall be wired as necessary on the ceiling void ELV distribution basket tray work and installed down to the unit positions via recessed mounted PVCu heavy duty conduit or surface mounted steel conduit dependent upon area of installation. All cabling to remote devices off the main tray work highway system shall be contained within galvanised steel conduit.

The electrical sub-contractor shall install all containment systems terminating the conduit to a one gang steel flush box for each of the readers.

As part of the door access control system the buildings main entrance shall also require a proximity reader column mounted which shall be integrated within a video intercom entry unit. All equipment for this shall be IP67 rated. As detailed on the security drawing E4000 a trench shall be required to supply the cabling for both the door access/intercom and the external IP camera. The electrical contractor shall allow for installing 2No 25mm conduits.

1.11 CCTV INSTALLATION

The electrical sub-contractor is to employ an approved, specialist NSI / SSAIB sub-contractor for the supply and installation of the complete CCTV system. The objective of the system is to provide coverage to the building envelope and to monitor pedestrian movement throughout the building.

The CCTV cameras, NVR's and Operational system will be of the HIK Vision type.

The positioning of all cameras shall be to maximise the area of coverage with final positions agreed with the users prior to final fixing.

It is proposed that some existing cameras shall be reused throughout the refurbishment. The specialist contractor shall provide a comprehensive list of what is being retained as well as handing back all existing cameras to your trust.

All cameras will be of the POE, static colour high resolution IP type. All CCTV cameras will utilise, progressive scan CMOS sensors and will encode images in Jpeg, Mpeg or H264 for transmission by means of TCP/IP. Cameras will be capable of transmitting multiple differing image streams with complete flexibility regarding image quality and frame rate

Internal Cameras will generally be dome type part number **DS-2CD3156G2-ISU** They will be of the 8 MP IR Varifocal Network Dome type Camera, surface mounted in the positions as indicated upon the accompanying drawing. The housing will be vandal resistant and environmentally rated to at least IP66 IK10. They will be of the Colour type with the ability to function down to an illumination level 0.01 Lux.

The External camera will be a **DS-2CD3356G2-ISU** They will be of the 2 MP VF Network surface mounted in the position indicated upon the accompanying drawing. The housing will be vandal resistant and environmentally rated to at least IP67 IK10. They will be of the Colour type with the ability to function down to an illumination level 0.002 Lux.

Cabling to each of the cameras will be supplied and installed by the Specialist Structured Wiring sub-contractor. Cabling will emanate from the main patch cabinet which will house the switch to provide POE services required to each of the cameras. Separate patch racks will be installed within the cabinet to facilitate the cameras only. Termination of the cabling adjacent to each camera will be to a ceiling void or high level mounted RJ45 Cat6 socket outlet.

As above the Cameras will be housed in recessed ceiling mounted or surface mounted, vandal resistant, suitably IP 66 or IP67 rated, fixed Dome Style white camera housings positioned in accordance with the area they are protecting.

Control of the cameras will be by rack mounted, minimum 64 channel, **Ultra Series-9600 – 9 Series** network video recorder. Capable of recording up to 48TB in RAID 6 hard drive configuration with a total throughput capacity of 900Mbps of recording video data with full channel recording at up to 12MP resolution HD Video Output.

The system shall come complete with a PC intended for Security viewing and management of the system.

This purpose built PC will be of minimum specification, Dell Rack mounted, i7 Processor, Windows 10 operating System, 4GB Dual Channel, 320GB Hard Drive, DVD/RW Drive and complete with suitable Graphics card to accommodate both the Monitors and all the cameras. It shall be complete with 12 Months Anti-Virus Software and minimum 3-year Service Warranty. It will be setup with all necessary Administrator, Manager & Operator user levels required to allow full & control use of the CCTV system.

2No 21" LED type HDMI, DVI, USB (1600x900) Blk UK/I monitor will be provided for full viewing of the System.

The IP CCTV system shall be functional and flexible to allow the client, upon handover, to determine exact camera views via the manual adjustment of the varifocal lens on each of the cameras.

The electrical sub-contractor shall fully manage his sub-contractor and ensure co-ordination with respect to other trades and the contract programme. All necessary containment will also be provided by the electrical sub-contractor which will be in the form of the previously detailed ELV distribution basket and compartmented trunkings as well as recessed PVCu and surface mounted galvanised steel conduits to extend the cabling from the basket or trunking down to outlet positions. These conduits shall be terminated to new camera positions to a 32mm 1-gang flush or surface mounted steel box.

The system shall be fully tested and commissioned upon completion of the works by the specialist sub-contractor with final configuration agreed with the client. All details and certification shall be included in fourfold as part of the O&M documentation.

Details of all proposed equipment and samples, shall be forwarded to Your Trust for approval, prior to requisition. Failure to do this may result in the removal and replacement of suitable equipment at the contractors own cost.

A separate end user demonstration shall be included for and carried out upon completion of the work at a pre-arranged date.

1.12 PUBLIC ADDRESS INSTALLATION

PA system Stage Electrics shall supply install and commission.

Contact – Saul Eagles
Stage Electrics,
Encore House,
Unit 3, Britannia Road,
Patchway Trading Estate,
Patchway,
Bristol,
BS34 5TA
Tel - 0117 938 4000

1.13 STRUCTURED WIRING SYSTEM

The electrical sub-contractor shall employ Your Trusts approved specialist data contractor to undertake the supply, installation; testing and commissioning of a complete CAT6a flood wired cabling and telephone wiring system to accommodate the new works.

The system shall be in accordance with BSEN 50174-2: 2001. Information Technology Cabling Installation Part 2: Installation Planning and Practices Inside Buildings and the specific Accor documents

All data communications system shall meet the requirements of the following as a minimum:

- BS EN 60950 (BS 702) – 1992
- BS EN 55022 – 1998
- BS EN 60801 -2
- BS EN 6100 -4-1-2001
- ISO 11801 2nd edition
- ISO/IEC PDTR 14763
- EN 50173 2nd edition
- TIA/EIA 568B TSB 95
- IEEE 802 3ab

All new data cabling shall be wired from the cabinet particular to that area as identified upon the accompanying drawings. The existing CCTV serving Rochdale councils network in the surrounding area is to be retained and supplied via the new data cabinet. The specialist contractor is to make them selves aware of the location and identification of these circuits. When disconnecting and terminating the existing CCTV network the specialist contractor shall contact the correct authorities to make them aware of any down time which may occur during the works.

The specialist contractor shall install a 42u cab within the basement floor server room to facilitate the required number of field outlets and incoming new Virgin Media fibre optic cable.

The cabinet will be floor mounted, front access type with a Glazed, lockable door mounted on heavy duty lockable castors and provided with 3No sets of door keys.

The Cabinet shall be equipped with the required number of 24-way CAT 6a lu patch panels to accept field cabling as well as the equivalent number of vertical & horizontal cable

management bars. The Cabinet shall be provided with a 1No 1U fan mounting plate complete with 4no pre wired fan units and filtered 13amp, 4 way and 10 way power distribution units.

The switches to provide POE services required to each of the CCTV cameras will be housed with the respective Active patch panels. Switches will be supplied and installed by the Electrical sub-contractors appointed specialist Structured wiring sub-contractor.

The PoE switches will be 24 port units to provide power and data using built-in IEEE 802.3af PoE on each port. They will provide 2410/100 Mbps ports, four copper 10/100/1000 Mbps ports and two combination (copper/hot-swappable small form-factor pluggable (SFP)) Gigabit ports for optional fibre connectivity. Management of the unit will be by a web-based tool to ease access and configuration as well as enabling monitoring and trouble-shooting.

Separate patch racks will be installed within the respective Inactive cabinet to facilitate the cabling to the cameras and to the access control only.

New main infrastructure cabling to the cab to form the network will be of fibre type cabling from the trusts preferred user (Virgin media). This specific cable type will need agreeing with the end users' engineers. However, at this stage of the project 12 core OM3 50/125µm Multi mode LSZH fibre cables will be installed between each of the cabs if another cabinet needs to be installed due to the maximum runs to each data point being limited to 90m. The fibres will be labelled and tested.

The Electrical sub-contractor shall include for the supply and installation of containment systems as detailed elsewhere in this Specification and as detailed upon the accompanying drawings, costed for under their relevant section of works.

This shall consist of a network of cable basket trays, compartmented dado and trunking systems and where appropriate, 20/25mm PVCu heavy duty conduits recessed within the building structure down to the outlet positions.

Where a 1 or 2 gang outlet is indicated a 1-gang surface of flush steel box shall be installed, but where a 3 or 4-gang outlet is indicated, a 2-gang box is to be installed.

All boxes shall be of depth 35mm. Surface mounted boxes are required to the outlets positioned within the ceiling void.

All active and non active equipment shall be provided by the universities approved specialist as part of the electrical contractors package

Data points shall be provided within ceiling voids to allow the installation of high level WI-FI routers.

The cabinets shall also be used to house other passive equipment and also any wiring and associated equipment for services such as CCTV & access control systems.

Cabling shall be of the Cat 6a type and shall be installed to provide a link between all data outlet points and the patch racks within the cabinets. The outlet points shall be standard RJ45.

Any cable found damaged by the contractor shall be replaced in full at the specialist sub-contractor's own expense. The specialist sub-contractor shall carefully plan all his routes

maximizing the available tray work routes so as cable lengths are not excessive and do not exceed 90mts inclusive of Patch cord length with the serving cabinet and at the service point.

The new CAT6 data cabling shall be of the four pair with spline, unshielded, twisted pair type, manufactured in accordance with ISO/IEC 11801, class E with 26 AWG solid copper conductors and overall purple LSZH sheath with 1 metre internal markers.

All cabling shall be installed upon and within the above detailed wireway systems in a neat and non-obstructive manner, loosely group tied using one piece black nylon cable ties at intervals of no more than 300mm.

Cabling to each of the CCTV cameras & Access Control will also be supplied and installed by the Specialist Structured Wiring sub-contractor. The CCTV & Access Control Systems will be wired as a true IP addressable system.

The points identified on the drawing are those specifically agreed with the end user.

Cabling to the access control will also be supplied and installed by the specialist structured wiring sub-contractor. The access control systems will be wired as a true IP addressable system.

The Electrical sub-contractor will also need to liaise with the appointed specialist for the provision of WI FI throughout the refurbishment. An initial tabletop report will be provided so as the electrical sub-contractor can provide a resolute design that will facilitate the future installation of WIFI units that will form part of the end users fit out items.

The M&E sub contractor will provide the number of outlets identified in this report so as to accommodate the future provisions. Locations of these outlets will be within the ceiling void area each correctly labelled and scheduled to identify their function.

The final termination of the cables within the field shall be to the required ganged RJ45 UTP Cat 6a outlet plates of type relevant to the **particular area of installation as detailed earlier within this specification**. Each outlet must be shuttered, certified to EIA/TIA Category 6a. They shall also be clearly labelled to identify the patch number applicable to its connection within the main panel. Each patch number within the main panel shall also be provided with text to describe its corresponding area of location.

Termination of the cabling adjacent to each CCTV camera will be to a ceiling void mounted RJ45 UTP Cat 6a outlet plates socket outlet.

Each data outlet will be labelled XX-YY-ZZ where XX is the rack ID in which the cable is terminated, YY is the label of the vertical position for the horizontal presentation strip in which the cable is terminated in the Patch Cabinet and ZZ is the label of the horizontal position in the presentation strip that the cable is terminated. In the Patch Cabinet 3mtr long Patch cords shall be provided for each UTP outlet located within the field.

Patch cords must be made of four pair Category 6a unshielded twisted pair cable terminated at each end with an RJ45 plug. They must conform to the relevant cable, plug and pin/pair specifications in EIA/TIA 568B.

Each RJ45 for telephony service shall be complete with type LJU adaptor to allow provision of telephone service.

The electrical sub-contractor shall carefully manage his sub-contractor ensuring coordination with all other services and the building structure as well as ensuring installation of the cabling at the key programme dates.

The works including the associated infrastructure cabling will be phased as required and scheduled to accommodate the proposed construction programme.

The systems shall be fully tested and commissioned upon completion of the works by the specialist sub-contractor with final configuration agreed with the client. All details and certification shall be included in fourfold as part of the O&M documentation.

Commissioning will be scheduled to accommodate the staged completion of the works.

Tests should be carried out in accordance with the guidelines set out in EIA/TIA TSB40.

On completion the test results should be incorporated into a test results schedule as follows:

- Test cable origination location
- Test cable destination location
- Cable number
- Length in metres
- DC resistance
- Impedance
- Loss recorded in dB
- Graphical trace detailing dB loss
- Graphical trace of attenuation
- Graphical trace of NEXT
- Certificate of system conformity to Cat 6

All test results to be clearly documented and downloaded from the test instrument A separate end user demonstration for the client shall be included for and carried out upon completion of the works at a pre-arranged date to enable the suppliers of equipment and the end users to become familiar with the installed wiring system.

1.14 PV SYSTEM

The electrical sub-contractor shall employ specialist sub-contractor for the supply, installation, testing and commissioning of a PV system. Contact details are listed below.

DESIGN PARAMETERS

- BS 7671– Section 712 – Solar Photovoltaic Power Supply Systems
- Specialist PV Subcontractor must be Micro-generation Certification Scheme (MCS) accredited
- All PV installations and associated equipment must be MCS accredited
- Engineering Recommendation G83/1 - Recommendations For The Connection Of Small-Scale Embedded Generators (up to 16 A per phase) In Parallel With Public Low-Voltage Distribution Networks
- G59 panel
- Engineering Recommendation G59/1 Recommendations for the connection of embedded generating plant to the Regional Electricity Companies' distribution systems (over 16 A per phase)
- Electricity Safety, Quality & Continuity Regulations 2002 (ESQCR)
- Roof mounted system required
- Orientation & angle of installation as per Architect's Roof General Arrangement Drawing

The photovoltaic system shall consist of PV panels fixed to the roof of the new building an incline of 30° to the horizontal.

The photovoltaic system shall be grid connected as coordinated and provided by the Electrical Sub-Contractor within the main LV switch panel. The photovoltaic system inverter shall be located within the basement main plant room.

The photovoltaic system shall be complete with inverters, isolator switches, meters, to serve each distribution board and all cable connections and labelling as necessary for a grid connection.

The Electrical Sub-Contractor shall be responsible for co-ordination of the works carried out by his Specialist Sub-Contractor with all other works, and for coordination of details prepared by his Specialist with Architects and Structural Engineers drawings.

The Specialist Sub-Contractor shall be responsible for producing all necessary information and details of his equipment and methods of fixing for a coordinated installation of his equipment. All detailed drawings shall be forwarded to the Engineer for approval prior to commencement on site.

SCHEDULE OF PHOTOVOLTAIC SYSTEM REQUIREMENTS

The Specialist Sub-Contractor shall at the time of placing his order shall provide information on their proposals as scheduled below: -

Target CO2 saving (kg/CO2/annum)	
Actual CO2 saving (kg/CO2/annum)	
Energy generated (kWh/annum)	
Monitoring Equipment (Y/N)	
Design/Supply/Installation (Y/N)	
Ofgem Approved ROC meter (Y/N)	
Import/Export meter (Y/N)	
Type of technology proposed	
Warranty: PV Panels & Inverters (months)	
Approx. area of PV Array (m2)	
No. of panels (Qty)	
Weight of each array (kg/m2)	
Orientation/Pitched angle of PV panels (o)	
Display equipment (Y/N)	
Roof Stand Offs (Y/N)	
Grid connection (Y/N)	

COMMISSIONING

The commissioning shall be provided by the Electrical Sub-Contractor who shall employ the photovoltaic Specialist Sub-Contractor to achieve the following: -

1. Complete all checks and commissioning operations recommended by the Specialist Sub-Contractor.
2. Test and prove safety interlocks and shut down routine.
3. Measure and verify the key performance criteria.
4. Test and prove all interfaces
5. Upon completion of the commissioning, the following documentation shall be provided: -
 - O&M manuals
 - Copy of permits and approvals.
 - Proof of commissioning
 - Method for Client to calculate performance, cost and carbon saving achieved based on data monitored by the BMS.

A full report shall be forwarded to the Engineer including test certificates, for evaluation, and dependent upon the test results outcome, action or forwarding to the Client for inclusion into the Operating and Maintenance Manuals.

POST COMMISSIONING REVIEW

The Electrical Sub-Contractor shall provide the following post commissioning review by the Specialist Sub-Contractor; for seasonal testing and commissioning at 3, 6 and 9 month intervals.

Each review shall include: -

1. Verify performance of photovoltaic systems
2. Review any faults that have occurred and state likely cause as well as any corrective/preventative action recommended.
3. Confirm energy, cost and CO2 savings achieved to date for typical 12 month operation.
4. Advise the Client of any actions that could be taken to further improve efficiency

1.15 SPECIALIST LIGHTING/SOUND SYSTEMS

Lighting/Sound system Stage Electrics shall supply install and commission.

Saul Eagles

Business Development Manager - Projects

T: +44 117 938 4000 | D: +44 7769 932670

Stage Electrics, Encore House, Unit 3, Britannia Road,
Patchway Trading Estate, Patchway, Bristol, BS34 5TA

Please revert to document HCC-SE-ZZ-ZZ-SW-EA-0001-P02 this document shall provide the electrical contractor with all the relevant information regarding the systems infrastructure.

1.16 LIGHTNING PROTECTION

The electrical sub-contractor shall employ a specialist contractor for the design, supply and installation of a lightning protection scheme to the whole of the premises to BSEN 62305.

The system shall be a traditional under tile system with PVC sheathing to all conductors of colour to be agreed with the architect. The system shall comply with BS6651/BS7430. It shall comprise of 25mm x 3mm PVC sheathed aluminium conductors secured at 1 metre centres throughout to form an air termination network. It shall be installed along ridges, around eaves and to hips ensuring no part of the roof is 5 metres from the nearest horizontal conductor. All roof level metal items shall be bonded to the system and chimney stacks or towers will be complete with a suitable air terminal rod.

Down conductors shall be equally positioned around the structure in locations agreed with the architect. They shall comprise of 25 x 3mm aluminium tape PVC covered terminating at test clamps attached to 2.4metre x 15mm copper bond earth driven electrodes housed in heavy duty, lockable type polymer pits.

Inspection pits identifying the lightning protection connection shall be free issued to the main building contractor for building in around the top of the earth electrode.

The electrical contractor shall be responsible for co-ordination of the above as well as for the supply and installation of the main equipotential bond from the main earth bar within the plantroom to the adjacent lightning bond accordingly testing these cabling and recording results upon the test certificates.

This bond cabling shall be of the 6491B type installed within UPVC cable ducts clearly identified at each connection point.

The complete system will be tested with certificates included to each of the O&M manuals. The Electrical Sub Contractor shall also be responsible for coordinating and providing the necessary builders work drawings and layout drawings for approval of the architect.

1.17 TESTING & COMMISSIONING

The electrical sub-contractor shall include for the testing and commissioning of all Works in line with the following documents:

BS 7671 IEE 18th Edition Wiring Regulations
CIBSE Commissioning Code L: Lighting

Commissioning with respect to all systems shall be carried out to the approved configurations identifying correct operation of each programmed function.

Commissioning of specialist systems installed as part of the electrical sub-contractor's works shall be carried out by the particular specialist contractor in conjunction with the electrical contractor.

The electrical contractor shall give the Consulting Engineer 7 days' notice with respect to final witness testing and shall provide all necessary access equipment throughout the contract to enable all works to be inspected by the Consulting Engineer.

Final commissioning data shall include all programmed functions and results and shall be included along with the relevant governing body accredited certificates in fourfold to the Operating and Maintenance Manuals.

In addition to the above the electrical contractor shall make allowance for the commissioning of all systems to be verified by the consulting engineer. This should be done after complete systems have been commissioned by the relevant specialist and prior to handover.

Please note that handover of the building will not be accepted until all systems have been witnessed by the consulting engineer and deemed acceptable.

SECTION TWO - GENERAL CONDITIONS / PREAMBLES

2.1 TENDER INSTRUCTIONS

The tenderer is to complete the Tender Breakdown sections 4.1, 4.2, 4.3 and 4.4 and shall prepare a quotation based on these documents which are to be read in conjunction with the Construction partner's preliminaries.

The tender is to be a fixed price on a domestic sub-contract basis, with a base date for starting and completing the works as indicated in the Preliminary details and full allowance shall be made for: -

- a) All hoisting, lifting and scaffolding, etc. required
- b) The supply and fixing of all brackets and supports including the drilling etc. of the structure

Full allowance shall be made in the Contractors estimates for the supply and fixing of all steelwork and supports for the support of pipework, cable trays and trunkings and ductwork, etc. throughout the building and the plant areas. The position and arrangement of any steel frames shall be agreed with the Construction partner prior to manufacture or installation.

If the contractor cannot tender for any part(s) of the work as defined in the tender documents, he must inform the Construction partner as soon as possible, defining the relevant part(s) and stating the reasons for his inability to tender. All exclusions shall be clearly indicated on the relevant tender return.

The Contractor's price shall be fully broken down into the various phases and sub headings of the specification. The Tender shall be provided in an itemised Summary Form separately from the building works.

The Contractor shall provide within 2 weeks of being appointed to carry out the works, 2 copies of the schedule of rates adding up to the total tender sum.

The Schedule of Rates is to be completed by the Contractor and approved by the Construction partner before the final acceptance of the Contractors tender. The Schedule of Rates should cover all items being used on the Contract by the Contractor. The schedule of rates shall be submitted within 14 days of so being requested to do so.

The submission of the above schedule does not remove the Contractors responsibility for the accuracy of the tender and the Contractor will be deemed to have included for all materials and labour, etc, for the complete installation as detailed in the tender specification and drawings.

All variations during the contract shall be based on the prices indicated within the schedule of rates submitted.

In addition to any other information requested within the general contract conditions applicable to this tender, the following information must be detailed in the appropriate appendix by the Contractor at the time of tender:

- a) Contractors shall detail the manufacturer's name and catalogue reference or type, and the expected delivery date for all items of plant and equipment on which their tender offer is based

The contractor (whether their tender is accepted or not) and any other recipients of the specification and documents (whether they submit a tender or not) shall treat the details of the specification and drawings, etc, as private and confidential and shall not reproduce same without the permission of the Construction Partner

In addition to and at the same time as the tender for the works as defined in the tender documents, the Contractor may, at his discretion, submit alternative manufacturers or suppliers for consideration. Alternatives which would involve significant changes to other work will not be considered.

Such alternative(s) must include all additional costs arising from necessary changes to the details of the installation, including changes to the design and drawings, as well as any associated ancillary equipment items.

Such alternative(s) is/are deemed to be alternative tender(s) and each must include a complete and precise statement of the effects on cost and programme and submit full details with their tender.

Full technical data for each such alternative must be submitted to the Construction partner before the execution of the contract together with details of any consequential amendments to the design and/or construction/installation of other parts of the Works. The employer does not undertake to accept alternative manufacturers or suppliers

Where the Contractor proposes to sublet any portion(s) of the Contract Works a list must be submitted before the execution of the contract.

The list will define such portion(s) and give, for each, the name and address of the proposed Sub-subcontractor.

Alterations and qualifications to the specification must not be made without the written consent of the Construction partner. Tenders containing such alterations or qualifications may be rejected. Costs relating to items in the specification which are not priced will be deemed to have been included elsewhere in the tender.

The Employer and his representatives offer no guarantee that the lowest, or any tender, will be recommended for acceptance or accepted and will not be responsible for any cost incurred in the preparation of any tender.

The details within the Specification are performance details only, the drawings produced are guideline details only and the working drawings and associated installation is the total responsibility of the contractor who may be requested to enter into a Collateral Warranty.

If any detail is not clearly shown, or any discrepancy occurs between the drawings and the specification, the Contractor is to ask for instructions before proceeding. Work completed due to such discrepancy, or affected by it, shall, if the Consulting Engineer so directs, be removed and redone at the Contractor's expense.

Dimensions should not be assumed or scaled from the drawings. The contractor shall check the documents and the page numbers and if there are any missing or if any figures are indistinct, then the Consulting Engineer shall be notified. No subsequent claim for loss consequent upon the sub-contractor's failure to comply with this clause will be entertained.

This summary is for guidance only for the Contractor in the preparation of their tender and no omission from the summary or from the other sections of this document shall relieve the Contractor from their obligation to carry out the works in accordance with relevant documentation and the specification.

The following specification is prepared as a "Detailed Specification".

The engineering services must comply fully with all relevant EU standards, NHS Standards, British Standards, Codes of Practice and local bylaws applicable to the site.

The specifications and drawings are issued to indicate agreed principles of the system design, design criteria and the client's requirements. The drawings and specifications do not attempt to detail every system component and it is the responsibility of the contractor to ensure that all items necessary to meet the requirements of the specification, design intent and the employer's requirements are included within their costs.

All communication, including distribution of correspondence, drawings and other information between the design team and the contractor employed to carry out the works shall be via the Employer, or his appointed representative.

In the event of there being any discrepancies between the specification and the schedules, the conditions of contract or the drawings, or any other documents issued in connection with this contract, the sub-contractor is to point out these to the Consulting Engineer prior to submitting their tender, and to obtain the Consulting Engineer's instructions as to exactly what is required. Failure to do this will not relieve the sub-contractor of the obligation to execute such items in accordance with the Consulting Engineer's intentions as part of the contract and without any extra payment.

The following documents are to be read in conjunction with our mechanical & electrical specifications as these are the standards that SHA adhere to when preparing mechanical and electrical specifications.

1. The current appropriate British Standard Specification & Codes of Practice relating to the materials and installation methods relevant to the works described hereafter
2. The current Building Regulations 2010 and associated Approved Documents
3. The CDM Regulations 2015
4. The BS 7671 - 18th Edition The IET Wiring Regulations and all subsequent amendments

5. CIBSE Guide Books:-
 - Guide A – Environmental Design 2015, updated 2021
 - Guide B (6 separate volumes) – H&V, Air Conditioning and Refrigeration 2016;
 - Guide C – Reference Data 2007;
 - Guide F – Energy Efficiency in buildings 2012;
 - Guide H – Building Control Systems 2009;
 - Guide K – Electricity in Buildings 2004;
 - Guide M – Maintenance Engineering and Management 2023
6. The Commissioning Codes A, B, C, L, M, R & W issued by the Chartered Institution of Building Services Engineers
7. CIBSE TM13 “Minimising the risk of Legionnaires disease”, 2013
8. CIBSE SLL Lighting Guidance series
9. CIBSE Building Log Book Toolkit TM31 – 2006
10. Institute of Lighting Professionals (ILP) - Guidance Note 1 The Reduction of Obtrusive Light – GN01-21
11. BSRIA Commissioning Guides:-
 - Commissioning Air Systems BG 49/2015;
 - Commissioning of Pipework Systems AG 20/95;
 - Commissioning HVAC Systems TM 1/88.1;
 - Pre-Commission Cleaning of Pipework Systems Amended 6th Edition BG 29/2021;
 - Factors in the Design of Flues for Condensing Boilers TN 2/89;
 - Commissioning Job Book BG 11/2010
 - Variable-flow Water systems AG16/2002
12. BRE’s Environmental Design Guide for Naturally Ventilated and Daylit Offices. Report 345 1998
13. BRE’s Thermal Insulation: avoiding risks guide, REP BR 262: 2002
14. NPL Beginner's guide to measurement in electronic & electrical engineering GPG132
15. NPL Beginner’s guide to measurement in mechanical engineering GPG131
16. Area Guidelines for Mainstream Schools BB103 2014 Area Guidelines for SEND and Alternative Provision BB104 2015
17. ISO 15686-1:2011 – Parts 1, 2, 3 and 6
18. World Health Organisation (WHO) - Guidelines for drinking-water quality, 4th edition inc 1st addendum
19. The Health & Safety at Work Act 1974
20. The Factories Act 1961
21. Provision and Use of Work Equipment Regulations 1998 (PUWER 98)
22. The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER 98)
23. Regulatory Reform (Fire Safety) Order 2005
24. The Gas Safety (Installation & Use) (Amendment) Regulations 2018

25. HSE Approved Code of Practice (ACoP) and guidance L8, "Legionnaires disease; The control of legionella bacteria in water systems", 2013
26. DIG 474 HOBO protocol: handover of office building operations (incorporating March 2003 amendment)
27. The Carbon Trust Website www.carbontrust.com
28. The Lift Regulations : BS EN81-20:2020; BS EN81-50:2020; BS EN 81-70:2021; BS EN 81-72:2020

Should any query arise regarding the interpretation of the tender/contract documents, then the Construction partner shall have the final ruling.

In addition to the above the contractor shall ensure for Healthcare Developments that the systems are installed and commissioned in accordance with current Health Building Note and Health Technical Memoranda, generally as listed below:

Reference	Title
Health building Notes (HBN's)	
HBN 00-01	General design principles
HBN 00-02	Sanitary spaces
HBN 00-03	Clinical and clinical support spaces
HBN 00-04	Circulation and communication spaces
Reference	Title
Health building Notes (HBN's)	
HBN 00-07	Resilience planning for the healthcare estate
HBN 00-08	Strategic framework for the efficient management of healthcare estates and facilities
HBN 00-08	Estatecode - Land and property appraisal
HBN 00-09	Infection control
HBN 00-10 A	Flooring
HBN 00-10 B	Walls & Ceilings
HBN 00-10 C	Sanitary Assemblies
HBN 00-10 D	Windows & Associated Hardware
HBN 01-01	Cardiac facilities
HBN 02-01	Cancer Care - facilities for cancer services
HBN 03-01	Mental Health - Adult Acute units

HBN 03-02	Facilities for child and adolescent mental health services
HBN 04-01	Adult in-patient facilities
HBN 04-01 A	Isolation rooms supplement
HBN 04-02	Critical care
HBN 07-01	Satellite dialysis unit
HBN 07-02	Main renal unit
HBN 08-02	Dementia-friendly Health & Social Care Environments
HBN 09-02	Maternity care facilities
HBN 09-03	Neonatal
HBN 10-02	Day surgery facilities
HBN 11-01	Facilities for primary and community care services (English edition)
HBN 11-01 A	Facilities for primary and community care services - Supplement A: Case studies
HBN 12-01 A	Supplement A: Consultation, examination and treatment facilities - Supplement A: Sexual and reproductive health clinics
HBN 14-01	Pharmacy and Radiopharmacy
HBN 15-01	A&E
HBN 6	Volume 1, Facilities for diagnostic imaging and interventional radiology
	Volume 2, PACS and specialist imaging
HBN 12	Out-patients department
Reference	Title
	Health building Notes (HBN's)
HBN 13	Sterile services department
HBN 15	Accommodation/Facilities for pathology services
HBN 23	Hospital accommodation for children and young people
HBN 26	Operating Department
	Health Technical Memoranda (HTM's)
HTM 00	Policy and principles of healthcare engineering
HTM 01-05	Decontamination in primary care dental practices
HTM 02-01 A	Medical gas pipeline systems, Part A - Design, installation, validation and verification
HTM 02-01 B	Medical gas pipeline systems, Part B - Operational management
HTM 03-01 A	Specialised ventilation for healthcare premises: Design and validation

HTM 03-01 B	Specialised ventilation for healthcare premises: Operational management and performance verification
HTM 04-01 A	Safe water in healthcare premises - Design, installation and commissioning
HTM 04-01 B	Safe water in healthcare premises - operational management
HTM 04-01 C	Safe water in healthcare premises - Pseudomonas aeruginosa - advice for augmented care units (formerly an addendum)
HTM 05-01	Managing healthcare fire safety
HTM 05-02	Guidance in support of functional provisions (Fire safety in the design of healthcare premises)
HTM 05-03: A	Operational provisions, Part A - General fire safety
HTM 05-03: B	Operational provisions, Part B - Fire detection and alarm systems
HTM 05-03: C	Operational provisions, Part C - Textiles and furnishings
HTM 05-03: D	Operational provisions, Part D - Commercial enterprises on hospital premises
HTM 05-03: E	Operational provisions, Part E - Escape lifts in healthcare premises
HTM 05-03: F	Operational provisions, Part F - Arson prevention in NHS premises
HTM 05-03: G	Operational provisions, Part G - Laboratories on healthcare premises
HTM 05-03: H	Operational provisions, Part H - Reducing false alarms in hospital premises
HTM 05-03: J	Operational provisions, Part J - Guidance on fire engineering of healthcare premises
Reference	Title
	Health Technical Memoranda (HTM's)
HTM 05-03: K	Operational provisions, Part K - Guidance on fire risk assessments in complex healthcare premises
	Operational provisions, Part K - Guidance on fire risk assessments in complex healthcare premises - Template
HTM 05-03: M	Operational provisions, Part M - Fire Safety in Atria
HTM 06-01	Electrical services supply and distribution, Part A - Design considerations
	Electrical services supply and distribution, Part B - Operational management
HTM 06-02	Electrical safety guidance for low voltage systems
HTM 06-03	Electrical safety guidance for high voltage systems
HTM 07-01	Safe management of healthcare waste
HTM 07-02	Encode 2015 - making energy work in healthcare

HTM 07-03	NHS car-parking management: environment and sustainability
HTM 07-04	Water management and water efficiency - best practice advice for the healthcare sector
HTM 07-07	Sustainable health and social care buildings
HTM 08-01	Acoustics
HTM 08-02	Lifts
HTM 08-03	Bedhead services
HTM 66	Cubicle curtain track
HTM 67	Laboratory fitting out system
	Medical gas pipeline systems, Supplement 1 update - Dental compressed air and vacuum systems
	Other publications
CFPP 01-01	Management and decontamination of surgical instruments (medical devices) used in acute care
CFPP 01-04	Decontamination of Linen for Health & Social Care
CFPP 01-06	Reprocessing of flexible endoscopes: management and decontamination
	A risk-based methodology for establishing and managing backlog
	An exemplar operational risk management strategy
	Best practice advice: Establishing and managing backlog
	Dementia Design Checklist
Reference	Title
	Other publications
	Design brief framework
	Design Guide: Day facilities for people with severe learning disabilities
	Design Guide: Medium secure psychiatric units
	Developing an estate strategy
	Developing bedside communications and entertainment in NHS hospitals
	Medium secure psychiatric units (Design guide)
	Sustainable development in the NHS
	Sustainable development: Environmental strategy for the National Health Service

The services shall also comply with the following Regulations, Codes of Practice, Byelaws and Design Data:-

- (i) Statutory and Local Authority Regulations and Byelaws.
- (ii) Water, Gas, Electricity, Fire Officer, Environmental Health Regulations and Recommendations.
- (iii) Current editions of British Standard Specifications and Codes of Practice.
- (iv) Chartered Institution of Building Services Engineers current recommendations with respect to design criteria and system commissioning codes.
- (v) BS 7671: 2008 IEE Wiring regulations (Incorporating all amendments).
- (vi) Health and Safety At Work Act including all Regulations and Statutory Instruments issued by the Health and Safety Executive. The Construction (Design and Management) Regulations shall also be complied with.

2.2 CONTRACT DUTIES

This document details the contract requirements for the provision of a complete and fully functioning mechanical /electrical services installation, which is fit for purpose, fully integrated and interfaced with the building and the other systems present. The contract includes but is not limited to: -

- a) Supply of all management, administration, engineering skills, supervision and labour
- b) Co-ordination and integration with the building and other systems. The Mechanical / Electrical Contractor shall make an allowance within their tender for coordination of the all services
- c) Functional interfaces between the mechanical and electrical installation and the building systems
- d) Provision of all design working and coordination and installation drawings and calculations
- e) Provision of builders work drawings
- f) Supply, installation and support of all plant, equipment, materials, fixtures and fittings
- g) Provision of controls and wiring diagrams and drawings and associated electrical work
- h) Testing and commissioning and witnessing of systems to Engineer
- i) Provision of Manufacturers drawings
- j) A demonstration of the systems and the provision of user training
- k) Repair of defects and faults in the systems or equipment during the guarantee period
- l) Provision of all samples at no cost to the project
- m) Provision of a building log book
- n) Training of clients staff
- o) Provision of Record drawings, information and maintenance manuals

The entire works shall comply with the requirements of this specification, all applicable standards, accepted good industry practice and be fit for purpose.

2.3 FORM OF CONTRACT

The form of contract and contract conditions shall be issued as a separate document by the Construction partner

Any conflict in form of contract and contract conditions between the above and this document shall be drawn to the project quantity surveyors attention within the tender period.

The contractor shall take note of the programme enclosed within the tender documentation.

The Contractor shall make due allowance within their tender for any lack of continuity of work caused by this programme.

The entire works shall comply with the requirements of this specification, all applicable standards, accepted good industry practice and be fit for purpose.

2.4 DUTIES OF THE CONTRACTOR

The Contractor shall execute the whole of the works to meet the requirements for the systems detailed in this specification. The installation shall comply with all relevant legislation and industry standards and recommendations and with accepted good practice.

The Contractor shall be responsible for the supply and installation including all warranties for the project.

The Contractor shall supply the management, administration, engineering skills, supervision and labour necessary to complete the works in a professional manner.

The Contractor shall ensure that the systems installed under their works are coordinated and integrated with the building and other systems present and that they are interfaced as necessary to ensure the correct operation of the building systems as a whole.

The Contractor shall submit all information, drawings and samples as soon as practicable, and in any event to allow adequate time for Construction Partner comments and to comply with the requirements of the Contract programme.

The Contractor shall provide all builderswork information necessary to accommodate the works within the building and its structure. This includes the following:

- a) Plant and equipment accommodation schedules
- b) Plant and equipment dimensions weights and dynamic loading
- c) Acoustic information relating to the plant and equipment
- d) Vertical and horizontal ducts, risers and hole sizes and positions

The Contractor shall supply and deliver all materials, plant and equipment to site, unload, store and hoist and place in position, fix and support, erect and connect, watch and protect during the Contract.

The Contractor shall test, commission and set to work all installations, materials, components and plant in accordance with this specification.

The Contractor shall demonstrate the systems and provide user training in accordance with this specification.

The Contractor shall provide and maintain accurate installation records on site in accordance with the specification

The Contractor shall provide record information and maintenance manuals in accordance with this specification.

The Contractor shall guarantee the complete works for a period of twelve months from the date of practical completion and repair defects and faults in the systems or equipment during this period in accordance with this specification.

The successful Contractor will be required to provide a list of emergency telephone numbers at which responsible members of their organisation may be contacted at all times in the event of any emergency.

Where specific requirements are quoted herein they must be adhered to and in all other cases designs are to be based on standards not less than those covered by the current edition of the Publications indicated in this Specification and local and statutory requirements, Building Regulations, Building Notes (HBN's) and Technical Memoranda (HTM's).

The successful Contractor after submission of tenders shall be required to furnish to the Construction Partner the whole of their installation and working drawings for comment and in the event of these requiring to be modified to comply with the foregoing such modifications shall be effected without increase of the tender price quoted.

After tender, the successful Contractor will be required to lodge with the Construction Partner a complete set of the draft installation and working drawings as referred to above for permanent retention. Following comment of the basic drawings duplicate copies of the final drawings are then to be forwarded to the Construction Partner for comment. After comment, up to 3 sets of drawings are to be forwarded to the Construction Partner for general distribution. These copies are in addition to those that will be required for the Contractor's own use. The release of the installation drawings to the Construction Partner in no way relieves successful Contractor of their responsibility for the design and operation of the systems.

2.5 CONSTRUCTION (DESIGN & MANAGEMENT) REGULATIONS 2015

All aspects of the Construction shall comply with The Construction (Design and Management) Regulations 2015 (CDM). The Contractor shall submit a CDM competence statement as required by the regulations.

The contractor shall allow for compliance with all aspects of the regulations and in particular:

- a) Implement adequate management systems and processes for Health and Safety which proactively seek to prevent accidents
- b) Ensure that those employed on the project have been properly trained in Health and Safety and are fully aware of their responsibilities under the CDM Regulations
- c) Allocate sufficient resources to the project to enable the duties to be carried out correctly

The Contractor shall provide method statements and risk assessments relevant to their duties under the contract and shall submit all supplementary information for the Health and Safety File as required by the Principle Designer

2.5.1 Health & Safety Information

The contractor shall submit a statement with the tender describing the organisation and resources which the contractor proposes and undertakes to provide to safeguard the health and safety of operatives, and of any person who may be affected by the Subcontract works, including:

- A copy of the contractors health and safety policy document, including risk assessment procedures
- Accident and illness records for the past five years
- Records of previous Health and Safety Executive enforcement action
- Records of training and training policy
- The number and type of staff responsible for health and safety on this project with details of their qualifications and duties

2.5.2 Risks to Health & Safety

The contractor shall submit a statement with the tender describing any significant and unavoidable risks which may arise as a result of carrying out the contract works and the measures proposed to safeguard the health and safety of operatives and of any person who may be affected by the contract/works.

2.6 DEFINITIONS

2.6.1 Technical Definitions

The definitions of technical terms associated with the engineering services installations are those included in:

CIBSE, IOP and BSRIA Technical Publications

Loss Prevention Council - Rules for Automatic Sprinkler Installations

BS 7671 - Requirements for Electrical Installations (IET Wiring Regulations)

British Standards, including Codes of Practice

Associated Statutory Acts

Where used in the documentation the following definitions apply:

Duct: An enclosed space specifically intended for the distribution of services, with direct access for personnel.

Trench: A covered horizontal service space in the floor or ground with access from above.

Cavity: A space enclosed within the elements of a building within which services are installed, e.g. the space between ceiling and floor above. Refer also to Building Regulations.

System: System means all equipment, accessories, controls, supports and ancillary items, including supply, installation, connection, testing, commissioning and setting to work necessary for that section of the Works to function.

Services: Services means the inclusion of one or more systems.

Service Areas: Includes areas within a building with limited finishes such as loading bays, car parks etc.

Exposed Services: Includes installations within plant rooms, outdoors or unprotected within service or occupied areas.

Concealed Services: Includes installations within ducts, trenches or cavities.

References to BSI documents are to the versions and amendments listed in the British Standards Catalogue and in subsequent issues of BSI Update Standards.

Manufacturers' references are those current at the time of Tender.

References mean the particular product as specified in the manufacturer's technical literature current at that time.

2.6.2 Drawing Definitions

Sketch drawings, schematic drawings, detailed design drawings, coordination drawings, installation drawings, installation wiring diagrams, shop drawings, manufacturer's drawings, manufacturer's certified drawings, record drawings, builder's work drawings are as defined in the BSRIA / BE4 Design Framework for Building Services

a) Tender Drawings

The tender drawings show the general arrangement of the Engineering Services to be provided and the inter-relationship of the Works with work to be installed by others. Tender drawings shall not be used as installation or working drawings.

b) Sketch Drawings

Line diagrams and layouts indicating basic proposals, location of main items of plant, routes of main pipes, air ducts and cable runs in such detail as to illustrate the incorporation of the Engineering Services within the project as a whole.

c) Schematic Drawings

A line diagram describing the interconnection of components in a complex system. The main features of a schematic drawing are as follows:

- A two dimensional layout drawing with divisions to show the distribution of the system between building levels. Or an isometric style layout indicating the distribution of systems across individual floor levels
- The drawing is not necessarily constructed to scale. Include all functional components which make up the system, i.e. plant items, pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components
- Symbols and line conventions in accordance with either recognised standard, BS or ISO, or as indicated on the drawing legend
- Label the drawing with appropriate pipe, duct and cable sizes where these are not shown elsewhere
- Indicate components which have a sensing and control function and show the links between them, e.g. building management systems, fire alarms and HV controls
- Identify the major components indicated on the schematic drawing so that their whereabouts in specification and on other drawings can be easily determined

Where used as part of the commissioning specification, the drawing should include all data essential to testing and commissioning including volumetric flow rates, design total pressure losses at equipment, locations of dampers, valves and flow measuring stations, electrical fault levels, current ratings, short circuit capacities and tripping times.

d) Detailed Design Drawings

A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design intent. The main features of detailed design drawings should be as follows:

- Plan layouts to a scale of at least 1:100
- Plant areas to a scale of at least 1:50 and accompanied by cross sections
- The drawing will not indicate the precise position of services, but it should be feasible to install the services within the general routes indicated. It should be possible to produce *co-ordination drawings* or *installation drawings* without major re-routing of the services
- Represent pipework by single line layouts
- Represent ductwork by either double or single line layouts as required to ensure that the routes indicated are feasible
- Symbols and line conventions in accordance with either recognised standard, BS or ISO, or as indicated on the drawing legend

Indicate on the drawing the space available for major service routing in both horizontal and vertical planes.

e) Co-Ordination Drawings

A drawing showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing are as follows:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas
- A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing. Provide dimensions in areas where tolerances are minimal
- Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing
- Make allowance for those plant items specified by the designer and identified in the design specification
- Make allowance for installation working space and space to facilitate commissioning and maintenance
- Indicate positions of main fixing points and supports where they have significance to the structural design
- Arrange the services so that it is possible to demonstrate a feasible sequence of installation
- Support the drawing with individual services drawings for clarity
- Plantroom layouts to a scale of at least 1:20, accompanied by cross sections and elevations to a scale of at least 1:20

f) Installation Drawings

A drawing based on the detailed drawing or co-ordination drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features of installation drawings should be as follows.

Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas

A spatially coordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing

Make allowance for inclusion of all supports and fixings necessary to install the works

Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing

Make allowance for installation details provided from shop drawings

Make allowance for installation working space; space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements

Make allowance for plant and equipment including those which are chosen as alternatives to the designer's specified option

Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen onsite

Plantroom layouts to a scale of at least 1:20, accompanied by cross sections and elevations to a scale of at least 1:20

g) Installation Wiring Diagram

Drawing showing the interconnection of electric components, panels etc in accordance with the design intent indicated in the schematic drawings and incorporating the details provided on manufacturer's certified drawings. Indicate the following; maximum electrical loading for

each supply cable; cable termination facilities; and cable identification and all terminal numbers.

h) Shop Drawings

Drawing prepared by a fabricator or supplier unique to the project. Including supplier's drawings for ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring.

i) Manufacturers Drawings

Drawing provided by a manufacturer or supplier to indicate a typical representation of the product, components or plant items to be supplied for a particular project.

j) Manufacturers Certified Drawings

Drawing provided by a manufacturer or supplier to indicate details of the product, components or plant items and which the manufacturer or supplier guarantees the supplied equipment will comply with.

k) Record Drawings

Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows:

Provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components
Use a scale not less than that of the installation drawings

Have marked on the drawings the positions of access points for operating and maintenance purposes

The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location

l) Builders Work Drawings

Design Stage

A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works. Also drawings (and schedules) of work to be carried out by building trade, and required to be costed at the design stage eg. plant bases.

Installation Stage

Drawing to show requirements for building works necessary to facilitate the installation of the engineering services (other than where it is appropriate to mark out on site).

m) Controls Logic Diagrams

Diagrams, drawings and/or schematic details of all control components and instruments showing the layout with each item uniquely identified together with a description of the controls operation and details of the associated interlocking.

n) Switchgear, Starter and Control Instrumentation Panel

Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices.

o) As-Installed Drawings:

Drawings/records retained on site to record the progress of and any site modifications to the Works; including any changes to software.

2.7 SITE CONDITIONS

The Contractor should visit the site, prior to submitting their tender, to gain knowledge of the accessibility and of the existing site conditions affecting labour, protection of existing services, carriage, unloading and storage of materials, the positions relative thereto of exposed works, buildings, structures, existing underground and above ground services and all other points or matters which can in any way affect the Design & Construction of the Works and the cost of the Contract Works.

Contractors shall satisfy themselves as to the staging, scaffolding, tools, storage, accommodation, etc., required for the proper execution of the Contract.

The Contractor shall also ascertain any such potential future works contemplated currently by the Employer, the Authorities, Companies and organisations and provide within the design of the works such measures as are necessary in these contemplated circumstances.

Any dimensions, quantities or any other information given in specifications, or provided otherwise by the Employer are approximate and provisional only, and the onus is upon the Contractor to obtain accurate dimensions and quantities and verify all aspects of the works and site, as he deems necessary. Any monetary or other claim by the Contractor on the ground of want of knowledge or any of the aforesaid matters or things will not be entertained nor allowed by the Employer and the Contractor accepts all risks in the Contract and interpretation of all information provided by the Employer within these Employers Requirement Documents and in the investigation and interpretation of site and underground conditions at all times.

The Contractor should inspect the drawings, which may be seen by appointment during normal office hours in the office of the Construction Partner.

The Contractor is to set out the works with due consideration for all other trades in accordance with the drawings. Any errors in setting out are to be remedied by the contractor at their own expense. Before the work is put in hand, the setting out is to be approved by the Construction Partner.

All works are to be priced including any item noted on the drawings and not referred to in the Specification or vice versa.

Any claims by the Contractor arising from lack of knowledge of the above mentioned conditions, will be disallowed and will not be considered to form a claim when the work is being installed or on completion.

2.8 INFORMATION PROVIDED BY THE EMPLOYER TO SITE AND OTHER CONDITIONS

Any information of whatsoever nature provided by the Employer, including drawings and specification and any in respect of existing services, ground conditions and any other known concealed conditions, structures and the like, is provided absolutely without liability.

The Contractor shall make their own investigations and satisfy himself as to the accuracy of the information provided by the Employer and shall not be entitled to any payment whatsoever or any Extension of Time arising from any conditions eventually discovered, to be in any way different from those indicated in such information, the costs arising from which shall be deemed incorporated within the Contract Sum.

2.9 MATERIALS AND WORKMANSHIP

The whole of the works shall be carried out in a good workmanlike manner and in accordance with recognised trade practices and agreements. All materials shall be, so far as procurable, the best of the respective kinds described in the specification and are to be of the same manufacture for their various types to simplify maintenance and replacements.

All design, materials, workmanship and installation shall be carried out in accordance with the relevant local authority's requirements, Building Control Officer, Fire Officer, British Standards, Codes of Practice, Health Technical Memoranda, Health Building Notes, The IET Wiring Regulations, the recommendations of the CIBSE and SLL guides

The contractor shall ensure that each and every product used on the project meets all the requirements and complies in all respects with the relevant British and European Standards

The contractor shall ensure that every care is taken in installing the various works, materials and equipment included in the Contract. During times of frost or inclement weather, suitable protection shall be provided where necessary, to all items.

The contractor shall, at his own expense, make good any loss or damage occurring to the various works, materials and equipment, included in the Contract before acceptance of the completed works. This shall include not only items to be supplied by the Contractor, but also items handed over to him for installation.

The contractor shall be responsible for keeping his work people under control, including employees of all his contractors, and will be liable for all damage to the property, adjoining property, grass, vegetation, roads, footpaths, fences and gates, caused by workpeople, lorries or by any other means whatsoever. The contractor's attention is directed to the particular requirements of the Main Contract Preliminaries in these and related matters.

The contractor shall be responsible for storage of all equipment and keeping areas clean and tidy at all times.

The services are to be installed, tested, commissioned and left in full working order to the complete satisfaction of the client and Consulting Engineer.

2.10 DELETERIOUS (PROHIBITED) MATERIALS

The contractor shall not use materials which are deleterious or harmful to human health or the environment during their installation or during long term disposal or degradation. The following substances will not be specified for use or used in the construction of the works:-

- a) High alumina cement in structural elements
- b) Wood wool slabs in permanent formwork to concrete
- c) Calcium chloride admixtures for use in reinforced concrete
- d) Asbestos or asbestos-containing products, as defined in the Control of Asbestos at Work Regulations, or any statutory modification or re-enactment thereof
- e) Any naturally occurring or man-made mineral fibres (for example, rock-wool or slag-wool) with a thickness of 3 microns or less and a length of 200 microns or less, unless they are appropriately sealed to prevent migration of fibres
- f) Aggregates for use in reinforced concrete which do not comply with BS EN 12620+A1 and/or aggregates for use in concrete which do not comply with BS EN 1992:1+A1
- g) Lead, lead paint or any other materials containing lead which may be ingested, inhaled or absorbed, except where copper alloy fittings also containing lead are specifically required in drinking water pipework by any relevant statutory requirement or where lead flashings or other lead roof coverings are specifically provided for in the contract
- h) Urea formaldehyde foam or materials which may release formaldehyde in quantities which may be hazardous with reference to the limits set by the Health and Safety Executive
- i) Calcium silicate bricks or tiles
- j) Vermiculite unless it is established as being fibre free
- k) Any of the products containing cadmium that are referred to in the Environmental Protection (Controls in Injurious Substances) (No.2) Regulations
- l) Any new timber treated with pentachlorophenol
- m) Tropical hardwoods from a non renewable source
- n) Polyisocyanurate or polyurethane foam
- o) Polyetrafluoroethylene expert where used as non stick sealing valves or insulating tape
- p) Glass reinforced concrete
- q) BCF (Halon) fire extinguishing systems
- r) Non-galvanised mild steel structural fixings for building elements particularly susceptible to erosion
- s) Concrete used in circumstances where it is susceptible to alkali/silica reaction
- t) Materials containing chlorofluorocarbons (CFCs)
- u) Solvent based paints except where water based paints are unsuitable or unavailable
- v) Any new materials not in accordance with statutory requirements, British Standards, Codes of Practice and good building practice current at the date of incorporation of the relevant materials into the works the subject of the Development or the specifications therefore

- w) Insulants within the building services installation shall avoid the use of substances with and ozone depleting potential (ODP) in either manufacture or composition
- x) Insulants within the building services installation shall avoid the use of substances with a global warming potential (GWP) of 5 or more in either manufacture or composition
- y) Other materials not in accordance with British Standards and codes of practice

2.11 PROGRAMME

The successful contractor shall submit within fourteen days of acceptance of tender an outline programme of works detailing the intended stages of work and approximate time scales involved. The programme shall also include the 'lead-in period' indicating completion of working/ builderswork drawings and shall include an information required schedule indicating dates when drawings and specifications are required from the Client's team and it shall also indicate key dates for ordering and the deliveries to site of major plant and shall include the number of staff estimated throughout the project.

The programme shall also indicate allowances for drawing submittals by the Contractor to the Client's team. The programme should allow two weeks for the approval period. It is essential that works do not commence without being fully approved by the Consulting Engineer and detailed on working drawings.

Following liaison with the Construction Partner it shall be necessary before starting on site to submit a fully detailed programme and other services. The programme shall be used during the contract to assess progress.

During the course of the contract detailed programmes of work shall be submitted for specific areas (e.g. Testing, Commissioning, Demonstration and User Training) as requested by the Construction Partner.

Due allowance is to be made in the programme for the Works for, but not limited to, the following:

- Ordering and installation periods
- Dates when information is required from others
- The completion of working and builderswork drawings, etc, including the minimum working days for comment
- Work resulting from instructions issued in respect to the expenditure of provisional sums
- Concurrent work by other trades
- Any temporary works necessary for the completion of the engineering services installations
- Pre-commissioning, commissioning and performance testing of the engineering services installations
- Preparation and provision of record drawings and operating and maintenance manuals

Programme information shall be provided as a simple bar chart or critical path network.

The contractor shall provide a separate and detailed commissioning programme for agreement with the Construction Partner. Make due allowance for the following:

- Commissioning, demonstration and instruction procedures
- Provision of written notice before each (or series of) test, inspection, commissioning or demonstration procedures are to be carried out, not less than two weeks
- Demonstration to the Construction Partner that test instruments and equipment are accurate

Due to the potentially disruptive nature of the works, particularly relating to breaking into existing services, the successful Contractor shall be required to provide a detailed schedule and timetable for all break-ins to the existing services, which shall be agreed with the appropriate Client. Upon agreement of the programme, the agreed dates shall be strictly adhered to.

Any variations or modifications to the agreed programme shall be immediately reported to the client for their approval. No changes to the programme or sequence of working shall be carried out unilaterally.

Ensure that procurement details of materials are incorporated in the contract programme.

Avoid delays by submitting details of alternative manufacturers or types of materials/products to the Construction Partner in time to comply with the agreed programme of the Works.

Order all materials/products necessary for the completion of the Works immediately after receipt of comments received and/or instructions to proceed.

No delay to practical completion, or completion of any part thereof caused by delays in ordering will be accepted.

2.12 PROCUREMENT, PLANT AND MATERIALS

2.12.1 Specialist Contractors

As soon as practicable after entering into the Contract, the Contractor shall enter into such Specialist Contracts required by the Preamble and/or he considers necessary, for the satisfactory completion of the Contract works.

The Construction Partner reserves the right to request that the Contractor shall provide copies of all or any Specialist Contract orders placed by him in connection with this Contract.

2.12.2 Responsibility for Suppliers

The Contractor shall be held responsible to the Employer for ensuring that the performance of all fittings or equipment meet the requirements of this specification, whether or not the manufacturers and suppliers of the fittings or equipment are mentioned in the specification.

The Construction Partner reserves the right to request that the Contractor shall provide a copy of all or any order for items of plant, equipment or materials placed by him in connection with this Contract.

2.12.3 Samples

The Construction Partner reserves the right to request that the Contractor shall provide a sample, properly labeled, of any materials and products proposed for use in the works at no additional cost to the contract.

Such samples shall be submitted to the Construction Partner for their comment at their offices or elsewhere as directed, with all parts left loose, so that they may be taken apart for internal inspection by hand without the necessity of using spanners, screwdrivers or wrenches.

The Construction Partner may require such samples to be subjected to tests designed to ensure compliance with British Standard and other relevant Specifications and requirements of this Preamble.

The Contractor shall provide the facilities and apparatus for such tests and carry them out in the presence of the Construction Partner. The Contractor shall also replace the samples where necessary.

Samples shall be liable to be retained for the purpose of comparison with future deliveries, but any or all of the samples shall be returned to the Contractor should he so request after their purpose has been served.

2.12.4 Site Delivery

The Contractor shall be responsible for the off-loading and storing of their plant and equipment in connection with this Contract.

2.12.5 Name Plates & Labels

All plant and equipment supplied for the works shall give the manufacturer's name, date of manufacture, shop number, type and working conditions, etc., together with all other particulars which will aid identification for the ordering of spare parts. Any item on which this is omitted will be rejected.

All items of plant shall be identified by means of a traffolyte label, inscribed with a suitable description of the plant and indicating any applicable references.

All valves throughout the project, with the exception of sanitary ware ball-o-fix valves, shall be fitted with a circular traffolyte label inscribed with its reference number. A typed valve schedule shall be included in the Operating and Maintenance Manual.

All lagged and unlagged pipework shall be identified, at no less than 6m centres, with the appropriate BS colour banding to identify the service. Additional bands shall be fitted adjacent to all valves, and also in all locations where there may be confusion between services.

2.12.6 Handling & Storing Materials & Products

The Contractor shall carry out the following:

- Deliver, off-load, store and transport about the Works all materials and products in the manner recommended by their manufacturers
- Provide adequate safe, covered storage and protection for all new materials and products

- Protect **all** open ends (on equipment, pipework, ductwork, cables, etc) from ingress of dirt dust and moisture by means of purpose made caps or covers
- Provide racks to prevent distortion for storage of conduits, pipes and similar materials
- Store all fittings, accessories and sundry items in clean bins or bagged and stowed in racks and maintained under suitable weatherproof cover
- Where materials and products cannot be stored in dry buildings, they shall be raised clear of the ground and supported. They shall be protected from damage by frost, water and building work with covers or other appropriate means. Materials and products must not be stored by placing directly on earth or any other damp or corrosive surface
- Materials and products shall be adequately coated to prevent damage by oxidation, etc. and this coating shall be maintained until ready for final finishing

2.12.7 Erection of Plant

The erection of all plant and equipment included in the works shall be the sole responsibility of the Contractor, who shall carry out any special instructions given, or recommended, by the manufacturer. In the absence of any instructions, the Contractor shall submit their proposals to the Construction Partner. Should any faulty erection of equipment affect the working efficiency of the plant, the Contractor shall be bound to make good at their own expense.

2.12.8 Quality of Services

All equipment, cabling and accessories provided shall be of excellent quality to prolong their service life and to reduce maintenance costs. All equipment installed shall be capable of being readily serviced, complete with an established local spares network facility.

All services shall be sited and positioned for ease of maintenance procedures. Equipment shall be provided with adequate warning labels and signage to assist in all maintenance procedures.

2.12.9 Standardisation

All materials and items of equipment are to be of the same manufacture for their various types in order to simplify maintenance and replacement.

2.12.10 Plant and System Selection

2.12.10.1 Environmental Aims

The general policy is to provide a building which is environmentally friendly from the global, local external and internal aspects and which minimises the impact on the local community. The building is designed to address the following:

- a) Minimise any negative impact on the local environment and where possible improve it
- b) Minimise the effect of ozone depletion
- c) Minimise the effect on global warming
- d) Minimise air pollution
- e) Minimise water pollution
- f) Minimise rainforest depletion
- g) Minimise non-renewable resource depletion
- h) Avoid radon contamination
- i) Minimise the risk of Legionnaires disease and the spread of Legionella
- j) Minimise the effects of ionising and electromagnetic radiation

- k) Avoid the use of potential irritants and/or toxic substances
- l) Avoid design features associated with Sick Building Syndrome
- m) Maximise the opportunity for recycling
- n) Enable planned preventative maintenance regimes to be used to maintain optimum performance

2.12.10.2 Design Philosophy/Building Life

The building must fully satisfy the requirements of the design criteria while being capable in all respects of providing a working environment which is pleasant, environmentally friendly, energy conserving and maintenance minimised.

Emphasis should be placed, wherever possible, on adopting durable low maintenance materials and avoiding over complicated design resource systems which are expensive to operate and maintain, and costly to replace.

The building should operate effectively and efficiently throughout its design life and materials and components be carefully selected with due consideration to their individual life cycles relative to the overall design life of thirty years required for the building.

In particular, items should not be incorporated which require premature replacement by virtue of their dependence, or relationship to, other elements having a shorter design life.

2.12.10.3 Plant & Equipment Life Factors

The plant and equipment that have been generally selected shall achieve the following plant life factors assuming a good standard of plant maintenance.

All plant and equipment shall be selected to provide an anticipated life to the mid-range of the life factors quoted in CIBSE "Guide to Ownership, Operation and Maintenance of Building Services"

2.12.10.4 Plant and System Sizing

All plant and distribution systems shall be sized in accordance with the recommendations of the CIBSE guides, Institute of Plumbing Guide, IET Wiring Regulations (BS7671) and all relevant British Standards.

The contractor shall clearly indicate in their calculations the publications upon which their design criteria are based.

2.12.10.5 Selection of Manufacturers/Suppliers

Where manufacturers, suppliers or installers of products are not identified by name the contractor shall select products that comply in all respects with the specification and, as and when requested, demonstrate such compliance.

Where manufacturers, suppliers or installers of products are identified by name, or names, but no reference is made to "Or approved" equivalent the contractor shall use only the specified equipment.

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "Or approved" equivalent the submitted tender must include the named or one of the named suppliers.

Alternatives may be selected and shall be submitted to the Construction Partner for approval, separately.

The contractor shall check that any proposed alternatives comply with any stated British (or other equivalent recognised International) Standards.

The contractor shall confirm equivalence in quality, operation and space requirements to those items which have been specified by name. If, and when requested demonstrate the proposed alternative is fully equivalent to the specified item and identify any constructional, cost, programme, maintenance or other differences.

2.12.10.6 List of Proposed Manufacturers/ Suppliers

A list of proposed manufacturers/supplies of products, equipment and plant, including all items for which the choice of manufacturer/supplier is at the discretion of the contractor, must be submitted within one week of request.

2.12.10.7 Enhanced Capital Allowances (ECA)

All equipment shall be selected to take advantage of the enhanced capital allowance scheme.

The Contractor shall provide the building owner, via the Construction Partner, all necessary information on the installed plant and systems to support a claim under the ECA.

2.12.11 Recommended Spare Parts:

The Contractor shall submit to the Construction Partner not less than 4 weeks before practical completion a schedule of spare parts as called for in individual sections of this specification and any others that the he may recommend should be obtained and kept in stock by the Employer for maintenance of the services installations.

Against each item the manufacturer shall state the current price, including packaging and delivery to site. Those items which are additional to those specified for inclusion in individual Sections should be highlighted.

2.13 DRAWINGS

2.13.1 Tender Drawings

This specification shall be read in conjunction with the Tender Drawings.

The Contract Sum for the Works shall be deemed to also include any item or labour not specifically mentioned herein, but which may be incidental or consequent upon carrying out the whole of the Works described.

The Contractor shall receive and examine all documents issued to him and shall read the documents and drawings issued with the Tender and draw the attention of the Services

Consultant to any discrepancies and to anything which in his opinion may be unsuitable, undesirable or inconsistent with his guarantees and responsibilities.

The Contractor shall draw the Services Consultant'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 works affected thereby.

The drawings provided by the Services Consultant are diagrammatic only, in that they are indicative of the general disposition of pipes, ducts, trunking, cables and the like and of the positions of plant. The Contractor shall be deemed to have had regard to the Architect and Structural Consultant's drawings available at the date of his Tender and to have included in his Tender for all necessary ductwork, pipework, cables, conduits and fittings required to overcome and allow for constraints imposed by the design of the structure and any existing structures likely to affect routes or positions.

Where runs of pipework, ductwork, cables, conduits, trays etc. are shown, these do not necessarily indicate exact positions. The Contractor has also to co-ordinate and include for any site visits deemed necessary to satisfactorily complete the Works in accordance with the specification and drawings.

Tender drawings shall not be used for installation purposes. The contractor shall prepare their own working and installation drawings.

2.13.2 Contract Drawings

The Services consultant shall provide 1 printed copy and 1 PDF copy of the Contract drawings showing the general arrangements of the installation.

The Contractor shall satisfy himself as to the accuracy of the information shown on the drawings, and whenever possible, dimensions, levels and positions must be checked on site, for use in the preparation of the installation drawings.

Contract drawings shall not be used for installation purposes. The contractor shall prepare their own working/installation drawings.

2.13.3 Installation Drawings (Working Drawings)

The Contractor shall provide the installation drawings for all services listed in the various sections of this document. Contract or tender drawings shall not be used for installation purposes.

The drawings shall be prepared using the current release of Revit / AutoCAD and the Contractor shall provide 3 paper copies and two electronic copies on CD of each drawing and any subsequent revision.

Installation drawings shall include: -

- a) Risk assessments
- b) General dimensioned layout drawings of the complete works
- c) Detailed layouts showing the location of all plant and equipment including service routes switch rooms and plant rooms
- d) Key area sectional layouts in risers, floor and ceiling voids

- e) Assembly drawings of all factory built equipment and site built assemblies
- f) System diagrams and circuit wiring diagrams for all installations and equipment

The Contractor shall also prepare detailed dimensioned layout drawings showing final connections to equipment.

The Contractor shall ensure that adequate space is provided for servicing and maintenance of all equipment.

If during the progress of the Contract, modifications are required to be made to the work, the Contractor shall submit revised drawings incorporating the modifications.

The Contractor shall be responsible for any discrepancies, errors or omissions in the above mentioned drawings, whether these drawings have been commented on by the Construction Partner or not. Comments given by the Construction Partner to any drawing shall in no way relieve the Contractor from their liability to complete the works in accordance with the document or exonerate him from any of their guarantee.

2.13.4 Manufacturer's Drawings

The Contractor shall provide to the Construction Partner for comment two copies of any Manufacturers Drawings giving all information, including dimensioned layouts, of all plant and equipment prior to manufacture.

Manufacture of relevant items of plant and equipment shall not commence until the Construction Partner comments on the relevant Manufacturers Drawing has been obtained.

2.13.5 Builderswork Drawings

The Contractor shall provide to the Construction Partner for comment two copies of fully dimensioned drawings to an approved scale, of builders work requirements in connection with this Contract.

Builders work drawings shall be fully dimensioned showing location of holding down bolts, details of anti-vibration mountings and secondary support steelwork, detail of plinths, holes, column bases, tray and trunking supports, all external ducts and duct routes etc. including all statutory authority ductwork and builders work details.

The Contractor shall provide to the Construction Partner full particulars of static and dynamic loading including moments, and dimensions and positions of foundations and plinths, and/or fixings necessary for the support and accommodation of all equipment to be supplied under this Contract, so that adequate provision may be made.

2.13.6 Examination of Drawings/Information

The Construction Partner will examine the propositions submitted for compliance, in principle, with the design intent. Such an examination shall not relieve the originator of such documents of his responsibilities and obligations under the contract.

2.14 BUILDERSWORK

Holes through walls/floors, chases for cable, pipework and drops shall generally be marked on site. However, if any part of the works requires a more detailed builderswork provision, builderswork drawings shall be issued to the Construction Partner as necessary via their Contractor.

All builderswork shall be submitted to satisfy the Construction Partner programme of works.

Should it not be possible to exactly define a builderswork requirement for any reason within the agreed programme this must clearly be stated to the Consulting Engineer within good time to enable suitable action to be taken.

Should any builderswork requirement not be defined by the Contractor on their drawings or should a detail be incorrectly shown, any alterations that may arise as a result may be subject to a charge by the Construction Partner

2.15 INSTALLATION

2.15.1 Co-Ordination

The Contractor or his appointed representative shall co-ordinate the contract works with the works of all other trades. The Contractor shall include for full liaison with all other Trades, including the all Contractors, with respect to routes and positions of equipment, prior to installation. No additional costs will be accepted due to abortive work due to non-compliance with this clause.

In positions where other services are to be installed in the vicinity the Contractor shall ensure that the order of installation of the services in relation to each other is coordinated and carefully planned before any installation work commences.

The Contractor shall submit to the Construction Partner dimensioned plan and section coordinated services drawings for known congested areas.

These drawings shall adequately demonstrate that proper co-ordination of the works will be achieved within the allocated special zones and with the building structure and finishes.

It is the Contractors responsibility to ensure that potential clashes are identified **before** work commences in all areas. The Contractor shall ensure that such co-ordination planning is programmed to provide reasonable time for modifications to be detailed where necessary before installation is due to commence.

The Installation Drawings shall be provided by the Contractor together with site sizes and the necessity of arranging access to all services for maintenance, and to establish the inter-relationship of services in confined spaces. Builderswork drawings shall be provided by the Contractor with full knowledge of the inter-relationship of all services present.

The exact position in the works of the above items relative to grid lines, floors, beams, ceiling, walls and other structural items and any other services in this Contract is the responsibility of the Contractor.

2.15.2 Progress and Monitoring

The contractor shall maintain copy of his programme on site and at weekly intervals update it as a record of progress. The programme shall be updated or redrafted as necessary where circumstances dictate a change which may affect the progress of works.

The Contractor shall keep on site one full set of paper prints of the Installation Drawings marked up to reflect "As Installed" details showing the progress of all work in connection with this Contract.

These drawings, which shall be maintained in clean condition, shall be kept up to date on a weekly basis, and all pipe lines, tray and trunking, positions of equipment and apparatus, including all modifications and/or variations, etc. shall be clearly recorded by the Contractor on the drawings as they are installed.

The contractor shall produce all pipework, ductwork and containment drawings in 'As Fitted' status for inspection prior to ceilings being closed off.

The Contractor shall make the above drawings available at any time for inspection by the Construction Partner.

2.15.3 Attendance

The Contractor shall be responsible for the execution of the following works:-

- a) Supplying all relevant information pertaining to service ducts and chases, etc., in floors, walls and ceilings where necessary
- b) Setting out all holes, ducts, etc., required through walls and any other structures
- c) In addition to (b) above, providing the information regarding the disposition, number and dimensions of all Services on partition walls

2.15.4 Labour & Supervision

The Contractor shall appoint a foreman-in-charge and/or site agent supported by a competent management and supervision team to manage the execution of the contract works.

The Supervisor shall prepare progress schedules and a programme to ensure full exchange of information with other trades and shall be available to attend meetings on site as required.

The Supervisor shall also keep a diary recording the day-to-day progress of the work and the details of all instructions received.

Only skilled tradesmen shall carry out the works, and only one apprentice for every two skilled tradesmen shall be employed on this Contract.

All personnel shall have the appropriate qualifications training and experience to execute their tasks safely and to the highest professional standards.

Each operative level shall be adequately supervised and controlled. The Contractor shall provide a management structure chart showing the key personnel accompanied by a CV for each member.

The Contractor shall observe those conditions of employment which have been agreed between the Employers Federation and the Trades Unions concerned to apply to the place and the circumstances in which these works are to be carried out.

The Contractor shall be responsible for the supervision and correct installation of all work carried out under this Contract whether or not he has, with the permission of the Construction Partner, let any portion of the works as a specialist Contract to this Contract.

Where such a portion of the works has been let to a specialist Sub- Contractor, all contact with him shall be through the Contractor. The Contractor shall ensure that a full time working foreman is employed on the works, to maintain continuity.

At no point during the works shall the foreman be changed without the express consent of the employer or their representative.

2.15.5 Painting & Anti-Corrosion Treatment

All components requiring anti-corrosive treatment shall be painted or shall be treated by other "metal coating" methods.

All welding, drilling, punching, cutting and bending of the metal component shall preferably be done before the protective treatment coating is applied.

All coatings applied shall be entirely suitable for the material to which it is applied and to the conditions to which it will be subjected to in service.

All components requiring metal protective coatings shall be manufactured from hot-dip zinc coated sheet steel complying with BS EN 10143 and galvanised steel tube and tubing to BS EN 10255. Where galvanising/ sherardizing coatings are specified these shall comply with BS EN ISO 3834 and BS EN ISO 17668 respectively.

All components requiring painting shall be thoroughly cleaned removing all mill scale, weld scale and corrosion and finally degreasing.

All paints shall be lead free type, with primers having good adhesion, good rust covering power, rust inhibiting and grain flowing properties. Gloss paint shall be machine finished paint having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

All paints shall be manufactured by one of the scheduled firms and supplied by one manufacturer, even if the painting is done off site. The paint shall be delivered to site in sealed containers labeled with the following information.

- a) Type of Paint
- b) Brand Name
- c) Manufacturer's batch reference

Work described as painted shall be given one coat of primer and two coats of gloss machine finished paint. Work described as primed shall be given one coat of primer.

Damage to metal coated/painted work shall be repaired to the satisfaction of the Engineer or the component replaced.

2.15.6 Fixing To Building Fabric

The Contractor shall be responsible for the structural integrity of all supports and fixings for plant, equipment and components.

Components and equipment shall be fixed firmly to the building fabric using screws or bolts, as specified, of the maximum size permitted by the fixing holes.

Screw-fixings to solid brickwork or concrete shall be made using substantial proprietary metal or plastic plugs, ensuring that both plug and screw are well embedded into the masonry behind and applied finish. Screw-fixing to sheet metal shall be made using sheet metal screws.

Through-the-wall bolt-fixings shall consist of a bolt sufficiently long to pass through the wall, spreader plate under the head and a nut and washer.

Bolt-fixings to solid brickwork, blockwork or concrete shall be made using self-drilling anchors. Bolt-fixings to hollow backgrounds shall be made using toggle-bolts or expanding plastic rawlnuts.

Bolt-fixings to structural steelwork shall be by means of clamps and adapters of the Lindaptor, installed in the manner recommended by their manufacturer.

The following operations must not be carried out without the permission of the Structural Engineer. Failure to observe this requirement may result in the Contractor having to make good the damage to structural steel, reinforced concrete, facing brick and other materials at their own expense.

- a) Manufacturer's batch reference
- b) Drilling or cutting of holes in structural steelwork
- c) Welding on structural steelwork
- d) Drilling of holes in reinforced concrete
- e) The use of cartridge operated tools
- f) Drilling or fixing to roof purlins

2.15.7 Room Terminal Locations

The positions of all connection points, accessories, apparatus, equipment and other room terminals shown on the tender drawings are approximate and for guidance in the preparation of the tender.

The contractor shall allow for the movement of all such terminals up to a radius of 2.0m from the positions shown on the drawings to account for possible on-site co-ordination.

Mounting heights indicated in tender documents are for tender purposes only. The contractor shall confirm mounting heights before commencing work on site.

The Contractor shall ensure by referring to the Architect's detailed drawings that all accessories are located to suit fitments, benches, etc., and the equipment served by the outlet or accessory.

2.15.8 Positions of electrical outlet points on drawings

Although the position of the electrical outlet points, control switches, and lighting points shall be indicated on the drawings, enquiries shall be made by the electrical contractor to the Consulting Engineer when the work is actually commenced as to the exact position of the various points.

2.15.9 Final Connections

The Contractor shall allow for making all final connections to equipment and for co-ordination with the equipment supplier and manufacturer.

“The use of E.P.D.M lined flexible connections for potable water services installations is strictly prohibited”.

2.15.10 Interruption of Existing Services

The Contractor shall not, unless he has received the written permission of the Construction Partner, interfere with, or interrupt in any way, operation of any existing services such as Gas Mains, Water Mains, Sewers, Drainage, Electricity Cables, etc., and in the case of the work of Statutory Authorities or Private Owners, without also having received permission of such Authorities or Owners.

The Contractor shall be responsible for any damage to such services caused by the Contractor's personnel and equipment and shall make good any such damage at their own expense, to the satisfaction of the Construction Partner, Authorities or Owners.

2.15.11 Connecting To Existing Services

The Contractor shall notify the Construction Partner in writing, giving a minimum of seven days' notice of their intention to connect into or isolate any of the existing services and await their approval for so doing. The notice shall be accompanied by a method statement for the works which includes detailed timings with regard to preparation duration and service interruption.

The Contractor shall include for all overtime and other additional payment necessary to ensure that the interruptions to existing services are carried out with the minimum possible inconvenience. The Contractor shall work without pause until the services are back to a normal situation.

All works shall be carried out under a permit to work system.

2.15.12 Public & Private Services

The Contractor shall be responsible for establishing the condition and capability of all existing services of whatsoever nature and any necessary modifications, diversions, extensions, etc which are necessary for the works, all to be carried out at the Contractors Cost.

The Contractor shall be responsible for and include in the Tender Sum for establishing the condition and capability of all existing gas and water supplies.

2.15.13 Existing Services – Connections and Utilisation in the Project

It is incumbent upon the Contractor to determine the locations, levels, etc of all existing services of whatsoever nature, in preparation of the design of the works and the execution of the works.

The Contractor shall remain solely responsible for all costs of whatsoever nature, arising from any discrepancy in or their failure to determine the locations, levels, etc of existing services and the Contractor shall have no entitlement to claim nor to the payment of any additional monies in respect of any consequences arising from such deficiencies nor shall he be entitled to any Extension of Time arising from any delays or disruption which might consequently arise.

Any particulars provided within the project specifications with regard to existing services are provided for guidance only and their provisions shall not under any circumstances place any responsibility upon the Employer for their accuracy, the entire risk for all works associated with, arising from and in connection with the existing services remaining solely with the contractor.

2.15.14 Notice Prior To Cover

The Contractor shall notify the Construction Partner in writing, giving a minimum of seven day's notice, whenever any works or materials are ready to be covered within building fabric, ceilings, earth or otherwise hidden and shall leave these works uncovered until they have been inspected and approved by the Construction Partner.

Any work which is covered or hidden before inspection by the Construction Partner, shall, where required by the Construction Partner, be uncovered and subsequently made good at the expense of the Contractor.

2.15.15 Protection of the Installation

The Contractor shall allow for taking all necessary precautions to protect the complete installation from any damage which may occur before handover and written acceptance by the Construction Partner.

Ensure all items are protected against ingress of water and dust, formation of condensation, extremes and rapid changes of temperature, building works and operations of others.

The contractor shall provide adequate and safe protection for all materials and products after installation.

Protect all finished items from damage and paint splashes.

Install items such as grilles, diffusers, lighting fittings, switches, accessories etc. as near to completion as practicable.

Only install filter media when the plant items concerned are being commissioned and tested.

Cap all open ends of pipes, ducts, conduit and trunking etc except when being worked upon.

Leave plant and equipment in a ready to paint condition where specified as part of the Works or to be carried out by others.

Paint parts liable to corrosion immediately after removal of any temporary protection.

Replace material, plant or equipment where deterioration or damage has occurred prior to handover. The cost involved in repairing any damage before handover and acceptance shall be borne by the Contractor.

2.15.16 Removal of Rubbish & Cleaning

The Contractor shall at all times keep the site free from obstruction and rubbish insofar as they are a direct result of carrying out the Contract Works and he shall remove from the site at their own expense, all surplus materials and temporary works which were brought on to the site by as soon as these are no longer required. On completion of the works, the Contractor shall leave the site in a clean and tidy condition, to the satisfaction of the Construction Partner.

2.15.17 Notices & Labels

The Contractor shall supply and erect all statutory warning and advisory notices in plant rooms and switchrooms. The notices shall wall mounted in a protective frame.

All plant, equipment, components, isolators and switches shall be fitted with labels detailing their function. The labels shall be black characters engraved on white Traffolyte securely fixed to the equipment.

2.15.18 Materials

All materials and items of equipment are to be of the same manufacture for their various types, in order to standardise and simplify maintenance and replacement.

All materials are to be adequately protected and stored, and the tender price to include for all necessary cabins required for this purpose.

2.15.19 Fire Precautions

The Contractor shall comply with the requirements of the Local Fire Authority, the Licensing Authority, and all documents pertinent to their requirements.

All materials and surfaces incorporated in the construction of the development should have the requisite fire resistance, surface spread of flame and other relevant characteristics appropriate to their location and purpose as specified by the above authorities

2.15.20 Electric Supply

The final electricity supply will be 400 volts, three phase and 230 volts, single phase, 50 cycles.

The contractor shall be responsible for the provision of all electrical transformers necessary for the completion of their works.

2.15.21 Design Intent

The contractor shall be responsible for ensuring that the Design Intent indicated on the contract drawings is in no way impaired due to additional bends, deviations or changes in the service routes and plant layout.

2.15.22 Access to Plant

Plant arrangement shall be installed in such a manner that components may be installed, accessed, maintained, removed and replaced without difficulty and without compromising the safety of personnel. The installation shall, as a minimum, satisfy the following requirements:-

- a) BS:7671 Requirements for Electrical Equipment of Buildings
- b) Manufacturers recommendations
- c) BS: 8313 (Accommodation of Building Services in Ducts)
- d) BSRIA Application Guides - Design for Maintainability
- e) BSRIA Technical Notes - Space Requirements for Building Services Distribution Systems
- f) Construction (Design & Management) Regulations
- g) HTM 2033 – 2 Access and Accommodation for Engineering Services

All maintainable items of plant shall be accessible from floor level or via permanent access walkways.

All items of plant which are likely to be replaced within the life of the building shall be arranged such that they can be removed without dismantling any elements of permanent structure and without comprising normal access and escape routes. For the purposes of this requirement permanent structure shall be defined as any building components which cannot be removed or reassembled within a time limit of two hours.

The above requirements are intended to indicate the expected standards.

Should it prove necessary to compromise any access provision the Contractor shall the record proposals and justification and shall submit to the Construction Partner and the CDM Coordinator / Principle Designer. If accepted as the most appropriate arrangement details of the non-compliance shall be recorded in the Operating and Maintenance manuals and the Health and Safety file.

2.15.23 Acoustic Control of Plant

The Contractor shall ensure that all plant, equipment and components provided meet the appropriate internal and external acoustic criteria for the development.

The Contractor shall assess the impact of each item upon internal and external noise levels and provide the acoustic treatment necessary to meet the requirements.

The Contractor shall submit details of these assessments and acoustic treatment to the Construction Partner before equipment is ordered.

2.15.24 Electromagnetic Compatibility

The contractor shall ensure all equipment and systems are installed to provide electromagnetic compatibility within the system and with any other systems installed in the same area. Ensure all systems and buildings are assessed for protection to, and that such protection meets the requirements of BS EN 62305 Part 1. Ensure all equipment meets the requirements of the appropriate electromagnetic compatibility standard.

2.15.25 Software

The contractor shall obtain on behalf of the end user all appropriate licenses', permissions, copyright waivers, rights of use and the like from the owners of the software rights.

Ensure that the end user is properly registered with the software supplier for support and appropriate updating.

Ensure that application software is written in compliance with the appropriate British and European Standards

2.15.26 Rotating Plant

Immediately prior to Practical Completion the contractor shall adjust, ease and lubricate moving parts as necessary to ensure easy and efficient operation.

2.15.27 Testing and Commissioning of Services

The testing and commissioning of the system shall be carried out fully in accordance with the details as contained in the specification and full cost allowances shall be included in this respect.

The contractor shall review all designs to ensure that systems are commissionable and highlight for review by the Construction Partner any considerations in respect of commissioning. Provide a report signed, by a competent person confirming, prior to installation that all system designs can be commissioned.

Ensure that the commissioning requirements are compatible with any project restraints concerning sectional handover/ phasing.

Agree with the Construction Partner a programme for pre-commissioning checks, setting to work, commissioning and performance testing, and allow for all costs incurred.

Give not less than 10 working days' notice to the Construction Partner and/or employer of any testing or commissioning works and state any requirements for the attendance and co-operation of others.

Maintain on site full records of all commissioning and performance testing, cross referenced to system components and on completion of the Works include a copy in each Operating and Maintenance Manual.

Prepare comprehensive commissioning method statements including procedures, logic diagrams and risk assessments for:

- Pre-commissioning checks
- Flushing and chemical cleaning
- Setting to work
- Commissioning and testing
- System proving

The contractor shall prepare a set of drawings and/or report sheets to record accurately the test and inspection information including the following.

- Plant identification, section and installation under test
- Manufacturer's reference number
- Date, time, duration of test, weather conditions
- Test results with itemised readings including records of all other checks and tests

Maintain records of all specified inspections and tests performed including third party and works test certificates.

Include in records, as appropriate, details of the element, item, batch or lot, the nature, number and date of the inspections and tests, the number and type of deficiencies found, any corrective action taken and other relevant particulars.

Maintain all records on site for inspection. On completion of the Works, include copies in the operating and maintenance manuals.

Submit copies of records within one week of request.

Test all equipment, material and systems as detailed in the particular specification. If an inspection or test fails, repeat the procedure, until satisfactory results are obtained.

The Construction Partner will only witness test proceedings, confirm recorded results and determine if the specified requirements have been satisfied. If following test or inspection any plant or part thereof is shown to be defective or not conforming to the specification the Construction Partner will reject such defective parts by written notice, within reasonable time, indicating area of dispute.

All tests shall be completed before any paint, cladding or similar materials are applied or before services are concealed.

Following satisfactory completion of testing and when the installations are in a safe and satisfactory condition, set to work, regulate and adjust, as necessary, to meet the specified design requirements.

Provide all necessary instruments and recorders to monitor systems during commissioning and performance testing.

The contractor shall provide all necessary attendance for commissioning works carried out by specialist contractors and equipment manufacturers.

Provide all necessary facilities to enable tests to be witnessed and inspections carried out including all necessary instruments and recorders to monitor systems during the commissioning and environmental proving period.

Ensure all certification is attained and witnessed as necessary for inclusion in the record documentation.

Provide all certification documents for approval by the Construction Partner before any system is offered for final acceptance.

Provide a final commissioning report, signed by a competent person, detailing the results of the commissioning and commenting on the performance of systems. The report to confirm that each installation is correctly tested and commissioned, achieves the specified performance and in accordance with CIBSE Code M.

All gas, fuel oil, electricity and water for testing and commissioning will be provided by the contractor unless alternative arrangements made with the client.

On completion of all works covered by the contract, the contractor shall ensure that all such work including all equipment is left in a clean and tidy state. They shall also be responsible for ensuring that all packing materials, empty cartons, unusable equipment and all waste materials are removed from the site.

2.16 SUPPLY CONNECTIONS AND LOCAL AUTHORITIES

The contractor shall carry out load assessments based upon the initial concept proposals and liaise directly with the statutory authorities in order to obtain quotations for the gas, water, electrical and BT.

The Contractor shall include for liaison with the utility service providers for electricity, gas, water, drainage and telecoms regarding the provision of service connections and associated ducting and builders work.

The contractor is responsible for organizing the necessary witness testing and installation programme dates with the statutory authorities including Building Control, the Water Supply Authority and Environmental health.

In addition to the above, the contractor shall be responsible for any diversions / disconnection required and shall liaise directly with the statutory authorities to successfully complete the works.

Upon completion of the works the Contractor shall demonstrate the systems to the utility representatives and make any modifications or alterations requested.

2.17 PRACTICAL COMPLETION OF WORKS

A certificate of Practical Completion will not be issued until the contractor has completed the installation works to the satisfaction of the Construction Partner.

The Contractor shall record readings of all water, gas, and electricity meters immediately on completion of the Works and forward, via the Construction Partner, to the Construction Partner.

This shall include:

- All engineering installations have been completed and snagging items attended to
- Commissioning and testing reports have been provided
- Record Drawings, Operating and Maintenance (O&M) Manuals and Building Log Books have been completed and issued
- Employers staff have been instructed in the correct operation of the installation

2.17.1 Systems Used Before Practical Completion

Systems may not, without the prior written approval of the Construction Partner be used before Practical Completion. Systems to be used before practical completion for the benefit of the Contractor and/or Subcontractor must have all defective consumable elements (including lamps and tubes) replaced by new not more than seven days prior to Practical Completion. No system shall be put into use prior to handover to the employer, except for testing and commissioning, unless in accordance with the following procedure:

Following the receipt of written instructions, the contractor shall operate designated parts of the Contract Works, provided that such operation is practicable and does not prejudice the contractor's responsibilities and obligations under the contract.

Additionally and with adjustment to the contract sum, the contractor, shall if instructed, provide:

- Comprehensive insurance including indirect loss for any plant being operated
- Maintenance of the installation
- Re-instatement of the installation to as new condition prior to handover to the Employer
- Allow the defects liability period to commence on handover

2.17.2 Training of Employer's Staff

The Contractor shall allow for providing demonstration of the purpose, function and operation of the installations including all items and procedures listed in the Operation and Maintenance Manual to not less than 4 of the Employers maintenance and/or operational staff before practical completion.

This shall include training in the use of the controls or BMS installations installed or modified as part of the works.

The contractor shall fully maintain all existing services to existing premises during the progress of the Works.

Provide any additional work and materials necessary to maintain these services at all times during the duration of the Contract. Any existing services disturbed by the Works are to be reinstated fully in accordance with the standards of quality defined in the specification and to the satisfaction of the Construction Partner.

Unless otherwise agreed with the Construction Partner, all connections to existing services shall be made out of normal working hours.

2.17.3 Proposals for Annual Maintenance Contract

The contractor shall submit before completion (but not less than 4 weeks prior) of the contract a supplementary proposal for an annual maintenance contract for the installations undertaken.

The proposal should include for maintaining the installation in efficient working order including routine checks, adjustments, lubrication and replacement of consumable spares, etc.

It should set out the terms of the offer, the work to be carried out, the guarantees of performance and the price of the first 12 months after Practical Completion of the Works or Section thereof.

The proposal will not necessarily be considered as part of the tender for the Subcontract Works and the Employer does not undertake to accept it.

2.18 12 MONTHS DEFECTS LIABILITY PERIOD

The Contractor shall include for a 12 months liability period commencing from the handover date of the installation. The contractor shall ensure that, where necessary, all plant and equipment have extended warranties to meet this contract condition.

Immediately the contractor effectively completes the installation, or any agreed section of the installation which shall be immediately prior to the Construction Partner handover, he shall advise the Consulting Engineer, in writing, to this effect and provide a list of outstanding matters.

The Consulting Engineer will then make a thorough examination of the installation and will prepare a defects list which will be issued to the Contractor.

Immediately upon receipt of this document it would be in the interest of the Contractor to complete and correct all items as listed within two weeks.

This shall include making good all defects due to the incorrect or poor installation of services provided. It shall not include for the wear and tear to the system by the users.

Failing which the Employer will execute the necessary repairs, including the supply of materials and labour and the account of the Contractor will be debited, via the Construction Partner with the cost incurred in the execution of such repairs, the obtaining of the materials and labour, and all establishments and other charges in connection therewith.

The contractor is to clearly state within the Operating and Maintenance manual the name, address and telephone number of persons to contact in the event of emergency and failure.

The sub-contractor is to allow within his tender the cost of a return visit to site within one month of handover to check that all systems are operating satisfactorily. Should defects be apparent the contractor is to make the necessary arrangements for these to be rectified.

The contractor is to include within the tender a return visit to site at the end of the defects liability period, to carry out a thorough check of all components and aspects of the system to ensure that everything is operating satisfactorily.

All requests for remedial action to the installation shall be quickly responded to (within 48 hours of being notified) and shall include all labour and replacement equipment as required.

2.18.1 Obligations during Defects Liability Period

The contractor shall:

Prepare and submit records of failures or malfunctions of any part of the Contract Works during the Defects Liability Period, together with details of remedial action taken, subsequent re-testing and the results.

Notify the Construction Partner of damage, failures or malfunctions to the Contract Works demonstrably caused by incorrect operation of the installations, vandalism or other actions by a third party.

Inform the Construction Partner in writing when all defects are finally rectified so that an inspection may be carried out prior to the issue of a Final Certificate.

2.19 OVERTIME

Unless otherwise stated, the contractor shall assume that the work may proceed during normal working hours and shall liaise with the Construction Partner to establish the duration of normal working hours. The excess cost of overtime or night work will only be paid for as an extra if it is worked on the written instructions of the Architect.

The contractor SHALL HOWEVER INCLUDE OVERTIME COSTS for ALL break-in's to existing installations

Time sheets in respect of overtime and/or night work ordered by the Architect/Contract Administrator shall be submitted weekly to the Architect/Contract Administrator and shall be properly filled in showing the names of the work people concerned, the hours worked and the rates of pay.

Should, however, the contractor wish to work overtime **at his/her own expense** to facilitate the progress of the contract works, the sanction of the Construction Partner must be obtained before the overtime is worked.

2.20 TEMPORARY POWER, LIGHTING AND WELFARE

All temporary power and lighting within the building and welfare facilities will be provided by the Construction Partner. The Contractor should advise in his tender for any specific abnormal requirements, e.g. temporary 3 phase power supply.

2.21 VARIATIONS

No variations or additions to the contract are to be undertaken without the prior written approval of the Construction partner.

Where possible, estimates are to be agreed prior to the work being commenced and are to be priced on the Schedule of Rates, which form part of the contract. The contractor shall submit to the Construction partner, within seven days of receipt of the written instruction, the price for each variation showing quantities and rates applicable for all labour and materials employed in accordance with the schedule of rates.

No works shall be certified for payment until this information has been provided.

Where work cannot properly be measured and valued, the Contractor shall allow Day Work Rates. Where such work is authorised, record sheets detailing all labour and materials employed are to be recorded daily and signed weekly by the Clerk of Works, and triplicate copies forwarded to the Construction partner Offices, immediately after signing.

No payment will be permitted unless the above conditions are strictly complied with.

2.22 VALUE ADDED TAX

The tender sum must be quoted, and subsequently the contract sum shall be exclusive of Value Added Tax.

Upon being informed that his tender is being recommended for acceptance, the contractor shall give to the Construction Partner a provisional assessment of that part of the value of the goods and services supplied under the sub-contract for which the sub-contractor will be liable at a positive rate of VAT (and for which VAT the Client will be called upon to pay under the VAT agreement) and that part for which he will be liable at zero rate, and shall also state the grounds on which he considers any supply of goods and services to be positively rated. Such provisional indication will not be binding on either party.

2.23 PROVISION OF RECORD DOCUMENTS

2.23.1 General

To satisfy the provisions of the Health and Safety at Work Act the Employer will not accept handover of the installations until full and adequate information concerning the installations is in the possession of his operating and maintenance staff.

The Contractor shall supply to the Construction Partner, as a pre-requisite to Practical Completion, comprehensive record documents in uniform indexed bound sets. The

Contractor is advised that great importance will be placed upon the quality, accuracy, clarity and completeness of the record documents and upon their prompt availability.

The Contractor shall demonstrate from time to time, as required by the Construction Partner throughout the execution of the Works, that adequate and accurate records are being kept such as will ensure the ultimate completeness and accuracy of the record documents and that the record documents are themselves being progressively compiled as the work on site proceeds.

Draft copies of all record drawings and O&M manuals shall be issued to the Construction Partner for comment a minimum of 4 weeks prior to practical completion.

Record documents shall comprise the following:

- a) Record Drawings and Schedules
- b) Operating and Maintenance Instructions

All record documents shall be provided in **triplicate** and be adequate for the following purposes: -

- a) to provide a comprehensive reference source about each installation
- b) to provide a basis for the correct and efficient operation of the installed plant and system
- c) to serve as an information base and detailed guide for the effective and efficient maintenance of each installation
- d) to serve as a basis for staff training in the operation and maintenance of each installation
- e) to serve as a basis for safety awareness

The record documents shall be correlated so that the terminology and the numerical and/or other references used are consistent with and similar to those used in the physical identification of component parts of the Works.

The contractor shall allow for obtaining and collating all necessary information to allow the preparation of the manual, including any charges that may be required by manufacturers or suppliers for the provision of literature and information.

Unless otherwise indicated, all drawings and manuals shall be supplied in both paper (hard copy) and electronic format.

If the Contractor fails to comply with these requirements, a specialist contractor may be instructed to be prepared the records and the whole of the costs involved in this, including all costs of surveying, printing etc, shall be borne by the Contractor.

2.23.2 Operating & Maintenance Instructions

Operating and Maintenance Instructions shall be provided by the Contractor and shall comprise the following as applicable (all contained in volumes strongly bound in flexible covers and suitable for heavy usage over a long period and electronic CD/memory stick copies also) written to be read in conjunction with the Record Drawings, Diagrams and Schedules:

- a) A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided
- b) A description of the mode of operation of all systems including services capacity and restrictions
- c) Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc
- d) Details of how to re-commission so that complex plant services within the building can be re-commissioned by an engineer without any historic knowledge of the systems
- e) A photo-reduction of all record drawings together with an index. Reduced size of drawings to be A3
- f) Legend of all colour-coded services
- g) 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
- h) The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers
- i) Manufacturer's 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
- j) A copy of all Test Certificates, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc., used in the installations. records shall be clearly cross referenced to system components
- k) A copy of all manufacturers' guarantees or warranties, together with maintenance agreements offered by sub-contractors and manufacturers
- l) Copies of Insurance & Inspecting Authority Certificates and Reports
- m) Starting up, operating and shutting down instructions for all equipment and systems installed
- n) Control sequences for all systems installed.
- o) Schedules of all fixed and variable equipment settings established during commissioning
- p) Data on general design parameters and associated normal operating values, based on the commissioning activity
- q) Procedures for seasonal change-overs and/or precautions necessary for the care of apparatus subject to seasonal disuse
- r) Detailed recommendations for the preventative maintenance frequency and procedures which should be adopted by the Employer to ensure the most efficient operation of the systems. This information may be supported in detail, but not replaced by, maintenance instructions provided by the suppliers or particular component apparatus
- s) Details of lubrication systems and lubrication schedules for all lubricated items
- t) Details of regular tests to be carried out (e.g. water cooling towers, water analysis for pseudomonas etc)
- u) Instructions in respect of any precautionary measures from time to time necessary (e.g. against bacterial contamination, corrosion or freezing)
- v) Details of procedures to maintain plant in safe working conditions
- w) Details of the disposal requirements for all items in the works

- x) A list of normal consumable items
- y) 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
- z) A list of any special tools needed for maintenance cross referenced to the particular item for which required

- aa) Procedures for fault finding
- bb) Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus
- cc) Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus
- dd) Two back-up copies of any system software, as commission.
- ee) Details of the software revision for all programmes provided.
- ff) Documentation of the procedures for updating and/or modifying software operating systems and control programmes
- gg) Instructions for the creation of control procedure routines and graphic diagrams
- hh) Copies of relevant HSE/CIBSE/IET Guidance notes etc
- ii) Contractual and legal information including but not limited to details of local and public authority consents; details of design team, consultants, installation contractors and associated subcontractors; start date for installation, date of practical completion and expiry date for the defects liability period; details of warranties for plant and systems including expiry dates, addresses and telephone numbers
- jj) Data on general design parameters and associated normal operating values, based on the commissioning activity

In addition, the following information shall be provided in respect of the controls and BMS installations.

- a) A written description of plant operation
- b) Control strategy/logic diagrams recording the final version of configuration software installed at handover
- c) Details of system application software configuration
- d) A points list including hard and soft-points (all points should have a unique mnemonic)
- e) A description of user adjustable points
- f) Commissioning record details
- g) Detailed data sheets for all control components and equipment
- h) Wiring circuit details including origin, route and destination of each cable
- i) Basic security access to the system
- j) Comprehensive instructions for switching on, operation, switching off, isolation, fault finding and procedures for dealing with emergency conditions
- k) Instructions for any precautionary measures necessary
- l) Instructions for the routine operation of the control system including simple day-to-day guidance for those operating the control system with limited technical skill
- m) Instructions for servicing and system upkeep
- n) A provision for update and modification

- o) For each programmable control item, schedules indicating for each input and output point Connected, full data in respect of that point including reference, type of input/output, connected equipment reference, set values of temperature or pressure etc., set values of start/stop/speed change times, alarm priority, control specification reference and any other such parameters as are applicable
- p) Each spare input and output point including reference, type of input/output and space for future entry of appropriate parameters as listed above
- q) Logic flow diagrams for each individual control or monitoring specification and for each building services engineering system to illustrate the logical basis of the software design
- r) Schedules setting out details of all initial values of user-defined variables, text statements for alarm messages etc. Copies of manufacturer's data shall be supplied with respect to the nature, type and method of operation of individual pieces of equipment, together with their detailed maintenance instructions. Such data, in the form of individual booklets and the like, shall be indexed and cross referenced to the Operating and Maintenance Instructions and presented suitably protected in box files or folders

The covers shall be printed with a specific fascia clearly indicating the names of the Project and Client and shall be to the approval of the Construction Partner.

Any record drawings to be inserted within the manuals shall be contained within individual plastic insert envelopes and folded to display title and drawing number clearly when in envelope. A further set of record drawings, reduced to A3 size shall also be included in the manual.

Any manufacturer's information sheets to be included within the manuals shall be contained within individual plastic insert envelopes and folded to display title and page number clearly when in envelope. A front index sheet shall also be included at the front of each of these sections to list the page numbers of the manufacturer's information sheets.

Each section of the manual shall be divided by a stiff divider of the same size as the folder. The divider shall be labeled as to the section of the manual which follows it.

All written instructions within the manual shall be typewritten.

Approved final copies of the O&M manuals are provided at handover. The O&M manual shall be properly indexed and all terminology and references shall be consistent with the physical identification of component parts.

2.23.3 Record Drawings

Record drawings shall be provided by the contractor for all works carried out under the contract. Record drawings shall include, but not be limited to, the following:

- a) The location of statutory service connections provided within the contract, whether installed by the contractor or the statutory authority, including buried depth, point of origin and termination, size and materials of pipelines, flowrates, pressures and all other relevant information
- b) The layout, location and depth of all underground services

- c) The layout, location and extent of all piped services, including pipe sizes and position of all valves, drain cocks, test points, gauges and all other instrumentation and fittings. All emitters shall be clearly referenced and their outputs identified
- d) The layout, location and extent of all air ducts, including builders work ducts, showing balancing dampers, fire dampers, silencers, grilles, diffusers, louvres, access panels, turning vanes, test points, gauges and instruments and all other associated fittings. Each duct and terminal should be marked with its dimensions and flowrate. All terminal devices shall be clearly referenced
- e) The layout, location and extent of all electrical services, including distribution boards, lighting, emergency lighting, small power, fire alarm intruder detection and all other specialist installations
- f) Detailed general arrangements of all plant rooms, tank rooms electrical switch rooms and other plant and apparatus, including the location, identity manufacturer, size and rating of each apparatus
- g) Control and wiring diagrams shall be provided incorporating details of each instrument and equipment item and a written description of the sequence of operation
- h) Location identity, size and details of all apparatus and control equipment served by, or associated with, each of the various services
- i) Schematic drawings of each system indicating principal items of plant, equipment, zoning, means of isolation, etc. in sufficient detail to make it possible to comprehend the system operation and the inter-connections between various systems
- j) Location and identity of each room or space housing plant, machinery or apparatus
- k) Details of co-ordination of wiring and connections with cable core identification, notation of fire alarm, security, control and instrumentation and similar systems provided as part of the Works
- l) Details to show inter-connections between the Works and equipment or systems provided by others to which wiring and connections are carried out as part of the Works
- m) All cable/conduit routes shall indicate if the service is surface mounted, concealed in wall chase, in floor screed, cast in-situ, above false ceiling etc
- n) Manufacturers' drawings of equipment indicating:
 - General arrangement and assembly of component parts which may require servicing
 - Internal wiring diagrams together with sufficient physical arrangement details to locate and identify component parts
- o) Schedules as required to locate, reference and provide details of ratings and duty of all items incorporated into the Works together with all fixed and variable equipment settings established during commissioning
- p) All record drawings shall be clearly marked "RECORD DRAWING" in 19mm text. In addition each record drawing shall show the following information:
 - The project title and, where appropriate, the zone or floor reference
 - Description of drawing, drawing number, scale and size
 - Name and address of the contractor and consulting engineer

Plans and sections of all plant areas, equipment rooms, service subways, trenches, ducts and other congested areas shall be to a scale of not less than 1:20.

Floor layouts shall be to a scale of not less than 1:50.

The drawings shall include symbols, valve charts, plans, sections, elevations and isometric interpretations to provide a comprehensive record of the installation.

Electrical drawings shall be in accordance with IET Wiring Regulations and with the specific requirements of the project specification.

The completed record drawings and schedules shall be submitted for comment with the operating and maintenance manuals.

Three complete sets of all record drawings in AutoCAD(or later) / Revit (BIM)format on CD, and three sets of paper prints shall be available at the contract completion date for handover to the employer.

2.23.4 Plant Room and Switch Room Record Drawings, Schedules and Schematics

In addition to Record Drawings, the contractor shall provide schedules and schematic drawings mounted within each plant room and switch room, any other appropriate location where directed by the Construction Partner.

These shall include, but shall not be limited to, the following:

- a) Location of mechanical and electrical plant and equipment items
- b) Schematic drawings of circuit layouts showing identification and duties of equipment, numbers and locations, controls and circuits
- c) Valve schedules in the form of printed sheets showing the number, type, location, application/service and symbol, and normal operating position of each means of isolation, control schematics
- d) Location of all plant and equipment items including plans and elevations of main switchgear showing physical disposition of switches
- e) First aid instructions for treatment of persons after electrical shock
- f) All other items required under Statutory or other regulations
- g) Location of all incoming services isolation valves/switches and metering facilities
- h) Emergency operating procedures and telephone numbers for emergency call out service applicable to any system or item of plant and equipment
- i) All other items required under statutory or other regulations

All drawings and schedules shall be framed under glass or other rigid, transparent, cleanable and protective surface.

2.23.5 Electronic Operating and Maintenance Manuals

Three copies of all operating and maintenance manuals shall be provided on CD in PDF format. The documentation shall be as provided in hard copy format and shall include all data sheets, testing and commissioning results, manufacturers literature, wiring diagrams and record drawings.

The electronic manuals shall be logically laid out, reflecting the format of the hard copy manuals.

2.23.6 Building Log Book

In addition to the O&M Manual provided above the sub-contractor shall also provide a log book which is to be handed over to the building owner and/or occupier. The log book shall give details of the installed building services plant and controls, their method of operation and maintenance, and other details that collectively enable energy consumption to be monitored and controlled. The information should be provided in summary form, suitable for day to day use and in easy to read user friendly text for non technical personnel. This summary could draw on or refer to information available as part of the Operation and Maintenance Manuals and the Health and Safety file.

The details to be provided should include:

- a) A description of the whole building, its intended use and design philosophy and the intended purpose of the individual building services systems
- a) A schedule of the floor areas of each of the building zones categorised by environmental servicing type (e.g. air-conditioned, naturally ventilated)
- b) The location of the relevant plant and equipment, including simplified schematic diagrams
- c) The installed capacities (input power and output rating) of the services plant
- d) Simple descriptions of the operational and control strategies of the energy consuming services in the building
- e) A copy of the report confirming that the building services equipment has been satisfactorily commissioned
- f) Operating and maintenance instructions that include provisions enabling the specified performance to be sustained during occupation
- g) A schedule of the building's energy supply meters and sub-meters, indicating for each meter, the fuel type, its location, identification and description, and instructions on their use. The instructions should indicate how the energy performance of the building (or each separate tenancy in the building where appropriate) can be calculated from the individual metered energy readings to facilitate comparison with published benchmarks
- h) The measured air permeability of the building

The above is a generalized list and the contractor shall provide all information necessary to comply with the Building Regulations Part L.

Notwithstanding the above, the Tenderer shall ensure that the format follows that adopted by CIBSE TM31 'Building Log Book Template'.

2.24 BUILDING USER GUIDE

To assist in achieving the required BREEAM rating (if applicable) the contractor shall assist the Construction Partner to compile a simple user guide that covers information relevant to the tenant / occupants and non technical building manager on the operation and environmental performance of the building. The sub-contractor will be expected to assist the Construction Partner by contributing to the building services aspects of the user guide and provide the relevant information required for inclusion.

A description of the whole user guide is provided below and the sub-contractor shall provide the Construction Partner with the required information, where relevant. This requirement is in addition to the requirement to provide O&M Manuals and the Building Log Book.

User Guide Contents

The list below indicates the type of information that should be included to meet the needs of the Facilities Management (FM) Team/Building Manager and the general users (staff).

1. Building Services Information

- **General User** – Information on heating, cooling and ventilation in the building and how these can be adjusted, e.g. thermostat location and use, implications of covering heating outlets with files, bags, etc. and use of lifts and security systems
- **FM** – As above plus, a non technical summary of the operation and maintenance of the building systems (including BMS if installed) and an overview of controls

2. Emergency Information

- **General user** – Include information on the location of fire exits, muster points, alarm systems and fire fighting systems
- **FM** – As above plus, details of location and nature of emergency and fire fighting systems, nearest emergency services, location of first aid equipment

3. Energy & Environmental Strategy

This should give owners and occupiers information on energy efficient features and strategies relating to the building and also provide an overview of the reasons for their use, e.g. economic and environmental savings. Information could include:

- **General User** – Information on the operation of innovative features such as automatic blinds, lighting systems etc, and guidance on the impacts of strategies covering window opening and the use of blinds, lighting and heating controls
- **FM** – As above plus, information on airtightness and solar gain (e.g. the impact of leaving windows/doors open in an air conditioned office, or use of blinds in winter with respect to solar gain); energy targets and benchmarks for the building type, information on monitoring such as the metering and sub metering strategy and how to read, record and present meter readings

4. Water Use

- **General User** – Details of water saving features and their use and benefits, e.g. aerating taps, low flush toilets, leak detection, metering etc
- **FM** – As above plus, details of main components (including controls) and operation. Recommendations for system maintenance and its importance, e.g. risk of legionella

5. Transport Facilities

- **General User** – Details of car parking and cycling provision; local public transport information, maps and timetables; information on alternative methods of transport to the workplace, e.g. car sharing schemes; local 'green' transport facilities
- **FM** – As above plus, information on conditions of access, maintenance and appropriate use of car parking and cycling facilities, e.g. number of spaces provided

The above information does not need to be included in the user's guide if there is a separate dedicated travel information space, accessible to the staff, and in compliance with BREEAM credit T10. However the guide must reference the travel information space, the information provided and its location.

6. Materials and Waste Policy

- **General User** – Information on the location of recyclable materials storage areas and how to use them appropriately
- **FM** – As above plus, information on recycling, including recyclable building/office/fit out components, waste storage and disposal requirements; examples of Waste Management Strategies and any cleaning maintenance requirements for particular materials and finishes

7. Re-fit/Re-arrangement Considerations

- **General User** – An explanation of the impact of repositioning of furniture, i.e. may cover grilles/outlets, implications of layout change, e.g. installation of screens
- **FM** – As above plus, environmental recommendations for consideration in any refit. Relevant issues covered in BREEAM should be highlighted, e.g. the use of natural ventilation, use of Green Guide 'A' rated materials, re-use of other materials etc., the potential impact of increasing occupancy and any provision made in the original design to accommodate future changes

8. Reporting Provision

- **General User** – Contact details of FM/manager, maintenance team, and/or help desk facility; and details of any building user group if relevant
- **FM** – As above plus, contact details of suppliers/installers of equipment and services and their areas of responsibility for reporting any subsequent problems

9. Training

Details of the proposed content and suggested suppliers of any training and/or demonstrations in the use of the building's services, features and facilities that will be needed. This could include:

- **General User** – Training in the use of any innovative/energy saving features
- **FM** – As above plus, training in emergency procedures and setting up, adjusting, and fine tuning, the systems in the building

10. Links and References

This should include links to other information including websites, publications and organisations. In particular, the 'Carbon Trust' programme should be referenced and links provided to its website and good practice guidance.

11. General

Where further technical detail may be required by the FM Team or Manager there should be references to the appropriate sections in the Operation and Maintenance Manual.

2.25 PATENT

The Contractor shall indemnify the Employer against all claims, cost or expense in connection with any patented, copy-righted or protected article supplied by the Contractor or their Specialist Sub-Contractor and used on or in connection with the works and any payments or royalties payable in one sum or by installments shall be included in the Contract price and paid by the Contractor to whosoever they may be due.

In the event of any such claims being made on the Employer, in connection with such patented articles, he shall immediately notify the Contractor who shall, at their own expense, conduct any negotiations or litigation in connection with such claims.

SECTION THREE – ELECTRICAL STANDARD SPECIFICATION

3.1 GENERAL

The clauses in this part of the specification comprise of the standard clauses detailing the performance specification of materials, method of installation and procedures to be adopted by the sub-contractor.

The entire installation shall be carried out all in accordance with the current edition of the IET Wiring Regulations (BS 7671) with amendments, in accordance with Building Regulations and all to the satisfaction of the local authorities.

3.2 STANDARD INSTALLATION REQUIREMENTS

This section describes the procedure and/or the methods of installation of equipment; materials, accessories etc. to the standard requirements of the Consulting Engineer, and shall apply to this Contract, where appropriate, in extension and amplification of the general intent and meaning of the basic descriptions given elsewhere in this specification and the associated drawings.

3.3 ARRANGEMENT OF ELECTRICAL SERVICES

Particular attention shall be given to the layout and arrangements of the electrical installation, which shall be neat, unobtrusive and as simple as possible. The wiring system shall fit in with the architectural and structural features of the building. Accessories shall be correctly aligned and co-ordinated with the Architect's room layouts and, in this respect, reference shall be made to the relevant architectural drawings.

The approximate position of electrical services, equipment, fittings and accessories are shown on the tender drawings or detailed in the Specification, and the electrical sub-contractor shall confirm all such positions on site with the Consulting Engineer and/or the Architect's representative and examine the Architect's room layout drawings. Any work done incorrectly without confirmation of the exact position shall be re-done and made good at the electrical sub-contractor's expense.

3.4 PROTECTIVE PAINTING

All iron and steel materials which show signs of rust shall be wire brushed bright metal clean, painted with one coat of rust remover and neutraliser, one coat of approved scaler and two coats of protective paint, one before erection and one after.

All junctions and joints in conduit work and all areas of conduit where there is evidence of enamelling or galvanising being damaged, shall also have one application of protective paint, directly after installation.

2010A PAINT MATERIALS:

Use the following materials as appropriate

Solvent borne priming paint to BS 7956 for bare woodwork

Red Oxide priming paint for bare iron and steelwork

Zinc Chromate priming paint for bare ferrous and non-ferrous metals

Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components

Undercoating paint for previously primed or painted surfaces before the application of finishing coats

Gloss finishing paint for previously primed or painted/undercoated surfaces

Epoxy resin paint for specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity

Aluminium paint to BS 1070 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required

Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation

Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured

Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important

Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water

Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water

2020 PAINT QUALITY:

Ensure paints used are of quality and type to suit application and that:-

Primers have good adhesion, covering power, rust-inhibiting and grain filling properties

Gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage

3020 WEATHER AND OTHER CONDITIONS:

Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint

3030A CLEANING AND PREPARING STEEL SURFACES FOR PAINTING:

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Clean steel surfaces in accordance with BS EN ISO 8503 and prepare surfaces for painting in accordance with BS EN ISO 4618

3030B CLEANING AND PREPARING SURFACES FOR PAINTING:

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Prepare surfaces for painting in accordance with BS EN ISO 4618

3040 APPLICATION OFF-SITE:

Wherever possible ensure paint finishes applied by component manufacturers are spray applied

3050 APPLICATION:

Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, or other application defects

3060 COLD GALVANIZING:

Repair damage to galvanized components due to installation process, i.e. following cutting, drilling or welding, by applying 2 no. substantial coats of cold galvanizing paint

3070 PROTECTION OF BRIGHT MACHINE PARTS:

Apply a protective coating to all bright machined parts before despatch from works

Do not remove protective coatings unless required for installation, testing or commissioning purposes and in such cases reinstate upon completion

Repair any damaged protective coating or bright machined part, or where necessary replace damaged component

Use and apply metal coatings in accordance with manufacturer's instructions

Complete where possible all welding, drilling, bending and other work before metal coating

3.5 FIXINGS

Generally, fixing centres for work described in this and other sections shall be as follows:

Type of installation	Horizontal runs on horizontal surfaces (mm)	Horizontal runs on vertical surfaces (mm)	Vertical runs (mm)
Conduit	1500	1200	1200
Cable trunking (surface type)	1500	1200	1800
FP TYPE & LSF/LSF cables	600	450	600
XLPE/SWA/LSF	900	900	1200
Cable tray	1200	1200	1200
Bus-bar trunking	1500	1200	1800
Earth bars for other copper work for static bonding etc.	600	450	600

The above figures are for guidance purposes only and actual fixing centres will be given by the Consulting Engineer's representative on site.

All lightweight fixings to brick or concrete shall be made with sherardized steel, greased wood screws and metal or plastic rawlplugs. Wood plugs shall not be used. In damp or exposed situations greased brass screws and soft metal non-deteriorating plugs shall be

employed. Holes of the requisite size for the plug, which shall suit the screw used, are to be neatly drilled in the concrete or brickwork (not joints between the bricks) to a depth, excluding plaster or soft wall finish, equal to the length of the plug to be used.

The plug length shall be such that when the screw is in place, all the threaded length is in the plug. Fixings to timber shall be made with greased brass wood screws. For fixing to hollow tiles etc., screw anchor type fixings shall be used, fitted as above as far as possible. Fixings to soft or hard fibre boards etc., which are inaccessible to the back shall be made with gravity toggle or spring fixings. Fixing to light gauge metal inaccessible at the back shall be made with sherardized self-tapping screws of appropriate size or with spring or gravity toggles.

All heavyweight fixings to brick or concrete shall be by means of M.S. bolts treated with rust repellent fluid in dry conditions and cadmium plated bolts in damp situations. The bolts shall be of the grouted type or one of the various expanding rawlbolt types.

The size of bolts or screws used shall be the largest permitted by the diameter of the hole in the apparatus to be fixed, and are to be of an adequate length. When fixing any item of equipment, all bolt or screw holes provided therein shall be used and the fixing in each hole is to be secure.

All fixings shall be made either directly or by means of saddles, brackets, hangers etc., supplied and fixed by the electrical sub-contractor, to the structural report of the building. No fixings shall be made to suspend ceiling systems or to apparatus or equipment supplied by other sub-contractors unless prior approval for this is given by the Consulting Engineer.

Y90 FIXING TO BUILDING FABRIC

1000 GENERAL

1010 PREPARATION:

Mark-out, set-out and firmly fix all equipment, components and necessary brackets and supports.

1020 MANUFACTURER'S DRAWINGS:

Use manufacturer's drawings and templates for purposes of marking and setting out

1030 FIXINGS:

Ensure structure and fixings are suitable for items to be fixed

1040 LOADING DETAILS:

Provide loading details for all fixing types

1050 BUILDING-IN BY OTHERS:

Provide all necessary assistance to enable any item of building-in type to be built in by others

1060 SIZE OF FIXING:

Use largest size of bolt, screw or other fixing permitted by diameter of hole in item to be fixed

1070 GREASING OF FIXINGS:

Ensure all bolts, screws or other fixings used are greased or lubricated in accordance with manufacturer's instructions

2010 STANDARDS:

Ensure that fixings such as expanding anchors are tested for tensile loading

2020 PLUGS:

Use plugs of suitable size and length for fixings. Use plastic, fibrous or soft metal non-deteriorating plugs to suit application

Do not use wood plugs

Ensure that when screw is in place, threaded length is in plug

Ensure plugs used for screw fixing are set-in to correct depth prior to final tightening

2030 SCREWS:

Use screws to BS 1580. Generally use sherardized steel wood screws for fixing to concrete, brickwork or blockwork. In damp or exposed situations use greased brass wood screws.

2080 NON-PENETRATIVE SUPPORT SYSTEMS FOR ROOF MOUNTED EQUIPMENT:

Obtain approval prior to using non-penetrative support systems for roof mounted equipment.

3010 DRILLING:

Drill holes squarely

Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work

3050 FIXING TO TIMBER RAILS:

Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut

3060A FIXING TO HOLLOW STUD/TILE/BLOCK WALLS:

Fix equipment, brackets and supports where there is access at rear of wall, by drilling hole through wall and fixing with bolt, back-plate, washer and loose nut

Fix equipment, brackets and supports where there is no access at rear of wall, drill hole and use screw anchor type fixing or gravity type toggle fixing

3070A FIXING TO CONCRETE, BRICKWORK OR BLOCKWORK:

Fix equipment, brackets and supports using wood screws in plugs or, as appropriate, drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing

3080A FIXING TO METALWORK:

Fix equipment, brackets and supports by drilling holes and fixing using set screws or bolts complete with washers, shakeproof washers and loose nuts

3090A FIXING TO STRUCTURAL STEELWORK AND CONCRETE STRUCTURES:

Provide manufacturer's information on recommended fixing

Obtain approval for any fixing to structure steel work and concrete structures

Generally use proprietary fixings to structural steelwork and concrete structures

Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork

3.6 EARTHING

The installation shall be effectively earthed in accordance with all statutory requirements and comply with the requirements listed below:

- a) The requirements of the Supply Authority together with type of earthing terminal to be provided by them
- b) Regulations for Electrical Installations (BS 7671) issued by the Institution of Engineering & Technology including all amendments and revisions
- c) British Code of practice for protective earthing of electrical installations BS 7430, including amendments

If there is no earthing terminal provided by the Supply Authority, then the main earthing terminal shall be connected via an earthing conductor to an earthing electrode.

All protective non-current carrying metal casings and coverings, including the metal frameworks forming the main switchboard shall be effectively bonded to earth with copper tape earth conductor to the following requirements:

Three second rating of switchgear		Size of copper earth bars:
Not exceeding area	Cross-sectional	Dimensions

14,000 A	100 mm ²	25 x 4 mm
22,000 A	157 mm ²	25 x 6.3 mm
30,000 A	250 mm ²	40 x 6.3 mm
44,000 A	400 mm ²	63 x 6.3 mm

All joints and connection in copper tapes used for each earth continuity conductor shall be tinned, riveted and sweated solid or welded.

Where satisfactory readings result and with appropriate prior approval, the sheath and armour of main or sub-main cables may be used to attain these requirements.

This option shall in no way relieve the electrical sub-contractor of any additional provisions for earthing which may prove to be necessary in order to obtain values specified in the above referred code of practice and the IET Regulations. Such additional provisions shall take the form of earth rods, single or multiple arrangements as required, driven into the ground at a position conveniently adjacent to the particular building served by the supply system.

All cable armouring and sheaths, all conduits and trunking (unless specifically exempted) to be mechanically and electrically continuous throughout the installation and to satisfy the earth resistance test specified in the IET Regulations.

Y80 EARTHING AND BONDING

1000 GENERAL

1010 MATERIALS GENERALLY:

Use materials and installations methods in accordance with BS EN/IEC 62305, BS 7671, BS 7430, Electricity Safety, Quality and Continuity Regulations and Local Electricity Supply Authority Requirements as appropriate

2090A MAIN EQUIPOTENTIAL BONDS:

Provide main equipotential bonds in accordance with BS 7671

Material - Insulated cable, single core to BS 6004

Use no joints in main equipotential bonds

2100A SUPPLEMENTARY EQUIPOTENTIAL BONDS:

Provide supplementary equipotential bonds to BS 7430, BS 7671 and BS EN 50310

Do not use joints in supplementing bonds

Material - Insulated cable, single core to BS 6004

2110A CIRCUIT PROTECTIVE CONDUCTORS:

Material insulated cable, single core to BS 6004 as indicated; metallic screwed conduits (excluding flexible); metallic trunking with tinned copper links; armouring and/or metallic sheathing of armoured cables or integral conductor of multi-core cable

Size

Provide protective conductors sized in accordance with BS 7671 (IET Regulations) 543.1.4 and Table 54.7

2120 EARTHING CLAMPS:

Use clamps complying with BS 951, for bonding pipes and earthing of conductors

For bonding of lead sheathed cables use soldered or spring clamps

2130A EARTH BUSBARS:

Material

Manufacture earth busbars from hard drawn, tinned, high conductivity copper bar

Substation Earth busbar

75 x 13mm cross section 600mm minimum length

Main Earth Terminal busbar

25 x 6mm minimum for incoming live conductor not exceeding 50mm and 50 x 6 mm minimum for incoming live conductor over 50mm²

2140 TEST LINKS:

Provide two test links, in connections between main earth conductors and earth busbar

Fabricate each from two additional sections of earth busbar. Mount one section on stand-off insulators matching earth busbar; use remaining section as removable test link. Secure 12mm high tensile brass studs to fixed sections of busbar and drill corresponding clearance holes in test links and provide brass washers, nuts and locking devices to secure frame/neutral earthing and test links

2150 LUGS/TAGS:

Provide lugs or tags to enable connection of bonding conductors to equipment earth terminals

2160 PROTECTIVE CABLE TERMINATIONS:

For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth

2170 PROTECTIVE CONDUCTOR WARNING NOTICES/LABELS:

Provide a permanent label durably marked in letters 4.75mm minimum height "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE", in visible position, at each bonding conductor connection to extraneous conductive parts

2180 MAIN EARTH CONDUCTOR - WARNING TAPES:

Provide green/yellow PVC tapes labelled "EARTHING CONDUCTOR" over complete external lengths of main earth conductors at 300mm depth below finished ground

2190 EARTH BAR LABEL:

Label earth bar "SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE" with wall mounted laminated plastic tablet engraved in 10mm high red letters on white background

3010 CLEAN EARTH DISTRIBUTION:

Install clean earth distribution in double insulated cables from earth electrodes to equipment points. Mount all busbars with insulators and separate from other earthing systems

3020 DISSIMILAR METALS:

Ensure, where dissimilar metals are used for system, that purpose made jointing materials are used such that corrosion and deterioration of the electrical connection are not caused
Ensure bonding connections to other metal parts of building are electrolytically compatible with those metal parts. Use the guidance given in BS 7430 Table 8 when bonding dissimilar materials

3040 STRANDED CONDUCTOR JOINTS:

Provide waterproof protection at joints subject to moisture
Joint copper stranded conductors with compression joints to BS EN 61284

3050A PROTECTIVE CABLE TERMINATIONS:

For bolted connections use crimp type lugs compressed by automatic tool to achieve correct pressure and crimp depth
Make connections between tape and equipment using high tensile grade brass bolts with brass nuts, washers and locking devices
Use phosphor bronze bolts, nuts and washers where connections are liable to corrosion

3.7 EQUIPOTENTIAL BONDING

From the main earthing terminal equipotential bonding conductors shall be connected to the extraneous conductive parts including the following:

- Main water pipes
- Main gas pipes
- Tank cold water main
- Ventilation Heating mains
- Ventilation ductwork
- Structural steelwork

Attention is drawn to BS7671 IET Regulations concerning point of entry to building.

From each sub-switchboard and distribution board, equipotential bonding conductors shall be installed as detailed, to create an equipotential zone in the area served by that switchboard.

From the main earth bar a 25mm² individual main equipotential cable is to be run to the items as detailed above.

The electrical sub-contractor is to provide supplementary bonding conductors, using a minimal 4mm² core green/yellow LSF cable to the following:

Wash hand basins in toilet areas to be bonded at the cold water pipe with a cross bond to the adjacent hot water supply.

The bonds to radiators etc. where such equipment is adjacent to socket outlets or other sources of supply.

Metal ceiling grids to be bonded to a luminaire position. (Note : Only one bond required in any particular room. One bond being required for each half floor in the open plan office areas).

Supplementary bonding cables are to be connected to the protective conductors of the nearest electrical outlet point.

Warning notices are required at all points of connection.

All stainless steel sinks shall be bonded to the incoming hot and cold water pipe and waste pipes.

3.8 LIGHTNING PROTECTION

The contractor shall include for the new building to have a lightening protection system installed and cross connected with the existing Building. The contractor shall also include for the modifications to the existing external lightening protection down tapes and earth rods where the new building is formed, generally as detailed on the tender drawings. The installation shall be designed, supplied and installed by a specialist sub contractor to the following specification requirements

General

The workmanship, installation, and testing of the lightning protection system shall conform in all respects with BS EN 62305 and HTM 06-01, if the building is a healthcare premises, to a level of protection to suit the risk assessment and be complete with surge protection.

Concealed Air Termination Networks. The air termination network at the roof ridge shall consist of solid metallic conductors, aluminium or copper of minimum cross sectional area of 50mm², and shall be concealed within the roof void underneath the roofing felt and securely fixed every 100mm.

Air finials at the ridge position shall be a minimum size of 10mm diameter located at distances recommended by BS EN 62305 and project above the crest/ridge tile by a distance of not less than 300mm. They shall be fixed with an appropriate terminal base and pass through the crest/ridge tile at the appropriate point and to connect the general network within the roof space.

Where penetration of the crest/ridge tile takes place, permanent and effective waterproofing shall be made with a silicon mastic or equivalent material.

Air terminals at the eaves position shall be 55mm x 55mm square tape clamps, of the correct material to match the air termination network, fixed to the external face of the roof material by means of a cavity fixing bolt (e.g. rawlnut 5250).

Alternatively, if a metal (i.e. aluminium) perimeter roof gutter is to be installed by the Main Contractor, then this may be used to form the strike point at the eaves position. If the metal gutter is to be used in this way then the Lightning Protection Installer must ensure that it is effectively bonded at all connection points.

Where indicated, metal framed or metal clad roofs or metal copings, which form part, or all of an air termination, shall be bonded across joints between constituent parts. The bonding may be carried out by the specialist roofing contractor but where this is not the case the bonds shall be made as indicated; no drilling of roofing or coping shall be done without the approval of the main contractor

Metalwork of structures, chimneys, pipes, cowlings, plant, walkways, handrails and similar components of the building that are exposed at or above roof level shall be bonded to the nearest air termination.

Where a signal aerial is mounted on the structure it shall be protected as bonded to the nearest cross tape.

Down Conductors

The type and location of down conductors shall be as determined by the specialist contractor and their final locations shall No aluminium conductor shall be buried in the ground.

Down conductors shall be of aluminium or copper, strip or rod of minimum cross sectional area 50mm² and where installed externally shall be provided with a PVC sheath, the colour of which shall match the finish of the building.

Where the down conductors are to be dropped internally they shall be enclosed in a suitable void or duct, which shall be provided by the Main contractor.

The exact fixing method of all down conductors shall be stated in Part EL of the Specification Document.

The appropriate size, colour and type of fixing clip shall be used and all down tapes shall be so positioned as to form a neat appearance.

Where a copper air termination network is utilised, the down conductor shall be terminated in a test clamp, located 500mm above the external damp proof course, the final connection to the earth rod being made in sheathed copper tape of 50mm² minimum cross sectional area.

Where an aluminium air termination network is utilised, the down conductor shall be terminated in a bimetallic connector with test clamp fitted below, located 500mm above the external damp proof course, the final connection to the earth rod being made in sheathed copper tape of 50mm² minimum cross sectional area.

Where the profile of the building would cause an overhang or re-entrant loop to be formed in a down conductor the Main Contractor shall be informed.

Where the reinforcement of a concrete structure forms the down conductors, welding of the reinforcement will be carried out by the Main Contractor, but the Electrical Services Installer shall carry out all testing to ensure acceptability in accordance with BS EN 62305

Connections from down conductors formed by reinforcing steel or concrete clad steel frames shall be made by the main contractor. They shall comprise stainless steel tape, not less than 20mm x 3mm, welded onto the steelwork. The main contractor shall agree with the Contract Administrator the length of tail to be left for subsequent connection.

Screws and rivets shall be of the following materials:

- a) for copper conductors, phosphor bronze, naval brass or high-tensile manganese brass.
- b) for aluminium conductors, stainless steel.

Joints

Joints in conductors shall be kept to a minimum.

All contact surfaces shall be thoroughly cleaned and coated with an anti-corrosive electrical jointing compound suitable for the conductor material. For bi-metallic joints a separate abrasive shall be used to clean each metal.

Joints between conductors of the same metal, other than at test points, shall be made by the termit welding process or by riveting and sweating. Overlap of conductors shall be not less than 100mm.

Where an aluminium conductor is jointed to a copper conductor, one of the following methods shall be used.

- a) a bi-metal connector formed by friction welding high purity copper and aluminium
- b) the copper conductor shall be completely sheathed for at least 100mm of its length with metal strip electrolytically compatible with copper and aluminium, and then clamped to the aluminium conductor

Bi-metal joints shall not be made at test points or between the test point and earth electrode.

Earth Electrodes

Earth electrodes shall consist of 16mm diameter copper bonded rods with appropriate couplings, if required, and be in accordance with BS EN 62305.

The top of each earth electrode shall be housed in a concrete pit to facilitate inspection and be complete with lid and installed flush with the finished ground level. The concrete pits are to be handed to the Main Contractor at an appropriate time who will locate the units and ensure that they are firmly fixed in the ground by surrounding it with concrete and aggregate mixture.

Where more than one earth rod per down conductor has to be installed, then they shall be, where practical, equally spaced in a line parallel to the structure at horizontal distances equal to the length of the rods or 3600mm whichever is the greater.

Extraneous Metalwork

Where extraneous metalwork occurs, it will be securely bonded to the air termination network with appropriate conductors and clamps.

Metalwork on or in the structure, which is within the recommended safe distance as defined in BS EN 62305, shall be bonded to the lightning protection system using appropriate conductors and clamps.

Cross Bonding

Where a service belongs to a Public Statutory Undertaker the permission of the Undertaker shall be obtained before connection is made.

The lightning protection system shall be bonded to the main earth terminal of the electrical installation with an 8mm diameter copper rod, or similar sized stranded cable, at the nearest down conductor, above the test clamp and shall be labelled as BS 7671, Requirements for Electrical Installations Wiring Regulations except that the wording shall be: -

"SAFETY BONDING CONNECTION, LIGHTNING PROTECTION SYSTEM"

Test Joints

A mechanical test clamp, of the circular screw down type, shall be provided in each down conductor; it shall be located 1m above ground level unless otherwise indicated. Test clamps shall be of cast gunmetal.

Test Results

A test certificate, including a drawing showing the location of the earth electrodes numbered in sequence, indicating the resistance of each electrode shall be provided to the main contractor.

3.9 CIRCUIT PROTECTIVE CONDUCTORS

All circuit protective conductors shall be of high conductivity copper.

All circuit protective conductors shall be terminated at the earth terminals provided at equipment and accessory points.

Connections on metalwork at points where purpose-made terminals are not provided shall be made with suitable bolts and washers of not less than 5mm diameter locked into a tapped hole. The circuit protective conductor shall terminate at the earth point in a bolt type lug. The conductor shall be tinned and sweated solid in the lug or be of the compression type.

Connections to motors and machinery having flexible connections shall be made with a separate circuit protective continuity conductor within the flexible connection.

Earth wire connections to be made to all items of electrical equipment and the whole of the installation to comply in all respects with the relevant clauses of the IET Regulations.

3.10 ACCESSORIES

The accessories shall be of the type and manufacture as detailed in the Project Specification and compliant with the clauses noted below.

The positions and mounting arrangements of all accessories shown on the drawings shall be confirmed on site by reference to the Consulting Engineer's representative.

The electrical sub-contractor shall pay particular attention to the fixing of all accessories. Accessories recessed in plaster walls shall be in the exact position, relative to the finished plaster, to permit the coverplate to be fixed accurately plumb and true. Surface mounted accessories shall be correctly aligned and mounted square on the wall. Accessories mounted in trunking lids and/or panels etc., shall be aligned to fit correctly.

All multiple arrangements of control accessories shall be arranged under a common coverplate, unless stated otherwise, and arranged in a symmetrical order correctly aligned to the approval of the Consulting Engineer's representative.

Wiring of more than one phase shall be installed in a switch box etc., designed for multi-phase use, having metal barriers and individual coverplates, totally enclosing and covering each phase section engraved 'Warning 400 Volts' and the overall coverplate.

All necessary boxes whether surface or flush shall be secured by a minimum of two fixing screws and rawlplugs entering brickwork or masonry to a minimum depth of 32mm.

Y74 ACCESSORIES FOR ELECTRICAL SERVICES

1000 GENERAL:

1010 APPLICATION:

Supply fixed electrical wiring accessories for use with fixed and portable peripheral equipment using either power or signalling cables.

1020 SAMPLES:

Submit samples of proposed materials and equipment for approval before work is started. Label each sample with name, catalogue number and reference to the use or services.

2010A ACCESSORIES COMMON REQUIREMENTS - WHITE PLASTIC PLATES GRID, FLUSH INSTALLATION:

Area of installation - Interior

Enclosure pattern - Flush

Accessory mounting

Adjustable steel grid for grid switches or direct to enclosure for all other accessories.

Enclosure material- Pressed steel

Enclosure finish - Galvanized

Coverplate finish, all accessories to match

Moulded plastic, colour - white

Coverplate pattern - Overlapping; with architrave where indicated.

Ancillaries

Earthing terminal integral within switch box

Neon indicator with red lens, illuminated in "ON" position, for connection units

Switch rocker bar colour - white

Operating keys for key operated switches, minimum number 2

Fuses to BS 1362

Blank inserts for spare ways on grid switches

Marking

Method - engraving. Mark front plate to indicate equipment served on connection units

Conduit and cable entries

Knockouts side, top and rear

Cable termination - Manufacturer's standard

Area of installation - Interior

Enclosure pattern - Flush

Accessory mounting

Adjustable steel grid for grid switches or direct to enclosure for all other accessories.

Enclosure material - Pressed steel

Enclosure finish - Galvanized

2010A ACCESSORIES COMMON REQUIREMENTS - WHITE PLASTIC PLATES GRID, FLUSH INSTALLATION:

Coverplate finish, all accessories to match

Brass with matt chrome surface

Coverplate pattern - Overlapping; with architrave where indicated

Ancillaries

Earthing terminal integral within switch box

Neon indicator with red lens, illuminated in "ON" position, for connection units

Switch rocker bar colour as indicated

Operating keys for key operated switches, minimum number 2

2010B ACCESSORIES COMMON REQUIREMENTS - MATT CHROME FINISH METAL PLATES, FLUSH INSTALLATION:

Fuses to BS 1362

Blank inserts for spare ways on grid switches

Marking

Method - engraving. Mark front plate to indicate equipment served on connection units.

Conduit and cable entries

Knockouts side, top and rear

Cable termination - Manufacturer's standard

2010C ACCESSORIES COMMON REQUIREMENTS - WHITE PLASTIC PLATES, EMBEDDED CABLES, SURFACE INSTALLATION:

Area of installation - Interior

Enclosure pattern - Surface

Accessory mounting - Direct to enclosure

Enclosure material - White moulded plastic

Coverplate finish, all accessories to match

Moulded plastic, colour - white

Coverplate pattern - Surface type
Ancillaries
Earthing terminal integral within switch box
Neon indicator with red lens, illuminated in "ON" position, for connection units
Switch rocker bar colour as indicated
Operating keys for key operated switches, minimum number 2
Fuses to BS 1362
Marking
Method - engraving. Mark front plate to indicate equipment served on connection units.
Conduit and cable entries
Knockouts side, top and rear
Cable termination - Manufacturer's standard

2010D ACCESSORIES COMMON REQUIREMENTS - METAL CLAD PLATES, SURFACE STEEL CONDUIT INSTALLATION:

Area of installation - Interior
Enclosure pattern - Surface
Accessory mounting - Direct to enclosure
Enclosure material
Pressed steel or cast iron
Enclosure finish
As conduit system or galvanized
Coverplate finish, all accessories to match
Metal clad
Coverplate pattern - Surface type
Ancillaries
Earthing terminal integral within switch box
Neon indicator with red lens, illuminated in "ON" position, for connection units.

2010D ACCESSORIES COMMON REQUIREMENTS - METAL CLAD PLATES, SURFACE STEEL CONDUIT INSTALLATION:

Switch rocker bar colour as indicated
Operating keys for key operated switches, minimum number 2
Fuses to BS 1362
Marking
Method - engraving. Mark front plate to indicate equipment served on connection units.
Conduit and cable entries

2010D ACCESSORIES COMMON REQUIREMENTS - METAL CLAD PLATES, SURFACE STEEL CONDUIT INSTALLATION:

Threaded entries, top, bottom or side to suit conduit system
Cable termination - Manufacturer's standard.

2010E ACCESSORIES COMMON REQUIREMENTS - SURFACE, STEEL CONDUIT, WEATHERPROOF INSTALLATION:

Area of installation - Exterior
Enclosure pattern - Surface and weatherproof

Accessory mounting - Direct to enclosure
Enclosure material - Cast iron
Enclosure finish - As conduit system or galvanized

2010E ACCESSORIES COMMON REQUIREMENTS - SURFACE, STEEL CONDUIT, WEATHERPROOF INSTALLATION:

Coverplate finish, all accessories to match
As enclosure
Coverplate pattern - Surface type
Ancillaries
Earthing terminal integral within switch box
Neon indicator with red lens, illuminated in "ON" position, for connection units
Screwed weathering cap and chain for socket outlets
Operating keys for key operated switches, minimum number 2
Fuses to BS 1362

2010E ACCESSORIES COMMON REQUIREMENTS - SURFACE, STEEL CONDUIT, WEATHERPROOF INSTALLATION:

Marking
Method - engraving. Mark front plate to indicate equipment served on connection units.
Conduit and cable entries
Threaded entries, top, bottom or side to suit conduit system
Cable termination - Manufacturer's standard.

2010F ACCESSORIES COMMON REQUIREMENTS - SURFACE, PLASTIC, WEATHERPROOF INSTALLATION:

Area of installation - Exterior
Enclosure degree of protection to BS EN 60529, IP 54
Enclosure pattern - Surface and weatherproof
Accessory mounting - Direct to enclosure
Enclosure material - Impact resistant plastic
Enclosure finish - Natural or self coloured
Coverplate finish, all accessories to match
Moulded plastic, colour as indicated
Coverplate pattern - Surface type
Ancillaries
Earthing terminal integral within switch box
Neon indicator with red lens, illuminated in "ON" position, for connection units
Protective shrouds to rocker bars
Screwed weathering cap and chain for socket outlets
Switch rocker bar colour as indicated
Operating keys for key operated switches, minimum number 2
Fuses to BS 1362
Conduit and cable entries
Threaded entries to suit cable/conduit system
Cable termination - Manufacturer's standard

2020A INTERIOR LIGHTING SWITCHES - GENERAL PURPOSE MOULDED PLASTIC:

Standard - BS EN 60669-1, enclosure box to BS 4662
Switch type - Rocker bar - moulded plastic
Rating - 10A
Gangs as indicated
Switch mechanism - Snap action microgap
Pole configurations
Single pole, double pole, 2 way or intermediate as indicated

2020F INTERIOR LIGHTING SWITCHES - GRID SECRET KEY:

Standard - BS EN 60669-1, enclosure box to BS 4662
Switch type - Rocker bar - secret key
Rating - 6A
Switch mechanism - Snap action microgap
Pole configurations - Single pole, 1 way, 2 way or intermediate as indicated

2040B TIME SWITCHES - 7 DAY:

Wire timer and switch circuits to separate terminals
Standard - BS EN 60730-2-7
Time switch type
Quartz stabilized solid state 50 hour nickel cadmium battery backup
Contacts duty - Inductive
Contacts rating - 15A
Special programme facilities
Number of "ON" and "OFF" operations - 4
Programme repeat cycle - 7 day

2070B ISOLATING SWITCHES - BS EN 60947-3:

Provide isolating switches for fixed appliances
Utilization category as indicated on schedule
Making capacity as indicated
Standard - Enclosure box to BS 4662, BS EN 60947-3
Switch type - Rocker bar
Rating as indicated on schedule
Pole configuration - DP, three pole or TPN as indicated

2080A FUSE CONNECTION UNITS - SWITCHED:

Standard - BS 1363-4, enclosure box to BS 4662 and switched
Unit type - Rocker bar - plastic
Pole configuration - DP
Ancillaries
Cord outlet or cord grip and fuse as indicated
Neon Indicator

2080B FUSE CONNECTION UNITS - UNSWITCHED:

Standard - BS 1363-4, enclosure box to BS 4662 and unswitched

Pole configuration - DP
Ancillaries
Cord outlet or cord grip and fuse as indicated
Lockable fuse carrier
Neon Indicator

2090A SOCKET-OUTLETS - SINGLE, SWITCHED:

Standard - 13A socket-outlet to BS 1363, enclosure box to BS 4662
Switching - Switched
Switch type - Rocker bar - plastic
Rating - 13A
Ancillaries
Gangs - 1

2090B SOCKET-OUTLETS - SINGLE WITH INTEGRAL RCD, SWITCHED:

Standard - Enclosure box to BS 4662, BS 7288
Switching - Switched
Switch type - Rocker bar - plastic
Rating - 13A
Ancillaries
RCD, BS 7288
Mains failure trip, sensitivity 30mA
Gangs - 1

2090C SOCKET-OUTLETS - DOUBLE SWITCHED:

Standard - 13A socket-outlet to BS 1363, enclosure box to BS 4662
Switching - Switched
Switch type - Rocker bar - plastic
Rating - 13A
Ancillaries
Gangs - 2

2090D SOCKET-OUTLETS - SINGLE, UNSWITCHED:

Standard - 13A socket-outlet to BS 1363, enclosure box to BS 4662
Switching - Unswitched
Rating - 13A
Gangs - 1

2090E SOCKET-OUTLETS - SINGLE WITH INTEGRAL RCD, UNSWITCHED:

Standard
Enclosed box to BS 4662, BS 7288
HBES systems BS EN 60669-2-5, enclosure box to BS 4662.
Switching - Unswitched
Rating - 13A.
Ancillaries
RCD, BS 7288. Mains failure trip, sensitivity 30mA

Gangs - 1

2100A COOKER CONTROL UNIT - WITH INTEGRAL SOCKET: (see also 3.12)

Standard - BS 4177, enclosure box to BS 4177.

Unit type - With integral 13A switched socket-outlet and pilot lamp. Pole configuration - DP

Rating - 45A

2100B COOKER CONTROL UNIT - WITHOUT SOCKET: (see also 3.12)

Standard - BS 4177, enclosure box to BS 4177

Unit type - With pilot lamp

Pole configuration - DP

Rating - 45A

2110A CORD OUTLETS - COOKER CONNECTION UNIT:

Standard - BS 5733, enclosure box to BS 4662

Format - Cooker connection. Rating - 45A

Pole configuration - DP&E

2120A CABLE AND APPLIANCE COUPLERS - 16A, 240V SINGLE PHASE, GENERAL PURPOSE:

Standard - BS EN 60309-2

Material - Polycarbonate male and female connectors

Rating - Voltage 220 - 240V; Current 16A

Configuration - 2PE

Colour - 220 - 240V, Blue

Ancillaries as indicated

ON/OFF switch; gang combinations 1, 2, 3 and 4; RCD. BS 7288 sensitivity 30mA

2130A TELEPHONE AND DATA OUTLET SOCKETS - GENERAL PURPOSE:

Standard

For jack socket to telephone service provider requirements and enclosure box to BS 4662

Size - Standard

Circuit configurations as indicated

3010 EARTHING:

Ensure metal framework of equipment is bonded to main earth point. Ensure that cable CPC's are connected to earth bar

Provide earth CPC between earth lug on metal box and accessory casing except where accessory is encased in plastic

3020 PROTECTION:

Ensure there is no physical or electrical damage to accessories when they are removed from their packaging and during installation

Provide masking covers for surface mounted accessories to protect surface from paint. Where accessories are flush mounted install front plate after painting is finished

3030 FIXING:

Align accessories horizontally and vertically. Where accessories are grouped, mount horizontally in line and parallel to each other and equidistant

Fix cover plates to boxes with brass fixing screws

3.11 SWITCHES AND SWITCH SOCKETS

The sub-contractor is to verify the position and swinging of doors with the Builder's working drawing to enable him to fix the position of switches on the correct side of the door.

All local lighting circuit switches are to be rated at 20amp and their mounting height shall generally be 1150mm from finished floor level unless otherwise denoted.

Switches for luminaires or equipment for special purposes may be ganged with switches for normal service, but must indicate their distinction by means of specific etch engraving particular to that specific plate. These switches shall also be mounted in segregated metal boxes.

Unless otherwise stated all switch sockets are to be 13amp rectangular pin general purpose pattern, for either flush or surface mounting as applicable, single or twin gang units, and wired in radial or ring-main circuits, generally not more than 10 sockets per circuit. Wiring to be not less than 2.5mm² and in no instance shall the number of sockets per circuit exceed 12 for ring-main circuits. Sockets are respectively to be supplied off 20a or 32amp ways in the various local distribution boards. Where indicated the arrangement of circuits to be as given on the drawings.

All sockets are to be double pole switched. Earth cabling to all socket outlet circuits shall be in compliance with BS7671 IET Wiring Regulations providing a dual earth facility to each outlet as well as earthing the accompanying back box.

All sockets to be mounted, either 150mm above the top of any fixed apparatus or fixed benches, cupboards etc., or 500mm above finished floor level unless specifically marked otherwise on the drawings. The sub-contractor is to be responsible for informing himself of the location of fixed apparatus or furniture together with details of their exact dimensions etc. from the Builders detailed drawings and he is to modify where necessary the position of any outlet, switch or switch sockets etc., where these positions conflict. The sub-contractor must give the Consulting Engineer prior notification of his intention to make such modification and obtain approval before commencement. Details of furniture and apparatus layout are given on large scale drawings issued to the builder at a later date.

All switch sockets supplying fixed or specific items of equipment shall be of the neon lamp indicating pattern.

The finish of all switch and switch sockets and similar accessory metal work front plates and the finish of all metal work of lighting fittings will be as denoted in the particular specification of schedules.

'External' pattern local lighting switches and general purpose switch socket outlets are to be used in all plantrooms, service ducts and similar situations, in addition to all external applications.

All fused connection units are to have cartridge fuses rated in accordance with the equipment supplied and are to be wired up as described above for socket outlets. These units are to be rated as socket outlets for the purpose of wiring and number per circuit, and generally mounted as indicated upon the drawings.

The mounting height above floor level of all data type outlet boxes is to be 500mm again unless otherwise denoted.

3.12 COOKER CONTROL UNITS

Cooker control units are to be 45amp to B.S.4177: type having D.P. switch and auxiliary 13amp switch socket with neon indicating lights for each. Where flush units are specified the cable connection to the cooker is to be made with 10mm² LSF insulated single core cables enclosed in conduit and terminated in a flush connector unit mounted in a metal box with moulded cover plate 500mm above floor level. The connection from the connector unit to the cooker is to be in 10.0mm² heavy circular braided workshop flexible cable. (Refer also to clause 3.11 2100A, 2100B and 2110A)

3.13 MOUNTING HEIGHTS

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

The right is reserved prior to the works commencing, to make minor alterations to positions of up to one metre in either direction without incurring any cost variation to the contract.

The mounting heights of all accessories shall be in full compliance with Building Regulations Approved document Part M and BS 8300

In car parks and garages comply with appropriate petroleum regulation for mounting heights of socket outlets.

They shall generally be as follows :

Lighting Switches	1150mm to centre AFFL
Thermostats/Sensors	1450mm to centre AFFL
Fire alarm break glass	1150mm to centre AFFL
Fire alarm sounder	2200mm to centre AFFL but no closer than 500mm from ceiling
Socket Outlets	500mm to centre AFFL (or 150mm above work top level)
Distribution boards	1800mm to centre
Hand dryers	1150mm to centre AFFL

Fire alarm panel	1500mm to centre AFFL
Clock	1900mm to underside

All groups of accessories shall be in line either vertically or horizontally, or as detailed otherwise on the drawings.

3.14 LUMINAIRES

Luminaires are to be supplied and installed by the sub-contractor of make and pattern as given in the schedule of luminaires and indicated on the various drawings.

Conduit boxes supporting luminaires designed for attachment thereto to be rigidly and separately supported to take the weight of the fittings when mounted on the box and leave no gap between the luminaire back plate and the ceiling boards or plaster. Where necessary the sub-contractor is to supply break joint rings or backing blocks to ensure neat junction between the ceiling or wall and the fitting and such accessories should completely cover the conduit box.

Where luminaires are required to be fixed to suspended ceilings, separate flat iron hangers to an approved arrangement shall be provided and fixed to the structural fabric of the building, to take the weight of the luminaires. Two or four corner fixing hangers are to be provided for each fluorescent luminaire according to the fitting dimensions and weight. In no circumstances will the electrical sub-contractor be permitted to support luminaires off the suspended ceilings. Alternative methods of supporting luminaires will be permitted only with the prior consent of the Consulting Engineer.

Unless specifically indicated otherwise, all wall brackets luminaires, other than any adjustable or bed head luminaires, are to be mounted 2200mm above floor level.

The positions given for luminaires on the drawings are approximate only and the sub-contractor is to check these positions with the Architect's large scale detailed drawing, particularly in areas where the ceiling patterns are envisaged, in order to ensure that conduit box outlets are in the centres of these patterns or ceiling panels etc.

The sub-contractor shall be responsible for the correct height and alignment of all luminaires and accessories in accordance with the instructions of the Consulting Engineer.
All metalwork of fittings is to be earthed.

In the case of pendant mounted luminaires, sub-circuit wiring shall not be taken direct to fitting terminals but shall terminate in the conduit box position into a fixed connector block and the final connection made to the fitting by means of glass-fibre, heat resisting, flexible cable, rated in accordance with the required current carrying capacity.

Electronic control gear is required for all luminaires except where specifically stated otherwise in the 'Schedule of Luminaires'.

The sub-contractor shall allow for the replacement of all glassware lamps etc., which may be broken or removed prior to formal hand-over, whether such defects occur as a result of

action by his own employees or not. This requirement is covered (together, indeed, with all materials supplied under this contract) in the conditions and is re-stated here for emphasis.

Where dimmable fluorescent lamps are installed, the contractor shall ensure a 100 hour burn in period at 100% output before dimming is applied.

Y73 LUMINAIRES AND LAMPS

1000 GENERAL

2060A LAMPHOLDERS - GENERALLY:

Lamp caps - BS EN 60061-1

Lamp holders - BS EN 60061-2

Lampholders with enhanced safety features - BS 7895

Bayonet lampholders - BS EN 61184

Lampholders for tubular fluorescent lamps and starter holders - BS EN 60400

Edison screw lampholders - BS EN 60238

Interchangeability

Ensure lampholders in luminaires of similar type and rating are identical

Earthing

Ensure metal lampholders incorporate an earthing terminal

2080A LAMPHOLDERS - MOUNTING:

Securely mount lampholder in luminaire when it is sole support for lamp

Cord grip

Provide integral cord grip type when lampholders are suspended by cord

Conduit mounted

When mounted directly to conduit system use backplate lampholder for conduit box

2090A CONTROL GEAR AND COMPONENTS:

Compatibility

Ensure control gear and components are suitable for lamp type, wattage and starting characteristics

Obtain from manufacturers written confirmation of compatibility

2095 CIRCUIT LOSSES:

Use high frequency ballasts to ensure the installed circuit load does not exceed 3 W/m²/ 100 lux

2100A FLUORESCENT LAMP BALLASTS AND STARTERS:

Ballasts

BS EN 61347-2-8 and BS EN 60929

BS EN 61347-2-3, BS EN 61347-2-7 and BS EN 60925 for d.c.supplied electronic ballasts

BS EN 60081 and BS EN 60901

Supply thermal protectors for ballasts for tubular fluorescent lamps to BS EN 60730-2-3

Starters - BS EN 61347-2-1 and BS EN 60927

Use low distortion type

2110A DISCHARGE LAMP BALLASTS AND STARTERS:

Ballasts - BS EN 61347-2-9 and BS EN 60923

Starters - BS EN 61347-2-1 and BS EN 60927

2120A CAPACITORS:

Use capacitors in accordance with BS EN 61048 and BS EN 61049 in tubular fluorescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.

2130 SUPPLY TERMINALS:

Use screw terminals for supply cables and circuit protective conductors, sized to terminate up to three 2.5mm² conductors. Provide separate terminal blocks for each incoming circuit, with marking to identify each circuit

2140 FUSE:

Include a fuse holder and BS 1362 fuse in each incoming circuit phase connection

2160 REMOTE GEAR:

Locate control gear in separate lockable cabinet of sheet steel with same degree of protection and finish specified for luminaire. Comply with manufacturer's recommendations for maximum cable length between gear and lamp

2165 TYPES OF HIGH EFFICIENCY LAMP FOR NON-DAYLIT AREAS:

Light Source	Type
High pressure sodium	All ratings above 70W
Metal halide	All ratings above 70W
Tubular fluorescent	All 26mm diameter (T) lamps and 16mm (T5) lamps rated above 11W, provided with low loss or high frequency control gear. 38mm diameter (T12) linear fluorescent lamps 2400mm in length
Compact fluorescent	All ratings above 26W

2180A FLUORESCENT LAMPS:

Internationally specified tubular fluorescent lamps to BS EN 60081. UK tubular fluorescent lamps to BS 1853-2

Single capped fluorescent lamps to BS EN 60901 and BS EN 61199. Double capped fluorescent lamps to BS EN 60081 and BS EN 61195. Self ballasted lamps to BS EN 60968

215A LED LAMPS:

Comply with BS EN 62031, DD IEC/PAS 62612, BS EN 62386-207 and BS EN 61347-2-13

2220A TRANSFORMERS FOR LV LUMINAIRES:

Type

Electronic

Single luminaire

Duty

Input voltage 230 volts

Output voltage to suit lamp

Single phase

Frequency 50Hz

Rating (kVA) to suit lamp

Standards

BS EN 55014

BS EN 61000

BS EN 61047

BS EN 61347-2-2

or BS EN 61558 as appropriate

Construction

Manufacturer's standard

Protection

Thermal cut out with automatic reset.

Location

Be accessible

Cabling

Secondary maximum cable length as manufacturer's recommendations

Separate transformer from secondary low voltage cables (m)

Connections to luminaires

Hard wired

Plug and socket

2240A SUPPORT SYSTEM - CONDUIT:

Use not less than 20mm conduit of same type as main conduit system. Material - steel

2250A SUPPORT SYSTEM - ROD:

Use continuously threaded rods with matching washers and nuts

Diameter - 6mm

Material - Cadmium plated steel.

2260A SUPPORT SYSTEM - CHAIN:

Use cadmium plated steel chain with load carrying capacity of not less than twice weight of complete luminaire

2270A SUPPORT SYSTEM - FLEXIBLE CORD:

Use size and type as indicated

Confirm temperature rating is suitable for operating temperature of luminaire or lampholder.
Confirm that cord is adequate for mass to be supported

2280A SUPPORT SYSTEM - WALL BRACKETS:

Provide wall brackets. Confirm wall brackets are suitable for supporting luminaire

2300A STEEL COLUMNS AND BOLLARDS:

Standards - BS EN 40-2 and BS EN 40-5

Material - Steel

Bracket - Match column

Earthing

Include earthing terminal fixed within service compartment

Column base plate - Standard

2300C ALUMINIUM COLUMNS AND BOLLARDS:

Standards - BS EN 40-2 and BS EN 40-6

Material - Aluminium

Bracket - Match column

Earthing

Include earthing terminal fixed within service compartment

Column base plate - Standard

3010A TRACK LIGHTING:

Where indicated provide track for fixing fittings in accordance with BS EN 60570

4060 MATERIAL OF SUPPORTING SURFACE:

Ensure classification of luminaires is appropriate. Do not mount luminaires on readily flammable surfaces

4100 INSTALLATION OF EXTRA LOW VOLTAGE TUNGSTEN HALOGEN LAMPS:

Use same wattage lamp on luminaires fed from common transformer. Supply each luminaire on common transformer by separate cable of same cross-sectional area

4110 SUPPORT:

Ensure support is adequate for weight of luminaires

Number

Provide the following minimum number of supports for each luminaire longer than 600mm:-

Luminaire Width (mm)	Minimum Number of Supports
Up to and including 300	2
Over 300	4

4120 SUPPORT FROM CONDUIT:

Where luminaire is supported from conduit provide a conduit box forming an integral part of conduit system at each point of suspension. Ensure suspensions are vertical

Where conduit enters luminaire use back-nuts and washers to secure luminaire body to conduit support. Provide tube with corrosion resistance equal to conduit system

Do not support luminaires directly from conduit boxes made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg

4130 SUPPORT FROM TRUNKING:

Where luminaire is supported from trunking use proprietary clamps or brackets appropriate to the luminaire and trunking

Do not support luminaires directly from trunking made from non-metal or heat sensitive materials, where the temperature of the material may exceed 60°C or the mass suspended exceeds 3kg

4140A SUPPORT BY DIRECT FIXING:

Refer to fixing methods, use luminaire supporting coupler to follow manufacturer's recommendations

4160 SUSPENSION:

Suspend luminaires at height indicated. Ensure suspensions hang vertically unless otherwise indicated

4170 SUSPENSION BY ROD:

Use washers, nut and lock-nut at top and bottom of rod. Paint cut ends with calcium plumbate primer or zinc rich paint

4180 SUSPENSION BY CHAIN:

Use hook cover for suspension from circular conduit box. For connection to luminaires use luminaire manufacturer's own chain hook, but if not available use hook with standard screw threaded body to be secured to luminaire body with nuts and washers. Where indicated use captive hooks

4210A COLUMNS AND BOLLARDS:

Location - Confirm location before excavation

Bases - Install bases in accordance with bollard or column manufacturer's instructions

Mounting

Mount column or bollard on base as recommended by manufacturer

Ensure columns and bollards are vertical unless otherwise indicated

Earthing

Install circuit protective conductor to connect luminaire to earthing terminal in service compartment; size circuit protective conductor same as live conductors

Bond accessible metal parts of column or bollard to earthing terminal

4220 CONNECTIONS TO LUMINAIRES:

Cable Protection

Use appropriate size of grommet where cables enter through hole in luminaire body

Earthing

Ensure that the earthing terminal of Class 1 luminaires is connected to the conduit protective conductor of the supply circuit

Loose Wiring

Clip or tie back with suitable proprietary devices loose wiring within luminaire, at 300mm intervals

4230A CONNECTIONS TO LUMINAIRES - DIRECT TO CONDUIT - TERMINAL BOX:

Terminate circuit wiring in terminal block within supporting conduit box. Use flexible cord from terminal block to luminaire

4230B CONNECTIONS TO LUMINAIRES - DIRECT TO CONDUIT - AT LUMINAIRE:

Terminate circuit wiring at supply terminals of luminaire

Take all conductors through same cable entry into luminaire

Terminate circuit wiring at supply terminals of luminaire

4230B connection to luminaires – direct to trunking at luminaire

Take all conductors through same cable entry into luminaire

4260A CONNECTIONS TO LUMINAIRES - RECESSED FITTINGS - PLUG AND SOCKET:

Where luminaires are recessed in a suspended ceiling, terminate circuit wiring at plug and socket to BS 546, located not more than 500mm from the access through the ceiling

Use flexible cord from plug of ceiling rose to supply terminals of luminaire

4270 CONNECTIONS TO LUMINAIRES - CONDUIT SUSPENSION:

Terminate circuit wiring in terminal block within supporting conduit box

Use flexible cable from terminal block to luminaire, installed within tube

4280 CONNECTIONS TO LUMINAIRES - ROD OR CHAIN SUSPENSION:

Terminate circuit wiring in terminal block within supporting conduit box

Use flexible cord from terminal block to luminaire and clip cable to one of the rods or chains, do not weave cable through links of the chain

3.15 CABLE GROUPING AND ROUTING

Cable trunking is to be used in all instances where the alternative requires a multiplicity of conduits following one route, and similarly perforated steel cable trays are to be used where a multiplicity of small section cables follow a common route.

Wherever possible, all main and sub-main cables, cable trunking and cable trays shall be routed in services ducts or corridor ceiling voids.

3.16 CONDUIT

Y60 CONDUIT AND CABLE TRUNKING

1000 GENERAL 1010 STANDARDS:

Provide conduit and cable trunking in accordance with the relevant British Standards and in particular the requirements of BS 7671 Requirements for Electrical Installations (The IET Wiring Regulations)

2010B CONDUIT SYSTEMS METAL RIGID CLASS 4:

Provide conduit systems to BS EN 61386

Use conduit of each type from one manufacturer

Material - Metal, steel

Method of connection - Threadable

Suitability for bending - Rigid, BS EN 61386-21

Electrical characteristics - with electrical continuity

Resistance against corrosive or polluting substances

Conduits with same protection outside and inside

High protection - Hot dip zinc coating. BS EN 61386-1 Table 10 Class 4

2020A RIGID CONDUIT SYSTEM - METALLIC CONDUIT:

Use couplers to match conduit grade and finish

Use solid couplers to join lengths of conduit unless inspection couplers are shown on the drawings or schedules

Conduit fittings and adaptable boxes

Material - Malleable iron adaptable boxes

Do not use factory made bends, inspection bends or inspection couplers unless shown on drawings or schedules

Ensure fittings are same class and finish as associated conduit system

Supply covers for circular or adaptable boxes in the same material and finish as boxes

Use steel dome or cheese headed screws to secure covers for Class 2 finish

Use brass dome or cheese headed screws to secure covers for Class 4 finish

Limit number of entry holes within loop-in boxes to four

Adaptable box, minimum size - 100mm x 100mm x 50mm

Connections

Use couplers and externally screwed brass bushes to connect conduit to loop-in circular conduit boxes, switchgear, distribution boards, and adaptable boxes. Use solid couplers

Conduit fixing saddles - Spacer bar. Plugs - Hexagonal malleable iron. Locknuts - Hexagonal steel

4060 SCREWED STEEL CONDUIT:

Use materials clean and free from defects, rust, scale and oil. Obtain prior permission in writing for use of materials subject to remedial work before erection. Repair any damage caused by threading, bending or erection by painting with zinc rich paint before any rust occurs

Ensure length of thread on conduit matches that in conduit couplers, fittings or equipment with no thread exposed after erection except at running couplers

Ensure conduits butt inside couplers

Use lubricant when cutting threads

Use minimum number of running couplings

For running couplings in Class 2 conduit, use coupler and locknut. Paint exposed thread with zinc rich paint

For running couplings in Class 4 conduit, use three piece conduit unions

3090 BUILDERSWORK:

Ensure conduit is not concealed until work has been inspected and approved. Obtain permission before horizontally chasing walls

Ensure that conduit and fittings buried in concrete or behind plaster are protected against corrosion or electrolytic action prior to rendering

Ensure conduit concealed in wall chases is covered by plaster and/or rendering to minimum depth of 12 mm

4010 DRAW-IN BOXES:

Provide draw-in boxes in conduit at maximum intervals of 10 metres or after bends and/or sets totalling 180 degrees

3080A WIRING:

Comply with BS 7671 when wiring installations. Segregate circuits as indicated

Ensure draw wires are left within empty conduits for use of specialist installers. Use draw wires comprising nylon tapes with fitted eyelets

For concealed conduit ensure system is installed to enable re-wiring to be carried out from boxes for fittings or accessories only. Draw-in boxes will only be permitted with prior permission in writing

Do not use tallow or any other substances to facilitate drawing-in of cables

3040 CONDENSATION PREVENTION:

Install conduit and trunking systems to ensure internal condensation does not affect operation of associated circuits. Provide drainage points in accordance with BS 7671

Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value

3050A PROTECTION AND REPAIR OF STEEL COMPONENTS:

Paint joints of conduit and minor damages to finish of conduit and trunking immediately after erection or after damage occurs

Use paint compatible with finish as follows

Galvanized finish, use two coats zinc rich paint

Black enamelled finish, use two coats of good quality, air drying, black enamel paint

Remove grease, oil, dirt and rust before applying protective paint

Notify serious damage and repair or replace as instructed

3060 EQUIPMENT CONNECTIONS:

Where surface mounted equipment is installed in conjunction with concealed conduit work, terminate concealed conduit at flush mounted conduit or adaptable box. Drill back of equipment, bush for back entry and mount equipment to conceal back box

Connect to fixed equipment via conduit box located adjacent to termination point, using either solid or flexible conduit as indicated for final connection to equipment terminations

Use conduit box as cable change point to facilitate changed wiring locally to adjacent equipment

Connect trunking to equipment by specially fabricated connectors or by couplers and externally screwed brass bushes

3070 CLEANING BEFORE WIRING:

Clean inside of conduits and trunking with swabs immediately before wiring

Inspect all components and remove any foreign matter, fit temporary plugs to open ends of conduit and trunking to prevent ingress of water and solid material

Ensure separation is in accordance with Appendix K of Guidance Note I Selection and Erection published by the IET and BS EN 50174

All conduits to be free from internal burrs

The ends of all conduit lengths are to be reamed to a smooth finish

No conduit of a smaller diameter overall than 20mm to be used

All surface installed conduits are to be securely fixed by means of 'Hospital' type distance saddles

All associated boxes are to be galvanised. Unless used in association with direct fixed equipment, all boxes are to be fitted with a steel cover lid fixed with brass screws and, where there is a possibility of moisture entering the boxes, they shall be provided with suitable water tight gaskets

Standard circular conduit boxes shall be of malleable iron for all surface work or pressed steel where concealed in the building fabric. Male brass bushes and couplings shall be used for all adaptable or switch box entries

Conduits shall be protected from mechanical damage and weather when stored on site

Conduits shall be installed in accordance with BS7671 IET Regulations in respect of cable capacity and be sufficiently large to allow easy draw-in or withdrawal of any one or all cables. Support conduit in accordance with Appendix 1 of Guidance note 1: Selection and Erection published by the IET.

Conduits shall be installed using independent systems for each of the following:

- a) Lighting
- b) General purpose power installations

- c) Data Systems
- d) Security Systems

All conduit systems are to be installed so that they permit rewire from directly accessible conduit outlet boxes. No conduit boxes, inspection elbows or tees or other like accessories, are to be installed buried in the building structure or otherwise inaccessibly located within the building fabric

All conduit to be mechanically and electrically continuous throughout the installation and to satisfy the earth resistance tests specified in the IET Regulations. All conduit shall be tested for continuity before plastering or floating concrete (sunk installations) or cabling (surface installations) is commenced

Conduit in walls to be securely fixed by crampets or other approved method so as not to damage the plaster when drawing in cable

Conduits buried in floor screeds are to be fixed by means of single hole fixing saddles with rawlplugs and screws. Where two conduits cross, the structural concrete is to be chased to allow one to pass under the other

Solid elbows and tee pieces will not be permitted

All conduits laid in 'in situ' concrete slabs are to be laid immediately over the structural reinforcement before concrete is poured. The electrical sub-contractor shall provide attendance during pouring operations to ensure that conduits are not displaced. Conduit boxes shall be fixed to shuttering to prevent such displacement, and suitably packed to prevent the ingress of concrete or moisture. The electrical sub-contractor shall be responsible for the accuracy of conduit outlets for lighting points etc

The conduit at expansion joints in 'in situ' concrete roofs shall terminate flush at one side of the joint in a screw-in slip solid coupler. The conduit at the other side of the joint shall bridge the expansion gap to engage the slip section of the coupler to allow not less than 12.5mm movement of the conduit without separation. A tinned copper flexible earth continuity conductor shall be installed between junction boxes on either side of the expansion joint. The conductor shall not be less than 4.0mm² and be secured to the back of the boxes with 3mm phosphorus bronze screws tapped in holes and secured with suitable washers and nuts

In all plaster finished walls, plastered or suspended ceilings and in all floors, the conduit is to be concealed in the screed, ceiling places etc., and all outlet boxes for lighting and power points are to finish flush with the finished wall or ceiling, allowing ample plaster covering for the conduit. Extension boxes are permitted where necessary to comply with this requirement

Conduit runs shall be so arranged that it is impossible for the lodgement of water to occur at any point in the tube. 'U' forming loops of conduit will not be permitted unless adequately drained

Straight junctions shall only be made with fixed length couplers

Where conduits are required to change from a sunk to surface installation along their route, or vice versa (as for switch drops on thin partition walls etc.) this shall be effected by means of a standard conduit box terminating the concealed run to which is then an extension conduit box and the surface installed conduit

Where the surface conduit turns to pass through a wall or ceiling a back outlet box shall be provided

All conduits after erection and before the pulling in of cables shall be cleaned free from dirt by drawing through of swabs until completely clean and dry

All rough edges and burrs caused by cutting and threading of the conduit are to be removed to ensure a completely smooth passage for the cables

Conduits shall be held in an efficient vice for screwing. The electrical sub-contractor is informed that badly marked conduit or poor threads will not be accepted

Conduits coupling to equipment having tapped conduit entries to be screwed tight with no visible thread showing

Conduits coupled to equipment having untapped conduit entries shall be smooth bore brass bushes inside the equipment, with brass compression rings and flanged couplings with backing circular locknuts outside the equipment.

Conduits coupled to cable trunking shall be by smooth bore brass bushes inside the trunking with brass compression rings or purpose-made lead washers and flanged couplings with backing circular locknuts outside the trunking

The inner radius of conduit bends shall not be less than two-and-a-half times the outside diameter of the conduit nor less than four times the diameter of the largest cable within the conduit. All bends and sets are to be made cold without alteration to the section

All surface conduit installations shall be complementary to the architectural features of the building, due allowance being made for accessibility, inspection and maintenance and attention shall be given to the alignment of accessories. Where practicable these shall be on the same horizontal or vertical centre lines. All corners and angles are to be neatly negotiated and vertical and horizontal runs shall be kept straight. No diagonal runs will be permitted and all branches shall be taken off at right angles

The electrical sub-contractor is to have a competent site supervisor in continuous attendance to supervise the laying of conduit in ceilings and walls and to check the positions of outlets etc., before conduits are concealed within the building fabric

Surface conduit on walls etc. is to be secured by distance saddles giving a minimum clearance of 5mm at even distances of not more than 1200mm apart, and so arranged that a distance of not more than 200mm exists between a saddle joint or bend. Spacer bar saddles shall not be used. Expanding soft metal plugs and sherardized screws shall be used for all conduit fixings in brick or concrete in all damp situations and exterior installations. Rawlplug fixings or other approved equivalents shall be used on all interior installations

Standard pattern circular conduit boxes are to be used for all surface work. Looping-in circular conduit boxes are to be used for concealed conduit work, where the building construction permits their use

Conduit boxes of the multiple adaptable type of dimensions not less than 150mm x 100mm x 38mm where two or more conduits run parallel. No more than three 20mm conduits will be permitted to enter the longer side of the box, and where more or larger conduits are to be accommodated, larger boxes shall be used

Unless by agreement with the Consulting Engineer all conduit runs are to be kept clear of gas, hot water and steam pipes by a minimum distance of 450mm and shall not be run behind or less than 900mm above heating radiators or convectors. In such instances where adequate segregation of metal pipes, gas and electric services are not possible effective bonding between these at all points of contact or near contact are to be completed as directed in the IET Regulations

Conduit shall not have more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory

Conduits shall not be installed in runs of more than 10m without drawing in boxes

Conduits shall not be concealed before inspection

Conduits shall not have cables drawn in until all conduit is complete

Conduits shall not be dismantled for wiring

Conduits shall not be installed in ducts without the express approval, in writing, of the Consulting Engineer

3.17 PVCu CONDUIT

All PVCu conduit and fittings shall be manufactured to comply with BS EN 61386. All conduit and accessories used on any PVCu system shall be of the same grade and manufacture.

Screwed PVCu conduit joints will not be permitted except where stated otherwise. All PVCu conduit joints shall be made with an adhesive recommended by the manufacturer.

All PVCu conduit shall be of the best grade high impact heavy gauge conduit. Standard or inferior grades by any manufacturer will not be permitted and the sub-contractor's attention is drawn to the fact that only the best grade made by the specified manufacturer shall be used.

PVCu conduits shall be protected from weather and all mechanical damage during installation or whilst stored on site. The conduit shall be protected by means of plastic caps to prevent the entrance of plaster or foreign matter.

PVCu conduits shall not be held in a pipe vice under any condition of installation.

PVCu conduits installed on the surface shall comply with the general requirements for the installation of steel conduits detailed in this Specification.

Concealed conduit installed under constant temperature conditions shall be fixed at not more than 1750mm and surface mounted conduits shall be supported at not more than 900mm centres. Where ambient temperatures are high or subject to rapid changes PVCu conduit shall be supported at centres not more than 500mm. PVCu conduit shall not be installed under very low ambient conditions.

The fixing on either side of a bend or accessory shall not exceed 150mm.

Cold bending of conduits will be permitted up to 25mm diameter. Conduits above 25mm diameter shall be of the pre manufactured type.

All connections to push fit spouted boxes, bends and accessories shall be sealed with a PVCu solvent to ensure a watertight fit.

Conduit within expansion couplers shall be spaced to allow adequate movement and the joint sealed with lubricant sealant to form a seal against ingress of moisture. Expansion couplers shall be used when a change of temperature above 25°C is likely to occur.

Expansion couplers shall be fitted where more than 8 metres (or two full standard lengths) of surface conduit is installed.

The number of cables installed in any conduit shall not exceed the number stated in the IET Regulations and the latest Code of Practice.

All boxes used with PVCu conduit systems shall be of the type which have brass inserts to accommodate the fixing screws and have provision for an earth terminal. The boxes shall all be of the long and/or webbed moulded spout type.

All accessories shall be of the same manufacture as the conduit. Mixing of different manufacturer's conduit and accessories on the same system will not be permitted.

Lighting fittings shall not be supported from PVCu conduit boxes or any part of the PVCu conduit system. Separate means of support shall be provided for lighting fittings and the use of a steel conduit box with screwed spouted entry will be permitted. The box shall be independently supported and the conduit supported on each side of the box with saddles at not more than 150mm from the centre line of the box.

3.18 FLEXIBLE METALLIC CONDUIT

2010D CONDUIT SYSTEMS - STEEL FLEXIBLE, LSF SHEATHED:

Provide conduit systems to BS EN 61386. Use conduit of each type from one manufacturer

Material - Metal, steel

Method of connection - Non-threadable

Suitability for bending - Flexible, BS EN 61386-23

Resistance to flame propagation

Non-flame propagating conduit

Resistance against corrosive or polluting substances

Conduits with same protection outside and inside

Medium protection

Conduits with greater protection outside than inside -Medium/high

Stove enamel inside, LSF sheathed outside. BS EN 61386-1 Table 10 Class 2

2040A PLIABLE OR FLEXIBLE CONDUIT SYSTEMS - METALLIC:

Type of Packing - Unpacked

Type of sheath - Low smoke and fume material

Fittings material - Brass adaptors

Connections

Use brass male adaptors to connect flexible conduit to motors and any other equipment having a threaded entry

Use male adaptors, solid couplers, flanged couplers with washer and externally screwed brass bushes to connect flexible conduit to trunking and equipment not having a threaded entry

Shade as approved.

Flexible metallic conduit shall be run between the internal wiring systems and fixed apparatus, motors, thermostats etc

Flexible metallic conduit shall be kept to the shortest length, to a maximum of 450mm

Flexible metallic conduit shall be connected to equipment with factory made clamps

Flexible metallic conduit shall be run with a circuit protective conductor of minimum size 2.5mm² insulated cable, installed internally and connected externally at each end of the conduit

3.19 ADAPTABLE BOXES

Adaptable boxes used external to buildings or in crawlways, ducts, lift, motor rooms, tank rooms, lavatories, pump rooms, calorifier rooms, basements, kitchens, subways, boilerhouse, laundries, bathrooms, sluice rooms, mortuaries, laboratories, cold rooms and steriliser rooms shall be of heavy duty GRP, Stainless steel or Galvanised Steel type complete with compatible IP rated flange protection and as detailed within the particular specification.

For 20mm conduit - 40mm deep

For 25mm conduit - 50mm deep

For 32mm conduit - 60mm deep

No adaptable box smaller than 75 x 75 x 40mm shall be used.

3.20 CABLE TRAY & BASKET SYSTEMS

Cable tray will be of perforated hot dipped galvanised sheet steel to BS EN 10143: self colour galvanised finished complete with steel angle supports, brackets and external earth bonding straps as recommended by the manufacturer. Heavy duty return flanged type cable tray is to be used for the distribution system for trays of sizes of 225mm and above, but below this size, medium duty return flanged cable tray is to be used.

On heavy duty tray the return flange shall be of a minimum height of 50mm and to the medium duty tray it shall be of minimum height of 25mm.

The cable basket will be of perforated hot dipped galvanised C4D steel rod to BS EN ISO 16120 surface coating with three types of finish: Electrolytic zinc coating according to Standard BS EN ISO 2081 and hot –dip galvanised coating to BS EN ISO 1461, brackets and external earth bonding straps as recommended by the manufacturer.

All bends and accessories for both system types shall be factory made purpose units of the same manufacture as the cable tray or basket. Bends, tees and accessories shall be of the same material thickness and finish as the cable tray or basket. Bends shall have an inner radius not less than 50mm and a straight length of not less than 100mm at each end.

Cable trays & baskets shall be of adequate size and have 25% spare capacity after completion of the installation of the cables for the particular installation.

Cables on trays or baskets shall not be bunched but shall be spaced a minimum of their overall diameter between cables.

A minimum clear space of 20mm shall be left behind all cable trays or baskets.

Mushroom head galvanised steel roofing bolts and nuts shall be used to fix together adjacent sections of cable trays and/or accessories. Fixing screws shall be not less than 6mm diameter.

Cable trays shall only be cut along a line of plain metal and not through the perforations. All cut edges of galvanised cable trays shall be prepared and painted with a zinc rich paint.

Holes cut in cable trays for the passage of cables shall be provided with grommets or, alternatively, bushed to prevent damage to cables.

Fixings for cable trays or baskets shall be installed at regular intervals not exceeding 1200mm and at 300mm from bends and intersections. Trays shall be carried on brackets or distance pieces and securely fastened to the structural walls or floor slabs.

Trays & baskets shall be capable of carrying, without undue deflection, the total weight of cable on the tray. They shall be spaced off the structure to which it is secured at a distance of not less than 75mm.

All parts of these systems shall be provided with means of bonding for electrical continuity and designed to maintain complete electrical and mechanical continuity.

Cable shall be fixed to these systems by means of proprietary forms of LSZH cable clips, saddle, straps etc.

Cables shall be fixed by means of galvanised metal saddles and clips where higher than average temperature are likely to be experienced and in line with the guidance of the current IET regulations BS7671.

Y63 SUPPORT COMPONENTS – CABLES

1000 GENERAL

1010 APPLICATION:

Cables referred to in this section are only those types that can be installed without further mechanical protection

2010A CABLE SUPPORTS AND FINISHES:

Cable supports

Support all cables throughout their length using conduit; or trunking and enclosures; or cable tray; or cable racking; or special support systems; or cleat or clip fixing direct to building fabric as indicated on the drawings/schedules

Ensure tray, racking and special support systems are continuous and firmly fixed to building fabric. Allow space for additional cables as indicated on the drawings/schedules

Ensure cable support system allows for spacing in accordance with BS 7671 for the design current of the cable

Fixings finishes

Ensure finish for all support components, fixings, hangers and accessories is as cable support system or manufacturer's standard

2020A CABLE SUPPORT SYSTEM - PERFORATED TRAY:

Type - Flanged or return flanged

Perforations

Admiralty pattern for light or medium duty; GDCCD pattern standard 23; or manufacturer's standard pattern

Thickness - Manufacturer's standard thickness for type

Fittings

Use factory made fittings throughout of same material, type, pattern, finish and thickness as cable tray

Use reducers, inside angles and outside angles as manufacturer's standard

Use flat bends, equal tees, unequal tees and crosses with corners gusseted

Join lengths of tray and fittings using manufacturer's standard shouldered ends, fish plates, or couplers, with galvanized or zinc plated slotted domed head 'roofing' bolts, nuts, washers and shakeproof washers

Material

Hot rolled steel galvanized after manufacture to BS EN 10346 or BS EN 10143. Finish - Self colour galvanized

2025 A CABLE CLIPS AND CLEATS:

- Standard BS EN 61914
- Material
- Impact resistance
- Resistance to electromagnetic forces
- Type
- One piece
- Single way pattern
- Hook pattern
- Claw pattern
- Two bolt pattern
- Shaped trefoil

- Triangular trefoil
- Non magnetic stainless steel loop
- Proprietary cable ties
- Type
- Two piece cable tray pattern
- Wrap round self locking releasable pattern
- Wrap round self locking non releasable pattern
- Cable clips
- Polypropylene surface type with pre-fixed hardened steel pin
- Bright copper one hole 'P' clips
- Two way saddles
- Bright copper
- PVC covered bright copper

2025A CABLE SUPPORT SYSTEM - PROPRIETARY CABLE TIES:

Two piece cable tray pattern, on cable tray only. Wrap round self locking non releasable pattern on everything except cable trays

2025B CABLE SUPPORT SYSTEM - CABLE CLIPS:

Polypropylene surface type with pre-fixed hardened steel pin for general use except on mineral insulated cables

For mineral insulated cables use bright copper one hole 'P' clips for unsheathed mineral insulated cables, PVC covered for sheathed mineral insulated cables

2025C CABLE SUPPORT SYSTEM - TWO WAY SADDLES:

Bright copper for unsheathed mineral insulated cables. PVC covered bright copper for sheathed mineral insulated cables

2025D CABLE SUPPORT SYSTEM - CABLE BASKET:

Proprietary system of wire basket with compatible jointing and fixing accessories

Fittings

Use factory made fittings throughout of same material finish as basket, for risers, bends, reducers, tees, crosses and drop outs

3010 CABLE TRAY INSTALLATION:

Support from building fabric with minimum clearance behind of 20mm. Install fixings at regular intervals to prevent visible sagging when loaded, with maximum spacing 1.2m and 230mm from fittings

Keep cutting of cable tray to a minimum. Cut along a line of unperforated metal. Make good finish with zinc rich paint, primer and top coat, or two pack epoxy paste, as appropriate to tray material and finish

Fit holes cut in tray for passage of cables with grommets, bushes or other lining

Install all bolts, fixings and hangers with threaded portion away from cables

Cable routes to cross at right angles or spacing to BS EN 50374

3020A CABLE CLEATS, TIES, SADDLES AND CLIPS INSTALLATION:

For cables on horizontal tray use ties for each circuit. Use tie manufacturer's special tensioning tool where available. Crop off tie ends

For cables on vertical tray use cleats bolted to tray for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables

Use cleats sized to grip cables firmly without undue pressure or strain on cable, but preventing slipping

For cables on vertical or horizontal rack use proprietary fixings to rack for paper, plastic or elastomeric insulated cables and saddles or clips for mineral insulated cables on continuous flat surfaces of wood, plaster, brick etc

Use polypropylene surface fixing clips with prefixed hardened steel pin for PVC insulated and sheathed cables and sheathed or bright mineral insulated cables

Use round or flat or flat twin pattern as appropriate, manufactured specifically for cable being fixed

Use one hole 'P' clips or two way saddles of bright copper for unsheathed mineral insulated cable. Use PVC covered for sheathed mineral insulated cables
Space cleats, ties, saddles and clips
As Appendix G of Guidance Notes 'Selection & Erection' published by the IET

3.21 LADDER RACK

2020B CABLE SUPPORT SYSTEM - CABLE RACK:

Proprietary system of channel sections with return lip and compatible jointing and fixing accessories / fittings

Use factory made fittings throughout of same material finish and section as rack, for risers, bends, reducers, tees, crosses and drop outs

Material

Hot rolled steel galvanized after manufacture to BS EN 10346 or BS EN 10143. Finish - Self colour galvanized

3.22 CABLE TRUNKING

2080A CABLE TRUNKING AND FITTINGS:

Comply with BS EN 50085. Use trunking of each type from one manufacturer

2090A METAL TRUNKING - FACTORY PAINTED FINISH:

Material

Steel trunking to BS EN 50085. Supply partitions and covers same material as trunking

Gauge of metal - BS EN 50085

Style

Use trunking manufactured with inward return edge flanges and fitted with flange couplers which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access

Protection to BS EN 50085

Electroplated zinc having a minimum thickness of zinc coating of 0.0012mm inside and outside with additional coating of stoved or air drying paint, applied at least to the external surface

Finish - Manufacturer's standard, all surfaces

Colour

Manufacturer's standard or to BS 4800 Shade as approved

Fixings

Use purpose made brackets to fix to structural steel or suspension rods

Provide external fixing lugs where specified protection for the installation is IP44 or greater

Fittings

Use bends, tees and angles of similar gauge, type and finish as trunking body and supplied by same manufacturer

Partitions and Covers

Ensure partitions are electrically continuous with the body of the trunking or provide a connector for a circuit protective conductor

Ensure gap between partitions and lids maintains segregation of circuits

Material - Same material as trunking

Joints

Use purpose made jointing pieces fixed with screws into captive nuts. Ensure screws do not protrude through the nuts

Ensure rigidity of trunking is maintained across joint

Ensure external dimensions of trunking are maintained and not reduced by more than 4% across joints between trunking lengths and/or fittings

Use purpose made fittings of the same manufacture where trunking connects to switchgear and distribution boards

Provide flanges for connection of flush floor trunking to vertical trunking to maintain the cross sectional area of compartments with 50 mm minimum radius

Maintain electrical continuity at each joint by a copperlink, (tinned copper for galvanized trunking), fixed on outside of trunking, secured by screws, nuts and shakeproof washers

Screws must not project through the nut. Make provision for continuity to be achieved without need to remove paint from ferrous metal where trunking has a painted finish

Screws, Nuts, Washers

Do not use self tapping screws. Use cheese or round head screws except where provision is made for the use of counter-sunk heads

Material

Use steel zinc coated

- BS 7371-Cable supports

Provide horizontal trunking with removable cable retainers or bridges to retain cables in situ

Provide vertical trunking with pin racks to support cables at 3000 mm maximum spacing.

Use insulated pins or insulation sleeved pins on pin racks

2090C LIGHTING TRUNKING COVER:

Provide cover strip to prevent ingress of foreign materials, locate cabling in place and act as closure strips between luminaires. Use trunking cover strip clipped into place in trunking body

Cover strip material

To match lighting trunking body or high quality colour fast extruded plastic

Colour - Manufacturer's standard or to BS 4800

Shade as approved

5020 ACCESS:

Arrange trunking to allow access to wiring. Locate covers on top or sides of trunking if practicable. Arrange access so covers are on a continuous face and cables can be laid in throughout the length of the trunking

Notify where either condition cannot be achieved

5030A FIXING TRUNKING:

Ensure trunking is independently fixed and supported from building fabric. Obtain approval for proposed fixings/supports

Support trunking in accordance with the manufacturer's requirements and/or Guidance Note 1 Selection and Erection published by the IET

Use two fixings minimum per standard length

5040A STEEL TRUNKING:

Install steel trunking in accordance with the manufacturer's requirements and those of BS 7671

Use trunking to avoid multiple parallel conduit runs, subject to approval

Cut trunking clean and square with axis, prepare ends and remove burrs and sharp edges

Ensure inside of trunking is free from anything liable to damage cables either during installation or after covers are fitted

When trunking is held in a vice, ensure surfaces remain undamaged and components are not warped. Avoid tool marking or damage to trunking system components

Do not site fabricate trunking tees, bends, flanges and other accessories. Use only factory made accessories

Form circular holes over 6 mm diameter in trunking body using correctly sized punch sets

Use twist drill for holes up to 6 mm maximum diameter

Use only factory formed openings for accessories

Line unprotected apertures in trunking with PVC or nylon edging strip

Fit ends of runs with removable blanking plates

Ensure connections are not made to covers unless indicated or approval obtained

Provide fixed section of cover projecting 25 mm either side of fabric where trunking passes through wall, floors or ceiling

Fit cable retaining straps at 500 mm intervals except where cover is on top

5060 TRUNKING OF INSULATING MATERIAL:

Comply with manufacturer's instructions

Do not install trunking where ambient temperature is below - 5°C or working temperature is above 60°C

Use solvents recommended by trunking manufacturer when making solvent welded joints

Remove excess solvent before surface damage occurs

Hold joints rigid and in position until welds set

Use manufacturer's standard radiused bends, connector tees, off-sets, end plates and component parts of trunking system assembly

Ensure no type of trunking other than that specified is installed without approval

Trunking may be substituted for conduit at certain positions subject to approval

The Electrical Sub Contractor shall also include for manufacturers recommended fire barrier protection where trunking passes through fire barrier protection walls, floors or ceiling void fire curtains

Floor tray type trunking shall not be less than 2.5mm pressed steel, single or multi-way, to sections as indicated on working drawings and will normally be fitted within floor screeds and with tray type lids containing lino or other floor finish as required by the situation. The lids shall be free from distortions and be fitted to give a reasonably watertight finish and be firmly fixed by brass flush fitting screws in brass pads at regular intervals not exceeding 600mm apart on each side of the lid, except where varying specification are shown on working drawings

Metal surface type trunking shall be run on the surface of walls and/or ceilings in such a manner that condensed moisture is drained off. It shall be kept 450mm clear of and below steam or hot water pipes and other services. Where such distances are not practicable, and with the approval of the Consulting Engineer, the trunking shall be bonded to pipework in the

manner described in the previous clause. Trunking shall be supported at intervals as specified by approved type metal clips. Drilling of structural steelwork for this purpose will not be permitted without written approval

The trunking shall be mechanically and electrically continuous throughout its entire length

Electrical continuity shall be assured by the use of copper links or continuous earth tape of 18.5mm² cross section, firmly attached so that every length of trunking or fitting is bonded to the main earth system

The trunking dimensions must be such that the total number of expected cables do not exceed half the total capacity of the trunking, as stated in the capacity tables published by the manufacturers

Trunking shall be filleted to cater for segregated services where these are required in compliance with clause 'Final Sub-Circuit Cables' in this section

When more than two circuits are run in one trunking, the cables in each circuit are to be laced together with adhesive tape or cord

Trunking covers shall be solidly fixed where passing through walls, floors or ceilings. The solidly fixed portion shall project 75mm on either side of walls and 150mm on either side of floors or ceilings

With the exception of trunking designed and installed specifically for the support of lighting fittings, no trunking shall be installed with the cover on the underside

Trunking shall be free from sharp projections and edges

All trunking shall be fitted with purpose made radiused bends and tees with wiring covers or lids. Site fabricated accessories will not be permitted unless with written permission

Where trunking is secured to switchgear, distribution boards, flanged couplings shall be used. Particular attention shall be given to corners at tees and bends and to the fitting of screws to avoid possible damage to cables

Trunking shall be fitted with internal fire barriers where trunking passes through fire barriers

3.23 PVCu TRUNKING

PVCu trunking shall be extruded unplasticised PVCu compound of the colours indicated on the drawings or in the schedule.

The trunking shall be smooth inside and outside and free from imperfections and manufactured by an approved manufacturer.

The trunking shall be of the high impact resisting heavy gauge type where necessary, fitted with drip-proof well fitting lids of an approved type and size or as indicated on the drawings or in the schedule.

All trunking and accessories shall be of the same manufacture and standardised throughout the installation.

Particular attention shall be paid to the arrangement and installation of surface mounted trunking systems to provide a satisfactory installation. Diagonal runs will not be permitted, and all surface mounted trunking on walls and ceilings shall be fixed horizontally or vertically as required. The trunking shall be fixed with no gaps between the trunking and the wall or ceiling surface.

Trunking shall be fitted with cable retaining straps where trunking is installed with cover on the underside.

Alternatively, trunking shall be formed with one edge turned to form a retaining trough; this method shall only be used where the lid of the trunking is not fitted on the top side.

Trunking shall be fitted with insulated cable support pins at intervals of 1.2m in vertical runs of trunking that exceeds 1.8m in length. The first pin in cases where junctions occur shall not be more than 0.3m from such junctions.

Trunking shall be fitted with internal fire barriers where trunking passes through fire barriers.

Trunking shall be fitted with manufacturer's standard tees, off-sets and other fittings where changes of direction occur. Site fabricated accessories will not be permitted.

Trunking shall be fitted with manufacturer's standard end plates where detailed to fit items of equipment.

Trunking shall be joined together using manufacturer's standard internal connectors, without the use of solvent, and as instructed by the manufacturers.

All cuts, holes and mitres to accommodate accessories or adjoining parts shall be made to the correct size without gaps or jagged edges.

Trunking shall be fixed to the building structure 50mm either side of the joint.

Trunking shall be installed in accordance with the appropriate conditions covering the installation of plastic conduit.

Trunking shall be adequately supported and substantially fixed to the building structure by purpose made supports fixed at not more than 1.2m centres.

3.24 DADO TRUNKING

Dado trunkings shall comply with the following:

2090E STEEL DADO TRUNKING:

Material steel - BS EN 50085

Wall/dado trunking - three compartment

Installation – surface

Style

2090E STEEL DADO TRUNKING:

Use trunking manufactured within ward return edge flanges and filled with flange couplers, which ensure that when the cover is removed a minimum of 80% of the nominal trunking or compartment width is available for access

Colour - manufacturer's standard or BS 4800 shade to be approved

2090F ALUMINIUM DADO TRUNKING:

Material extruded aluminium - BS EN 50085

Wall/dado trunking - three compartment

Installation - surface

Style - extrusion as manufacturer's standard

Colour - manufacturer's standard or BS 4800 shade to be approved

2130C PVC DADO TRUNKING - GENERAL PURPOSE:

Trunking to BS 4678-4

Mechanical properties, trunking for medium mechanical stress

Temperature tolerances - BS 4678-4, Table 1

Electrical characteristics

Without electrical insulating characteristics

Resistance against ingress of solid objects

Protected against solid objects greater than 1.0mm (IP4X)

Resistance to ingress of water

Protected against dripping water (IPX2)

Resistance against corrosive or polluting substances

Medium protection

Fittings

Use fittings from same manufacturer as trunking. Use 'snap-on' covers

Use trunking fittings and accessories suitable for jointing by solvent welding

Use proprietary cable retaining clips at 500mm maximum intervals on trunking that exceeds 1.8m in length. Where junctions occur ensure first clip is not more than 300mm from junctions

3.25 CABLE INSTALLATIONS GENERALLY

Y61 HV/LV CABLES AND WIRING

1000 GENERAL

1010 CABLE MANUFACTURER:

Use new cables, delivered to site with seals intact, manufactured not more than one year prior to delivery, labelled with manufacturer's name, size, description, BS number, classification, length, grade and date of manufacture

1020 CABLE CERTIFICATION MARKING:

Mark all types of cables with CENELEC cable certification marking or if included in British Approvals Service for Cables (BASEC) in accordance with BASEC regulations

1030 MEDIUM VOLTAGE CABLE RECORDS:

Keep records of MV cable drum numbers and supporting information, mark information on record drawings, indicating precise location of each length of cable, and submit copies of manufacturer's cable test certificate

2005 LSOH SHEATHING:

Supply cables with Low Smoke Zero Halogen (LSOH) sheathing, tested in accordance with BS EN 60754 and BS EN IEC 60332-3-21

2010A STANDARD ORDINARY FLEXIBLE WIRES - SINGLE COPPER CORE:

Standard - BS 6004, Table 4(b), 5 and 12

2010B STANDARD LSF FLEXIBLE WIRES - SINGLE COPPER CORE:

Standard - BS 7211, Tables 3(b) and 4(b)

2010C STANDARD HEAT RESISTING (110 DEGREES CENTIGRADE OR MORE) FLEXIBLE WIRES - SINGLE COPPER CORE:

Standard – BS EN 50525-1, BS EN 50525-2-41, BS EN 50525-2-42

2010D STANDARD ORDINARY FLEXIBLE CORDS - MULTI COPPER CORES:

Standard - BS EN 50255 (2-11) (2-12) (2-21) (2-71) (2-51) (2-83), (3-21) BS6004

2020A STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED:

Standard - BS 5467, Tables 4, 6, 8, and 10. Mechanical protection – Unarmoured

2020B STANDARD POWER SUPPLY CABLES, COPPER CONDUCTORS, THERMOSETTING INSULATION, SHEATHED AND ARMoured:

Standard - BS 5467, Tables 4, 6, 8, and 12 Mechanical protection - Armour

2020G STANDARD CABLES FOR CONDUIT AND TRUNKING, COPPER CONDUCTORS, LSF INSULATED:

Standard - BS 7211, Tables 3(a) and 4(a)
Mechanical protection - Conduit and trunking

2050B PAIRED, SCREENED CONTROL CABLES WITH OR WITHOUT METALLIC PROTECTION:

Standard - BS EN 50288-7
Paired, screened control cables, with or without metallic protection

2050G MULTI-CORE UNARMoured LSF, SHEATHED AUXILIARY CABLES:

Standard - BS 7211, Table 6

Mechanical protection – Unarmoured

2050H MULTI-CORE ARMoured LSF, SHEATHED AUXILIARY CABLES:

Standard - BS 6724, Table 18

Mechanical protection - Armour

2070B STANDARD COMMUNICATIONS CABLES FOR INDOOR USE:

Standard - BT CW 1308; BT CW 1370; BT CW 1700; and BT CW 1750

2090A OPTICAL FIBRE CABLES:

Standard - BS EN 60794-2-11. Category of fibre to BS EN 60793-2-10 A1a or A1b

2100A INFORMATION TECHNOLOGY CABLES - STRUCTURED WIRING: CATEGORY 5:

Provide IT cables in accordance with the IT system suppliers specification

Type of system - Structured cabling - BS EN 50173-1

Standard - BS EN 50288-3-1

Termination reference - EIA/TIA TSB-40

Cable construction - Multi pair; unshielded (UTP)

3010A CABLES GLANDS - UNARMoured CABLES, INDOORS:

Cable type

Flexible; wiring and power; control and auxiliary; and communications

Standard - BS EN 50262 non-metallic, cable retention, IP54; Type A1 as BS 6121-5 Annex A

Environment - Indoor

3010B CABLES GLANDS - UNARMoured CABLES, OUTDOORS:

Cable type

Flexible; wiring and power; control and auxiliary; and communications

Standard - BS EN 62444 non-metallic, cable retention, IP54; Type A2 as BS 6121-5 Annex A.
Environment – Outdoor

3010C CABLES GLANDS - ARMoured CABLES, DRY INDOORS:

Cable type

Wiring and power; and control and auxiliary

Standard - BS EN 62444 metallic, cable retention Class A, protective connection to earth, IP54. Type B as BS 6121-5 Annex A

Environment - Dry indoors

3010D CABLE GLANDS - ARMoured CABLES, INDOORS:

Cable type

Wiring and power; and control and auxiliary

Standard - BS EN 602444 metallic, cable retention Class A, protective connection to earth, IP54 Type B as BS 6121-5 Annex A
Environment – Indoor

3010E CABLE GLANDS - ARMoured CABLES, OUTDOORS:

Cable type
Wiring and power; and control and auxiliary
Standard - BS EN 602444 metallic, cable retention Class A, protective connection to earth, IP54 with shroud. Type C as BS 6121-5 Annex A
Environment - Outdoor

3060A CABLE JOINTS AND TERMINATIONS:

Use only cable joints as supplied or recommended by cable manufacturer
Cable type - Power or control and auxiliary
Joint arrangement - Straight through or tee
Joint type - BS 7888, cold pour or heat shrink
Accessories - Armour bonds, BS 7197; filling compounds
Environment - Underground

3110A CABLE DUCTS:

Standard
BS 4660 provided by Electricity Supply Company

3120A CABLE SLEEVES:

Supply and hand to others for installation non ferrous cable sleeves for incorporation into the structure where cables pass through fire compartment floors and walls
Packing material
Weak mix mortar; intumescent, plaster or mastic; solid intumescent material; or intumescent granule filled bags

3130A CABLE COVERS AND MARKERS:

Material - Recovered plastic, integral tape
Marking - Electricity or telephone. Plastic marker tape
Yellow, marked electricity or telephone

4010 CABLE INSTALLATION - GENERAL:

Use and install cables only as directed in the appropriate standard or as directed by the manufacturer in writing. Lay cables in one length unless otherwise indicated. Obtain permission from supervising officer for all through joints, and where overall length requirement exceeds practical drum size
Handle, install and dispose of cables on wooden drums in accordance with BS 8512
Install cables when ambient temperature is 5°C or greater, using cables stored at or above this temperature for not less than 24 hours
Use drum stands, drum axles, fair leads, rollers, cable stockings and other equipment as recommended by the cable manufacturer and as appropriate to the method of installation

4020 CABLE INSTALLATION IN LOW TEMPERATURES:

Install cables at lower installation temperatures when authorised by manufacturer in a written statement

4030 INSTALLATION OF LSF CABLE:

Install LSF cables in accordance with manufacturer's instructions. Ensure ambient temperature is above 5°C. Ensure oversheaths are not damaged by abrasion or scuffing

4040 INSTALLATION OF UNARMoured CABLES:

Install and use unarmoured cable to BS 7540-1, BS EN 50565-2, BS EN 50565-3 or the manufacturer's written instructions

4060 CABLE INSTALLATION IN TRENCHES:

Lay cables on newly prepared bedding. Ensure multiple layers of cable are separated vertically by a 50mm layer of hard rammed bedding material

When using a power winch ensure tension on the cable is taken by element of the cable designed for that purpose, that is armour or conductor cores as appropriate and not plastic sheath, metal sheath or core insulation

When hand pulling cable ensure no kinks are formed and that flaking, when used, is done in the correct direction

Do not allow cable to twist during installation. Use swivels to connect pulling bond to cable stocking or equivalent fitting

Check drum is suitable for jacking before commencing installation. If drum or reel is unsuitable for jacking, flake cable in correct direction in maximum size turns from drum or reel before commencing installation. Use skilled labour to supervise all unreeling, flaking or running of cable from a drum

Lay cables in the formation shown, ensure spacing is not reduced below that indicated

Bind trefoil groups at 1m intervals. Bind any associated earth or protective conductor to its cable or trefoil group at 1m intervals

Space multiple cables in trenches in accordance with BS 7671

Ensure installation radii and permanent bending radii are not less than those recommended by the manufacturer

Do not lay cables to BS EN 50525, BS 7211 or BS 6004 direct in the ground

4080 CABLE INSTALLATION INTO DUCTS:

Install cables into newly proved and cleaned duct.

Use lubricants, recommended by the cable manufacturer in writing, to assist drawing process

Flake cable if drums or reels are not suitable for jacking. At intermediate draw pits with exit duct more than 15 degrees off line of entry duct, flake cable before entering or provide comprehensive system of corner plates, roller and blocks

Use maximum practical size of turns when flaking and ensure direction is correct

Do not exceed manufacturer's installation tension on cable and ensure the pulling tension is taken on cable elements designed for that purpose, that is armour or conductor cores and not on other elements, such as plastic sheath or conductor insulation

Do not allow cables being pulled into ducts to twist. Use appropriate swivel between pulling bond and cable stocking or similar appliance

Bind trefoil groups of single core cables installed into a single duct at 1m intervals. Install earth or protective conductors into the same duct as the associated cable where practical, through manholes, draw pits and jointing chambers. Bind the two cables together. Pull all cables in one duct as a group. Ensure group does not twist or cross over

Report any damage to cable sheath during installation and carry out any instructed work to remedy the damage

Seal between cable and duct ends after cable installation. Ensure cable ends in jointing chambers are temporarily sealed where required

4090A CABLE INSTALLATION IN CONDUIT AND TRUNKING:

Install cables so that they are orderly and capable of being withdrawn. Arrange single core wiring generally using the loop-in method

Trunking

In vertical trunking provide pin racks at 3m intervals. Use ties at 2m intervals for all wires of the same circuit reference. Mark ties with circuit reference number at 10m intervals

Conduit

Provide cable clamps in conduit boxes at 10m intervals in vertical conduit

Allow for full range of movement at building construction movement joints. Make all joints to wiring at terminal blocks in conduit boxes

4110A CABLE SURFACE INSTALLATION:

Dress cables flat, free from twists, kinks and strain, and align parallel to building elements

When glands and clamps are not required, take sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection

4120A CABLE EMBEDDED INSTALLATION:

Dress cables flat, free from twists, kinks and strain, and align parallel to building elements

When glands and clamps are not required, take sheathing of cables into accessory boxes and equipment and protect against abrasion using grommets or similar sharp edge protection

Ensure plaster or screed over cable is a minimum of 12mm. Protect embedded cables with metal capping or PVC oval conduit

4140 CABLE INSTALLATION - FLEXIBLE CORDS:

Grip cords securely at connections

Where they do not form an integral part of the connected accessory or equipment, provide separate proprietary cord grips

4150A CABLE JOINTING AND TERMINATING GENERALLY:

Ensure all joints and terminations are made by appropriately qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and the jointing accessory manufacturer. Install cable glands in accordance with BS 6121-5

Cold pour resin and heat shrink joints

Cut all cable ends immediately prior to jointing or terminating. Seal cables left unconnected for more than 24 hours to prevent the ingress of moisture. Seal plastic sheathed cables using proprietary shrink on end caps. Seal lead sheathed cables by a plumbed dressed lead cap with an airspace to allow conductor movement

Strip cables to bring out the cores and expose conductors, for the minimum length required for connection, to leave no exposed length of conductor after termination. Ensure that strands are not damaged when stripping cable cores. Twist strands together. Do not reduce number of strands. Secure all strands at terminations

Clean armour thoroughly prior to jointing or terminating

At connections to equipment and switchgear without integral cable clamping terminals, use compression or solder type lugs for bolted terminal connections, of correct bore

Form all compression connections to components using tools that cannot be released unless the correct degree of compression has been achieved

Install and inspect compression and mechanical connectors on conductors in accordance with BS EN 60228 and BS 7609

Bolt core terminations with lugs to equipment using washers or proprietary shakeproof devices Do not bunch more than three cores at clamping terminals or bolted connections

Mark cable conductor phasing, or other core identification, at each end of all cables, and at all joints, maintaining consistency of marking with any existing system

Connect all cores, including multicore cable spare cores, at all joints and terminations. Bond any unused cores or multicore cables to earth at both ends, unless otherwise indicated

4170 CABLE JOINTING AND TERMINATING - ELASTOMER AND PLASTIC INSULATED CABLES:

Joint cables using glands of the type indicated, in accordance with the manufacturer's instructions. Use shrouds at all glands, unless otherwise instructed

At core connections to equipment without integral clamping terminals use compression lugs unless otherwise indicated

3.26 CABLES IN CONDUIT AND TRUNKING

Single core LSZH insulated only 450/750-volt grade cables having copper conductors of cross section as indicated on the drawings or accompanying schedules.

Ref - 6491B Cable (H07Z-R) LSZH (Low smoke Zero Halogen) manufactured to BS7211/BS EN 50525-3-41. The cable will be of the stranded plain annealed compacted circular copper conductor, low smoke and zero halogen (LSZH) outer sheath. 450/750 volts grade to BS7211/BS EN 50525-3-41. Acid gas emission to BS EN 60754, smoke emission to BS EN 61034 and flame propagation to BS EN 60332, low smoke and zero halogen (LSZH). BASEC/LPCB or HAR approved

Sizes of all cables in the installation to comply with IET Regulations governing current carrying capacity and voltage drop.

The minimum size of cable shall be 1.5mm² for lighting circuits and 2.5mm² for power circuits. The number of wires in each conduit is to comply with the current edition of IET Regulations BS7671

Cables to be coloured in accordance with IET Regulations or fitted with coloured sleeves only with the approval of the Consulting Engineer.

Cables shall be terminated at equipment positions, unless otherwise indicated, by means of either sweated lugs of appropriate size eyelet type cable termination or crimped type

termination of reputable manufacture. Shakeproof washers shall be used where electric motors are connected.

3.27 ARMOURED CABLES

Mains LSZH manufactured to BS6724. The cable features stranded plain annealed copper conductors, XLPE insulated, low smoke and zero halogen (LSZH) extruded bedding, galvanised steel wire armour, low smoke and zero halogen (LSZH) outer sheath. Black. 600/1000 volts grade to BS6724. Acid gas emission to BS EN 60754-1, smoke emission to BS EN 61034 and flame propagation to IEC 60332-1, IEC 60332-3, Category C; BS EN 60332, low smoke and zero halogen (LSZH). BASEC/LPCB or HAR approved.

They shall be c/w manufacturers recommended and approved indoor & outdoor type cable terminations to be manufactured in accordance with the relevant British Standard. Earth type rings shall be installed with each termination and bolted to the termination point accordingly accepting and extending the same size earth cable to the earth connection point within the equipment.

These cables are to be of grade, size and type as indicated on the drawings and/or in the associated schedules.

All main or sub-main feeder cables are to be routed in as neat and unobtrusive a manner as possible and shall not conflict with the various routes selected for heating pipes or other services. In this respect, the sub-contractor shall confer with the various other sub-contractors concerned in order to arrange for the installation of their respective plant and equipment to an orderly and approved plan.

The exact routes of all cables are to be agreed on site with the Consulting Engineer or his representative and no cables shall be placed on order until the precise route has been determined. No allowance will be made for expressed ignorance on this point, neither will straight through joints be permitted other than those necessary by manufacturer's limitations on length per cable drum for use of handling.

The sub-contractor shall provide all cable jacks, fair leads, cable stockings, hauling tackle and the like and shall be responsible for ensuring that these are maintained in a safe and serviceable condition at all times.

Where cables are to be buried in the open ground these are to be laid in a bed 75mm deep comprising sieved earth or sand from which all stones etc., have been removed and covered by a similar and equal depth of sieved stone-free bedding over the cable.

The electrical sub-contractor is to then supply and install interlocking cable protection tiles separately over each cable and the cable and the cable trench shall be of sufficient depth so that the apex of these tiles is not less than 450mm below ground level for all medium or low voltage cables and 900mm below ground for all H.T. cables.

Cables installed underground shall be marked at the end of every straight run or deviation there from by pre-cast concrete marker posts inscribed 'Electric Cable' and projecting not

less than 200mm above the finished ground level, or by similarity inscribed marker slabs not less than 450mm x 300mm x 75mm. All buried cable joints are to be similarly located.

Where cables are required to cross roads or pathways these shall be drawn through earthenware ducts provided for this purpose. The ends of all earthenware ducts are to be sealed after the cables have been drawn in.

Cables run in service ducts and other selected routes above ground level are to be supported by approved 'J' type cable hangers, single or multi-way perforated cable tray and saddles; or claw-type cable cleats, racked for multi-way use, as required.

Instructions as to the electrical sub-contractor's responsibility for excavation, reinstatement and supply of earthenware pipes will be given in the project specification.

All cables routed vertically or horizontally are to be supported, at spacing centres in accordance with IET Regulations BS7671 by means of claw-type cleats, or approved pattern cast saddles, or cable tray and saddles only. All cleats, saddles etc., shall give satisfactory support to cables in such a manner that no undue strain is put on the cable or sealing glands.

The internal radius of all bends made in cables shall be in accordance with IET Regulations BS7671

Unless otherwise specifically permitted by the Consulting Engineer, all cable routes are to be arranged so that they are kept at a minimum distance of 450mm from cables supplying Telecommunication services.

3.28 FP 200 CABLES

Where the installation is required to be carried out with MICC cables, these shall be provided with a LSZH sheath overall and complete with all accessories of approved design and recommended by the manufacturers.

Cable Specification: Enhanced Cable Fire Alarm Cable manufactured to British Standards BS5839 and BS7629. The cable will have plain annealed copper conductors, enhanced silicon rubber insulated, enhanced aluminium/polyester tape screen, tinned annealed copper earth wire, enhanced low smoke zero halogen outer sheath. Red. Manufactured to meet the Enhanced standard of BS5839-1 + A2: Clause 26.2e Enhanced and also the requirements of BS8434 - 2: 120 minutes and BS EN 50200 Class PH120. Fire resistant to BS7629-1; BS6387: clause 11 CWZ, halogen emissions to BS EN 60754 and low smoke standard BS EN 61034-2: BASEC/LPCB or HAR approved.

Single screw fixing clips will be permitted along concealed routes, but two screw fixing saddles or centre-screw spring fixing clips only are to be used for all surface wiring. Corrosion resistant round-headed screws not less than 20mm x 8 shall be employed. All wiring to be secured by the above described accessories at intervals not exceeding 500mm for vertical runs for all cables whose external diameter does not exceed 8mm. Cables exceeding this diameter shall be secured at distances prescribed in the IET Regulations BS7671

Cables shall be installed with a bend which has a radius less than six times the overall diameter of the cable and no such bend shall be put in any cable either before or during erection.

Cables installed either on the surface of or buried behind walls or ceilings shall be routed in straight vertical or horizontal routes, to an approved neat and orderly pattern. Cable runs are to be installed parallel or perpendicular to associated walls and ceilings and must not be installed diagonally across these areas.

LSF sheathing over the cables are to be colour coded according to the particular service they supply. The colours to be used to identify each specific service are as described elsewhere in this specification or indicated on the associated drawings or will be given to the sub-contractor on site by the Consulting Engineer.

Plastic cable clips for the installation of fire rated / enhanced cables not allowed.

3.29 XLPE INSULATED/ LSZH SHEATHING CABLES

The installation of cables shall be carried out in strict accordance with the appropriate regulations in the current edition of the Institution of Electrical Engineers Regulations for installation.

Twin & Earth type cable, 6242B LSZH cable for domestic wiring 300/500v rated, Plain annealed copper conductors with I: XLPE (Cross linked polyethylene) insulation and LSZH (Low smoke zero halogen) overall sheath.

Operating Temperature: Maximum 90°C, Minimum bending -15°C. Sheath Colour: White: Conductor identification: Brown, Blue and Bare (earth) Standards: Low smoke and HLC maximum 0.5% in accordance with BS EN 60754-1: Common test under fire conditions. Tests on gases evolved during combustion of materials from cables. Apparatus. BS EN 60754-1, BS EN 60754-2: Common test methods for cables under fire conditions. Tests on gases evolved during combustion of materials from cables, Procedures, determination of the amount of halogen acid has. BS EN 60332-3-10: Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables.

All XLPE Insulated/ LSZH sheathed cables shall be twin or three core with minimum 1.5mm² circuit protective conductor, single core cables shall not be permitted. Project specification shall state whether or not separate circuit protective conductors have to be installed.

The utmost care shall be taken during the installation of the cables to avoid damage to the sheathing.

Where cables enter metal switch or socket outlet boxes or fittings suitable rubber grommets shall be inserted in the entry holes.

In no case may more than two conductors be bunched at any one terminal point unless approval is obtained from the Consulting Engineer.

No intermediate joints shall be made in any cable between one definite terminal joint and another, but in certain circumstances permission will be granted for the use of junction boxes of a make and pattern approved by the Consulting Engineer.

Cable colours are to confirm with the appropriate regulations of the Institute of Electrical Engineers Regulations.

The spacing of cable clips and supports for horizontal and vertical runs are not to exceed the distances indicated in the IET Regulations BS7671

All cables shall be run so to be concealed wherever it is possible to do so by way of ceiling voids down partition cavity walls by recessing into brick walls. On brickwork the cables shall be mechanically protected by suitable conduit bushed at entry into ceiling void, with metal box for suitable fitting accessory.

The runs for all cables shall be carefully selected so that when installed the cables are not likely to be disrupted or damaged, the cables shall run straight and not diagonally and all drops to switches and accessories shall be vertical.

The cables shall be completely isolated from contact with heating pipes.

3.30 FLEXIBLE CABLES

Flexible cables shall have conductors of minimum size of 0.75mm².

Flexible cables shall be multi-core cables of circular form coloured white unless otherwise specified. Flexible cables to light fittings shall be heat resistant type silicone rubber or other approved equal.

Flexible cables shall have metallic protection where required by the Engineer, i.e. in places where cables are liable to mechanical damage, boilerhouses etc.

Flexible cables shall include, where necessary, a straining cord to ensure weight is not carried on the conductors in accordance with IET Regulations.

Flexible cables have circuit protective conductors of sufficient length to ensure that no undue stress is placed on the circuit protective conductor.

Flexible cables shall be in accordance with BS EN 50525

3.31 SPECIAL CABLE

Special cables, where specified, shall comply with the relevant standards and be as detailed in the project specification and/or working drawings issued for the contract.

Special cable, e.g. co-axial and telecommunication cables, shall be installed and protected generally in accordance with any relevant part of this specification and as detailed on the working drawings or supplementary specification issued with the contract.

3.32 SWITCHBOARDS AND PANELS

All switchgear on switchboards shall be metal clad, interlocked, totally enclosed and suitable for 4 wire 400/230 volt 50Hz supply.

Off loaded, dismantled and re-assembled where necessary by the electrical sub-contractor, who shall also include for any storage required.

Switchboards shall be either of the fuse switch or moulded case breaker type and shall be:

All moulded case breaker boards shall be cubicle type.

Assembled by a manufacturer, unless otherwise indicated in the project specification or with the written approval of the Engineer. All switchgear shall be of the same manufacture.

Neatly and symmetrically set out and connected with purpose made adaptors to trunking and bus-bar chambers so as to enclose all cables.

Supplied with a header trunking to run across the top of the distribution board to take all outgoing conduit and/or cables or as agreed with the Engineer.

Erected completely free of any rust or damage, and all such rust or damage incurred after erection must be made good by the electrical sub-contractor before the completion of the contract.

Erected in accordance with a block diagram which must be submitted to the Engineer for approval.

Fitted with identifying labels, secured by R.H. brass screws.

The electrical sub-contractor shall maintain full liaison with the Electricity Board to ensure that sufficient space be provided within or adjacent the intake switchboard for the Supply Authority's fused cut-out and/or metering panels.

Facilities shall be provided for current transformer chambers for metering purposes where required or as indicated on the working drawing. The transformer chambers shall be designed to provide reasonable and easy safe means of transformer replacement.

Where metering arrangements are not incorporated in the main intake panel, adequate space shall be made available for the Supply Authority's metering equipment. The electrical sub-contractor shall provide and install meter tails which shall be protected in steel conduit and/or trunking throughout their length and the cost shall be included in the tender. Where the metering arrangements are remote from the building suitable cables adequately protected shall be provided and installed and the cost included in the tender.

All switchgear glands and cable terminations shall be of the correct size for the specified cable and the responsibility will lie with the electrical sub-contractor for the provision of these items.

In certain cases the specified circuit cables may be oversized (being governed by voltage drop consideration) compared with the current to be carried, and attention is drawn to the necessity for ensuring that the switchgear glands, terminal etc. are of adequate size for the cable specified.

All switchboards shall have a fault rating equal to or above that of the incoming supply. Where circuit breakers are used for outgoing circuits then if the units are not so rated, fault current limiting H.R.C. fuses shall be used in series with the circuit breakers in order to achieve the required fault rating.

The full responsibility for ensuring that switchboards can be satisfactorily installed lies with the electrical sub-contractor. The electrical sub-contractor shall submit for approval drawings (scale 1:20) showing with details of cable entries before installation commences

Switchgear shall comply with the following:

Y71 LV SWITCHGEAR AND DISTRIBUTION BOARDS

2010A CUBICLE SWITCHBOARD - LV SWITCHGEAR AND CONTROLGEAR ASSEMBLY:

Standard - BS EN 61439-1

External design - Cubicle type assembly

Usage - Switchboard

Conditions of installation - Indoors

Electrical characteristics

Rated operational voltage 400V +10% -6%

Service conditions

Standard - BS EN 61439-1

Ambient air temperature and altitude as BS EN 61439

2020A FLOOR STANDING ASSEMBLY CONSTRUCTION:

Enclosure standard - BS EN 62208

Material of enclosure - Manufacturer's standard

Terminals for external conductors, main power circuits

Accommodate cross-sectional area of copper cables in accordance with BS EN 61439-1

Terminals for external conductor, control and auxiliary circuits

Terminal block. Mounting as manufacturer's standard

Size of neutrals on three phase supplies - Full sized

Degree of protection to BS EN 60529, IP31 for assembly

Protection against direct and indirect contact

Manufacturer's standard

Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage

Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings

Adjusting and re-setting of relays, releases and electronic devices

Replacement of fuselinks and indicating lamps

Fault location by voltage and current measuring

Accessibility for maintenance

Provide space between functional unit or group and adjacent functional units or groups

Provide retainable fastening means for parts likely to be removed for maintenance

Removable parts and withdrawable parts as manufacturer's standard. Internal separation - Form 4

Input voltage variations for electronic equipment supply - BS EN 61439

Supply frequency deviation - BS EN 61439

Mounting - Floor standing.

2030A ENCLOSURE FINISH:

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness

Finish - Manufacturer's standard

Colour - Manufacturer's standard colour

2060 SITE BUILT ASSEMBLIES:

Ensure that components of site assemblies are part of a proprietary system and type tested as appropriate

Install assemblies in accordance with manufacturer's drawings and instructions

2070 SITE MODIFICATION:

Do not make site alterations unless authorised. Where site modifications to assemblies are authorised make in accordance with manufacturer's certified drawings and instructions. Ensure that modifications made comply with type test certificate obtained for arrangement of components

2080A WALL MOUNTED, TOP ENTRY BATTERY CHARGER AND BATTERY UNIT:

Supply a unit for tripping

Input Supply - 230 V single phase 50 Hz

DC Output

Voltage 50 Volt -20% +10%

Operating temperature range 10°C to 45°C

Charger type - Thyristor or transistor

Battery type

Lead acid (sealed) or Nickel Cadmium (maintenance free)

Cubicle (sheet steel) - Wall mounted

Cable entry - Top

Finish - Manufacturer's standard

Colour - Manufacturer's standard

Ventilation - Natural

Facilities - MCB input protection; float charge

Battery over-discharge protection

Fuses for battery protection; MCB's for outgoing circuits; automatic selection of boost charge Meters

Battery voltage; charging current (dual scale for float and boost); output current

Lamp indications

Supply on; supply fail (monitor input terminals); floatcharge; boost charge; no charge (when supply is on); battery voltage low; battery voltage high
Alarms (connected to operate a relay with shrouded 230V3A a.c. or 0.5A d.c. N/C volt free contacts, closed on any alarm, for remote indication circuit)
Supply failed; no charge (when supply is on); battery voltage low; battery voltage high

2090B UTILISATION A, MCCB AIR BREAK CIRCUIT BREAKERS:

Provide circuit breakers in accordance with BS EN 60947
Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage
Standard - BS EN 60947-2
Details of equipment - Circuit breaker
Characteristics of circuit breakers
a.c. Interrupting medium - Air
Rated and limiting values for the main circuit
Rated voltage (Volts) - operational, 400
Rated frequency 50 Hertz
Circuit breaker Utilisation category - A
Enclosure degree of protection IP 31
Circuit breakers and switches
Provide manual closing air-break circuit breakers, (MCCB)
Closing mechanism
Independent manual spring operated
Provide automatic shutters to cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing
Provide a padlock to lock circuit breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing
Provide moulded case circuit breakers with provision for safe maintenance

2090D UTILISATION B, MCCB AIR BREAK CIRCUIT BREAKERS:

Provide circuit breakers in accordance with BS EN 60947. Ensure that uninterrupted current rating indicated applies when unit is enclosed and in operating environment at rated operational voltage
Standard - BS EN 60947-2
Details of equipment - Circuit breaker
Characteristics of circuit breakers
a.c. Interrupting medium - Air
Rated and limiting values for the main circuit
Rated voltage (Volts) - operational, 400
Rated frequency 50 Hertz
Circuit breaker Utilisation category - B
Enclosure degree of protection IP 31
Circuit breakers and switches
Provide manual closing air-break circuit breakers, (MCCB)
Closing mechanism
Independent manual spring operated
Provide automatic shutters to cover all live contacts when circuit breaker is isolated, withdrawn or removed from housing

Provide a padlock to lock circuit breaker in isolated/withdrawn position, and to lock automatic shutters covering live contacts when removed from housing
Provide moulded case circuit breakers with provision for safe maintenance

2100A SWITCH DISCONNECTORS:

Supply switch disconnectors in accordance with BS EN 60947
Standard - BS EN 60947-3
Details of equipment - Switch-disconnector
a.c. Interrupting medium - Air
Rated and limiting values for the main circuit
Rated voltage (Volts) 230/400
Rated frequency 50 Hertz
Utilisation category - AC 23A
Enclosure degree of protection IP 65
Fit each switch with facility to padlock in OFF position
Provide switches with auxiliary contacts as indicated
Where switches isolate final connections between a starter and its motor, fit one set of contacts to open starter coil circuit when switch is opened

2100B FUSE COMBINATION UNITS:

Supply fuse combination units in accordance with BS EN 60269 (BS 88)
Standard - BS EN 60947-3
Details of equipment - Fuse combination unit
a.c. Interrupting medium - Air
Rated and limiting values for the main circuit
Rated voltage (Volts) 230/400
Rated frequency 50 Hertz
Utilisation category - AC23A
Enclosure degree of protection IP 31
Fit removable neutral link in switches controlling circuits with neutral conductor
Fit solid links in isolating switches
Fit each switch with facility to padlock in OFF position
Ensure that withdrawable chassis isolating type switches are provided with fully shrouded fixed contacts or insulated coverplates, to prevent accidental contact with live parts
Ensure that switches in individual enclosures have an earth terminal, meet the degree of protection for the switchboard and have operating mechanisms interlinked with access door
Provide switches with auxiliary contacts as indicated
Where switches isolate final connections between a starter and its motor, fit one set of contacts to open starter coil circuit when switch is opened

2140 CURRENT TRANSFORMERS:

Comply with BS EN 61869-2 and BS EN 61869-5
Provide separate current transformers for each protection device and instrumentation.
Ensure current transformers provide appropriate accuracy and are compatible with over current factors, characteristics, performance and VA rating required for satisfactory operation of protection devices, instruments and meters indicated

Ensure that current transformers are capable of withstanding maximum short time withstand current of value and duration indicated for assembly
Provide test links in secondary connections of all current transformers to facilitate testing of instruments, meters and protection devices

2150A INSTRUMENTS AND METERS:

Standards

Comply with BS 89 and BS EN 60051-1 for voltmeters, ammeters, watt meters, frequency indicators and power factor indicators

Comply with BS 7856, BS EN 62053-11, BS EN 62053-22 or BS EN 62053-21 for kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters, and BS EN 62053-23 for KVAhr meters

Protect wiring to voltmeters by separate fuses

Protect potential coils of watt meters, frequency indicators, power factor indicators and kWh meters, kVA and kW maximum demand meters and polyphase reactive kVA meters by separate fuses

Supply instruments and meters suitable for flush mounting and type, size and accuracy as indicated

Ensure that indicating scales for all instruments comply with BS 3693

Supply so that normal indication is 50% to 75% of full scale deflection

Completely segregate all instruments in instrument compartments. Panel mount meters on front of instrument compartment

2170A INDICATOR LIGHTS:

Supply lamps of same type throughout. Provide indicator lamps with lamp test facility

Lamps

Supply interchangeable indicators for respective units. Protect wiring to indicator lamp units by separate cartridge fuses

Lens Colour in accordance with BS EN 60073

2190A FRAMEWORK:

Construct framework for supporting electrical equipment from mild steel plate and strip, cold and hot rolled steel sections or slotted angles, in accordance with BS EN 10210 respectively

Comply with BS EN 1011-2 for metal arc welding

Finish

Frameworks mounted inside building manufacturer's standard finish

Frameworks mounted outside building hot dip galvanized to BS EN ISO 1461

Supply cadmium or zinc electroplated bolts, nuts, washers and screws

2200A FUSES:

Supply cartridge fuse links including fuse carrier, bases and associated components that comply with BS EN 60269 (BS 88), fusing factor category gG, unless otherwise indicated

2220A CONSUMER UNITS:

Comply with BS EN 60529, IP 31

Provide fuses or miniature circuit-breakers and means of isolation

2230A MINIATURE CIRCUIT BREAKERS:

Standard - BS EN 60898-1

Supply miniature circuit-breakers with voltage and current ratings, type according to instantaneous tripping current, energy limiting class, category of duty and frequency in accordance with BS EN 60898-1

2240A RESIDUAL CURRENT DEVICE:

Comply with BS EN 61008

Supply residual current devices (RCCDs) with rated voltage, rated current, rated tripping current, rated tripping time and rated breaking capacity as indicated

DC component

Ensure dc component does not affect operation

Overcurrent protection

Fit RCDs with integral overcurrent protection

2245 COMBINED RESIDUAL CURRENT/OVER CURRENT OPERATED CIRCUIT BREAKERS:

Supply combined residual current/over current operated circuit breakers (RCBOs) in accordance with BS EN 61009

2250 CABLE TERMINATIONS:

Ensure that switchgear and distribution boards are provided with facilities to terminate size, number and type of cable indicated. Where necessary use fabricated steel extension boxes for glanding large and multiple cables

Provide non-ferrous metal glanding plates for single core cable terminations

3010 FIXING:

Fix all equipment independently of wiring system. Use cadmium or zinc electroplated bolts, nuts, washers and screws

3020 MOUNTING HEIGHT:

Mount single items of equipment 1450mm above finished floor level to centre of equipment, unless otherwise indicated

Arrange groups of equipment, other than floor mounted assemblies, so that all parts of equipment requiring access for operation or maintenance are at least 500mm and no more than 2000mm above finished floor level, unless otherwise indicated

3030 ACCESS:

Ensure that clearance in front of switchgear and controlgear is not less than 1m, or as indicated

3040A MARKING AND DRAWING:

Number terminals, cables and component parts to correspond with manufacturer's certified drawings

3050 CABLE TERMINATIONS:

Terminate paper-insulated cable by means of switchboard manufacturer's standard compound filled cable boxes

Terminate PVC SWA PVC and MICS cables inside enclosure by securing cables to switchboard with glanding plates or glanding brackets; and outside enclosure with glanding plates or fabricated steel extension boxes

3060A INSTALLATION AND COMMISSIONING:

Install and commission switchgear and control gear in accordance with the appropriate standard and the manufacturer's recommendations. Include CT Polarity check in commission tests

3.33 DISTRIBUTION GEAR

In each case of lighting, small power and similar circuits in distribution boards, these are to be fitted complete with fuses or miniature circuit breaker units, as detailed on the drawings or given in the schedule or in accordance with the maximum current loading on each particular circuit.

Miniature circuit breakers shall be thermal magnetic type to BS EN 60898. Tripping of the triple pole breaker shall isolate simultaneously all poles. HRC fuses are to be to BS 88.

All spare ways are to be fully equipped with MCB units or HRC bases, fuse units and carriers complete, as appropriate, and rated at the maximum circuit loadings. Distribution boards to be supplied with 50% spare HRC fuses.

Distribution boards are to be positioned as approximately shown on the drawings.

Distribution boards shall be fitted with insulating shields to prevent accidental contact and barrier shall be provided between each phase and between phase(s) and neutral.

Distribution boards shall be fitted with locks where specified in the project specification, and in such cases two keys shall be supplied.

Distribution boards shall be fitted at the height of not more than 2000mm to the top unless otherwise approved by the Engineer.

Distribution boards shall be fitted with charts mounted on the inside of the unit which shall be type written and placed in transparent non-flammable pockets securely screwed to the door

Distribution boards shall be fitted with identifying labels secured by R.H. brass screws.

All switches and Distribution boards shall contain neutral blocks with outgoing cable connections equal to the number of circuits. An earth bar/connection block shall be provided with outgoing cable connections equal to the number of circuits and shields between neutral and earth.

All conduits to be coupled to the distribution boards or adaptable boxes by means of smooth bore male brass bushes and conduit coupling pieces.

All section and distribution boards are to be of the flush or surface type as indicated, and of steel clad 'clean line' pattern with internal holes for screw fixings. Where the wiring system to any surface distribution board sunk behind plaster finished walls etc., the conduits or cables are to be terminated into a flush fixed adaptable conduit box (or short length of cable trunking). A slot of ample dimensions is to be cut in the back of these distribution boards to allow the passage of wiring to and from the 'Board'. The conduit system and distribution boards are to be adequately bonded to ensure earth continuity.

Spare conduits shall be installed from all flush boards or the flush boxes referred to above, running up to the nearest ceiling void or other convenient access point and down into the service duct or basement where these exist. The number of spare conduits allowed in each particular distribution board shall be at least equal to half the number of spare circuits in the board, and all boards shall have at least one 25mm diameter spare conduit running in an upward and downward direction from the board into these service or inter-floor spaces; other spare conduits may be 20mm diameter. These conduit ends are to be fitted with couplings and brass end stops.

Distribution boards for special duties such as mixed current rating circuit ways or split bus-bars to accommodate two supply sources within a common case etc., are specifically detailed as such in the appropriate schedules accompanying this specification. The design of these 'special' dis-boards is to have the prior approval of the Consulting Engineer and these, or any necessary modification to standard dis-boards, shall be undertaken by the manufacturer.

2210A DISTRIBUTION BOARDS:

Comply with BS EN 61439-3 (basic requirements) as appropriate

Make internal separation Form 1 unless otherwise indicated. Make fuseboards fully shrouded. Fit each distribution board with an isolating switch.

Install busbars in same position relative to their fuse carriers or miniature circuit-breakers (MCBs) for each pole

In TPN distribution boards supply neutral busbars with one outgoing terminal for each outgoing circuit

Provide a multi-terminal earthing bar for circuit protective conductors for both insulated and metal-cased boards, with one terminal for each outgoing circuit

Connect directly to earthing terminal without dependence on exposed conductive parts of enclosure

Identify each fuseway and MCB way by numbering. Identify each terminal on neutral busbar and earthing bar with its respective fuseway or MCB way

Where specific ratings are indicated incorporate fuses or MCBs, otherwise leave ways blank for future additions

Enclosures finish

Finish - Manufacturer's standard

Colour - Manufacturer's standard colour

3.34 CONTACTOR AND STARTERS

Y72 CONTACTORS AND STARTERS

1000 GENERAL

1010A 3 PHASE SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for 3 phase power supply to BS EN 60038

1010B SINGLE PHASE ELECTRICAL SUPPLY:

Ensure all electrical equipment supplied and installed is suitable for single phase power supply to BS EN 60038

1020A MANUFACTURER FITTED SURGE SUPPRESSORS:

Supply surge suppressors to star connected motors and to all motors subject to star-delta starting to limit peak voltage to 1200 volts. Fitted by manufacturer

1020B INSTALLER FITTED SURGE SUPPRESSORS:

Supply surge suppressors to star connected motors and to all motors subject to star-delta starting to limit peak voltage to 1200 volts. Fitted by installer

2010A CONTROLGEAR ASSEMBLY:

Standard - BS EN 61439-1 and BS EN 61439-2

External design - Cubicle type assembly

Usage - Control panel, motor control centre or single starter enclosure

Conditions of installation - Indoors

Electrical characteristics

Rated operational voltage, 400 V. Rated short-time withstand current, 20 times rated current.

Service conditions - Ambient air temperature and altitude as BS EN 61439

2020A ASSEMBLY CONSTRUCTION:

Enclosure standard - BS EN 62208

Material of enclosure - Manufacturer's standard

Terminals for external conductors, main power circuits

Accommodate cross-sectional area of copper cables in accordance with BS EN 61439-1, Appendix A

Terminals for external conductor, control and auxiliary circuits

Terminal block. Mounting - top hat rails (35mm) to DET-STAN 59-40 Part 1

Size of neutrals on three phase supplies

Full current-carrying capacity of phase conductor

Degree of protection to BS EN 60529

IP 31 for units installed inside buildings excluding boiler rooms and pump rooms

IP 55 for units installed in boiler rooms, pump rooms and outside buildings

Protection against direct and indirect contact as Manufacturer's standard

Accessibility for inspection

Arrange for following operations to be performed when assembly is in service and under voltage

Visual inspection of switching devices and other apparatus; settings and indicators of relays and releases; conductor connections and markings

Adjusting and re-setting of relays, releases and electronic devices

Replacement of fuselinks and indicating lamps. Fault location by voltage and current measuring

Accessibility for maintenance

Provide space between functional unit or group and adjacent functional units or groups.

Provide retainable fastening means for parts likely to be removed for maintenance

Use barrier protected sub-sections for each functional unit or group

Use compartments for each functional unit or group

Removable parts and withdrawable parts

Degree of protection of assembly after removal or withdrawal of part as manufacturer's standard

Internal separation - Manufacturer's standard

Input voltage variations for electronic equipment supply - BS EN 61439, Section 7.9.1

Supply frequency deviation - BS EN 61439, Section 7.9.4

Mounting - Floor standing or wall mounted

2030A ENCLOSURE FINISH:

Apply high standard finish to enclosure and supporting metalwork. Degrease metal and remove rust prior to applying finish

Comply with paint manufacturer's recommendations regarding preparation, stoving times, temperatures, mixing of finishes, application and coat thickness

Finish - Manufacturer's standard

Colour - Manufacturer's standard colour

2050B UNINTERRUPTED LV CONTACTORS AND MOTOR STARTERS:

Standard - BS EN 60947-4-1 or BS EN 60947-4-2

Type of equipment - A.c. mechanical contactor

Interrupting medium air

Operating condition

Method of operation - Electromagnetic

Method of control - Automatic

Rated and limiting values for the main circuit

Rated voltage (Volts) - Operational, 400

Rated duty - Uninterrupted

Operational performance

One rotation direction, with motor stopping between operations

Control circuits

Electrical - ac; rated frequency (Hertz), 50; rated voltage (Volts), 230

Co-ordination with short-circuit protective devices - Type1

Enclosure degree of protection to BS EN 60529, IP 31

Minimum mechanical and electrical endurance

Mechanical 0.3 million; electrical 15,000

Provide mechanical and electrical interlocks to prevent simultaneous closure of paired contactors

2050C CONTINUOUS LV CONTACTORS AND MOTOR STARTERS:

Standard - BS EN 60947-4-1 or BS EN 60947-4-2

Type of equipment - A.c. mechanical contactor

Interrupting medium air

Operating condition

Method of operation - Electromagnetic

Method of control - Automatic

Rated and limiting values for the main circuit

Rated voltage (Volts) - Operational, 400

Rated duty - Continuous

Operational performance

One rotation direction, with motor stopping between operations

Control circuits

Electrical - ac; rated frequency (Hertz), 50; rated voltage (Volts), 230

Co-ordination with short-circuit protective devices - Type1

Enclosure degree of protection to BS EN 60529, IP 31

Minimum mechanical and electrical endurance

Mechanical 0.3 million; electrical 15,000

Provide mechanical and electrical interlocks to prevent simultaneous closure of paired contactors

2260A STARTER AND CONTROL PANEL INTERNAL WIRING:

Standard - BS 6231

Wiring coding - Random colours and CPC green/yellow

Control wiring. Segregate control wiring from power circuits

Contain control wiring in ventilated plastic trunking. Identify each end of each wire with a unique number

Power wiring

Take account of thermal effects of grouping when routing power wiring. Identify each end of each wire with a unique number

3010 INSTALLATION:

Install control panels, motor control centres, contactors and starters in accordance with BS EN 60947 and manufacturer's recommendations

3.35 MOTOR TERMINATIONS

Final connections to electric motors or similar appliances rated at one-half horse power or less are to terminate in a single or three-phase shuttered industrial pattern socket outlet. Where these sockets are employed, they may be considered to replace isolating switches called for with regard to all motor installations. The wiring from this socket is to be via a solid pin plug and is to be in metallic flexible armoured cable terminating in a lug grip gland.

Where the wiring system to the electric motors rated above this value is PVC in conduit, then the final connection is to be galvanised flexible metallic conduit, coupled to the solid conduit by means of an approved conduit union. Earthing arrangements shall be as described in clause 3.7 for all motors up to and including 7.5KW. For all motors exceeding this rating, both flexible cable and flexible conduit arrangements are to be supplemented for earthing purposes by a length of flat copper tape of adequate capacity, but not less than 50mm² clamped to the solid conduit system and bolted to the motor frame.

MICC cable connections to motors are to be equipped with glands, as referred elsewhere in this specification, and the cable is to be formed into a small neat loop as recommended by the manufacturers, prior to the gland fixing in the motor terminal box.

Unless otherwise stated, the electrical sub-contractor is to supply and install separate isolating switches, of appropriate rating, adjacent to every motor installation and install isolators in all instances where these are stated to be supplied by others.

HRC fuses supplied for the direct protection of electrical motors shall be of the 'motor circuit' pattern. The various ratings given by this manufacturer against specific horse-power ratings shall be strictly complied with.

3.36 LABELLING

All distribution switchgear or fusegear or other control equipment and all main or sub-main cables are to be clearly labelled.

All labels are to be secured either by brass round head screws fixed in tapped holes or fixed washers and nuts, to facilitate their removal and replacement.

Labels are to indicate the descriptions and/or the duty of the item so labelled, the equipment or area served, any identity reference letters and/or numbers, phase connections, cable sizes etc., as appropriate and as later more specifically directed by the Consulting Engineer.

Any items of equipment supplied by more than one phase to bear the label 'WARNING 400 VOLTS' marked clearly on the outside of the case by means of black letters on white taffolyte plate, or by means of a separate internal plate for ganged switched units having circuits supplied off separate phases.

All distribution boards are to be provided with a panel on the inside of the board cases for numbering and describing of the various local outgoing circuits. This is to be completed either typed or in clear black printing ink or similar permanent marking.

2010A LABELS AND NOTICES:

Apply identification labels and notices in accordance with BS 7671 (IET Wiring Regulations), section 514 to all electrical cables plant and equipment including components of mechanical systems

Identification of protective devices

Diagrams, charts or tables to comply with Clauses 514.9 and 560.7.9

Warning notices, voltages in excess of 250 volts

Periodic inspection and test notices

Residual current device notices

Earth electrode safety electrical connection label

Bonding conductor connector point to extraneous conductive parts label

Earth free local equipotential bonding areas warning notice

Electrical separation areas warning notice

Outdoor equipment socket outlet notice

2020A MATERIALS:

Use materials for labels and notices with a predicted life equal to or greater than the design life of the electrical cables, plant, equipment or installation to which it refers

External

Signwritten, or stencil in paint compatible with surface. Colour - Background, plant standard finish

Lettering, white

Internal

Engraved thermosetting plastic laminate

Colour - Background, white or red. Lettering, red or white

2030A FIXING - INTERNAL:

Fix labels and notices using materials compatible with label or notice and surface to which it is fixed by screws into tapped hole or bolted complete with washer nut and locking device

2040A ARRANGEMENT:

Obtain approval prior to manufacture, with regard to style, colour, lettering, size and position of all labels and notices

Provide sample showing style, colour, lettering and size, for approval

2050A LETTERING AND SIZE OF LABELS AND NOTICES:

Ensure that all lettering and symbols comply with the requirements laid out in BS ISO 3864-1 for height of lettering where not otherwise indicated

Ensure labels and notices of adequate size for the lettering required, and allow a minimum margin around all lettering of one line space vertically and two letter spacing horizontally

Font - Helvetica Medium

Size - BS ISO 3864-1 or 5mm minimum high letters

2060A CONDUCTOR ARRANGEMENT:

Arrange circuit polarity so that phases read in phase rotation order followed by the neutral, if any, from top to bottom in horizontal conductor layouts and left to right in vertical conductor layouts. Ensure flat horizontal arrays have leading phase to the left and neutral to the right from left to right when viewed from supply point. Arrange phase or live pole of two wire apparatus at top or left hand and neutral and earth both at bottom or right hand side. In all cases, ensure conductor arrangements defined are when viewed from front face of all equipment and terminating facilities. Apply identification markers in accordance with BS 7671 (IET Wiring Regulations), section 514 to all conductor termination points

2070A SAFETY SIGNS:

Label all electrical plant and equipment using safety sign 8.A.0044 of BS EN ISO 7010 where voltages above ELV exist. Provide supplementary or text signs complying with BS EN ISO 7010 with each safety sign 8.A.0044 as indicated

Label all electrical plant and equipment with the labels specified in the appropriate British Standards for that plant or equipment

Identify each substation and main switchroom with safety sign 8.A.0044 to BS EN ISO 7010 for any fire extinguishing system and notice giving details of, name of the substation or switchroom

The presence of Medium and Low Voltages. Administrative instructions for access

Location and method of contacting controlling authority

Actions to be taken in an emergency

2080A PLANT AND EQUIPMENT LABELS:

Fit labels on all items of plant, equipment, switches, etc., include the following information: service controlled, circuit reference, voltage, type of supply and phase etc., circuit protection type and rating

2085 GRAPHICAL SYMBOLS FOR USE ON EQUIPMENT IN ACCORDANCE WITH BS EN 80416:

Graphical symbols for use on equipment to be created and applied in accordance with BS EN 80416-1, BS EN 80416-2, BS EN 80416-3

2090 MAINTENANCE NOTICES:

Fix notices giving warning of, and instructions on, any special maintenance procedures to plant and equipment

2100 COLOUR CORRECTED LIGHT FITTINGS:

Fix a warning or identification disc to light fittings containing colour corrected fluorescent tubes or other colour corrected light sources to ensure that maintenance staff install the correct lamps

2110A MOTORS AND STARTERS LABELS:

Fit identification labels to all motors, starters and starter panels. Ensure positive identification of respective motors and starters. Provide motors with non-corrodible labels attached adjacent to each bearing giving details of the lubricant to be used. Mark direction of normal rotation on motor casing. Provide labels to identify motor equipment fitted with surge suppressors and thermistors stating that insulation test voltages must not be applied to thermistors and thermistor control units

Ensure labelling is compatible with schematic and wiring diagrams, and complies with BS EN 60034-8

2120A LABELLED ACCESSORY PLATES - ENGRAVED:

Label accessory plates, including lighting switches, socket outlets and connection units to indicate their use. Label by engraving, lettering 6mm high colour red.

2130A SWITCHGEAR:

Fit labels on switchgear as required by BS EN 61439 to indicate duty of unit, its voltage, phase and current rating, protective device rating size of conductor involved, and all other necessary details.

Use an agreed serial coding system, provide at the switch a key to the coding system.

2140 DISTRIBUTION BOARDS:

On each distribution board identify every outgoing way with a renewable circuit chart in a transparent plastic envelope permanently fitted inside distribution board cover

Clearly indicate in typed script, circuit identification number, cable size, fuse or circuit breaker rating and a description of item supplied and area supplied by circuit

2150A SCHEMATIC DIAGRAMS:

Provide a purpose made schematic diagram permanently fixed showing the connections of the equipment and plant

Locations and materials as indicated in contract preliminaries

2160A SPECIAL PURPOSE EARTHING:

Fit labels to special purpose earthing conductors and connection points, describing their purposes and any instructions necessary for their operation and maintenance

IT equipment "Clean Earths"

Telecommunications functional earths as BS 6701

2170A INDICATOR LAMPS AND PUSH BUTTONS FOR POWER SYSTEMS:

Use indicator lamp and push button colours in accordance with BS EN 60073

Indicator lamp

Red, danger or alarm; yellow, caution; green, safety

Push buttons

Red, emergency action; red, stop or off; yellow, intervention; green, start or on

Illuminated push buttons - Type a

2180A CONDUIT AND TRUNKING COLOUR CODING:

In areas of mechanical plant or voids accommodating mechanical services, or where otherwise indicated, identify electrical conduits and ducts in accordance with BS 1710. Apply colour orange to BS 4800 by painting on service as a band over 150mm or applying an adhesive tape type wrap around services over a length of 150mm

Place identification colours at bulkheads, wall penetrations and any other place where identification is necessary

2190A CABLE IDENTIFICATION:

Provide all cables, other than final sub-circuit wiring enclosed in conduits or trunking, with labels fixed at each end of cable either side of wall and floor penetrations at approximately 12m intervals at convenient inspection points by means of non-releasable plastic straps, minimum width 4mm

Ensure labels show the reference number of cable

2200A TERMINAL MARKING AND CONDUCTOR IDENTIFICATION:

Provide for switchgear and control gear elements whose terminals are marked in accordance with BS 5472 (EN 50005) and BS 6272 (EN 50042). Use a unique reference to identify each element in the switchgear or control gear. Mark on or adjacent to each element its reference. Identify each terminal for connection to external wiring or cabling using a reference system complying with BS EN 60445 based on the element reference and the appropriate element terminal reference. Adjacent to terminals

Use lettered or numbered ferrules or sleeves to BS 3858 to mark each auxiliary conductor or control cable core with the identity of the terminal to which it is connected and the reference of plant or equipment to which it is connected and the identity of the terminal at the remote end

Ensure that main circuit conductors are identified in accordance with BS 7671 (IET Wiring Regulations) section 514. Ensure that all identification of terminals and conductors is recorded and included on record drawings and in operation and maintenance documentation

2210A UNDERGROUND CABLE IDENTIFICATION:

Identify external underground cable routes by means of approved markers along their length at distances not exceeding 50m and where a change of direction occurs on such routes. Provide cables markers with a brass plate or impress concrete to clearly indicate the reference of group of cables or reference number of cable and operating voltage of cable. Provide key to any reference system used at switchgear. Mark and protect direct buried cables with plastic tape yellow printed black "DANGER ELECTRIC CABLES" elsewhere

2220A CABLE CONDUCTOR COLOUR CODING:

Identify cable conductors in accordance with BS 7671 (IET Wiring Regulations) section 514 and Appendix 7, note that a lighting sub-circuit switch wire is a phase conductor in a single phase circuit

2230 CABLE JOINTING AND TERMINATION:

Connect all cables in the installation so that the correct sequence of phase rotation is maintained throughout. Where straight through joints are approved joint medium voltage conductors as they lie, ensuring their complete length is phased out on completion. Ensure connections at terminations of MV cables are made in the correct phase rotation and ensure cable conductor termination marking if any, complies with this phase sequence

Where straight through joints are approved on low voltage cables, whether power cables or control or auxiliary cables, joint conductors strictly in accordance with their colour or numeric coding. Where such joints are approved on mineral insulated or other non-coded conductor cables, identify each core at the joint and make the joint core to core

2240A CABLE SHEATH IDENTIFICATION - INTERNAL:

Use to identify coloured cables sheaths for various services as follows:

- Fire alarm, red
- Clock circuits, brown
- Telecommunications, grey
- Data as system suppliers requirements
- Control, black

- LV, black
- LV mineral insulated, orange
- MV red
- Code cables for various services using alpha numeric symbols as follows:
- Code letters preceding cable reference
- Fire alarm, FA
- Clock, CL
- Telecommunications, T
- Data, D
- Control, C
- Low voltage, LV
- Extra low voltage, ELV
- LV Essential circuits EM
- Medium voltage, HV

2250A CABLE SHEATH IDENTIFICATION - EXTERNAL:

Identify cable sheaths for various services in accordance with NJUG Guidelines on the Positioning and Colour Coding of Utilities' Apparatus, as follows:

MV Red

LV Black

Telecommunications and data, Grey

2250B CABLE SHEATH IDENTIFICATION - EXTERNAL, SCOTLAND:

Identify cable sheaths for various services in accordance with NJUG Guidelines on the Positioning and Colour Coding of Utilities' Apparatus, as follows.:

MV Red

LV Purple

Telecommunications and data, Grey

2260A ADDITIONAL SAFETY SIGNS:

Provide at locations shown or as appropriate safety signs to BS ISO 3864-1

Application

For main switch and electrical plant room access doors

BS EN ISO 7010, complete with supplementary signs as shown

6.C.0019. 6.A.002 with supplementary sign "Authorised persons only"

7.A.022

Application

For use with permit to work systems, BS EN ISO 7010, complete with supplementary signs as shown

6.C.0021. Printed on rigid plastic, with hanging loop, with supplementary wording "Do not operate. Work in progress"

Application

For use at each emergency stop

BS EN ISO 7010, complete with supplementary signs as shown. 9.B.0097

With supplementary sign "Emergency stop push-button"

3.37 TESTING AT ELECTRICAL SUB-CONTRACTORS WORKS

The Consulting Engineer or their duly appointed representative shall have access at all reasonable times to such parts of the electrical sub-contractor's works, as may be necessary for the purpose of inspection, examining the testing and materials workmanship and performance of plant.

Except where otherwise provided in the contract, the electrical sub-contractor shall provide all labour, materials, power, fuel stores, apparatus and properly calibrated and certified instructions for carrying out necessary tests at his own or his sub-contractor's works.

The electrical sub-contractor shall give the Consulting Engineer written notice when any portion of the plant is ready for test, and if the Engineers do not themselves or through their representative attend to witness the test within seven days from the receipt by them of such notice, then the electrical sub-contractor may proceed with the tests, duly forwarding to the Consulting Engineer certified copies of the results obtained. In such a case, the test shall be deemed to have been made in the Consulting Engineer's presence.

3.38 TESTING & COMMISSIONING OF ELECTRICAL SERVICES

The installation on completion in whole or part, as required, shall be tested by the electrical sub-contractor in accordance with BS7671 IET Regulations. Test shall be carried out in sequence as indicated in these Regulations. These tests must be witnessed by the Consulting Engineer or his accredited representative. In order to avoid the duplication of testing, the sub-contractor may apply to the Consulting Engineer for permission to conduct these tests concurrently with any testing required by the Local Supply Authority.

The sub-contractor must give at least fourteen days notice to the Consulting Engineer for the proposed day of carrying out these tests.

The testing of the installation shall comply in all respects with the full requirements of the IEE Regulations and shall be carried out wholly or in part at the discretion of the Consulting Engineer or the Employer.

These test reports are to be signed by the sub-contractor's site representative and copies forwarded monthly to the Consulting Engineer's site representative for record.

The sub-contractor shall provide all equipment and associated apparatus, cabling and labour necessary for testing purposes and complete the prescribed 'Completion Certificate' and 'Inspection Certificate' as detailed in the IET Regulations, which shall be forwarded in triplicate to the Consulting Engineer, together with an equal number of copies of the test results upon which the certificate information is based.

The sub-contractor is to include for any out-of-normal working hours, time that may be necessary for the testing of various services due to phased take-over of the building projects.

Y81 TESTING AND COMMISSIONING OF ELECTRICAL SERVICES

1000 GENERAL

2010A INCORPORATED EQUIPMENT CHARACTERISTICS:

Obtain and use information from manufacturers of equipment provided
Use information provided, for equipment supplied by others and incorporated into installation

2020A PROSPECTIVE SHORT CIRCUIT CURRENT:

Determine values of IP by measurement, unless other means are indicated. Determine IP at all necessary points within installation to confirm correct equipment selections
Obtain from supply undertaker written confirmation of maximum and minimum values of IP at origin of installation. Adjust subsequent measured values of IP accordingly

2030A INITIAL VERIFICATION:

Carry out detailed inspection to verify the requirements of BS 7671, Section 611 in the order given in clause 611.3

2040A TEST EQUIPMENT AND CONSUMABLES:

Provide test equipment and consumables to complete tests satisfactorily and to retest any failed installations following corrective measures
Test equipment quality assurance requirements to BS EN ISO 10012

2050A TESTING:

Carry out in the same order as published the tests required by BS 7671, Section 612 for New Installation or Altered or Added Installation as appropriate

2070A EARTH FAULT LOOP IMPEDANCE:

Use 25 A test current. Measure and record source impedance (ZE)
If alternative LV supply arrangements are available, measure ZS when using supply with highest impedance
Measure ZS with main equipotential bonding conductors connected. Do not summate values of several parts of each loop

2080 SETTINGS AND ADJUSTMENTS:

Confirm characteristics and settings of protective devices are within maximum and minimum specified tripping times. Check correct operation of devices. Confirm interlocks and sequences operate safely and as indicated

2120E EMERGENCY LIGHTING INSTALLATIONS:

Carry out site testing and inspection and provide test certificates for emergency lighting installations in accordance with BS EN 50172

2130 CALIBRATION:

Provide current certificates of calibration for all instruments used during test procedures
Record particular instrument identity on record sheets

2140A CERTIFICATION AND REPORTING:

Complete and hand over to the Client a Completion and Inspection Certificate to BS 7671 Appendix 6 for New Installation or Altered or Added Installation as appropriate

2150A INSTALLATION CERTIFICATES:

Provide installation certificates for electrical installations in accordance with BS 7671 (IET Regulations)

Record details of departures from BS 7671 (IET Wiring Regulations) on certificate

Provide copies of calculations justifying departure from BS 7671 (IET Wiring Regulations) and attach to certificates

2160 RECORDS:

Record all results and instrument readings on approved Record Sheets and hand over to the client two copies for each inspection and test

Hand over copies of complete Record Sheets

Provide copies of Record Sheets

3010 CONDUCTIVE PARTS:

Test conductive parts simultaneously accessible with exposed conductive parts of extraneous conductive parts. Establish that they are either not an extraneous conductive part, or that they are reliably connected by metal to main equipotential bonding. Confirm conductive parts which are not extraneous conductive parts are separated from earth by an impedance greater than 50,000 ohms. Confirm other conductive parts are bonded to equipotential zone earthbar by an impedance not exceeding 0.1 ohms

3040A LV BURIED CABLES:

Test continuity and insulation of buried cables immediately after back-filling. Test continuity and insulation of buried cables prior to handover

3.39 APPLICATION FORMS AND TEST NOTICES

The electrical sub-contractor shall ensure that all formalities in connection with application forms, test notices, agreement forms and completion forms are complied with, and any documents requiring signature are forwarded to the Consulting Engineer in ample time.

3.40 INSTRUCTIONS ON OPERATION

The electrical sub-contractor shall instruct the person in charge of the premises or an appointed representative in the use of the electrical installation. This shall include the following:

- a) Use of switchgear and replacement fuses
- b) Operation of local switches
- c) Operation of systems provided by the electrical sub-contractor, e.g. security systems, fire alarms, clock systems, and Data Systems

- d) Dismantling and re-assembly of any applicable lighting fittings for re-lamping and cleaning
- e) Where specialist systems are involved, the electrical sub-contractor shall make arrangements for a demonstration by the specialists, i.e. Data Systems, PA and T.V. installations, induction loop systems etc., and instruction in the use of the system

3.41 COMPLETION PROCEDURE

Minimum of two weeks prior to the handover of the installation works the electrical sub-contractor shall provide the Consulting Engineer's representative with a Completion Certificate (in triplicate) certifying the overall completion in accordance with the Conditions of Contract, Supplementary Specification, drawings and any variation instructions, together with draft 'As fitted' drawings for approval. Completed record drawings and operating manuals shall be available at handover.

Immediately the electrical sub-contractor effectively completes the installation, or any agreed section of the installation which shall be immediately prior to the Main Contractor's handover, he shall advise the Consulting Engineer, in writing, to this effect and provide a list of outstanding matters, together with record documents comprising:

- Record Drawings
- Room by room List of Light Fittings
- Operational Manuals

The Consulting Engineer's representative will then make a thorough examination of the installation, and make known to the electrical sub-contractor for remedial action any defects which become apparent by the inspection. The electrical sub-contractor shall also be responsible for any latent defects which become apparent during the maintenance and/or guarantee period.

The electrical sub-contractor shall commission all sections of the electrical installation, fully adjust, regulate and test the installation and submit detailed test results to the Consulting Engineer.

The Completion Certificates called for shall be available by handover.

SECTION FOUR - TENDER SUMMARY

4.1 TENDER BREAKDOWN

The sub-contractor is to state below lump sum figures for each section of the works inclusive of 2½% main contractor's discount.

1.	Removal of Existing	£
2.	LV Distribution	£
3.	Containment Installations	£
4.	Mains Equipotential & Supplementary Bonding	£
5.	General Lighting Installation	£
6.	Emergency Lighting Installation	£
7.	Small Power Installation	£
8.	Wiring for mechanical services	£
9.	Fire Alarm Installation	£
10.	Intruder Alarm Installation	£
11.	Access Control Installation	£
12.	Structured Cabling Provisions and wiring	£
13.	Testing & Commissioning	£
14.	As Fitted Drawings & O+M Manuals	£
15.	Any other item not listed above:	
	a.	£
	b.	£
	c.	£
16.	Contingency – Unknown Services	£ 10,000.00
17.	Provisional Sum – Performance Space Power	£ 3,000.00
18.	Provisional Sum – Additional Feature Lighting	£ 2,000.00
19.	Provisional Sum – Assisted Listening Power	£ 2,000.00
20.	Provisional Sum – Additional Containment	£ 10,000.00

TOTAL

SIGNED

COMPANY

ADDRESS

.....
TEL NO. DATE

4.2 DAYWORK RATES

The sub-contractor is to complete the following daywork rates with the submission to tender.

	<u>Basics</u>	<u>Addition</u>
A. Materials	Nett Cost	plus %
B. Labour	(i) Hourly wage rate in accordance with National Employer/Trade Union agreements including Holiday Credits, but excluding allowances.	plus %
	(ii) Allowances.	plus %
C. Sub-contractors	Nett invoice, at contract rates.	plus %

SIGNED

COMPANY

ADDRESS

.....

.....

TEL NO. DATE

4.3 COLLUSION

The essence of selective tendering is that the Client shall receive bona fide competitive tenders from all firms tendering. In recognition of this principle, we certify that this is a bona fide tender intended to be competitive, and that we have not fixed or adjusted the amount of the tender in accordance with any agreement or arrangement with any other person. We also certify that we have not done and we undertake that we will not do at any time before the returnable date for this tender any of the following:

- a) Communicating to a person other than the person calling for the tenders the amount or approximate amount of the proposed tender.
- b) Entering into any agreement or arrangement with any other person relating to the tender.
- c) Offering or paying or giving or agreeing to pay or give any sum of money or valuable consideration directly or indirectly to any person for doing or having done or causing or having caused to be done in relation to any other tender or proposed tender for the said work any act or thing of the sort described above.

In this certificate the word 'person' includes any persons and any body or association, corporate or unincorporate; and 'any agreement or arrangement' includes any such transaction, formal or informal, and whether legally binding or not.

SIGNED

COMPANY

ADDRESS

.....

.....

TEL NO. DATE

4.4 SUB-CONTRACTORS

Should the contractor propose to utilise sub-contractor trade then they should be listed below for approval by the Consulting Engineer.

Company Name & Address

Installation

