

Wood Green Crown Court External Lighting Replacement General Technical Preliminaries for the Engineering Services

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Contents

1.0	INTRODUCTION	1
1.1	The Project	1
1.2	The Project Team	2
1.3	Related Specifications	3
1.4	Conflict between Specifications	3
1.5	Definition of Terms and Abbreviations	3
2.0	PROJECT REQUIREMENTS	5
2.1	General requirements	5
2.2	Legislation and Standards	5
2.3	Statutory Requirements	5
2.4	Precedence	6
2.5	Regulations, Standards and General Parameters	6
2.6	CDM Regulations	10
2.7	Building Regulations Part-L and EPC	10
2.8	Planning Permission Compliance	11
2.9	Enhanced Capital Allowances	11
2.10	General Design Parameters	12
2.11	Materials and Workmanship	12
2.12	Design Life	13
2.13	Compatibility	13
2.14	Obsolescence	13
2.15	Access and Maintenance	13
2.16	Electrical Characteristics	14
2.17	Electromagnetic Compatibility and Electromagnetic Fields	14
2.18	Explosive Atmospheres	16
2.19	Service Conditions	17
2.20	Prevention of Zinc Whiskers	17
2.21	Excluded Materials and Substances	18
3.0	CONTRACTOR'S RESPONSIBILITIES AND OBLIGATIONS	20
3.1	Overview	20
3.2	Contractor Design Portion (CDP)	21
3.3	Co-ordination of Engineering Services	22
3.4	Co-ordination with Direct Procurement Suppliers	23
3.5	Design and Build Contracts	23
3.6	Samples	23
3.7	Mock Ups	24
3.8	Setting Out	24
3.9	Responsibility for Plant and Equipment	24
3.10	Fire Precautions	24
3.11	Builder's Work Information	25
3.12	Services through Fire Stopping Walls, Floors, etc	25
3.13	Utilities, Water & Fuel	25
3.14	Water Sampling	25
4.0	THE SITE / EXISTING BUILDINGS	27

4.1	The Site / Existing Buildings	27
4.2	Risks to Health and Safety.....	27
4.3	Site Visit.....	27
4.4	Site Survey.....	27
4.5	Working in a Live Building.....	28
4.6	Existing Buildings.....	28
4.7	Maintenance of Existing Services.....	29
4.8	Strip-out or Diversion of Existing Services and Utilities.....	29
4.9	Authorised Engineer/Permit to Work System	29
5.0	TENDERING	31
5.1	Summary of Standards.....	31
5.2	Tendering	31
5.3	Pricing/Submission of Documents	31
5.4	Programme of Works.....	32
5.5	Interpretation of Tender Documents.....	32
5.6	Pricing of Performance Specified Work	32
5.7	Schedule of Rates and Quantities	32
5.8	Selection of Manufacturers/Suppliers	33
5.9	Quality Assurance	33
5.10	Maintenance of the Engineering Installation.....	34
6.0	DRAWINGS & MODELS.....	35
6.1	Summary of Standards.....	35
6.2	Summary of Drawing Requirements.....	35
6.3	Summary of Modelling Requirements	37
6.4	Preparation of Drawings	38
6.5	Drawing Types.....	41
6.6	Concept Sketch Drawings.....	41
6.7	Concept Schematics	42
6.8	Developed Design Drawing.....	42
6.9	Developed Schematics	42
6.10	Technical Design Drawing	42
6.11	Builder's Work Information.....	43
6.12	Co-Ordinated Working Drawings	43
6.13	Installation Drawing	43
6.14	Installation Wiring Diagram	43
6.15	Builder's Work Details.....	43
6.16	Manufacturer's Drawing	44
6.17	Controls Diagrams	44
6.18	Switchgear, Starter and Control Instrumentation Panel Drawings.....	44
6.19	Working Drawings.....	44
6.20	Record Drawings and Schedules	44
6.21	Plant Room and Switch Room Drawings, Schedules and Schematics.....	46
7.0	TECHNICAL SUBMITTALS	48
7.1	Preparation of Technical Submittals	48
7.2	Specifications	48
7.3	Calculations	48
7.4	Mechanical Calculations.....	48
7.5	Electrical Calculations	49

7.6	Fire Safety Systems and Specifications	49
7.7	Plant and Equipment Submittals.....	50
7.8	Review of Technical Submittals	50
7.9	Manufacturers References.....	51
7.10	Manufacturers Information	51
7.11	Method Statements	51
8.0	WORKS EXECUTION	52
8.1	Project Quality Plan (PQP).....	52
8.2	Co-Operate.....	53
8.3	Supervision Requirements	53
8.4	Meetings	53
8.5	Programme/Progress	54
8.6	Site Access.....	55
8.7	Working Hours	55
8.8	Noise/Nuisance	55
8.9	Dimensions.....	56
8.10	Setting out for the Contract Work	56
8.11	Off Site Prefabrication.....	56
8.12	Site Built Assemblies	56
8.13	Site Modifications	56
8.14	Ordering of materials and products.....	56
8.15	Responsibility for Plant and Equipment.....	57
8.16	Delivery, Handling and Storage of Materials	57
8.17	Protection and Cleaning of Materials and Works	58
8.18	Working in Confined Spaces	59
8.19	Rotating Plant.....	59
8.20	Assessment and Monitoring	60
8.21	Inspection and Measurement of Work.....	60
8.22	Covering-Up	60
8.23	Systems Used Before Practical Completion	60
8.24	Operation of Systems before the Production of Drawings and/or Operating and Maintenance Manuals.....	60
8.25	Inspection by Employer's Insurance Company	61
8.26	Technical Literature	61
8.27	Maintenance Instructions and Guarantees	61
8.28	Photographs.....	61
8.29	Sectional Working	62
8.30	Valuation of Instructions & Variations.....	62
9.0	OPERATION AND MAINTENANCE MANUALS.....	63
9.1	Summary of Standards.....	63
9.2	Submission of Documents for Health and Safety File	63
9.3	Record Documents.....	64
9.4	Operating and Maintenance Manuals	65
9.5	Building User Guide - BREEAM.....	67
9.6	Building Regulation Part-L, EPC and DEC Requirements.....	67
9.7	Presentation of the Operating and Maintenance Manuals	68
9.8	Reading of Meters.....	68
10.0	PROVISION OF SPARES AND TOOLS	69

10.1	Spares and Tools to be Provided in the Contract.....	69
10.2	Initial Supply of Additional Spare Parts.....	71
10.3	Recommended Tools	72
11.0	TRAINING OF EMPLOYER'S STAFF	73
11.1	General Requirements	73
11.2	Systems Training	73
11.3	Training on BMS & Controls Systems.....	73
12.0	COMPLETION & POST COMPLETION	75
12.1	Practical Completion	75
12.2	Defects Liability	75

1.0 Introduction

1.1 The Project

1.1.1 Project Particulars

PROJECT INFORMATION SCHEDULE		
Project Name	EQUANS- Wood Green Crown Court External Lighting Replacement	
Project Address	Wood Green Crown Court Lordship Lane London N22 5LF	
Project Description	Replacement of existing external lighting	
LISTED SUB-CONTRACTORS		
Listed Sub-Contractors are required on the project:	No	
OTHER SUPPLIERS AND CONTRACTORS		
Other suppliers and Contractors procured separately by the client:	No	
UTILITIES		
Utilities shall be ordered by the parties as follows:		
Electricity	No	
Water	No	
Gas	No	
Drainage	No	
Telecoms	No	
Satellite	No	
BUILDING ENERGY PERFORMANCE TARGET		
The project includes a building energy performance target	No	
ENVIRONMENTAL ASSESSMENT		
BREEAM Assessment	No	
LEED Assessment	No	
NABERS Assessment	No	
Where an environmental assessment method is applicable to the project the MEPH Contractors are required to include all necessary works such as but not limited to specific material procurement, reporting, thermal and energy studies required in order to comply with the targeted credits. The detailed requirements of the environmental assessment can be found in the project		
BIM		

Will the project require Building Information Modelling (BIM)?	No	
SOFT LANDINGS		
Soft Landings process to be adopted?	Yes	– Contractor to coordinate
ENHANCED CAPITAL ALLOWANCES		
Enhanced Capital Allowances (ECA's) are to be claimed on qualifying expenditure for plant and equipment	No	

1.1.2 Additional Details

None

TYPE OF BUILDING CONTRACT	
Standard form of Contract	JCT
Contract Type	Design and build

1.2 The Project Team

	COMPANY	CONTACT	EMAIL
The Employer	EQUANS	Wayne Henderson	wayne.henderson@equans.com
Principal Designer	RED Engineering	Eleanor Brennan	eleanor.brennan@red-eng.com
Project Manager	EQUANS	Wayne Henderson	wayne.henderson@equans.com
M&E Services Consultant	RED Engineering	Robert Wright	robert.wright@red-eng.com

1.3 Related Specifications

This specification is for MEPHF & ICT (Mechanical, Electrical, Public Health and Fire and ICT) Engineering Services installations for the proposed development. The specifications form part of the Employers Requirements.

Specifications are subdivided into the following categories:

- **Standard Specifications:** Documents that define the general specifications for plant, equipment, system and workmanship and materials standards as well as General Requirements and Preliminaries. Documents that provide details of the contract requirements.
- **Particular Specifications:** Documents that provide prescriptive project specific requirements. They provide a description of the installations, operation and control of the works. (They may include portions that require further design.)
- **Performance Specifications:** Documents that provide project specific requirements that require further design. They define the operational requirements of the installations.
- **Equipment Schedules:** Documents that provide project specific equipment requirements such as technical performance criteria and dimensional information.

1.4 Conflict between Specifications

The Particular Specifications and Equipment Schedules will take precedence in the event of conflict between specifications.

Any potential conflict between the specification and legislation, statutory documents, approved documents or approved codes of practice, shall be notified to the Engineer in accordance with the tender or contract technical query or Request for Information (RFI) procedures.

1.5 Definition of Terms and Abbreviations

1.5.1 Definition of Terms

Terms	Definition
"As indicated", "where indicated", and "unless otherwise indicated"	refer to items or requirements which are, or may be given elsewhere in the tender documents issued in connection with the contract, (e.g. on a drawing, in a supplementary specification or in a schedule to this specification).
"Employers Agent" or "Client Agent" or "Contract Administrator (CA)"	Person authorised by the Client to instruct the Contractor
Acts, Regulations, Standards and Codes of Practice	Acts of Parliament, Regulations, and Codes of Practice used in the work element are generally not given a year of issue or amendment. The published versions that apply to the works are those current 10 days before the date set for tender return.
Approval	The Engineer's acceptance that the design solution on a defined sub-section of the overall design meets the "Design Intent" on the specified works. Any review, comments, acceptance, or approval does not relieve the Contractor of their contractual obligations, including ensuring that the work is compliant, complete, accurate and correct. The approval of a design or piece of equipment shall be without prejudice to the acceptance tests required after installation.

Terms	Definition
Approved Document	Guidance documents for the Building regulations
Client	The company or person procuring the works
Complete Installation	Shall mean not only the major items of plant and equipment conveyed by this specification, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation, with their labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the contract.
Concealed Services	Includes installations within ducts, trenches, or cavities.
Contractor	The successful tenderer of the work element who is appointed to carry the work specified
Engineer	RED
Exposed Services	MEPHF and ICT installations that are not covered by solid ceiling within occupied space; within plant room or installed externally of the building.
Main Contractor	The company employed by the client to assume overall responsibility for the construction of the works.
Principal Contractor	A principal Contractor is the Contractor with control over the construction phase of a project involving more than one Contractor. They are appointed in writing by the client (commercial or domestic) to plan, manage, monitor and coordinate health and safety during this phase.
Principal Designer	A principal designer is a designer who is an organisation or individual (on smaller projects) appointed by the client to take control of the pre-construction phase of any project involving more than one Contractor.
Project Manager	Person responsible for managing the project on behalf of the Client.
Provide	Design, supply, install, test, commission and set to work.
Remove	Remove complete with all ancillary devices and equipment. Dispose of off-site in an environmentally safe manner. Ensure that equipment is completely isolated from any energy sources prior to removal. All piping and wiring shall be removed back to the nearest isolating point.
Reviewed	Activity carried out by the Engineer for general conformance with the Design Intent and general compliance with the Contract Documents. Any review, comments, acceptance, or approval does not relieve the Contractor of their contractual obligations, including ensuring that the work is compliant, complete, accurate and correct. The review of a design or piece of equipment shall be without prejudice to the acceptance tests required after installation.
Size	When related to pipe work means nominal size which generally approximates to the bore of steel tubes and the outside diameter of copper and plastic tubes.
System	System shall mean all equipment, accessories, electrical supplies and interface, controls, supports and ancillary items, including supply, installation, testing, commissioning and setting to work necessary to meet the "Design Intent" of the specified works.
Substantial Completion	Full or partial hand over of any part or section of the building. FR = Facility Ready.
Work	The works defined in the mechanical, electrical, public health, fire and ICT specifications and drawings

2.0 Project Requirements

2.1 General requirements

This specification shall be read in conjunction with the Architectural, Civil, Structural, Mechanical, Electrical, Public Health, Fire and ICT drawings, other relevant specifications and contract documentation, preliminaries, etc, that make up the contract documents and as listed in the issue register, which are relevant to the specific work element.

The Contractor shall be responsible for the design, supply, installation, testing and commissioning of the specified engineering installations detailed in the documents and shall meet all the parameters specified and requirements detailed within the design documentation, drawings and specifications.

The Mechanical, Electrical, Public Health, BMS, Fire and ICT Engineering Specifications and drawings are issued to indicate the principles of the system design, design criteria and client's requirements. They do not attempt to detail every system component and it is the responsibility of the Contractor to ensure that he has included within their costs for all items necessary to meet the requirements of the specifications, drawings, engineering design intent and Employer's requirements.

The work shall be complete in every respect and the Contractor shall include for all items, though some may not be particularly specified, to ensure that the work shall be complete in every detail for the sum stated in the Tender.

No claims for extras shall be considered unless specific instructions have been issued in writing by the Employer's Agent to execute works additional to the Contract.

2.2 Legislation and Standards

All of the equipment detailed within this specification and on the drawings shall be manufactured and installed in full compliance with the latest edition of all relevant British, European, International and local standards, Codes of Practice and Regulations applicable to the country of the installation wherever they are more stringent. It is the responsibility of the Contractor and their supply chain (sub-Contractors and equipment suppliers) to document this.

2.3 Statutory Requirements

The Contractor shall be responsible, and shall make due allowance, for giving all notices and attendance for inspection to the Utility Service Providers and the Local and Public Authorities. These requirements include obtaining all necessary consents and paying all fees legally demandable.

The Contractor shall be satisfied and confirm, in writing, that the whole of the installation is in accordance with the Byelaws, Building Regulations, Building Control and regulations of the Local Authority having jurisdiction, the requirements of the Public Health Officer, the Regional Electricity Company / Network owner / Manager, the Fire Brigade and all interested parties.

Authorities shall be notified as necessary about the connection of all utility supplies.

Liaise with the Statutory Authorities and provide any test notices required to ensure final connections are made in accordance with the requirements of the programme. Specifically, with respect to meet the testing and commissioning requirements.

Provide all formalities in connection with Test Notices, Agreement and Application for Supply Forms etc. Ensure all documents requiring the Employer's signature are forwarded to the Employers Agent in time to meet the building programme in order for the necessary test and supply arrangements to be made. No additional payments will be made for expenses incurred due to reconnections, re-visits etc., by Supply Authorities or any other officials.

Any such portion of the works requiring the inspection and approval of all relevant regulatory authorities and utility companies shall not be built in, covered or otherwise obscured until such approval has been obtained. Any additional costs incurred by the Contractor for non-compliance with this clause shall be borne by the Contractor.

2.4 Precedence

The requirements of legislation shall take precedence over those of approved documents and approved codes of practice.

The requirements of approved documents and approved codes of practice shall take precedence over those of national standards (in general, British Standards).

The requirements of national standards shall take precedence over those of regional standards (in general, European Norms).

The requirements of regional standards (in general, European Norms) shall take precedence over those of international standards and standards of other countries.

In the event of there being discrepancies between the Standards, Regulations etc., or between this Specification and the Standards, Regulations, etc., the most stringent shall be deemed to apply.

2.5 Regulations, Standards and General Parameters

Provide all materials and works in accordance with the appropriate British Standard or Code of Practice, European Standards, EU Commission Regulations or other Local Standards. Where no Standard or Code of Practice is applicable the comply with the Agreement Certificate for the particular item.

Provide products in accordance with the Construction Products Regulations (CPR). Products covered by harmonised European product standards (hENs) must have a Declaration of Performance (DoP) certificate for the product and be CE marked. Manufacturers of products not fully covered by a hEN or which do not fall within the scope of a hEN shall provide Declaration of Performance documentation in accordance with one of the methods in the CPR.

Comply with all statutory instruments and regulations, relating to the area of the site current at the date of tender.

Comply with all Statutory Obligations arising from current legislation and regulations, together with other requirements, including, but not limited to, the following as applicable to particular projects:

STANDARD	STATUTORY OBLIGATIONS
Local Authority	The requirements of the Local Authority Building Inspector
UK HSE	Health and Safety at Work Act
UK HSE	HSE L8 Legionnaires' Disease. The Control of Legionella Bacteria in Water Systems ACOP and all parts of HSG274 (for technical guidance)
UK HSE	HSE L5 Control of Substances Hazardous to Health. ACOP and guidance
UK Gov Legislation	Management of Health & Safety at Work Regulations

STANDARD	STATUTORY OBLIGATIONS
UK HSE	Gas Safety (Installation and Use) Regulations
UK Gov Legislation	HSE L56 Safety in the Installation and Use of Gas Systems and Appliances: Gas Safety (Installation and Use) Regulations 1998. ACOP and guidance
UK Gov Legislation	The Gas Appliances (Safety) Regulations
UK Gov Legislation	The Gas (Meters) Regulations
UK Gov Legislation	The Measuring Instruments (Gas Meters) Regulations
UK Gov Legislation	The Control of Pollution (Oil Storage) Regulations
UK Gov Legislation	The Pipelines Safety Regulations and amendments
UK HSE	HSE L82 Guide to the Pipelines Safety Regulations
UK Gov Legislation	Pressure Systems Safety Regulations
UK HSE	HSE L122 Safety of Pressure Systems. Pressure Systems Safety Regulations. ACOP and guidance
UK Gov Legislation	Pressure Equipment (Amendment) Regulations and The Pressure Equipment (Safety) Regulations
UK Gov Legislation	The Confined Spaces Regulations
UK HSE	HSE L101 Safe work in confined spaces. Confined Spaces Regulations. ACOP and guidance
UK Gov Legislation	Building Regulations and current amendments, and relevant Approved Documents in England and Wales
UK Gov Legislation	Building Standards (Scotland) Regulations and current amendments and relevant Technical Handbooks and supporting Guidance
UK Gov Legislation	Building Regulations Northern Ireland and relevant Technical Booklets
UK Gov Legislation	The Energy Performance of Buildings Regulations (England and Wales) Regulations and amendments
UK Gov Legislation	The Ecodesign for Energy-Related Products Regulations as amended
UK Gov Legislation	The Renewable Heat Incentive Scheme Regulations and the Domestic Renewable Heat Incentive Scheme Regulations
UK Gov Legislation	England and Wales - The Water Supply (Water Fittings) Regulations, the Water Act and The Construction Products Regulations
Scottish Water	Scotland - The Water Supply (Water Fittings) Byelaws
UK Gov Legislation	Northern Ireland - The Water Supply (Water Fittings) Regulations
UK Gov Legislation	London Building Acts and/or Building (Inner London) Regulations, both as amended
UK Gov Legislation	Public Health Acts
UK Gov Legislation	Electricity Act
UK Gov Legislation	The Electricity at Work Regulations
UK HSE	HSE HSR25 The Electricity at Work Regulations. Guidance on Regulations
UK Gov Legislation	The Electricity Safety, Quality and Continuity Regulation
UK Gov Legislation	Factories Act
UK Gov Legislation	Clean Air Act
UK Gov Legislation	The Environmental Protection Act
UK Gov Legislation	The Control of Pollution Act
UK Gov Legislation	Air Quality Standards Regulations
UK Gov Legislation	The Fluorinated Greenhouse Gases Regulations
UK Gov Legislation	The Workplace (Health, Safety and Welfare) Regulations
UK HSE	HSE L24 Workplace health, safety and welfare. ACOP and guidance
UK HSE	The Construction (Design and Management) Regulations
UK HSE	The Health and Safety (Display Screen Equipment) Regulations
UK HSE	HSE L26 Work with display screen equipment. Health and Safety (Display Screen Equipment) Regulations. Guidance on Regulations
UK Gov Legislation	The Clean Air (Arrestment Plant) (Exemption) Regulations
UK HSE	The Control of Substances Hazardous to Health (COSHH) Regulations
UK HSE	Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

STANDARD	STATUTORY OBLIGATIONS
UK HSE	HSE L138 Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations. ACOP and guidance
UK HSE	The Control of Major Accident Hazards Regulations (COMAH)
UK Gov Legislation	The Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations
EU Directive 99/92/EC	ATEX Workplace Directive
EU Directive 2014/34/EU	ATEX Equipment Directive
European Agency for Safety and Health at Work	The CLP (Certification, Labelling and Packaging of Substances and Mixtures) Regulations
UK Gov Legislation	Control of Asbestos Regulations
UK HSE	HSE L143 Managing and working with asbestos. Control of Asbestos Regulations 2012. ACOP and guidance
UK Gov Legislation	The Provision and Use of Work Equipment Regulations (PUWER)
UK HSE	HSE L22 Safe use of work equipment. Provision and Use of Work Equipment Regulations. ACOP and guidance
UK Gov Legislation	Personal Protective Equipment at Work Regulations
UK HSE	HSE L25 Personal protective equipment at work. Personal Protective Equipment at Work Regulations 1992. Guidance on Regulations
UK Gov Legislation	The Lifting Operations and Lifting Equipment Regulations (LOLER)
UK HSE	HSE L113 Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations. ACOP and guidance
UK Gov Legislation	The Equality Act and current amendments
British Standard	BS EN 547 series - Safety of machinery. Human Body measurements. Anthropometric data.
British Standard	BS Design of buildings and their approaches to meet the needs of disabled people. Code of practice
UK Gov Legislation	The Control of Electromagnetic Fields at Work Regulations
UK Gov Legislation	The Electromagnetic Compatibility Regulations
UK Gov Legislation	The Radio and Telecommunications Terminal Equipment Regulations
UK Gov Legislation	The Medical Devices Regulations
UK Gov Legislation	The Supply of Machinery (Safety) Regulations
UK Gov Legislation	Public Utility Company and/or Statutory Authority regulations, specifications, and requirements
British Standard	BS 7671 - Requirements for Electrical Installations (IET Wiring Regulations)
British Standard	BS EN 50110 series - Operation of Electrical Installations

STANDARD	GENERAL GUIDES & STANDARDS
-	Insurance Company Requirements
British Standards	British Standards and Codes of Practice
IEC	IEC Standards
CIBSE Guide A	Environmental Design
CIBSE Guide B	Heating, Ventilating, Air Conditioning and Refrigeration
CIBSE Guide C	Reference Data
CIBSE Guide D	Transportation Systems in Buildings
CIBSE Guide E	Fire Safety Engineering
CIBSE Guide F	Energy Efficiency
CIBSE Guide G	Public Health Engineering
CIBSE Guide H	Building Control Systems
CIBSE Guide K	Electricity in Buildings
CIBSE Guide L	Sustainability

STANDARD	GENERAL GUIDES & STANDARDS
CIBSE Guide M	Maintenance Engineering & Management
CIBSE SLL Code	SLL Code for Lighting
CIBSE TM	Technical Memoranda
CIPHE	Plumbing Engineering Services Design Guide
ASHRAE	Handbook
BSRIA	BSRIA BG Series Guides
BSRIA BG/55	Safety in Building Services Design

STANDARD	SPECIFIC GUIDES & STANDARDS
ENA EREC G5/5 (UK)	Harmonic voltage distortion and the connection of harmonic sources and/or resonant plant to transmission systems and distribution networks in the United Kingdom
EN50160 (EU)	Voltage characteristics of electricity supplied by public electricity networks (+A3:2019) (Incorporating corrigendum December 2010)
BS EN 61000	Electromagnetic Compatibility (EMC) – Generic Standards
BS EN 50121	Railway Applications Electromagnetic Compatibility.
BS EN 62305	Protection Against Lightning
BS 7671	IET Wiring Regulations
BS EN50310	Telecommunications bonding networks for buildings and other structures
BS6701	Telecommunications equipment and telecommunications cabling. Specification for installation, operation and maintenance - Specification for installation, operation and maintenance.
BS EN 50174	Installation Technology. Cabling Installation
BS EN 60079-series	Explosive Atmospheres
BS EN 13463-2	Non-electrical equipment for use in potentially explosive atmospheres
BS EN 80079	Explosive Atmospheres
Association of Petroleum and Explosive Administration (APEA) / Energy Institute publication	Design construction, modification, maintenance and decommissioning of filling stations (Blue Book)
HSEG47	Avoiding danger from underground services
HSEG85	Electricity at work: Safe working practices

Wherever reference is made to a British Standard (BS), a British Standard Institution harmonized equivalent European Standard may be acceptable if agreed with the Engineer. If the project is not located in the UK, then any British Standard list shall be replaced with the equivalent National Standards. Each type of work/equipment/material selected shall comply fully with the most recent edition of the Standards.

This specification is based on UK and European Standards, to achieve an approach for safety and compatibility for electrical, data network and information technology installations, and equipment, aligning with the European Committee for Electrotechnical Standardisation (CENELEC) approach.

Identify any instances where the proposed solution does not conform to the above.

Notify all authorities in accordance with their regulations and obtain any required approvals for the installation.

Where no specific design, performance or installation standards are quoted the following shall apply:

- CIBSE Guides
 - Guide A Environmental Design
 - Guide B Heating, Ventilating, Air Conditioning and Refrigeration
 - Guide C Reference Data
 - CIBSE the SLL Code for Lighting
 - CIBSE Technical Memoranda
- Chartered Institute of Plumbing and Heating Engineering, Plumbing Engineering Services Design Guide
- BSRIA BG Series

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

Supply plant and equipment to achieve the specified design conditions and to provide stable control. Modular or prefabricated plant and systems (e.g. prefabricated boiler house, fire pump system) shall be tested as a single assemble in according to the relevant BS / BS EN standards.

For insulation: comply with online guide to check long term impact of material selection - www.thegreenguide.org.uk

2.6 CDM Regulations

This project shall be executed under the Construction (Design and Management) Regulations or equivalent national health and safety regulations in the relevant country, and the Contractor shall be responsible for providing all required documentation to the Principal Designer and Principal Contractor for the project Health and Safety file.

The Contractor shall comply with the requirements of the CDM Regulations by:

- Adhering to the rules of the Pre-Construction Information and Construction Phase Plan
- Reporting accidents, injuries or dangerous occurrences to the Main Contractor
- Providing the main Contractor with appropriate input to the health and safety plan, including risk assessments, and to the health and safety file
- Providing the main Contractor with information on the contract works which might affect the health or safety of any person

2.7 Building Regulations Part-L and EPC

The Contractor shall consider and advise on the impact of any changes to the building services plant selection and system arrangement that may impact the final building emission (CO₂) results.

The Contractor shall prepare supporting documentation for the Building Regulations approvals and compliance.

The Contractor shall be responsible for the final “as-built” building emission modelling as required under the Building Regulation Part-L including all necessary information gathering from different parties. The emission calculation shall be carried out by a qualified person.

2.8 Planning Permission Compliance

The Contractor shall prepare supporting documentation to discharge any Planning Conditions and demonstrate compliance.

2.9 Enhanced Capital Allowances

Where the client wishes to claim Enhanced Capital Allowances (ECA's) on the qualifying expenditure for plant and equipment the Contractor shall comply with the following:

- Where available, plant and machinery shall be selected from the Energy Technology List or the Water Technology List provided on the government website <http://gov.uk/etl/>. Products selected must meet the eligibility criteria as detailed on the website
- Refer to the Project Information Schedule for plant and equipment for which the intention is to claim ECA's
- The schedule comprises items on the Energy Technology Product List (ETPL) that meet the criteria for equipment set out in the Energy Technology Criteria List (ETCL) and has been identified at the design stage for qualification for Enhanced Capital Allowances. Provide the additional information required at the earliest opportunity in the procurement programme
- The manufacturers quoted against each item on the schedule are those on which the design, to date, has been based and the manufacturer's model references in the schedule are given for tender purposes only and based on products on the list at the time of producing the tender documentation. Do not order any plant against these model numbers
- Before ordering plant confirm the current model that both complies with the performance / technical criteria detailed elsewhere in the specification and is included on the ETCL then complete the schedule (including providing all detailed information requested) for approval
- Any alternative ECA compliant items of plant or equipment to the named manufacturers / models shall be identified within the tender return. The alternatives shall comply fully with the performance and technical details given elsewhere in this specification
- Any additional cost, if applicable, for each of these ECA compliant alternatives shall also be provided with the tender, in order to allow the Client to appraise the benefit on an item by item basis
- Provide proof of eligibility prior to ordering the equipment from the supplier
- During the course of the contract ensure that the Client is provided with all necessary information in relation to equipment, transportation and installation costs to permit a claim to be submitted by the Client
- Provide either a letter or e-mail from the supplier, manufacturer or installer of a non-listed product as evidence of compliance with the ECA eligibility criteria relevant to that technology. Letter from manufacturer/supplier/installer to be on company headed paper with signature and contact details of person signing the letter. Confirmation e-mail from manufacturer /supplier

/installer with company signature on email along with the contact details of the person sending the email

- Verbal confirmation of compliance with any of the eligibility criteria will not be accepted

2.10 General Design Parameters

All sections of the installation shall be designed to achieve a standard, which as a minimum, provides the following:

- Conformance with the levels of finish and quality achieved and stated within this document and the rest of the contract documentation
- Operational safety and hygiene
- First Class OEM materials which are durable and of proven reliability and performance
- Systems that maintain their integrity during their operational lives
- Systems that fully meet the needs and constraints that the property is intended for
- The design of the installations shall take into account the overall appearance of the building in as much as the colour and location of all external components are to be co-ordinated with the external fabric and architectural features.
- All systems shall be designed and all equipment selected with a view to minimising energy consumption, cost in use and maintenance.
- The Contractor shall comply with the recommendations in BSRIA BG/55 Safety in Building Services Design.

2.11 Materials and Workmanship

All materials and their workmanship shall be of the best quality of their respective kinds. All materials referred to in the Specifications shall be subject to the Employers Agents approval and samples where requested shall form the standard of quality for all such materials used in the Works.

Where the quality of materials is not specified, they shall be the best of their respective kinds and shall be in accordance with any relevant British Standard Specification or local standard applicable and samples or full details shall be submitted to the Employers Agent for approval before use.

Should the Contractor wish to deviate in any way from specified items, he must do so in writing to the Employers Agent and obtain approval prior to submitting his priced Tender, otherwise he shall be held to have included for any one of the specified manufacturers.

When such terms as 'equal' or 'equal and approved' are used alternative articles may be accepted, but shall only be submitted for consideration as an alternative to those specified and they shall then be scheduled with full details and price differences. The alternative articles may only be utilised after the Engineer has commented and agreed their use in writing.

The Employer's Agent may require the Contractor to submit correctly identified and documented samples of any materials or workmanship to be used in the Contract Works for his appraisal. The Contractor shall allow for any charges necessary in complying with this condition. All materials and workmanship for which samples have been accepted must conform in every respect with such samples, and any items not conforming to the accepted standard shall be removed and replaced with new materials at the Contractors own expense.

The complete installation shall be carried out in a neat and proper manner, particular attention being paid to the continuity of the whole system and sound and secure fixing of all materials and equipment. Under no circumstances will any inferior work be accepted by the Employers Agent or his appointed representative.

All plant materials shall be new and the Contractor shall ensure that no materials or equipment are fitted which show signs of corrosion or faults or are damaged in any way. Replacement of such plant or materials shall be at the expense of the Contractor.

2.12 Design Life

The services installations shall be such to provide a service, which will have a minimum life expectancy of twenty-five years, in conjunction with a planned maintenance programme.

All materials and equipment used shall generally have an expected life as appropriate for the system and acceptable International Standards, typically as detailed in the CIBSE Guide M or the ASHRAE Handbook.

2.13 Compatibility

Similar items of apparatus and equipment shall be made by the same manufacturer. Corresponding parts of all apparatus and equipment shall be interchangeable.

2.14 Obsolescence

The proposed equipment is to be of a current design utilising readily available components with a minimum availability of all spares for 15 years following the completion of this project. All systems are to be designed around an 'open protocol' system to provide compatibility between different suppliers, manufacturers and flexibility in maintenance.

2.15 Access and Maintenance

In the preparation of installation drawings and in the erection of the mechanical and electrical contract work, the contractor shall ensure that adequate provision is made for access to, operation and maintenance of the various valves, damper components, plant and equipment.

Systems that are fully accessible to facilitate the ease of maintenance. For the avoidance of doubt, access for maintenance of machinery, switchgear, control gear and generators shall comply with a suitable standard for accessibility, compliance with BS EN 547-series is a minimum requirement.

All plant and equipment shall be located for safe and proper maintenance. Access ways with handrails are to be provided to enable routine maintenance of high-level equipment. Protective guards are to be provided for all elements of the installation which are unsafe to touch.

Routine maintenance shall be possible without the removal or dismantling of other plant and equipment.

Provision shall be made so that apparatus which needs regular removal for maintenance may be removed with the minimum of its connection and without interference to other adjacent installations.

Services in ducts and in other voids shall be so arranged and secured that as far as is practicable, they will not prevent convenient access for the maintenance and renewal of any other service.

The installations shall be such that the equipment shall be easily maintainable using standard tools and equipment. The need to use specialist tools and equipment to carry out maintenance shall be avoided if at all possible.

Provision of access shall be deemed to provide for installation, testing/commissioning, identification and future maintenance/replacements.

2.16 Electrical Characteristics

Ensure that electrical characteristics of component parts of assemblies are as indicated in the Contract Documents and apply when components and their assemblies are installed in their final environment, including, where necessary, mounting in any enclosures.

The load and short circuit withstand capacity of equipment and components shall be derated accounting for the deleterious effect of ambient temperature conditions on their normal operating temperature. The allowable temperature rise of conductor insulation under fault shall not be exceeded and determined by taking into account, ambient temperature, heat transfer through enclosures, heat sources from other components, and interconnections, enclosures, other components, and inter-connections.

It is the Contractors responsibility to ensure the final installation shall meet the requirements of G5/5 for the connection of harmonic sources and resonant plant to electricity distribution networks. The harmonic voltage distortion of the equipment caused by the load, including the background harmonic contribution from the electricity network, shall not exceed immunity level of the equipment.

The voltage and frequency of the electrical supply connection at the equipment shall be regulated within the ranges tolerated by the equipment for all loading scenarios, including all part loads from no-load to full load, whilst the utility supply voltage and frequency is within normal limits.

2.17 Electromagnetic Compatibility and Electromagnetic Fields

Ensure that the installation complies with the Electromagnetic Compatibility Regulations. Ensure all equipment and systems are installed to provide electro-magnetic compatibility within the systems and with any other systems installed in the same location.

Comply with the Control of Electromagnetic Fields at Work Regulations during the construction and commissioning of the works.

Ensure the completed works comply as necessary with the Control of Electromagnetic Fields at Work Regulations.

The Contractor shall ensure all equipment and installations meet the requirements of the following relevant legislation:

- The Electromagnetic Compatibility Regulations 2016
- The Radio and Telecommunications Terminal Equipment Regulations 2000 as amended
- The Medical Devices Regulations 2002 as amended
- The Supply of Machinery (Safety) Regulations 2008 as amended

Ensure all equipment and installations are suitable for the electromagnetic environment in which they will operate:

- Electromagnetic environment zoning:
 - Conduct a study to validate the electromagnetic environment at each location

- Domestic, commercial and light industrial environment:
 - Emissions BS EN 61000-6-3
 - Immunity BS EN 61000-6-1
- Industrial environment:
 - Emissions BS EN 61000-6-4
 - Immunity BS EN 61000-6-2
- Power station or substation environment:
 - Emissions BS EN 61000-6-4
 - Immunity BS EN 61000-6-5
- High-altitude Electromagnetic Pulse (HEMP) immunity:
 - Indoor equipment BS IEC 61000-6-6
 - Distributed infrastructure DD IEC/TS 61000-5-8
- Railway fixed power supply installations and apparatus:
 - BS EN 50121-1
 - BS EN 50121-5
- Railway signalling and telecommunications equipment:
 - BS EN 50121-1
 - BS EN 50121-4

Ensure all systems and buildings are assessed for protection to, and that such protection meets the requirements of, BS EN 62305 and BS 7671 (IET Wiring Regulations) for surge protection and lightning protection.

Ensure electrical power installations comply with the electromagnetic compatibility requirements of BS 7671 (IET Wiring Regulations)

Ensure that earthing arrangements and earthing systems comply with BS EN 50310 and BS IEC 61000-5-2

Ensure that telecommunications installations comply with BS 6701.

Ensure that data and control systems cabling infrastructure complies with BS EN 50174-series

Ensure that records of installation practices used to achieve compliance with relevant legislation and standards, are maintained throughout design, installation and commissioning, and are provided in operation and maintenance information.

Validate electromagnetic compatibility of the completed works:

- Provide evidence of good EMC installation practices.
- Provide evidence of product conformity to relevant legislation and standards for electromagnetic compatibility, and suitability of the equipment for the zone(s) in which it is to be installed and used.

Undertake measurements of electromagnetic emissions on completion, to demonstrate that emission levels are within the limits set by the relevant emissions standard for the electromagnetic environment within each zone.

Comply with the Control of Electromagnetic Fields at Work Regulations 2016 during the construction and commissioning of the works.

Ensure the completed works comply as necessary with the Control of Electromagnetic Fields at Work Regulations 2016

Ensure that areas intended for general occupation and use, do not exceed the indirect-effect action levels and exposure limit values mandated in the Control of Electromagnetic Fields at Work Regulations 2016.

Ensure that the following are clearly identified in the Operation and Maintenance Manual and where appropriate the Health and Safety File:

- All areas where the indirect-effect action levels and exposure limit values may be exceeded, and any relevant precautions, safe methods of work and personal protective equipment, that apply to those areas.
- All operations and maintenance activities that may exceed the exposure limit values and/or indirect-effect action levels, along with recommended safe methods of work and personal protective equipment required.
- All areas where electromagnetic fields exist that may affect employees at particular risk, including users of active and passive implanted medical devices, body worn medical devices or as a result of pregnancy.

2.18 Explosive Atmospheres

The Contractor shall ensure that all aspects of the Works comply with relevant legislation including:

- The Control of Major Accident Hazards Regulations 2015 (COMAH)
- Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
- EU Directive 99/92/EC – ATEX Workplace Directive
- EU Directive 2014/34/EU – ATEX Equipment Directive
- The equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 1996

The Contractor shall employ relevant standards and guidance in the design, selection, construction and erection of the Works:

- BS EN 60079-series
- BS EN 13463-2
- BS EN 13463-3
- BS EN 80079-series
- Association of Petroleum and Explosive Administration (APEA) / Energy Institute publication, Design construction, modification, maintenance and decommissioning of filling stations (Blue Book)
- HSE L138 Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. ACOP and guidance (second edition, 2013)

The Contractor shall ensure all equipment and installations are suitable for the explosive atmosphere zone in which they will operate as follows:

- Hazardous area zoning:
 - Conduct and document a risk assessment and study to ascertain and validate the hazardous area zoning in accordance with:
 - BS EN 60079-10-1 for explosive gas atmospheres

- BS EN 60079-10-2 for explosive dust atmospheres
- Electrical installations and systems:
 - Ensure electrical installations and systems are designed, selected and erected in accordance with BS EN 60079-14 and BS 7671 (IET Wiring Regulations)
 - Ensure electrical installations and systems are designed to be maintained in accordance with BS EN 60079-17 and BS EN 60079-19
 - Ensure intrinsically safe electrical systems and equipment comply with BS EN 60079-25

Ensure equipment and other products conform to relevant parts of BS EN 60079, BS EN 80079 and BS EN 13463 for the zone(s) in which they are to be installed and used.

Ensure electrostatic hazards are controlled in accordance with PD CLC/TR 60079-32-1

Provide evidence of product conformity to relevant legislation and standards for explosive atmospheres, and suitability of the equipment for the zones(s) in which it is to be installed and used.

2.19 Service Conditions

The engineering installations have been designed to fully withstand the ambient conditions detailed herein.

Special attention shall be paid to the selection of equipment positioned in direct sunlight, or certain artificial light sources, to account for temperature rise and damage caused by ultraviolet (UV) radiation.

All services and equipment shall be suitably rated to be compatible with the operational conditions and external influences it is intended to operate in, including but not limited to the degree of protection of electrical installations and equipment to persons, equipment, mechanical impact, and the ingress of water and solids.

In determining the ambient and operating temperature of equipment, temperature increases from installation conditions and adjacent equipment and services that emit heat, shall be taken into consideration when selecting the equipment, sizing cables, and verifying and validating protective devices.

Care shall be taken by the Contractor when selecting equipment that one item of equipment does not unduly affect an adjacent item of equipment due to its temperature rating.

2.20 Prevention of Zinc Whiskers

The Contractor and plant & equipment suppliers shall ensure that the materials used in the construction of containment systems, services supports, or any systems or equipment located in, or serving any areas containing critical electronics should not incorporate any electro-galvanised steel. This is to prevent the formation of zinc whiskers, any steel shall be either hot dip galvanised or powder coated.

Hot dip galvanisation or powder coating does not allow the formation of zinc whiskers. Whilst hot-dipped galvanization still involves coating steel in zinc, it creates a layer of zinc that is under far less pressure than one produced through the electroplating process. Zinc deposited on to steel via the hot dipping process is not under compressive stress and therefore does not force zinc filaments outward through any weak spots. As an alternative powder coated finishes prevent corrosion and prolong the life of the steel, but since they are zinc-free, it is not possible for them to generate zinc whiskers.

2.21 Excluded Materials and Substances

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.

Materials shall not:

- Be deleterious in themselves
- Become deleterious when used in a particular situation or in combination with other materials.
- Become deleterious with passage of time.
- Become deleterious as a result of poor workmanship during construction.
- Become deleterious without a level of maintenance which is higher than that which would normally be expected in premises similar to the project.
- Become deleterious by being damaged by or causing damage to the structure in which they are incorporated or to which they are affixed.

For the purposes of this document, the word “deleterious” shall be deemed to include any use of materials or combinations of materials that are harmful to human health, harmful to the environment or would or might have the effect of reducing the normal life expectancy of:

- The materials themselves
- Any materials to which they are affixed
- The structure in which they are incorporated or to which they are affixed
- The project or any part thereof to a period less than that which has been specified or would normally be expected

Without prejudice to the foregoing, the following materials shall, in any event, be deemed to be deleterious for the purpose of this contract:

- High Alumina cement or concrete in structural elements
- Woodwool slabs in permanent formwork to concrete or in structural elements
- Calcium chloride in admixtures for use in reinforced concrete
- Asbestos products
- Aggregates for use in reinforced concrete which do not comply with British Standard Specification 882 and aggregates for use in concrete which do not comply with the provisions of British Standard Specification 8110
- Lead or any products containing lead in water piping and pipe fittings which do not comply with BS 869, Part 2
- Products formed using urea formaldehyde
- Products containing expanded polystyrene or other similar combustible materials
- Products containing polyisocyanate foam
- Materials containing fibres less than 3 microns diameter
- Calcium silicate bricks and tiles
- Slip bricks which do not conform to BS 5628, Part 3 and BS 3921
- Tropical hardwoods from a non-renewable source
- Products containing or manufactured using CFC's (chlorofluorocarbons)

- Products containing or used to refill equipment or manufactured using banned F Gases under current F-Gas Regulation
- BCF (Halon) fire extinguishing systems
- Solvents or adhesives that omit noxious vapours which in use and/or over an extended period of time, following occupation of the buildings are detrimental to indoor air quality

3.0 Contractor's Responsibilities and Obligations

3.1 Overview

Certain design responsibilities on the project shall be as detailed in this document. The absence of a design activity does not imply it is not required on the project.

The Contractor shall be responsible for ensuring that the 'Design Intent' indicated on the Contract Drawings is in no way impaired due to deviations or changes in the service routes (e.g. additional bends), plant layout changes, final equipment selections or works undertaken as part of Contractor Design Packages (see Contractor Design Portion section).

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

The Contractor shall include for all plant, tools and vehicles necessary for the execution of the Contract Works and allow for all costs in conveying materials and plant to the site, for moving about the site to suit the progress and conditions of the Works and for later removal.

The Contractor shall be responsible for all works detailed in the Engineering Specifications and in particular the following items:

- Liaising with statutory bodies including those supplying services to the site
- Providing builderswork fabrication and co-ordinated drawings for all services and detailed wiring diagrams for all equipment
- Inspecting all plant, equipment and materials as delivered or where specified at the Manufacturer's works
- Fixing or installing correctly all plant, equipment and materials, in line with the requirements of the standard specifications and manufacturers recommendations.
- The contractor shall be totally responsible for the design of all secondary support systems associated with the works which are required to provide a fully functional installation.
- Ensuring all associated works such as electrical wiring, connecting pipework, builderswork etc., are properly executed and co-ordinated
- Testing, commissioning and setting to work of the complete installation, including making adjustments and balancing as necessary to meet the design intent, or as agreed by the Engineer.
- Demonstrating that the equipment is capable of the performance and method of operation specified to the satisfaction and acceptance of the Engineer
- Providing samples and mock-ups, where requested, of all materials exposed to view in the finished works for comment
- Demonstrating that the overall and completed systems perform correctly in the required manner and as intended by the Specification to the satisfaction and acceptance of the Engineer
- Providing record drawings of the completed installation
- Providing operating instructions and maintenance manuals for the completed systems

- Provide detailed method statements for all testing and commissioning operations.
- Providing a full set of test results in an approved format for all tests, commissioning and balancing operations
- Training of clients' staff
- Nothing less than the requirements stipulated will be accepted without prior approval by the Employers Agent

3.2 Contractor Design Portion (CDP)

The following design and installation elements shall be designed by the Contractor. The Contractor is responsible for ensuring these systems meet the required standards, regulations and performance requirements outlined in the specifications and on the accompanying drawings as well as being fully compatible with systems designed by others. The Contractor shall submit as part of the Technical Submittal process a detailed submission clearly outlining how their design meets the requirements of the contract documentation.

- Installation and fabrication details
- Detailing of builder's work penetrations smaller than 300 x 300mm or 300mm diameter
- Electronic systems generally (fire alarm & detection, public address, CCTV, Security, Fire telephone, ICT, AV, etc.)
- Building-wide radio communication systems including the installation of base stations / antennae
- Pipework expansion, contraction and stress analysis and the design of all support systems, guides, brackets, anchors etc.
- Services Seismic analysis and the design of services movement and seismic isolation
- Siphonic rainwater systems
- Lift and Escalators
- BMS and automatic control systems, including all customised software
- Energy metering and billing systems
- Data / comm's
- Lighting control systems
- Lighting ballasts and drivers
- Fire protection systems (sprinkler, water mist, gaseous type systems, etc.)
- Standby generator fuel storage and distribution systems
- Lightning protection systems
- Irrigation systems
- Refrigerant piping design and sizing
- Water treatment systems
- Underfloor heating and cooling
- Electrical trace heating and freeze protection systems
- Water leakage detection systems

- Firefighting lobby smoke and loading bay ventilation system (including LA approval and CFD studies where necessary)
- Carpark impulse ventilation (including LA approval and CFD studies where necessary)
- Flue discharge design for water heaters; boilers; CHP and generators
- All support systems and bracketry for all MEPH engineering services. Contractor shall prepare and submit calculations for structural engineer approval
- Anti-vibration mountings
- Final selection of acoustic attenuators and insulation
- Secondary metal-work for risers and plant room
- Step-overs and plant access platforms, including riser grillage where applicable
- Final mechanical pressure drop calculations based on Contractor's installation drawings
- Final electrical distribution cable sizing verification and grading studies based on Contractor's installation drawings
- Temporary works in connection with MEPHF & ICT
- All consequential MEPHF & ICT design changes arising from Contractor alternative plant and equipment selection
- Photovoltaic electricity generating systems
- Electric Vehicle Charging Systems

3.3 Co-ordination of Engineering Services

The Contractor shall:

- By fully responsible for the final co-ordination for all MEPF & ICT services
- Agree principles of co-ordination with all parties concerned
- Incorporate details provided by others into the Co-ordinated Drawings
- Provide all necessary details/drawings/schedules etc, required to enable the co-ordinated drawings to be prepared.
- Produce co-ordinated builder's work information and setting out details required for all the building services installation
- Ensure the installation drawings make due allowance for all building elements, insulation, structure and other services
- The Contractor shall be deemed to have included within their tender submission for all services to move by up to 3 metres in any direction prior to installation at no extra cost to the contract
- The Contractor shall ensure all plant and equipment can be safely and easily maintained. Safe access facilities such as ladders and gangways shall be allocated on co-ordination drawings as necessary
- The Contractor shall carry out site measurement to verify on-site building elements dimensions
- Prior to submission check and approve all drawings, schedules and any other information provided by manufacturers, nominated suppliers or specialist sub-Contractors to ensure that all the requirements of the contract documentation have been incorporated. Accompany all documents submitted with a certificate indicating that they have been checked by the Contractor

Particular care shall be taken to obtain uniform and tidy arrangements of wall and ceiling mounted equipment. The precise position of a piece of equipment shall be determined as follows:

- Single items of equipment, which are visually remote from other electrical or mechanical equipment, shall be erected at the mounting heights stated in the Specification or on the drawings
- Two or more items of equipment whether electrical or mechanical or both, which are to be erected on the same wall or ceiling, or which will be otherwise visually close to each other, shall be arranged in a neat and symmetrical group. Symmetry of arrangement shall be obtained by horizontal and vertical alignment through the centre lines and not the edges of the equipment, and for this purpose the mounting heights stated in the Specification or on the drawings may be varied slightly
- The proposed arrangements showing the outlines of all the electrical and mechanical equipment in each group shall be marked on the wall and the approval of the Architect or their representative obtained before any holes or chases are cut out
- All equipment shall be located such that its readily accessible based on both operational and maintenance needs.

3.4 Co-ordination with Direct Procurement Suppliers

The Contractor shall be responsible for coordinating fully with all suppliers of directly procured equipment to ensure complete compatibility of technical interfaces, programme interfaces and commissioning interfaces and specific requirements. The Contractor shall also refer to the contract documentation for further details of responsibilities and requirements.

3.5 Design and Build Contracts

Under a Design and Build contract the contractor shall be responsible for all elements of the design, specification, installation, setting to work, testing and commissioning of the services, to meet all the parameters specified and all the requirements detailed within the specifications, drawings and contract documentation.

The contractor is also responsible for providing detailed design drawings and specifications for all aspects of the services design.

3.6 Samples

The Contractor is to obtain or execute samples of material and workmanship and deposit same with the Employer's Agent at no additional expense to the contract for approval, if required, before incorporating in any part of the work. The Employer's Agent retains the power to reject any materials or workmanship that are, in his opinion, unsatisfactory and not up to standard and the Contractor shall immediately remove or amend such rejected materials or workmanship at his own expense.

The contractor shall submit to the Engineer for comment, such samples of workmanship, materials or equipment which the contractor proposes to use in the execution of the works.

Where, in the opinion of the Engineer and the Employers Agent, the samples submitted are not of a suitable standard, he reserves the right to instruct the contractor to obtain alternative materials or equipment from such a source as the Employers Agent may direct or agree with the contractor.

As an alternative to the provision of samples, the Engineer may at his sole discretion, accept to visit existing installations where the requisite item(s) is installed.

All expenditure in connection with samples shall be borne by the contractor.

The Employer's Agent shall determine whether approved samples are to be retained on site, incorporated into the works or disposed of free of charge.

3.7 Mock Ups

The contractor shall be instructed by the Employer's Agent to take part in construction of mock ups of the works to resolve quality standards, typical arrangements of the works or to resolve pinch point areas.

Where such mock ups are undertaken within the frame of the building in the site of the works pertaining to the mock up, the mock up may form part of the permanent installation only in the event of an issue of an instruction advising the Employer's Agent acceptance for this purpose.

Where such mock ups are constructed away from the works, or materials utilised in a non-permanent mock up, they shall be considered to be samples, i.e. fan coil and associated ductwork and fittings.

3.8 Setting Out

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.

Agree, with Employers Agent, which terminals are subject to final positioning on-site.

Allow for the movement of all such terminals up to a radius of 3.0m from the positions shown on the drawings.

Mounting heights indicated in tender documents are for tender purposes only. Confirm mounting heights with the Employers Agent before commencing work on-site. If the confirmation hasn't been sought by the Employers Agent, the Contractor shall re-locate the item at their own cost at the discretion of the Employers Agent.

3.9 Responsibility for Plant and Equipment

The Contractor shall ensure that the suppliers are provided with all performance data, specification and standards, necessary for the provision of equipment.

Where plant and equipment is pre-tendered the Contractor shall ensure that their tender complies with all relevant technical information contained in the specification irrespective of any pre-tender information suppliers provided to the Engineer.

The Contractor shall give supervision, inspection, and testing reports during manufacture or fabrication at works or on site, as and when required; and is to ensure that delivery, assembly and completion of the order and amendments or modifications thereto comply with the programme.

3.10 Fire Precautions

The Contractor shall include for all necessary materials, goods, work and attendance required to ensure that safe methods of working are followed when using any equipment or materials which may involve danger to life or property.

The Contractor shall particularly safeguard and take all necessary precautions against damage by fire or explosion where the execution of the work may involve the presence of flame or sparks.

All flammable and vaporising liquid required for the works shall be used and stored in accordance with the Regulations governing the storage and use of such products.

When equipment and vessels containing these items are not in use they shall be removed, together with their contents, to a safe place of storage.

3.11 Builder's Work Information

Builder's work is included in the Contract. The final detailing of builder's work is the responsibility of the Contractor, based on the requirements outlined in the contract documentation.

Work such as drilling and/or plugging walls, floors, ceilings etc., for fixings for services is not considered builder's work but is none the less included in the Contract.

The Contractor shall provide Builder's Work Information, appropriate to the stage of design development, and include requirements for foundations, bases, and supporting structures for plant and equipment, including fully dimensioned drawings showing both size and position of builder's work.

Mark out on-site, all cut holes and chases required, any pockets cast in concrete, any inserts, any built in sleeves or similar items.

Holes may not be cut in steelwork, reinforced or precast concrete without written permission from the Employers Agent.

Under no circumstances will holes be cut in pre-stressed concrete. Permitted holes in steelwork must be drilled - burning by means of welding equipment is prohibited.

Where holes of a significant nature have already been agreed with the Architect, the Contractor shall check such builder's work provisions and satisfy themselves that the allowances are sufficient. The Contractor must report to the Employers Agent within seven days of the Contract award, their confirmation of such openings, otherwise they will be deemed to be acceptable.

The Contractor shall bear the full costs of any rectifications carried out due to incorrect work carried out by them.

3.12 Services through Fire Stopping Walls, Floors, etc

Where services pass through fire stop walls or floors, any resulting gaps left around the service and hole in the building structure shall be effectively infilled and sealed with fire resistant material to provide an air tight seal to prevent the passage of any smoke and thus maintain the fire-break. In addition, on pipework systems, proprietary metal decorative pipe covers will be required to be fitted on both side of walls or floors. These shall be attached to the pipe and included in the Tender price.

3.13 Utilities, Water & Fuel

The Contractor shall allow for the electricity, gas, water, oil and fuel required during installation, testing, mock-up, commissioning and demonstration up to Practical Completion, including leaving all water and fuel tanks full.

3.14 Water Sampling

The Contractor shall employ an accredited water specialist to carry out water sampling including, laboratory analysis of the incoming water supply. The water treatment specialist shall advise appropriate site-specific water treatment requirements and procedures. The Contractor shall consult with equipment manufacturers to ensure that product performance and durability will not be adversely affected. Any chemical or device used in water treatment shall be compatible with installed

services. Reports shall be submitted to the Employers Agent for approval. Note: some grades of stainless steel may be affected by the composition of the potable water supply.

4.0 The Site / Existing Buildings

4.1 The Site / Existing Buildings

The site/existing buildings are described in Main Contract Preliminaries.

4.1.1 Existing Mains / Services

The Contractor shall undertake all necessary steps to understand the nature and extent of all existing services within or within close proximity of the site prior to commencing works.

4.2 Risks to Health and Safety

The nature and condition of the site/building(s) cannot be fully and certainly ascertained before opening up. For further information, where available, please refer to:

- Pre-Construction Information Pack
- Existing site Health & Safety File
- Existing site O&Ms
- FM providers Induction Pack

The accuracy and sufficiency of this information is not guaranteed by the Employer or the Employers Agent and the Contractor must ascertain for themselves any information they may require to ensure the safety of all persons and the Works. The Contractor is to include for any additional surveys that may be required to achieve this (e.g. Cranage, ground condition surveys etc).

Comply with the requirements of the CDM Regulations by:

- Compiling risk assessments for the Contract works
- Providing information on the Contract works which might affect the health or safety of any person
- Providing appropriate input to the Pre-Construction Information, Construction Phase Plan, and Health and Safety Files for the works

4.3 Site Visit

Before tendering, ascertain the nature of the site and all local conditions and restrictions likely to affect the execution of the Works.

A site visit may be made by the Contractor. Arrangements for visiting the site must be made with prior agreement with the Employers Agent.

No claim for lack of knowledge in this regard will be allowed.

4.4 Site Survey

Before commencing work, carry out a survey and examination of buildings, structure and engineering services affected by the works.

Examine all available drawings of the engineering services and report any discrepancies to the Employers Agent.

The Contractor shall be responsible for setting out their own works using common datums established within the works by others. Should further datums be required, the Contractor shall establish these for themselves.

4.5 Working in a Live Building

Where the works or some of the works are contained within a live building, the existing building outside the scope of this work shall be kept fully operational.

Method statements shall be submitted to the Employer's Agent and the building manager prior to commencing work.

Contractors are responsible for preparing dilapidation schedules of the existing building services installation and building elements. The schedule shall be agreed with the Employer's Agent prior to the commencement of work.

The Contractor shall obtain permission in writing from the Employer's Agent prior to entering or working in any existing occupied area, or any beneficial use of existing or newly installed vertical transport systems.

The Contractor shall ensure when work is carried out, in or adjacent to existing buildings or areas that the areas and their occupants are allowed to operate in the usual manner during normal working hours. The contractor shall ensure that noise is kept to an absolute minimum particularly during office hours. In the case of dispute it shall be noted that the Employer's Agent decision shall be final.

The Contractor shall include for draining down any existing installation to which connections or alternations are to be made and for refilling, setting to work and re-commissioning such installations upon completion.

The refilling of any pipework systems shall include for chemical treatment and antifreeze agent in accordance with any existing or specified treatment procedures.

Dust sheets shall be used and provided by the Contractor, at their expense, for covering furnishing and carpets etc, when working in areas requiring protection.

4.6 Existing Buildings

The existing building outside the scope of this work shall be kept fully operational.

Method statements shall be submitted to the Employer's Agent and the building manager prior to commencing.

Contractors are responsible to prepare dilapidation schedules of the existing building services installation and building elements. The schedule shall be agreed with the Employer's Agent prior to the commencement of work.

The Contractor shall obtain permission in writing from the Employer's Agent prior to entering or working in any existing occupied area, or any beneficial use of existing or newly installed vertical transport systems.

The Contractor shall include for draining down any existing installation to which connections or alternations are to be made and for refilling, setting to work and re-commissioning such installations upon completion. The Contractor shall be responsible for protecting existing installations that are to be drained down from dirt and moisture ingress and protect against corrosion where necessary by filling drained down systems with inert gas.

The refilling shall include for chemical treatment and antifreeze agent in accordance with any existing or specified treatment procedures.

4.7 Maintenance of Existing Services

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

- Gas
- Water
- Electricity
- Telephones and ICT
- Soil and Waste
- Rainwater
- Fire Alarms
- Life Safety Systems such as smoke extract, fire suppression systems and emergency lighting

Provide safe means of escape through parts of the building still occupied.

Maintain operation of any data, CCTV, external lighting or other services required to kept operational through 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 Employer's Agent.

Make all connections to existing services out of normal working hours.

4.8 Strip-out or Diversion of Existing Services and Utilities

The Contractor shall include for the strip-out or diversion of any existing services or utilities that are required to be undertaken to facilitate the works described in this contract. It is the responsibility of the Contractor to liaise with the Employer's Agent and any utility providers to facilitate this.

4.9 Authorised Engineer/Permit to Work System

The Contractor shall employ an authorised person to carry out electrical switching on site (where relevant). This person shall be solely responsible for the switching, and safe operation of the electrical systems associated with this works package. This shall include safe isolation procedures, HSE Guidance HSG47, Electricity at work-Safe working Practices (HSG85) on underground power cables, and safe energisation procedures.

The Contractor shall operate a permit to work system within all electrical switch rooms and all plant rooms.

The Contractor shall submit the authorised person's certificate, which must be fully up-to-date, together with curriculum vitae of the persons experience to the Engineer for approval.

The Engineer reserves the right to reject this person without prejudice, if he considers this person inexperienced. The Contractor shall submit an alternative authorised person for approval at no extra cost to the contract. This shall continue until the Engineer is satisfied.

All works into and/or affecting live buildings will be carried out under a permit to work system. The Contractor will be responsible for preparing detailed Safe Systems of Work, method statements and associated risk assessments for all of the works.

The Contractor shall allow a 14-day period to obtain approval of all method statements prior to commencing the associated works.

5.0 Tendering

5.1 Summary of Standards

The following table lists the standards relevant to this section. Wherever reference is made to a British Standard (BS), a British Standard Institution harmonized equivalent European Standard may be acceptable if agreed with the Engineer. If the project is not located in the UK, then any British Standard list shall be replaced with the equivalent National Standards. Each type of work/equipment/material selected shall comply fully with the most recent edition of the Standards.

STANDARD	TITLE
BS EN ISO 9001	Quality management systems. Requirements

5.2 Tendering

5.2.1 Scope

These conditions are supplementary to those stated in the invitation to tender and on the Form of Tender and Agreement.

The Contractor shall carefully and thoroughly examine the drawings, specification and all other documentation provided, and fully acquaint themselves with the work to be done, as no allowance for claims will be considered for any alleged deficiency of work or materials. If any work or materials obviously necessary to complete the Works have been omitted to be defined in the Specification, such work or materials shall be provided without any additional payment. Within their costs the Contractor is to make all necessary allowances for any surveys they require in order to complete the works.

The Contractor shall take their own dimensions for both the preparation of their tender and for the execution of the work, and he alone shall be responsible for the accuracy of such dimensions and of drawings made there from. All dimensions specially marked on the drawings shall be rigorously adhered to.

5.2.2 Exclusions

If the Contractor cannot tender for any part(s) of the work as defined in the tender documents, he must inform the Employer's Agent as soon as possible, defining the relevant part(s) and stating the reasons for their inability to tender.

5.3 Pricing/Submission of Documents

5.3.1 Information to be Provided at the Time of Tender

The following information shall be provided by the Contractor in their tender:

- Statement of compliance confirming that the tender is complete and fully specification compliant
- Details of professional consultants employed to undertake the required design services
- A technical proposal for the system(s) which will be installed including method statement for the execution of the works
- A schedule of proposed suppliers/manufacturers of products, equipment and plant, including all items which the choice of manufacture/supplier is at the discretion of the Contractor

- A method statement describing the organization and resources which the Contractor proposed and undertakes to provide to control the quality of the contract works. The statement must include the number and type of staff responsible for quality control, with details of their qualifications and duties
- Where the Contractor proposes to sublet any portion(s) of the contract works a list must be submitted at the time of tender defining such portion(s) and giving for each, the name and address of the proposed Contractor
- The Contractor shall provide the complete working details of all interfaces with other services that he has included within their tender return. Failure to provide such details will result in the tender being void
- A commissioning and testing management plan

5.4 Programme of Works

The Contractor shall generate a programme of works. Where required, this is to be integrated into the Contractors or Construction Manager's Programme of Works. The Contractor's tender must include all necessary shift working/overtime to comply with the required programme as detailed in the main project preliminaries document.

The Contractor will allow in his Tender for the purchase of all materials and equipment from stockists and other suppliers at such time, and in such a manner, as may be necessary to allow for the completion of the work in accordance with the Contract Programme.

The Contractor shall advise prior to entering into the Contract if the delivery programme cannot be met for any item involved.

5.5 Interpretation of Tender Documents

Items, which are described in the Specification and not indicated on the drawings or vice versa, shall be deemed to be included within the contract works. Contractors are reminded that the time for queries or clarification of information in the Specifications or on the drawings is during the tender period. Any doubts as to the full intention of the Specification and Contract Drawings should be raised with the Employer's Agent before the Return of Tender. Thereafter, interpretation as to the intent of the documents will be as defined by the Employers Agent. Claims for additional costs to the Contract due to this procedure being ignored will not be considered for payment.

5.6 Pricing of Performance Specified Work

Ensure tenders include for all work necessary to meet the requirements for the Performance Specified Work and its completion and proper integration with the Works generally.

5.7 Schedule of Rates and Quantities

The Contractor shall, prior to entering into the Contract, submit to the Employer's Agent a full Schedule of Rates inclusive of all material and labour rates and indicating all associated overheads and profits.

The Schedule of Rates shall show in detail the figure numbers, quantities, prices and extensions used in the calculation of the prices and the Contractor shall accept responsibility for the accuracy of any quantities and extensions contained therein. The Schedule shall be priced separately. The Schedule total shall match the agreed Contract price for the works.

The net rates in the Schedule shall be used for measurement and valuation of any alteration, addition to or omission from, the work authorised by the Employer's Agent.

Where it is not practical to apply the net rates in the manner aforementioned, such alterations, additions and omissions as ordered shall be valued at rates or prices as may be agreed with the Employer's Agent.

5.8 Selection of Manufacturers/Suppliers

Where manufacturers, suppliers or installers of products are NOT identified by name select products that comply in all respects with the specification and, as and when requested, demonstrate such compliance. These suppliers shall operate a quality management system which complies with the requirements of BS EN ISO 9001.

Where manufacturers, suppliers or installers of products are identified by name, or names, but no reference is made to "Or equal and approved by the Engineer ", use these exclusively.

If for any reason the Contractor does not wish to offer the services of any of the suppliers specifically named, he may, in the appropriate appendix, offer an alternative indicating what the cost difference would be to their tender. By providing this information it does not relieve them of their responsibility to supply and install the pre- selected equipment specified.

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "Or equal and approved by the Engineer " equivalent alternatives may be selected and shall be submitted to the Engineer for approval. These suppliers shall operate a quality management system which complies with the requirements of BS EN 9001.

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "Or equal and approved by the Engineer " the submitted tender must include the named or one of the named suppliers. Alternatives, which comply fully with the Specification and are not of a lesser quality than the named equipment may be selected and shall be submitted to the Engineer for approval, separately.

Check that any proposed alternatives comply with any stated British (or other equivalent recognised International Standards. 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.

Where the Contractor uses an "approved" alternative, any associated changes in the design and coordination of the associated services and any other aspects of the project shall be the responsibility of the Contractor and any associated costs shall be borne by them.

5.9 Quality Assurance

All Contractors and suppliers are required where possible, to implement a management quality assurance system in accordance with ISO 9001, ISO 9002, ISO 9003 (as relevant to the work involved).

For the purposes of the project, the following categories shall apply:

- Registered Quality Assessed Companies
- Non-Registered Companies implementing documented Quality Assurance Practices
- Non-Quality Assured Companies

Contractors and suppliers shall be registered Quality Assured Companies, registered with a Registered Body accredited by the National Accreditation Council for Certification Bodies (NACCB). Acceptable Registration Bodies, include, but are not limited to:

- Associated Offices Quality Certification
- Construction Quality Assurance
- National Inspection Council Quality Assurance
- Lloyds Register Quality Assurance or any other equivalent body considered appropriate by the Employers Agent

Where Contractors and suppliers are not registered Quality Assured Companies, they shall be required to submit evidence of an implemented Quality Assurance management System to the Employer's Agent. Such evidence could be the Contractors Quality Assurance Manual. Contractors in this category may, at the discretion of the Employer's Agent be required to submit to a quality assurance assessment of their documented management system.

Contractors and suppliers without any formal Quality Assurance System, may prior to appointment be assessed by a Quality Assurance Assessor appointed by the Employer's Agent to determine the management control systems operating within the Company that assess the contract requirements, provide contract control to attain specification requirements.

N.B. Quality Assurance Assessments shall be at the cost of the relevant Contractor or Specialist Contractor in advance prior to the assessment.

5.10 Maintenance of the Engineering Installation

A supplementary proposal for an annual maintenance contract for the works is to be supplied.

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 be considered as part of the tender for the contract works and the employer does not undertake to accept it.

6.0 Drawings & Models

6.1 Summary of Standards

The following table lists the standards relevant to this section. Wherever reference is made to a British Standard (BS), a British Standard Institution harmonized equivalent European Standard may be acceptable if agreed with the Engineer. If the project is not located in the UK, then any British Standard list shall be replaced with the equivalent National Standards. Each type of work/equipment/material selected shall comply fully with the most recent edition of the Standards.

STANDARD	TITLE
BS EN 19650	Building Information Modelling
BS 8541	Library Objects for Architecture, Engineering and Construction
BS 1192-4:2014	Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice
BS 1192+A2	Collaborative production of architectural, engineering and construction information. Code of practice
PAS 1192-2	Specification for information management for the capital/delivery phase of construction projects using building information modelling
PAS 1192-3	Specification for information management for the operational phase of assets using building information modelling
PAS 1192-5	Specification for security-minded building information modelling, digital built environments and smart asset management
ISO 29481	Building Information Models – Information Delivery Manual
CIC	BIM Protocol
UK Cabinet Office	Government Soft Landings
BS EN 19650	Building Information Modelling
BS EN 61082	Preparation of documents used in electrotechnology
BS EN ISO 13567	Technical product documentation. Organization and naming of layers for CAD
BS EN 11091	Construction Drawings. Landscape Drawing Practice

6.2 Summary of Drawing Requirements

The Contractor shall allow for all necessary BIM and Modelling resources for the production of drawings and make due allowance in the programme to revise the drawings as necessary to take account of the design development.

The Contractor is advised that all drawings produced in electronic format shall be in accordance with the BIM Execution Plan.

For Revit projects all manufacturers' drawings for physical equipment shall be produced using the latest version of Revit to allow them to form part of the integrated building model. All schematics shall be produced using the latest version of AutoCAD.

The Contractor is responsible for producing all the following drawings:

- Concept Sketch Drawings
- Concept Schematics
- Developed Design Schematics and Layouts
- Technical Design Schematics and Layouts

- Builderswork Information
- Co-ordinated Working Drawings
- Manufacturers Drawings
- Installation Drawings
- Working Drawings
- Record Drawings

The Contractor shall maintain on site a full set of up-to-date drawings that can be viewed by the Engineer at any time. These drawings shall be updated in line with all amendments issued by the Engineer within 10 working days.

The Contractor shall be responsible for producing all working drawings and shall obtain from their suppliers, detailed arrangement working drawings, builderswork drawings, etc. supplied within the time stated in the Contract Documents. Such drawings are to be submitted to the Employers Agent for comment before delivery or erection of the section or plant commences. The final details, including all technical aspects and calculations where applicable shall be submitted in a clear, definable and easily read format with the specified technical details, notes and performance data clearly shown.

If the Employers Agent or Engineer issues comments on the Contractors working drawings the Contractor shall, within seven (7) days modify the drawings to meet the reasonable requirements of the Employers Agent and the Engineer and reissue them.

Where plant or equipment is to be installed within or adjacent to any building or structure, the Contractor shall take their own dimensions of the building or structure for the purpose of installing any plant and materials which are being supplied and fixed under this contract and shall be responsible for the accuracy of such dimensions. These dimensions shall be used in preference to any noted on the drawings.

All dimensions shown on the drawings shall be checked and verified by the Contractor prior to commencing installation.

All drawings shall be read in conjunction with the Architectural, Civil and Structural drawings, and it shall be the Contractors responsibility to ensure that work is being carried out in accordance with the latest issue of the relevant architects, structural and engineers' drawings.

The Contractor must make every provision for installing the works specified herein to meet the building conditions to provide for every contingency in connection therein.

The Contractor is to prepare and submit for approval of the Employers Agent all detailed drawings of the scheme, plant and any other details necessary for the instruction of their workforce. Should the Contractor fail to comply with the requirements of this clause, they shall be responsible for any works of rectification including associated builderswork, mechanical or electrical work, etc., at their own cost if instructed by the Employers Agent.

The Contractor should note that the Engineers' drawings are prepared to indicate the Design intent for the relevant services and should not adopt these as working drawings. It is the Contractors responsibility to produce their own working drawings. These drawings must be submitted for comment prior to commencement of work and must include the services as depicted on the Engineers' design Intent drawings.

The Contractor shall be responsible for the production of all site co-ordination drawings incorporating all mechanical and electrical services and such drawings will be submitted for comment as noted

previously. In addition, the Contractor shall be responsible for carrying out any alterations to their working drawings due to revisions to the architectural or structural layout. Alterations to the Services' Installations will be forwarded to the Contractor in sketch or drawing form and it will be the Contractors responsibilities to update their Revit model and drawings and issue revised drawings to the Employers Agent one week from receipt of the Engineers' revised drawings.

Contractors working drawings shall be produced for all services described inclusive of, but not restricted to, the following:

- Ductwork manufacturers drawings
- Specialist Automatic Controls Schematic and Wiring Diagrams
- Working drawings of services general arrangement along with plant room layouts for boilerhouse, ventilation plant rooms, chilled water plantrooms, switchrooms, etc. Services drawings to be 1:50 scale and plant room details 1:20 scale
- Working drawings of all electrical installations along with plant room details, General electrical drawings to be 1:50 scale and plant room drawings 1:20 scale
- Schematic drawings
- Builderswork drawings including details of plinths, bases, brackets, wall and floor openings, roof openings, including fan curbs and trimmer requirements
- Details of access requirements throughout, suitable for testing, commissioning and maintenance
- Relevant openings required in suspended ceilings, together with access requirements suitable for testing, commissioning and maintenance
- Schedule of electrical requirements listing manufacturers specific data associated with all electrical plant and equipment being provided by the Contractor
- Air handling unit manufacturers dimensioned arrangement drawings
- Boiler manufacturers dimensioned arrangement drawings
- HWS calorifier manufacturers drawings
- Cold water storage tank drawings
- All packaged equipment certified drawings including chillers, fan coil units etc
- Electrical panel wiring diagrams

6.3 Summary of Modelling Requirements

Where BIM (Building Information Modelling), will be used during the project, it shall be in accordance with the project BIM Execution Plan and the requirements of BS EN 19650.

For library objects for architecture, engineering and construction classification comply with:

- BS 8541-1
- BS 8541-2
- BS 8541-3
- BS 8541-4

2D symbols will be used as per BS 8541-2.

Information delivery as BS ISO 29481-1.

Comply with BS 1192 for collaborative production of information.

Comply with PAS 1192-2:2013 Specification for Information Management for the Capital/Delivery/Phase of Construction Projects using Building Information Modelling.

6.4 Preparation of Drawings

The Contractor shall prepare drawings to commonly recognised scales generally on A1 sheets and details and schedules on A4 sheets.

Agree scales, drawing sheet size and format with the Employer's Agent before preparing any documents.

Agree with the Employer's Agent the document numbering/registration system to be used before preparing any documents.

Use symbols and line conventions in accordance with the project BIM execution plan.

Prepare electrical drawings in accordance with BS EN 61082-1.

The Contractors drawings, including Manufacturers Drawings, shall be submitted to the Engineer for their appraisal, prior to the works commencing, and the Contractor shall allow in their programming for such submission and / or re-submission as required.

The Contractor shall submit drawings for the design team and client in the following forms:

- Initial copies for comment
 - PDF format
 - CAD format
 - RVT format (if applicable)
 - BIM360 (if applicable)
 - Comply with BS EN ISO 13567-1
 - Comply with BS EN ISO 13567-2
- Final copies for final distribution
 - PDF format
 - CAD format
 - RVT format (if applicable)
 - BIM360 (if applicable)
 - Comply with BS EN ISO 13567-1
 - Comply with BS EN ISO 13567-2

The drawings will be checked to ensure that they do not contradict the Design Intent and comment by the Engineer will be so limited. Drawings should be issued through the Technical Submittal process, an allowance of 10 working days should be made for such appraisal.

The Contractor shall be responsible for dimensioning, setting out, detailed co-ordination of the services within the scope of their Contract. Should the details shown on the Contractors drawings necessitate a variation in cost, then this must be advised to the Employer's Agent when the initial submission is made for comment.

Unless specifically noted as such the Engineer's comment will not constitute any variation in cost to the Contract or any variation in programme.

The Contractor shall be responsible for any omission, errors or any discrepancies in the drawings and other particulars supplied by them or their suppliers, whether or not such drawings or particulars have been commented upon by the Engineer. This responsibility shall hold unless such omission, errors or discrepancies are due to inaccurate information of particulars provided in writing to the Contractor by the Engineer.

Comments on any drawing by the Engineer shall not mean that the Engineer is responsible for the correctness of the drawing or its suitability for purpose. These responsibilities shall remain with the Contractor.

The Contractor shall also be responsible for updating their drawings and model, on a weekly basis, with the installation progress as installed. These drawings/models shall be kept up to date at all times together with any amendments or variations to the works, which shall be recorded upon them. Failure to keep the record drawings/model up to date will result in a deduction on the monthly valuation.

The drawings and documents on site shall be available for inspection by the Engineer at all times.

6.4.1 Contractor's Mechanical Services Schematics Minimum Level of Detail

DRAWING CONTENT	DETAIL
No of main plant items/components	✓
System configuration complete with all system components	✓
All pipe work and ductwork sizes	✓
All plant and component references	✓
All valve unique identifiers	✓
Component references such as commissioning sets, supply air grilles, extract grilles	✓
Directional flow arrows on all pipe work and ductwork	✓
Controls sensors	✓
Flow rates at all balancing or metering points	✓

6.4.2 Contractor's Electrical Services Schematics Minimum Level of Detail

DRAWING CONTENT	DETAIL
System configuration complete with all system components	✓
All protective and control relays	✓
All panel lamps	✓
All current transformers and metering requirements	✓
All interlocks/key interlocks	✓
Cable references for all cables	✓
All plant/panel/breaker references etc	✓
Breaker/switch/fuse frame sizes	✓
No. of poles and presence of motor operators	✓

DRAWING CONTENT	DETAIL
Breaker fault ratings	✓
Breaker types (draw-out/plug-in/fixed)	✓
Breaker normal positions	✓
Protection settings for all protective devices, relays etc	✓
Settings of time delay control devices	✓
Prospective short circuit currents at all panels	✓
Earth fault and cance level at all points	✓
Maximum demand values at each panel	✓
Nominal and fault ratings of all busbar systems	✓
Earth bars and arrangements	✓
Neutral sizing and neutral earth links	✓
Surge protective devices	✓
Spare devices/capacity	✓
Interfaces to other panels and systems (BMS/SCADA)	✓
Ancillary equipment (PFC/AHF etc.)	✓

6.4.3 Contractor's Mechanical Services General Layouts Minimum Requirements

DRAWING CONTENT	DETAIL
Main plant locations	✓
Main service distribution routes	✓
Riser locations	✓
Weights and dimensions of major plant items	✓
All pipe work and ductwork sizes	✓
All plant references	✓
All System components such as valves, dampers, grilles, test points etc.	✓
Component References such as commissioning sets, supply air grilles, extract grilles, etc.	✓
Directional flow arrows on pipe work and ductwork	✓
All services support systems	✓
Sections & details to illustrate coordination	✓
Builderswork in connection with services	✓

6.4.4 Contractor's Electrical Services General Layouts Minimum Requirements

DRAWING CONTENT	DETAIL
Main plant locations & Critical setting out dimensions	✓
Main service distribution routes & sizes	✓
Riser locations & details	✓
Weights and dimensions of major plant items	✓
All cable tray, trunking, etc. size	✓
All plant references	✓
All circuit references	✓

DRAWING CONTENT	DETAIL
Cable details on containment (i.e. cable numbers to ensure separate routing of A & B system cabling)	✓
Cable references	✓
Light fittings with references, lamp orientation & emergency lighting	✓
Lighting control details with circuit references	✓
Smoke detectors indicating type of detector	✓
Fire alarm sounders, beacons & ancillary devices	✓
HSSD Detection systems	✓
Small power layouts with circuit references	✓
Public Address speakers, microphones & wiring details	✓
SCADA/EMS system equipment locations & wiring details	✓
Sections & details to illustrate coordination	✓
Lightning protection system tape routing, bonding & earth points	✓
Builderswork in connection with services	✓
All services support systems	✓

6.4.5 Plant Room Layout & Sections Minimum Requirements

DRAWING CONTENT	DETAIL
All Plant Positions	✓
All Valves, Dampers, components etc.	✓
All Pipe work and Ductwork Sizes	✓
All Plant References	✓
All Services Support Details	✓
Directional Flow Arrows on Pipe work and Ductwork	✓
Maintenance Access Requirements	✓
Standard Drawing Notes	✓
All Cable References	✓
Sections through Cable Ladders showing Cable Details and Phase Rotation	✓
Switch Panel Elevations	✓
All services support systems	✓
Sections & details to illustrate coordination	✓
Builderswork in connection with services	✓

6.5 Drawing Types

Concept sketch drawings, concept schematics, developed design drawings, developed schematics, technical design drawings, builder's work information, co-ordination/co-ordinated working drawings, installation drawings, builder's work details, manufacturer's drawings and record drawings are as defined in BSRIA BG 6.

6.6 Concept 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 and with respect to any zoning.

6.7 Concept Schematics

Line diagrams indicating main items of plant and their interrelationships in such detail as to illustrate the incorporation of the engineering services within the project as a whole.

6.8 Developed Design Drawing

A drawing showing the extent of the services installations. The main features of developed design drawings should be as follows:

- Plan layouts to a scale of at least 1:100
- Show the extent and types of services terminals visible within the occupied space
- Show approximate locations of horizontal and vertical service runs
- Show plant and distribution system sizes, particularly those affecting spatial allocation, while acknowledging that these may need some adjustment and refinement in the operation of the detailed design drawings and equipment schedules
- Pipework and electrical containment represented by single line layouts. Ductwork represented by either double line or single line layouts as required to demonstrate that the routes indicated are feasible. Symbols and lines conventions in accordance with either a recognised standard (ISO or BS), or a supplied legend.

6.9 Developed Schematics

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

- The drawings should include all the functional components that make the system work, such as ducts, pipes, cables, busbars, plant items, pumps, fans, valves, dampers, control devices, terminals, electrical switchgear and components, security and fire sensors and control equipment
- Symbols and line conventions in accordance with BS EN ISO 11091 recommendations for symbols and other graphic conventions
- Symbols and line conventions in accordance with project BIM Execution Plan
- Label the drawings with appropriate pipe, duct, busbar and cable sizes, pressures and flow rates
- Label the drawings with project document reference system as defined in the project BIM Execution Plan
- Indicate components which have a sensing, control or measurement function
- The major components indicated on the schematic drawings should be identified for cross-referencing purposes

6.10 Technical Design Drawing

A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design. The main features of technical 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 nevertheless be feasible to install the services within the general routes indicated. It should be possible to produce co-ordinated working drawings or installation drawings without major re-routeing of the services.

6.11 Builder's Work Information

A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works.

Drawings (or schedules) of work to be carried out by building trade and required to be costed at the design state e.g. plant bases.

6.12 Co-Ordinated Working Drawings

Drawings showing the inter-relationship of 2 or more engineering services and their relation to the structure and building fabric. The main features of a co-ordinated 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
- The drawing should be spatially co-ordinated and there should be no physical clashes between the system components when installed. Critical dimensions, datum levels and invert levels and pipework installation gradients (where applicable) should be provided
- The spaces between pipe and duct runs shown on the drawing should make allowance for the service at its widest point. Allow for insulation, standard fitting dimensions and joint widths on the drawing
- 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 or spatial constraints

6.13 Installation Drawing

A drawing based on the technical design drawing or co-ordinated working 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 per co-ordinated working drawings plus:

- Allowances for inclusion of all supports and fixings necessary to install the works
- Allowances for installation details provided from manufacturers' drawings
- Allowances for plant and equipment. This includes any alternatives to the designer's original specified options that have been chosen

6.14 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.

6.15 Builder's Work Details

Drawings to show requirements for building works necessary to facilitate the installation of the engineering services. Unless agreed otherwise, the following can be marked out on-site:

- Holes less than the threshold agreed by the team.
- Electrical socket and switch boxes
- Openings that are best cut into blockwork or partitions

6.16 Manufacturer's Drawing

Drawing prepared by a manufacturer, fabricator or supplier for a particular project and which is unique to that project. Examples include drawings for ductwork, prefabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring, prefabricated plant, customised plant and equipment.

6.17 Controls 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 control's operation and details of the associated interlocking
- Panel layouts, schedules and bill of materials to include suppliers and part numbers for each component
- Wiring diagrams and termination schedules for panels and junction boxes
- Software control logic drawings in paper or electronic format
- Description of operation detailing permissive to start, start up, shut down and any associated interlocking

6.18 Switchgear, Starter and Control Instrumentation Panel Drawings

Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices, including field controls and signal cables.

All circuit and layout diagrams shall include explanatory notes and shall show the required sizes and type of all cables with the rating of such items on fuses, switches, etc.

6.19 Working Drawings

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

6.20 Record Drawings and Schedules

Drawing showing the building and services installations as installed at the date of practical completion.

Prepare Record Drawings as defined in BSRIA BG 6/2018 and Schedules. Drawings shall be at a scale not less than 1:50 from the Installation Drawings maintained on-site as the Works progress. Endorse all such documents 'RECORD DRAWINGS'. Where agreed with the Employer's Agent certain detailed information may be provided in schedule form. Prepare electrical drawings in accordance with BS EN 61082-1

Each record drawing shall show the following information:

- The name of the contract and, where appropriate, the zone or floor designation
- Description of drawing, drawing numbers and scale
- Name and address of the Contractor and the Consulting Engineer
- The completed Record Drawings and Schedules shall be signed by the Contractor as record drawings and shall be submitted to the Engineer at the same time as the operating and maintenance manual is handed over for comment

The Contractor shall provide reduced scale copies for inclusion in the operating and maintenance manuals.

Record Drawings and Schedules shall include, but not be limited to:

- Use a scale not less than that of the installation drawings
- Include locations of all the mechanical, electrical and public health systems and components installed including ducts, pipes, cables, busbars, plant items, pumps, fans, valves, dampers, control devices, strainers, terminals, electrical switchgear and components, security and fire sensors and control components
- Labelled with appropriate pipe, duct and cable sizes, pressures and flow rates
- 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
- Location, including level if electron, of Utility Service connections, including those provided by the appropriate Authority, indicating points of origin and termination, size and material of service, pressure and/or other relevant information
- Disposition and depth of all underground systems
- Schematic drawings of each system indicating principal items of plant, equipment, zoning, all naming, means of isolation, etc. in sufficient detail to make it possible to comprehend the system operation and the inter-connections between various systems
- Details of the principles of application of automatic controls and instrumentation
- Diagrammatic dimensioned plans and sections of each system or service showing sizes and locations of all ancillaries, plant, equipment controls, test points, and means of isolation etc. including any items forming an integral part of the engineering systems provided by others (such as plenum ceilings, builders' work shafts, chimneys etc.)
- Identification of all terminals/cables etc. by size/type and duty/rating as recorded from the approved commissioning results
- Detailed wiring drawings/diagrams/schedules for all systems, including controls, showing origin, route, cable/conduit size, type, number of conductors, length, termination size and identification, and measured conductor and earth continuity resistance of each circuit
- Ensure routes indicate if cable/conduit is surface mounted, concealed in wall chase, in floor screed, cast in-situ, above false ceiling etc
- 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
- 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
- Location and identity of each room or space housing plant, machinery or apparatus

- The layout, location and extent of all air ducts, including those formed in builders work or otherwise outside the contract, showing dampers and other equipment, acoustic silencers, grilles, diffusers, other air terminals, balancing dampers, access panels, fire dampers, turning vanes, hand holes, test holes, gauges and instruments
- All necessary sections, elevations, isometrics and schematics of the plant spaces
- Dimensioned plans and sections at a scale of 1:20 shall be provided of plant rooms, service subways, trenches, ducts and other congested areas where in the opinion of the CA smaller scale drawings cannot provide an adequate record

The Contractor shall provide manufacturers' drawings of equipment indicating but not limited to the following:

- 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
- 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
- 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
- Each spare input and output point including reference, type of input/output and space for future entry of appropriate parameters as listed above
- 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
- Schedules setting out details of all initial values of user-defined variables, text statements for alarm messages etc

All Record Drawings are to be collated with the O&M manuals. With 2x paper copies onsite plus an electronic copy with both pdfs and native file formats.

6.21 Plant Room and Switch Room Drawings, Schedules and Schematics

The Contractor shall provide good quality plant and switch room drawings, schedules and schematics, in English as well as local language, where applicable.

The Contractor shall provide A1 sized, non-fading prints, fixed in a glazed hardwood frame in the switch rooms and plant rooms of the following:

- Schematic drawings of circuit layouts showing identification and duties of equipment, numbers and locations, controls and circuits
- Schematics of each pipework system showing identification and duties of equipment and all valves, sensors, gauges, test points, etc
- Valve schedules in the form of printed sheets showing the number, type, location, application/service and symbol, and normal operating position of each valve
- Control schematics

- Location of mechanical and electrical plant and equipment items
- Location of isolating switch for electricity supply
- Location of main incoming gas valve serving gas meter
- Location of sprinkler fire main control valve
- Typed circuit charts for all distribution boards, showing distribution board reference, earth fault loop impedance at DB's, size and length of all cables including CPS's design current, type and rating of all protective devices and the names of all points served, and their locations. In addition, indicate source of the supply cable. Enclose these charts in sturdy transparent protective folders and fix them with nuts and bolts, self tapping screws, pop-rivet or other approved mechanical fastening into the inside cover of the DB. Ensure fixings do not reduce clearance to live or moving parts
- Plantroom layout showing the location of all plant and equipment items including plans and elevations of main switchgear showing physical disposition of switches
- First aid instructions for treatment of persons after electrical shock
- All other items required under Statutory or other regulations
- Locations of all EPOs
- Location of all incoming service isolating and metering facilities
- Emergency operating procedures and telephone numbers for emergency call out service applicable to any system or item of plant and equipment.
- Location of interface with renewable energy generating equipment such as Photovoltaic Systems

7.0 Technical Submittals

7.1 Preparation of Technical Submittals

At the project outset the Contractor shall provide the Engineer and the Employers Agent with a schedule of Technical Submittals along with dates that they will be issued and dates for the return of comments. This is required by the Engineer to plan the associated resource in order to meet the 10-working day return of comments requirement. If a schedule of Technical Submittals has not been shared with the Engineer at the outset, the Engineer may not be able to return comment in the required timescales.

Technical submittals are to be provided for all plant and equipment being procured by the contractor as well as for all design activities being undertaken by the contractor. This may include specifications, calculations or equipment submittals.

On each Technical Submittal the Contractor shall confirm that the equipment is fully compliant with the drawings and specifications. Unless explicitly stated on the front page of the technical submittal, all materials, equipment, systems, etc. shall be deemed to be fully compliant with the specifications and drawings. Any review, comments, acceptance, or approval of the technical submittal does not remove the responsibility from the Contractor to provide an installation fully compliant with the Specifications and Drawings.

Technical Submittals are to be concise and are only to include material relevant to that topic of the submittal. The Engineer reserves the right to reject submittals that contain excess un-necessary information or don't have a compliance statement. The contractor may be liable for additional fees to be paid to the consultant for their time to review Technical Submittals if the Contractors submittals are persistently rejected due to not meeting the requirements of the project or contract documentation.

7.2 Specifications

The Contractor shall generate Mechanical, Electrical and Public Health Services design intent documents describing in detail how systems are intended to work and be commissioned including set points of equipment and systems, relay and protective devices;

As part of the Building Management System submittal the Contractor is to provide points schedules, detailed description of operations and control schematic wiring diagrams for each mechanical services control panel.

7.3 Calculations

Calculations shall be clearly and concisely set out and shall be sub-headed to identify the exact section of the works to which they refer.

The calculations shall be issued to the Engineer for comment.

Inspection or approval of any of the Contractor's calculations, whether verbally or in writing shall in no way alleviate the Contractor's responsibility or obligations in ensuring the correct performance and safety aspects of the mechanical and electrical services installation. It shall not be deemed to affect the Contractor/Client design warranty.

7.4 Mechanical Calculations

The Contractor shall carry out pipework and ductwork system resistance calculations based on the final installation drawings arrangement and selected equipment and components.

The calculations shall be performed by approved software such as Hevacomp (latest version) and submitted to the Engineer for comment.

Where the contractor has further design responsibilities the following calculations are to be provided where required.

- Mechanical load schedules in spread sheet format.
- Heating system calculations
- Cooling system calculations
- Fresh air ventilation rates
- Pipe sizing calculations
- Duct sizing calculations
- Air condition plant and equipment selection calculations
- Heating plant and equipment selection calculations
- Ventilation plant and equipment selection calculations
- Refrigerant pipework, plant and leak detection calculations
- Domestic hot water plant and equipment selection calculations
- Potable and cold water system plant and selection calculations

7.5 Electrical Calculations

A co-ordination study shall be carried out to verify the complete protection grading and settings for the installation to complete electrical distribution system, including all connected equipment.

The report shall methodically present the following fault calculations:-

- General description of calculation methods, assumptions and base per unit quantities selected.
- One-line equivalent circuit diagrams that detail the service impedance data, including impedance and resistive ratios and source characteristics.
- Calculations of three phase symmetrical and earth fault currents at each switchboard, motor control centre and distribution board.
- Electrical load schedules in spread sheet format.
- Diversities at sub and main distribution points, used to ascertain load and maximum demands.
- Calculations for current carrying conductors to show assumed electrical load, rating of circuit protection, current carried, length of conductors, grouping factor, installation conditions and volt drop.
- Calculations for sizing protective conductors for all mains, sub-mains and sub-circuits.
- Distribution boards schedules showing item/area supplied, load (watts and current), cable size to type, rating and type of protective device.

7.6 Fire Safety Systems and Specifications

The contractor shall provide the following submittals where required: Fire services schematics, cause and effect matrix and Smoke control system strategy.

These documents shall be issued to the Engineer for comment as part of the technical submittal process.

7.7 Plant and Equipment Submittals

The Plant and Equipment submittals shall consist of manufacturer's literature, which technically describes the performance of the equipment, manufacturers drawings, and photographs, which illustrate the appearance of the equipment.

Details of the equipment as selected for inclusion into the Works and shall include, in a format to be agreed, the following information:

- Statement of compliance
- Plant item description, reference identification and serial number
- Capacity – kW, kg/s, m3/s, etc
- Electrical input rating – kW, kVA, Volts, Phases, etc
- Electrical Short Circuit withstand
- Operating mode - duty, standby, etc
- Starting characteristics - starter type, current, starts/hour and starting time
- Performance characteristics - (full load current, power factor and harmonic emissions and immunity)
- Noise level
- Size and Weight
- Environment (temperature, humidity, ingress protection, Corrosion, Seismic, Vibration)
- Environmental Product Declaration (EPD) Certificates including information on the Embodied Carbon and details of how the product/equipment can be recycled at end-of-life

As part of the technical submittal process suppliers are to provide details of their service base which will service the location of the project including number of personnel with the required experience for servicing this equipment.

Technical submittals should also include a schedule of recommended spares, this should be addressed to the Employers Agent.

7.8 Review of Technical Submittals

All information associated with this works package shall be submitted to the Engineer for review prior to any works on the respective systems commencing.

The Contractor shall allow in the programme for any technical submissions to be commented on and returned within 10 working days of the submission. Technical submissions are to be submitted through the electronic document management system for the project. The comments on the documentation shall be accompanied by a submission review status as follows:

- Status A - The submission has been reviewed with no comments. The supplier/Contractor retains responsibility for compliance with the specification.
- Status B - The submission is returned with comments. The supplier/Contractor may proceed if the comments are incorporated and a follow-on submission is not mandatory. The supplier/Contractor retains responsibility for compliance with the specification.

- Status C - The submission is rejected with or without comments. The supplier/Contractor must review and re-submit before progressing. The supplier/Contractor retains responsibility for compliance with the specification.

Review of any technical submittals will be carried out by the Engineer for general conformance with the Design Intent and general compliance with the Contract Documents. Such review does not relieve the Contractor of contractual obligations including ensuring that the work is compliant, complete, accurate and correct.

7.9 Manufacturers References

Manufacturers' references are those current at the time this tender document was last revised. References mean the particular product as specified in the manufacturer's technical literature current at that time.

7.10 Manufacturers Information

The Contractor shall include the relevant manufacturers technical information for the equipment being reviewed in the submittal. The manufacturers information shall not be in the form of a generic catalogue but shall be specific to the model being proposed and the design conditions specified. Technical submittals with generic catalogue information shall be rejected.

7.11 Method Statements

The Contractor will be responsible for preparing detailed method statements and associated risk assessments for all works.

The Contractor shall allow a 14-day period to obtain agreement to all method statements prior to commencing the associated works.

The Contractor shall allow to sequence the works to ensure that downtime of any existing installations is avoided where at all possible. If equipment shutdowns are required, these shall be highlighted at the earliest opportunity for Client approval.

8.0 Works Execution

8.1 Project Quality Plan (PQP)

The Contractor shall produce a project quality plan for the building services works within four weeks of contract appointment. The plan shall as a minimum contain the following information:

- A statement on how the quality plan will be controlled i.e. the revision and update mechanism
- Quality auditing procedures
- Key staff contact list. The names, addresses, telephones numbers and email addresses of the key staff involved in carrying out the building services work including the Contractor's staff, consultants, building services Contractors staff and all the specialist suppliers and manufacturers staff
- A statement allocating responsibilities for the key staff involved in project work
- Organograms of all the Contractors, consultants and specialist suppliers project structures
- Organograms shall extend from the person with project ownership in the company down to site staff
- A programme for the engineering works. The initial submission shall contain a high level programme with series of separate work activity programmes behind it that highlight the trade activities and milestones associated with the system or area of work. The programme shall be integrated with the main contract programme. The commissioning programme shall be prepared and agreed with the Main Contractors commissioning specialist
- A method statement breakdown structure, e.g. general activities, pipework installation, insulation installation, etc
- A schedule for all meetings associated with the engineering services works
- The design management procedures and description of the design development process
- A construction design information submission programme
- The engineering services work package break down structure
- A pack of standard forms, e.g. requests for information, test certificates, inspection certificates, etc.

The Contractor shall include procedures for all the main construction activities including:

- Procurement including a work package breakdown
- Off-site manufacturing, inspection and testing
- Packaging, delivery, unloading and storage on site
- Protection of the works
- Requests for Information
- Site supervision
- Site inspection
- Testing

- Commissioning
- Progress payments
- Handover

The project quality plan will remain a “live” document throughout the construction period with all the sub-Contractors and specialist suppliers adding to it.

The document will be “owned” by the Contractors work package Project Manager and it will be that person’s responsibility to update the document and ensure that all copies in circulation are current. Current copies of the project quality plan shall be issued to the Main Contractor Engineering Services Manager and form part of the project PQP.

8.2 Co-Operate

Co-operate with the Main Contractor, other Sub-Contractors, suppliers, local authorities and statutory undertakings in the execution of their work.

8.3 Supervision Requirements

The Contractor shall include in the Tender the provision of all necessary supervision during the execution of the works. The Contractor shall employ constantly on site, a competent Foreman in charge to manage and direct the execution of the works and he shall on behalf of the Contractor, receive and have charge of all drawings and documents which may be delivered or given for use by the Contractor.

The Contractor shall also include supervision, management and organisation by a competent engineer in addition to their Foreman-in-Charge of the works, who shall be considered to be the duly accredited representative of the Contractor, empowered to take instructions from the Employer’s Agent and to execute same. This engineer must be in attendance at the premises until the whole of the works have been completed and passed by the Employer’s Agent and shall instruct and give all information regarding the operation of the installation to the Employer’s representative.

The Contractor shall ensure that supervision is of a high standard embracing quality of workmanship, interpretation of and compliance with specification and current drawings, to ensure a satisfactory installation in all respects.

The Contractor shall provide the necessary full and part time technical staff to ensure that the works are carried out to meet the technical specifications and the project programme including all phasing requirements.

The Contractor shall be responsible for ensuring that their specialist technical representatives are available to attend meetings when required.

8.4 Meetings

The Contractor shall attend co-ordination meetings with other Contractors, suppliers and the client team and agree co-ordination not only relating to the sequence of installation and operation but also to the preparation of working drawings which will fully reflect the agreed co-ordinated information.

The Contractor shall include within their tender for attendance at commercial, site progress meetings, co-ordination meetings and commissioning meetings throughout the duration of the contract.

Each Contractor shall attend site meetings as required and prior to the meetings, shall provide a detailed technical report for each site meeting which shall include the following:

- Works' progress/programme
- Procurement items
- Resource schedule
- Technical issues
- Any other issues
- All parties attending the site meetings shall be able to understand all of the technical issues and be capable of answering the issues at the site meeting.

8.5 Programme/Progress

The contractor shall prepare a detailed programme for the works, and submit it for approval within two weeks of commencement of the contract. The programme shall fully co-ordinate with the Main Contract programme, materials procurement and the needs for liaison with other work package contractors.

The Contractor shall obtain detailed sub-programmes from sub-Contractors and vendors to assist the Main Contractor in producing a Master Programme for the Contract Works

Due allowance shall be made in the programme(s) for the Works for, but not limited to, the following:

- Ordering and installation periods
- The completion of drawing, etc. including the minimum 14 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 follows:

- Simple bar chart type
- Critical path network

Provide a separate and detailed commissioning programme for agreement with the Employer's Agent. 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 10 working days
- Demonstration to the Employer's Agent that test instruments and equipment are accurate
- Any off-site equipment factory acceptance tests
- Provision of temporary utilities or equipment (e.g. load banks)

The Contractor shall review the programme on a weekly basis and update the programme as necessary. If any circumstances arise that affect the progress of the works the Contractor shall immediately notify The Project Manager and advise solutions to resolve the issues.

Additional costs resulting from non-compliance with the above shall be borne by the Contractor.

8.6 Site Access

Generally, access to the site, working hours and storage facilities shall be agreed with the Employer's Agent at the pre-contract site meeting and as detailed in the main preliminary document. However, certain restrictions may be applicable to the project and the Contractor shall include within their tender for any restrictions on access, working hours that may be imposed by the Local Authorities and as indicated in the Contract Preliminaries.

The Contractor is especially requested to examine the means of access and approach to the site, and the local conditions, as no extra cost will be allowed on the grounds of lack or absence of information in this respect.

The Contractor shall be responsible for obtaining his own information on all matters, which can in any way influence the Contract works.

No claim will be considered arising from want of knowledge in this respect.

8.7 Working Hours

The Contractor and all of his Sub Contractors/Specialist Suppliers shall be deemed to have included for working all hours necessary to complete their works on programme.

All weekend working and multiple shifts working as necessary shall be deemed to be included within the returned tender submissions to complete the project on programme.

Refer to relevant section in the main preliminary document.

8.8 Noise/Nuisance

The Contractor is responsible for carrying out the work with as little noise as possible and with no nuisance. The Contractor shall fully comply with the requirements of the Environment Protection Officer.

It shall be the responsibility of the contractor to ascertain from the Authorities concerned, prior to the submission of his tender, whether the requirements and restrictions relate to hours of working permissible, maximum noise levels not to be exceeded, methods of working and/or type of plant to be employed.

The contractor shall comply with all requirements and restrictions, which may be imposed and shall allow for the cost of such compliance and all resultant programme requirements.

The Contractor shall take all necessary precautions to prevent nuisance from smoke, rubbish and other causes.

The Contractor shall fit all compressors, percussion tools and vehicles with effective silencers of a type recommended by manufacturers of the equipment.

8.9 Dimensions

Where installations are dependent upon site dimensions, ensure that these are available before proceeding with the Works.

Do not take dimensions by scaling from the drawings.

Where dimensions are indicated on drawings check these on-site, as appropriate, to ensure building construction and manufacturing tolerances can be accommodated.

Do not order or manufacture equipment using dimensions indicated on the tender drawings, specification or schedules.

8.10 Setting out for the Contract Work

The Contractor is responsible for final co-ordination and setting out of all equipment and services.

Where this is done by the Main Contractor check its accuracy and obtain their approval before proceeding with the work.

8.11 Off Site Prefabrication

Where possible, the Contractor shall make use of offsite prefabrication for the assembly of pipework, ductwork components, etc. prior to site works starting.

At the time of Tender, the Contractor shall identify off site prefabrication works and also advise where this work is to be carried out so that the Employer's Agent or the Engineer can regularly inspect the works.

8.12 Site Built Assemblies

Site built assemblies shall only be used following approval by the Engineer.

The Contractor shall ensure that components of site assemblies are part of a proprietary system and type tested as appropriate.

8.13 Site Modifications

Do not make site modifications to assemblies without authorisation.

Where site modifications to assemblies are authorised, make in accordance with manufacturer's certified drawings and instructions.

Ensure that modifications made comply with any type test certificate obtained for arrangement of components.

8.14 Ordering of materials and products

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

Avoid delays by submitting details of alternative manufacturers or types of materials/products to the Employer's Agent 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 substantial completion, or completion of any part thereof caused by delays in ordering will be accepted.

8.15 Responsibility for Plant and Equipment

The Contractor shall ensure that the suppliers are provided with all performance data, specification and standards, necessary for the provision of equipment suitable for the specified duty and purpose.

Where plant and equipment is pre-tendered the Contractor shall ensure that their tender complies with all relevant technical information contained in the specification irrespective of any pre-tender information suppliers provided to the Engineer.

The Contractor shall give supervision, inspection, and testing reports during manufacture or fabrication at works or on site, as and when required; and is to ensure that delivery, assembly and completion of the order and amendments or modifications thereto comply with the programme.

8.16 Delivery, Handling and Storage of Materials

The Contractor shall be responsible for accepting delivery of and storing on site, all materials appertaining to their works and shall provide adequate and safe storage and protection for all new materials, plant and equipment provided and/or installed by them.

8.16.1 Delivery

- Provide an adequate and safe protection for all materials and products during transport to site
- Deliver all ductwork, tubes, conduit, trunking and associated equipment with open ends effectively plugged, capped or sealed
- Threads protected by means of purpose made end caps

8.16.2 Handling

- Offload and transport about the Works all materials and products as recommended by manufacturers

8.16.3 Storage

- Store all materials and products as recommended by manufacturers
- Provide sufficient, safe and secure storage for all materials and products
- 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
- Pipework and similar materials shall be adequately supported and stored on properly made racks approved by the Engineer to prevent bending and distortion. The ends shall be closed and threads protected by means of purpose made end caps
- All tubes, conduit, trunking and associated equipment with open ends shall be effectively plugged, capped or sealed.
- The storage of pipework or other materials by laying them on earth, tarmac, concrete, etc., will not be permitted

- Where materials, plant and equipment cannot be stored in suitable buildings, the Contractor shall provide suitable huttred accommodation or alternatively, materials shall be raised and supported clear of the ground and be protected against frost, damage due to building work and operations by other Contractors with waterproof covers or other appropriate means

The Employer's Agent shall have the authority to have any plant or materials not complying with the above requirements removed from site and replaced at the Contractor's cost.

8.17 Protection and Cleaning of Materials and Works

The Contractor shall include for taking all necessary precautions to protect plant, building materials and equipment from damage and theft during the execution of the Contract Works and shall be liable for such damage and theft.

The Contractor shall provide full protection for all equipment, plant, motors, materials, fixed or unfixed, to prevent mechanical damage, ingress of dirt, dust and/or moisture. Precautions must be taken and all protection provided to safeguard the works during frost and inclement weather.

Proprietary plugs and caps must be fitted at every open end of pipework during installation of the works. Any blockages developing in pipework during the maintenance period found to be caused by debris or foreign material shall be cleared by the Contractor free of charge to the Employer.

All exposed duct connections; ventilation or cooling units intake and discharge connections and grilles shall be sealed and covered prior to system commissioning.

Filter media shall only be installed when the plant items concerned are being commissioned and tested.

Any damaged items shall be replaced to the satisfaction of the Employer's Agent, at the Contractors own expense.

The Contractor shall thoroughly clean out the interior of each item of the installation and plant immediately after the execution of any work on that item, to the satisfaction of the Engineer.

Items such as grilles, diffusers, lighting fittings, switches, accessories etc. shall be installed as near to completion as practicable.

Machined and bright surfaces shall be protected by paint, tallow or grease, where this has not been carried out by others or has become removed in transit. On completion, surfaces so coated shall be cleaned and where appropriate, polished.

All plant and equipment is to be left in a condition ready for painting where painting is specified, either as part of this Contract or by others. Parts liable to corrode are to be painted immediately after removal of the temporary protection.

All easily damaged materials shall be protected during erection with hardboard covers or heavy duty polythene sheet. Such items include but are not limited to:

- Control panels
- Switchboards
- Distribution boards
- Heater batteries
- Finned pipework

- Gauge glasses

Protect all finished items from damage and paint splashes.

Immediately prior to the date for completion of the Contract works, the Contractor shall thoroughly clean down the works in an approved manner, and ensure the installation, including all plant is free from dust, dirt, moisture and other foreign matter. The necessary Substantial Completion Certificate will not be issued until this work has been accepted by the Employers Agent.

8.18 Working in Confined Spaces

The Contractor shall be governed by a 'Safe System of Work' and all such works shall be undertaken in accordance with an appropriate 'Permit to Work' procedure where such procedures are in operation on the site.

Where no 'Permit to Work' system is in operation, the works shall be undertaken only after full investigation and resolution of the following matters has been completed and the Employer's Agent informed in writing of the proposals :-

- a. Assessment of the task to be undertaken
- b. Identification of the hazards of the task
- c. Decision on Methods of Working to avoid hazards
- d. Implementation of the system of work incorporating these methods
- e. Monitoring of a system of work

Before commencing work and before Personnel enter the space concerned, it shall be demonstrated to be safe by testing that no toxic or asphyxiant gases are present and that adequate oxygen levels are present.

Before commencing work, include an assessment of the likelihood of the conditions remaining as found. The impact of any materials or equipment to be taken into the confined space or found there (deposits, sludge, residues, etc.) and the possibility of any hazardous gases or vapours being able to enter the space.)

Only trained Personnel shall progress the works which shall be undertaken after consideration of the following:-

- a. The provision of safe means of access and egress
- b. The presence of personnel to keep watch outside
- c. The provision of effective communications between personnel inside and outside
- d. The provision of suitable protective equipment including harnesses, if possible, and self rescuing breathing apparatus, if appropriate
- e. The availability of gas detection equipment and staff trained in its use.
- f. A means of effecting a rescue in the event of an emergency

8.19 Rotating Plant

Immediately prior to Substantial Completion adjust, ease and lubricate moving parts as necessary to ensure easy and efficient operation.

Ensure that, whenever necessary, temporary supplies are provided to enable motive plant items delivered and/or installed to be run at regular intervals to avoid damage or deterioration.

Ensure that rotating plant is hand-turned periodically if temporary supplies are not available.

8.20 Assessment and Monitoring

Record progress of the Works weekly on a copy of the programme kept on-site. Update or redraft programme without delay if any circumstances arise which affect the progress of the Works.

Mark up "As Installed" details weekly and before any work is hidden from view.

Update the environmental assessment of project weekly to identify progress against the criteria for the target rating under the relevant Environmental Assessment Scheme.

8.21 Inspection and Measurement of Work

Provide all necessary assistance to enable Employer's Agent to examine or measure the Works.

8.22 Covering-Up

Ensure no section of the Works are covered, concealed or insulated until completion of a witnessed satisfactory test.

Give notice when Works which are to be covered or concealed are ready for examination and/or measurement, not less than 10 working days.

The Contractor shall give a minimum of 10 working days' notice to the Engineer when works which are to be covered or buried are ready for examination and the Engineer shall carry out such examination and/or measuring without undue delay. Any work covered or hidden without written authority from the Engineer may be required to be uncovered at the Contractors expense.

8.23 Systems Used Before Practical Completion

Systems may not, without the prior written approval of the Employer's Agent be used before Practical Completion. Systems to be used before practical completion for the benefit of the Contractor must have all defective consumable elements (including; filters, seals, 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 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-installment of the installation to as new condition prior to handover to the Employer
- Allow the defects liability period to commence on handover

8.24 Operation of Systems before the Production of Drawings and/or Operating and Maintenance Manuals

The Contractor shall provide attendance, at no expense to the Employer, to put into service, operate 24 hours a day and maintain the systems to the Employer's requirements, including the provision of

suitable competent labour, in the event that the Record Drawings and/or Maintenance Manuals are not available when the Works would, in the opinion of the Employer's Agent, otherwise qualify for Practical Completion.

In the event of the Contractor failing to provide this service satisfactorily the Employer shall be entitled to make their own arrangements and recover the full cost through the Contract.

8.25 Inspection by Employer's Insurance Company

Where indicated in the Work Sections items are to be inspected by a competent person acting for the Employer's Insurance Company, appointed under the provisions of the Factories Act or other relevant legislation. The installations concerned shall satisfy the Insurance Company's requirements in all respects.

Agree a programme for inspection and certification of specified equipment.

Inform the Employer's Agent when equipment is to be ready for examination.

The Employer will place an order with the Insurance Company. Details and nature of the order will be provided to all interested parties.

Provide all detailed drawings etc. of the equipment to enable the Insurance Company to approve design before manufacture.

Arrange for the attendance of the Insurance Company's Engineer/Surveyor at each stage of manufacture and installation and provide all necessary access and facilities for inspecting and testing as may be required.

No plant which is subject to inspection will be accepted on behalf of the employer until a satisfactory certificate has been received by the Employer from the Insurance Company.

8.26 Technical Literature

The Contractor is required:

- To keep copies of the following on-site, readily accessible for reference by all supervisory personnel
- Manufacturer's current literature relating to all products to be used in the Works
- Relevant BS Codes of Practice

8.27 Maintenance Instructions and Guarantees

- Retain copies delivered with components and equipment (failing which, obtain), register with manufacturer as necessary and hand over to Employer's Agent on or before Practical Completion.
- Notify Employer's Agent of telephone numbers for emergency services by SubContractors after Practical Completion.

8.28 Photographs

Provide weekly progress photographs of the Contract Works in colour:

- For all key plant rooms, risers, critical areas and external plant areas

- At resolution not less than 1920 x 1080

8.29 Sectional Working

The work shall be carried out to the satisfaction of the Employers Agent and in such sections as to suit the Programme. The Contractor must include for all sectional working and necessary sectional pressure testing required.

Some areas of the building may require to be released to the Employer prior to Practical Completion. The Contractor will, therefore, ensure that all main systems are complete and working to allow early occupation to be achieved as detailed in the main preliminary documents.

8.30 Valuation of Instructions & Variations

Verbal instructions have no effect unless confirmed in writing (as Contract).

The Contractor shall submit to the Employer's Agent, within seven days of the receipt of the written instruction, the price of each variation showing the quantities and rates applicable for all materials etc employed in accordance with the schedule of rates. No work shall be certified for payment until this information is provided.

9.0 Operation and Maintenance Manuals

9.1 Summary of Standards

The following table lists the standards relevant to this section. Wherever reference is made to a British Standard (BS), a British Standard Institution harmonized equivalent European Standard may be acceptable if agreed with the Engineer. If the project is not located in the UK, then any British Standard list shall be replaced with the equivalent National Standards. Each type of work/equipment/material selected shall comply fully with the most recent edition of the Standards.

STANDARD	TITLE
UK HSE	Health & Safety at Work Act
BS EN 61082-1.	Preparation of documents used in electrotechnology - Rules
BS EN 12170	Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems requiring a trained operator
BS EN 12171	Heating systems in buildings. Procedure for the preparation of documents for operation, maintenance and use. Heating systems not requiring a trained operator
BSRIA BG79	Handover Information and O&M Manuals.
BS EN 82079-1	Preparation of information for use (instructions for use) of products - Principles and general requirements
CIBSE TM 31	Building Log Book Toolkit
UK Gov Legislation	Approved Document for Conservation of Fuel and Power (Part L)
Scottish Building Standards	Section 6.8.1 of the Scottish Technical handbook - Energy.
BREEAM	Issue ID MAN 4 - BREEAM 2008
BREEAM	New Construction and Refurbishment and Fit-Out 2014
BREEAM	Issue ID MAN 5 - Aftercare
Regulation (EU) No 517/2014	EU-F Gas Regulation

9.2 Submission of Documents for Health and Safety File

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 their operating and maintenance staff.

The Contractor shall provide Record Documents - being part of the Works - prior, and as a prerequisite, to Practical Completion to the satisfaction of the Employers Agent.

Operation and Maintenance manuals shall be prepared in draft as the Works progress and make suitable arrangements where the Works are subject to Partial Possession or Sectional Completion.

The Contractor is advised that great importance will be placed upon quality, accuracy, clarity and completeness of the record documents and upon their being made available promptly.

Draft Record Documents shall be submitted to the Employer's Agent for comment prior to commissioning.

The record documentation should be collated utilising an online portal that allows commenting from the Contractors Team, Engineer, Commissioning Agent & Employer's Agent and other required parties.

Prepare two temporary Manuals with provisional record drawings and preliminary performance data available at commencement of commissioning to enable Employer's staff to familiarise themselves with the installation. These should be of the same format as the final Manuals with temporary insertions for items which cannot be finalised until the installations are commissioned and performance tested.

Provide the Employer's Agent with copies of the final Manual 4 weeks prior to Practical Completion, this version of the Manual shall have been reviewed and approved for issue by the Contractor's team and should have been reviewed by the Engineer with a minimum of a Status B.

Prepare electrical record drawings in accordance with BS EN 61082-1.

Prepare Operating and Maintenance Manuals for heating systems requiring a trained operator in accordance with BS EN 12170.

Prepare Operating and Maintenance Manuals for heating systems not requiring a trained operator in accordance with BS EN 12171.

9.3 Record Documents

Provide operating and maintenance manuals, system records and full documentation in accordance with the following standards as appropriate:

- BSRIA BG 79 – Handover Information and O&M Manuals
- BS EN 82079-1 - General structuring, content and presentation of instructions for use

The record documents shall include:

- Record Drawings and Schedules
- Plant room and switch room drawings, schedules and schematics
- Operating and Maintenance Manuals
- Blank maintenance logs
- Refrigerant records log following (EU) No 517/2014 F-Gas Regulation
- Building Log book following guidance in CIBSE TM 31: Building Log Book Toolkit

The record documents shall:

- Clearly record the arrangements of the various sections of the Works as actually installed and identify and locate all component parts
- Make it possible to comprehend the extent and purpose of the Works and the method of operation thereof
- Set out the extent to which maintenance and servicing is required and how, in detail, it should be executed
- Provide sufficient, readily accessible and proper information to enable spares and replacements to be ordered
- Be correlated so that the terminology and the references used are consistent with those used in the physical identification of the component parts of the installations.

The Contractor shall demonstrate as required throughout the execution of the Works that complete and accurate records are being maintained and that the record documents are being progressively compiled as the work on-site proceeds.

The building log book shall contain the information outlined in the section on Providing Information in the appropriate Approved Document for, Conservation of fuel and power.

The building log book shall contain the information outlined in Section 6.8.1 of the Scottish Technical handbook - Energy.

All drawings, manuals, and documents shall be in both English and the local language (where applicable).

9.4 Operating and Maintenance Manuals

The operating and maintenance manuals shall be prepared using a proprietary electronic operation and maintenance manual writing software tool. Facilitating the review and commenting by sub-Contractors, client and consulting teams via an online web portal.

The O&M manuals shall be arranged in a logical hierarchical structure in line with BS EN 82079-1.

The operating and maintenance manuals shall include as a minimum:

- A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided
- A description of the mode of operation of all systems including services capacity and restrictions
- Diagrammatic drawings of each system indicating principal items of plant, equipment, valves and all associated naming/references etc
- 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
- All record drawings together with an index
- Legend of all colour-coded services
- Schedules (system by system) of plant, equipment, valves, etc. stating their locations, plant references, model numbers, serial numbers, duties and performance figures. Each item must have a unique number cross-referenced to the record and diagrammatic drawings and schedules
- The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers
- 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
- Statutory certification including; electrical installation completion, gas safety certificates, emergency lighting and fire alarm to be present when works are completed.
- A copy of all Test Certificates, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, water service sampling / disinfection results, corrosion tests, type tests, start and commissioning tests) for the installations and plant, systems, equipment, valves, etc. used in the installations
- A copy of all manufacturers' guarantees or warranties, together with maintenance agreements offered by Sub-Contractors and manufacturers
- Copies of Insurance & Inspecting Authority Certificates and Reports
- Starting up, operating and shutting down instructions for all equipment and systems installed
- Control sequences for all systems installed

- Schedules of all fixed and variable equipment settings established during commissioning
- Detailed procedures for the starting up, running and shutting down of each individual system
- Procedures for seasonal change-overs and/or precautions necessary for the care of apparatus subject to seasonal disuse
- 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
- Details of lubrication systems and lubrication schedules for all lubricated items
- Details of regular tests to be carried out (e.g., water cooling towers etc.)
- Details of procedures to maintain all systems, plant and equipment in safe working conditions
- Details of the disposal requirements for all items in the works
- A list of normal consumable items
- A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date
- A list of any special tools needed for maintenance cross referenced to the particular item for which required
- Procedures for fault finding
- Emergency procedures, including telephone numbers for emergency services
- Back-up copies of any system software
- Documentation of the procedures for updating and/or modifying software operating systems and control programmes
- Instructions for the creation of control procedure routines and graphic diagrams
- Details of the software revision for all programmes provided
- Two back-up copies of all software items, as commissioned
- Copies of relevant HSE/CIBSE/IET Guidance notes etc
- 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 sub-Contractors; 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
- The Contractor shall ensure that all information is specific to this project
- The Contractor shall make the necessary arrangements to ensure all information is obtained by contacting plant and equipment manufacturers/suppliers for specific information
- The Contractor shall include for all charges that may be required by manufacturers/suppliers for the provision of information and literature

9.4.1 BMS Operation and Maintenance Manuals

The BMS O&M manual shall include the following and shall be included in the site health and safety file:

- Comprehensive operating instructions for the entire BMS system

- A written description of the Sequence of Operations for each and every engineering system
- Control strategy/logic diagrams recording the final version of configuration software installed at handover
- Complete list of controls set points, alarms set points and trending points
- Details of system application software configuration including details of software licenses
- A system-by-system points list including hard and soft points (all points should have a unique mnemonic)
- A description of user adjustable points
- Procedures for handling alarms
- Commissioning record details
- Detailed data sheets for all control components and equipment
- Wiring circuit details including origin, route and destination of each cable
- Basic security access to the system
- Comprehensive instructions for switching on, operation, switching off, isolation, fault finding and procedures for dealing with emergency conditions and trending data
- IP address register for Controls Devices
- Instructions for any precautionary measures necessary
- 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
- Instructions for servicing and system upkeep
- Procedures for calibration
- A provision for update and modification

9.5 Building User Guide - BREEAM

Provide contents applicable to the Building Services Systems for incorporation into a Building Users Guide that will be produced by the Contractor or other Specialist including:

- Any BREEAM or alternative Environmental Assessment method certificate and associated report
- Information on energy-efficient features and strategies and how they should be used
- Information on water use and water saving features/benefits
- Information on the control's algorithm where a BMS is installed
- For refurbishment projects - Comply with BREEAM 2008 Issue ID Man 4
- For new build projects - comply with BREEAM New Construction and Refurbishment and Fit-out 2014
- Comply with Issue ID Man 05 Aftercare

9.6 Building Regulation Part-L, EPC and DEC Requirements

On completion of the work the Contractor shall carry out CO₂ emission rate tests as follows:

- Dwelling: Carry out Dwelling CO2 Emission Rate (DER) to confirm the as-built building carbon emission and energy performance
- Non-Dwelling: Carry out Building CO2 Emission Rate (BER) to confirm the as-built building carbon emission and energy performance

The Contractor shall provide a DEC and advisory report for buildings with a total useful floor area over 1000m² that are occupied in whole or part by public authorities and by institutions providing public services to a large number of persons and therefore frequently visited by those persons.

9.7 Presentation of the Operating and Maintenance Manuals

- The Contractor shall agree format and contents with the Employer's Agent
- Encase the Manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover- titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings
- Dividers used between sections shall use stepped, overlapping printed card
- The paper weight to be at least 100gsm
- Electronic format stored on USB thumb drive or on approved online hosted platform
- General document format in PDF
- Drawings in native format: AutoCAD DWG
- Drawings in PDF format
- BIM federation model format in IFC & RVT
- BIM export model format in NWD

9.8 Reading of Meters

Record readings of all water, gas, and electricity meters immediately on completion of the Works and forward, via the Main Contractor, to the Employer's Agent.

10.0 Provision of Spares and Tools

10.1 Spares and Tools to be Provided in the Contract

Prior to handover, the Contractor shall provide Employer's Agent with all of the spares specified herein and as may be subsequently instructed. The Contractor shall prepare a form for the Employer's Agent to acknowledge receipt for spares.

During the course of the contract, via the technical submittal process, and in any instance no later than 1 month prior to completion, the Contractor shall provide the Employers Agent with schedules of the manufacturers and/or Contractors recommended spare parts stock list for all of the works. These schedules shall include the purchase price to the project, i.e. inclusive of any Contractors costs. The Contractor shall state against each item the manufacturer's current price, including packaging and delivery to site. The Contractor shall identify those items which are additional to those specified for inclusion in individual Sections

The Contractor shall obtain an instruction from the Employers Agent for provision of any such additional items which the Employer chooses to procure via the Contractor.

Irrespective of any instruction to provide additional items, the Contractor shall provide the following spares within the tender cost:

10.1.1 Keys

Provide two sets of all keys necessary for the operation and maintenance of any items of equipment. Suitably tag for identification purposes and schedule ID numbers to relevant equipment references. Allow to provide a suitable key storage cabinet with spare capacity, however, obtain the Employers Agents approval to type and the need to supply this item prior to procurement

10.1.2 Tools

Provide two sets of all special tools necessary for the operation and maintenance of provided items of equipment and hand to the Employers Agent with a detailed list of applicability. Each tool or appliance shall be clearly marked with its size and/or purpose. The tools and appliances provided shall be in a new and unused condition. Each set of tools shall be suitably arranged in fitted steel boxes, the number of boxes being determined in relation to the layout of the plant and equipment in question. The boxes shall each be fitted with a lock, stove enamelled and clearly marked in white letters with the name of the plant or equipment for which the tools and appliances therein are intended. Where racking handles/trolleys or other equipment are required for the withdrawal or removal of parts, then such equipment shall be provided at each location required. Provide two full sets of specialist tools for the generators including grease and oil guns necessary for normal maintenance of each set and its controls. Tools shall be of good quality and contained within a suitable robust steel toolbox, which will be lockable.

10.1.3 Filters

Provide one complete set of filters for all transported fluids for each item of plant or equipment. All replacement filters shall be boxed and sealed, with the boxes bearing the manufacturers name, filter type and size and the applicable plant references

10.1.4 Grease & Lubricants

The Contractor shall include for supplying the initial charge of all grease and lubricants for lubrication points on all equipment supplied under the Contract and shall include for all necessary following up and topping up to ensure the correct levels and conditions are maintained until the plant and equipment is handed over.

Instructions for lubrication, frequency and grade of lubricant required shall be included with the instructions contained within the item of equipment, the operating and maintenance manuals and incorporated into the planned preventative maintenance scheme. Provide grease and lubricants sufficient for one year's operation and maintenance of applicable plant.

10.1.5 Lamps

Provide spare lamps of each type utilised in the contract, which shall be handed to the Employers Agent prior to completion, in quantities as follows:

- 1% of all LED lamps or a minimum of one of each type, whichever is the greater quantity
- 5% of all linear fluorescent lamps
- 5% of all compact fluorescent lamps
- 10% of all discharge lamps
- 10% of all low voltage or capsule lamps or a minimum quantity of five of each type, whichever is the greater quantity

10.1.6 Fuses & Circuit breakers

All switchgear shall be provided with suitable locks for padlocking the switches in the 'OFF' position. Provide spare fuses and/or circuit breakers of each capacity adopted - one complete set of HRC cartridge fuses of each size used in switch and fuse gear, 5% of each MCB size used, up to 60 ampere. All spare fuses shall be housed in a rust proofed sheet metal cabinet fixed in each main switchroom. The cabinet shall be labelled 'SPARE FUSES'

10.1.7 Safety Devices

Provide spare parts as required to ensure operational continuity in the event of a failure, e.g. springs, padlocks, bursting disks etc

10.1.8 Drive Belts

A full set of drive belts for each indirect driven motor assembly. ID tag each set with the relevant equipment reference

10.1.9 Anti-Freeze Fluids

Sufficient anti-freeze fluid for one year's operation of each plant item

10.1.10 Gauges

- 2 pressure gauges
- 2 pipeline thermometers
- 2 duct thermometers
- 2 test plug thermometers and pressure gauges
- 1 hand held digital temperature and humidity sensor suitable for measuring air and water

10.1.11 Water Treatment

One 30m length of reinforced plastic hosepipe complete with drain cock connector and 12 months operating supply of water treatment chemicals

10.1.12 Pump Seals

2 spare seals for each type of pump fitted with a mechanical seal

10.1.13 Fire Systems

- 6 fusible links for air duct fire dampers
- Provide Fire Alarm spares as listed. Quantity of each item to suit type and size of installation:
 - Heat detectors
 - Smoke detectors
 - Flame detectors
 - Call points
 - Sounders
 - Beacons
 - Door retention units
- Provide Fire Alarm system test equipment and consumables as listed. Quantity of each type to suit type and size of installation:
 - Detector head removal tool
 - Detector base skirt removal tool
 - Call point testing tool
 - Detector test smoke canister
 - Detector test adapter
 - Aerosol dispensing tube
 - Extension tubes
 - Spare log book

Provide a full spare set of bar code labels, if the option for bar coding is specified. All spares are to be provided in addition to any consumable items which may be required in the event of Beneficial Use occurring

None of the above spares may be utilised by the Contractor prior to handover

10.2 Initial Supply of Additional Spare Parts

Within 2 weeks of a request the Contractor shall submit to the Employer's Agent a quotation, priced in detail, for the initial supply to the Employer of the additional spare parts, and including for:

- Checking that each spare part is suitable for the replacement of the corresponding part supplied with the item of plant or equipment
- Checking receipt, marking and numbering in accordance with the schedule of spare parts

- Referencing to the plant and equipment list in the Operation and Maintenance Manual
- Painting, greasing, etc. and packing to prevent deterioration during storage

10.3 Recommended Tools

At least 4 weeks prior to practical completion the Contractor shall submit to the Employer's Agent a schedule of tools and portable instruments as called for in individual Sections and any others that the Contractor recommends should be obtained and kept in stock by the Employer for maintenance of the services installations included in the Contract. Time scale.

State against each item the manufacturer's current price, including packaging and delivery to site. Identify those items which are additional to those specified for inclusion in individual Sections.

11.0 Training of Employer's Staff

11.1 General Requirements

Before practical completion, the Contractor shall explain and demonstrate the purpose, function and operation of all the engineering services installations including all items and procedures listed in the Operation and Maintenance Manual to the Employer's maintenance staff and to the employer's operational staff.

The training shall include all new and amended MEP systems under this work contract and the Contractor shall allow for a period of not less than 28 number of operating days for this purpose and demonstrate the safe day to day running and maintenance of all systems, plant and equipment.

Training sessions are to be agreed with the Employer's Agent to suit any shift operations for the facility, such that training is provided to the required representatives on all shifts.

Written training material is to be provided before any training session is undertaken, this is to include a summary of the training and a list of supplementary information (e.g. manufacturers guides, O&M information etc).

All training sessions (of each type) are to be recorded by a videographer such they can be used as part of the induction process for new staff. These are to either be uploaded to the respective O&M platform or provided on a memory stick.

11.2 Systems Training

The contractor shall be required to train the Employer's personnel in the use of relevant systems, utilising specialists as necessary including but not limited to:

- BMS and mechanical control system
- Smoke ventilation system
- HVAC systems
- General maintenance procedures
- Automatic control systems
- Fire suppression system
- MV installation
- LV installation
- Fire alarm system
- CCTV and security systems
- Lighting and emergency lighting installation.
- Uninterruptible power system
- Electrical generation system
- DC equipment
- Public address system
- Telephone system
- Information technology systems

11.3 Training on BMS & Controls Systems

The Contractor shall provide training for the operation of the controls, monitoring or BMS installations for the following levels of operator:

- Basic operator. Ensure that the operator is trained to:

- Call up and view point-data from plant schematics and/or points lists
 - Acknowledge system alarms
 - View trend logs.
 - Intermediate operator
- In addition to the requirements for a basic operator, ensure that the operator is trained to make basic alterations to the BMS including changes to:
 - Time and occupancy programmes
 - Control set-points
 - Setting up trend logs
 - Setting up alarm routines
 - Ensure that the operator is also trained for testing and routine inspection of sensors and actuators
- Advanced operator. In addition to the requirements for an Intermediate operator, ensure that the operator is trained to:
 - Add or change graphics/schematics
 - Change control strategies
 - Add analogue and digital inputs/outputs to the system
 - Back-up the system and archive logged data
 - Re-load system software/configuration details
 - Add/modify passwords/monitor system security
 - Ensure that training is completed before the BMS is handed over
 - Ensure that each trained operator signs a training acceptance certificate(s)
 - Provide training off-site at the BMS suppliers training facility. Complement this off-site training with 'hands on' on-site training
 - All training sessions shall be video recorded, saved in electronic format (e.g. MPEG 4 AVI), included in the O&M manual
 - Provide appropriate reference and training manuals for the operator
 - Include for not less than 28 number of operating days for this purpose and demonstrate the safe day to day running and maintenance of all systems, plant and equipment

12.0 Completion & Post Completion

12.1 Practical Completion

A Certificate of Practical Completion will not be issued until the contractor has completed the Installation Works to the Satisfaction of the Employer's Agents and, in particular, to include the following items:

- a. Engineering installation has been completed and snags attended to.
- b. Commissioning and Testing Report has been provided.
- c. Performance and Acceptance Tests have been carried out.
- d. "As installed" drawings have been provided.
- e. Operating Instructions and Maintenance Manuals have been provided.
- f. Spares have been provided.
- g. Employer's Staff have been instructed in the correct operation of the Installation.
- h. No further disruptions to the site are required.

12.2 Defects Liability

The date of the final completion certificate will also be the start of the Contractors 12-month defect liability period. It is the Contractors responsibility to ensure that all plant and equipment supplies have extended warranties in place to meet this Contract condition.

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 Main Contractor 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 Employer's Agent, via the Main Contractor, in writing when all defects are finally rectified so that an inspection may be carried out prior to the issue of a Final Certificate.