



SPECIFICATION

FOR THE

ELECTRICAL SERVICES INSTALLATION

AT

COOMBE HOSPITAL WATER TANK UPGRADE

LINKED PRACTICES

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ELECTRICAL SERVICES SPECIFICATION

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APPENDIX 18: N/A

APPENDIX 18: EQUIPMENT SCHEDULE

ELECTRICAL SERVICES SPECIFICATION

PREFACE

1. DEFINITIONS:

- 1.1. The definitions ascribed to the parties and consultants to the contract in the Form of Tender shall prevail throughout this Specification.
- 1.2. 'Indicated' as used in 'as indicated', 'where indicated', 'unless otherwise indicated' and like phrases shall mean indicated in the addenda to the Specification and/or in the equipment schedules in the appendices, or on the drawings or any other relevant contract documentation. 'Specified' shall be interpreted similarly.
- 1.3. 'Approval' means approval in principle from the Engineer, and does not infer that the Contractor is in any way relieved of the consequential responsibility of adhering to the spirit of the contract documentation with regard to standard of workmanship, materials and design intent.

2. INTERPRETATION:

- 2.1. Section 1: Indicates the scope of the Contractor's responsibility to provide a complete and satisfactory working installation, complying with all necessary requirements, for hand-over to the Employer.
- 2.2. Section 2: Provides a description of the electrical services general specification for materials along with any other relevant information.
- 2.3. Section 3: The Particular Specification sets out the requirements and standards for workmanship, material, equipment and services/systems to be provided. The Contractor shall ensure that the installation conforms to the standard of workmanship called for and that materials and equipment are to the standard required.
- 2.4. Appendices: includes specifications for specialist equipment, record documentation and sub-system certification, particular to the project.
- 2.5. This Specification shall be read in conjunction with the general conditions of contract, drawings and all other contract documentation. Any discrepancy shall be referred to the Engineer in writing for clarification as soon as practicable.

SECTION 1 - GENERAL REQUIREMENTS

1. SCOPE OF CONTRACTOR'S RESPONSIBILITY:

- 1.1. The Contractor shall be entirely responsible for the works set out in the contract and associated documentation, whether under construction or during tests, and until the works have been handed over, or deemed to have been handed over in compliance with the conditions of the contract. Receiving the responsible Engineer's approval does not relieve the Contractor of this responsibility.
- 1.2. Unless otherwise stipulated, the works shall include the provision of electricity supply, delivery, installation, testing, commissioning, setting to work, making good any defects that occur during the defects liability period, provision of 'as-installed' drawings and maintenance and operating manuals, and all of the labour and materials necessary to form a complete installation, whether or not all the necessary (labour) components are indicated.
- 1.3. The Contractor shall be responsible for ensuring that any firm that is appointed on his/her/their behalf as a sub-contractor/supplier, complies with, and fulfils all relevant undertakings and conditions detailed in the contract documentation. The Contractor shall also be responsible for incorporating the works of his/her/their appointed sub-contractors/suppliers into the programme of works.
- 1.4. The Contractor shall conduct inspections and tests, and document same in reports during manufacture or fabrication, on or off site, as and when required to ensure that sub-contractors/suppliers achieve satisfactory quality, workmanship, delivery, assembly, erection, testing, setting to work and completion. The Contractor shall not impose additional contract conditions on any sub-contractor/supplier that they appointed, over and above those contained in the conditions of contract for the works.
- 1.5. The Contractor shall, through a tender submission, guarantee that all materials, equipment and work carried out shall be 'Fit for the Purpose' and shall secure similar guarantees from his/her/their appointed sub-contractors/suppliers.
- 1.6. The design of plant, equipment, specialist installations or materials used by the Contractor, and requiring the input of the manufacturer's specialist designers, shall be the responsibility of the manufacturer/supplier of the specific plant, equipment, specialist installations or materials. The Contractor shall, when placing orders, be responsible for ensuring that all relevant information, regarding every relevant aspect of the project, is passed on to the manufacturer/supplier. Moreover, the Contractor is responsible for ensuring that the plant, equipment, specialist installations or materials, are suitable for the application and comply with the Engineer's design intent and the associated Specification.
- 1.7. Unless otherwise indicated, all materials and equipment to be installed shall be new. Equipment shall be installed in accordance with manufacturers' written instructions and complicit with any specific standards associated with the materials and equipment.

- 1.8. Where equipment is supplied by others as free-issue items, the Contractor shall take delivery, erect, test and commission the equipment unless otherwise indicated.
- 1.9. The Contractor shall ensure, before ordering, that all equipment can be installed in allotted spaces and shall maintain adequate access for maintenance and repair.
- 1.10. A notice to cover shall be provided in reasonable time by the Contractor to the Engineer whenever any works or materials are intended to be covered by earth, lagging, structural duct covers, walls, floors, ceilings, building in, or otherwise.
- 1.11. The Contractor shall include for all services expansion and flexible joints as necessary in cross building expansion joints.
- 1.12. The Contractor shall regard all maps, plans, drawings, sketches, etc. of the works as highly confidential, and shall only share them with other persons on a need-to-know basis.
- 1.13. All project works shall be carried out to the complete satisfaction of the responsible Engineer who shall reserve the right to reject any workmanship and materials that, in the opinion of the Engineer, do not conform to the Specification. The Contractor shall be obliged to carry out such alterations or replacements of materials at his/her/their own expense.
- 1.14. The Contractor shall not interrupt or interfere with any existing services without prior written permission from the client. Arrangements to undertake any such work shall be processed by the Contractor through the Main Contractor as part of the co-ordination requirements.
- 1.15. The Contractor shall note that the responsible Engineer reserves the right to change, amend or modify the specifications, drawings, design or layout as required throughout the contract.

2. STANDARDS AND CODES OF PRACTICE:

- 2.1. Unless specifically stated otherwise, or approved by the responsible Engineer, installation, materials and equipment shall be in accordance with the relevant Irish, European and British Standards, and Codes of Practice and CIBSE Guidelines, whether indicated in this Specification or not.
- 2.2. Although relevant Standards and Codes of Practice are referred to in this Specification, the Contractor shall ensure that the Standards and Codes of Practice referred to, shall be current editions, dated three months before the date for return of tenders.
- 2.3. Any differences between these Standards and Codes of Practice, and any part of this Specification, shall be brought to the attention of the responsible Engineer for clarification.

- 2.4. Commodities conforming to Standards shall be clearly and indelibly marked with the Standard reference. Where this is impracticable, the relevant advice and delivery notes shall include the Standard reference with which they are to comply.
- 2.5. Where commodities/services are specified to be by registered/approved firms under Certification and/or Quality Assurance schemes, the proposed firm must be a current participant in the relevant scheme.
- 2.6. Certificates or compliance with Standards, Certification schemes and/or Quality Assurance schemes shall be provided to the responsible Engineer on request.

3. NATIONAL AND LOCAL AUTHORITIES:

- 3.1. The Contractor shall ensure that all materials, items of equipment, methods of installation and standards of workmanship are in compliance with the recommendations and requirements of the relevant national and local authorities and shall arrange for such authorities to witness any testing which may be required.

4. ACTS AND REGULATIONS:

- 4.1. The installation(s) shall comply with all Acts, relevant Statutory Instruments and Regulations including any special Regulations issued by the electricity, gas and/or water authorities. The tender shall be based on the Acts and Regulations current on the date for return of tenders. If these Acts and/or Regulations are amended or new Acts and/or Regulations are enacted after that date the Contractor shall inform the Engineer immediately.

5. HEALTH AND SAFETY:

- 5.1. The Contractor shall comply fully with the health and safety requirements as detailed in the Main Contract and all relevant Safety, Health and Welfare at Work Statutory Instruments. Of particular note are the relevant sections of the following:-
 - 5.1.1. Health and safety and welfare at work Act 2005
 - 5.1.2. S.I.299/2007 General Applications
 - 5.1.3. S.I.732/2007 General Applications
 - 5.1.4. S.I.291/2013 Construction Regulations

- 5.2. All equipment deployed in a temporary capacity (during installation works), and permanently as part of the project contract works, shall comply with the current European directives in connection with safety of machinery and electrical equipment:-

- 5.2.1. Machinery Directive (2006/42/EC)
- 5.2.2. The low Voltage Directive (2014/35/EU)
- 5.2.3. Electro Magnetic Compatibility (2014/30/EU)

All such equipment shall carry the "CE" marking. Equipment not bearing this marking will be rejected by the Engineer and the Contractor shall be required to replace it with certified (and marked) equivalents without cost penalty to the Client.

- 5.3. The hardware/software/firmware supplied shall be accompanied by documentation that states this conformity.

6. PRIME COST AND PROVISIONAL SUMS:

- 6.1. Where prime cost and provisional sums are included, the Contractor shall submit a schedule to the responsible Engineer indicating the latest date by which s/he requires instructions in order to comply with the programme.
- 6.2. The dates indicated shall be neither unreasonably distant from, nor unreasonably close to, the dates on which it will be necessary to receive the information in order to comply with the programme and achieve the completion schedule.

7. INTERIM CLAIMS:

- 7.1. Claims for interim payment shall be in accordance with the dates set out in the Appendix to the Main Contract.
- 7.2. The Contractor shall agree the format for submitting interim claims with the responsible Engineer before the first payment is due.
- 7.3. Interim claims shall be accompanied by a certificate confirming that the works executed, and materials on site under the claim, are in accordance with the contract documentation. Failure to provide this certificate will invalidate the claim.

8. ASBESTOS MATERIALS:

- 8.1. Asbestos materials shall not be installed. This requirement applies to major items, e.g. thermal insulation, and to sundry minor components such as gaskets, fire seals and valve packings.

- 8.1.1. Where there is asbestos in an existing installation where works are proposed, it is subject to the Chemicals (Asbestos Articles) Regulations, 2011 (S.I. 248 of 2011). Further, where installation work could interfere with said asbestos, a full risk assessment pertaining to the implications of proposed the work, and the potential affects relating to the asbestos, is required.
- 8.2. Should asbestos (historical, natural, or new) be identified by the Contractor on the site where work in being carried out and during the course of the contract, the following procedural undertakings must be adhered to.
 - 8.2.1. Work is to cease in the associated area(s) and the area(s) is/are to be identified as restricted,
 - 8.2.2. The Main Contractor, Foreman and the responsible Engineer are to be informed immediately
 - 8.2.3. Work can only continue in the restricted area(s) once a suitable risk assessment and method statement, in line with S.I. 386/2006 and S.I. 589/2010, are undertaken and approved by all affected parties.

9. CFCS AND HCFCs:

- 9.1. Products containing and/or requiring the use of CFCs in their manufacture, will not be specified (where practicable) in the fulfilment of the contract. Those containing and/or requiring the use of HCFCs may only be used with the permission of the Engineer. The Contractor shall confirm in writing that such products are free of CFCs and/or HCFCs prior to delivery to site.

10. SITE ADMINISTRATION:

- 10.1. The Contractor shall provide all necessary supervision during the execution of the works. Suitably qualified engineering staff shall be employed and given charge of the site works from commencement to completion. Supervisory staff shall be on site at all times while the work is in progress and shall be authorised to receive instructions from the responsible Engineer on the Contractor's behalf.
- 10.2. The Contractor shall, for the duration of the contract, facilitate attendance, at all site meetings, involving the services installations, and for attendance at site visits by the responsible Engineer.
- 10.3. The Contractor shall provide sufficient staff with appropriate competence, as necessary in the opinion of the responsible Engineer, for preparing programmes, records, working drawings, builder's work drawings, progress drawings and any other documentation as is required for efficient and satisfactory execution of the works involved in the completion of the Contract.

- 10.4. The Contractor shall provide all necessary staff, as and when required, to liaise with the Main Contractor in the production and maintenance of the overall works programme. Such staff shall also engage in the programming and monitoring of the progress within the overall programme. The programme shall be continuously updated, and shall be available to the responsible Engineer on request.
- 10.5. The Contractor shall submit a professional report detailing the manpower and plant engaged on site to the responsible Engineer on a weekly basis. The report shall include details of materials in storage on and off site, progress made relative to the agreed programme, items requiring clarification, clarifications provided and/or site instructions, etc.

11. SERVICES DRAWINGS AND CO-ORDINATION:

- 11.1. The definition of drawing types applying to the works shall be as set out in BSRIA BG 6 "A Design Framework for Building Services".
- 11.2. The tender drawings associated with the contract are brought to the stage of *detailed design drawings* as detailed in BSRIA BG 6. These drawings show the locations of plant items and services routes in such detail as to indicate the design intent and the initial co-ordination of services (design stage) with the building structure. These drawings, while not necessarily indicating the precise position of services, should be sufficiently feasible to install the services within the general routes and general locations indicated, and to produce *co-ordinated drawings* or *installation drawings* without major re-routing of services. Symbol and line conventions are in accordance with the schedule of symbols and notations issued with the tender documents.
- 11.3. Identified ATEX classified hazardous areas are to be supplied to all contracting services. The Main Contractor shall have responsibility for qualifying that all services entering and exiting these zones are suitable and clearly identified to all affected parties at a design stage as well as the suitable marking and identification at the completion stage.
- 11.4. The Main Contractor shall have responsibility for performing the overall co-ordination process in respect to all building services. The Main Contractor shall assign competent staff to this task with proven knowledge and experience of building services to ensure that the service co-ordination activities are successfully completed. The responsibilities of the staff so assigned shall include but are not limited to: -
 - 11.4.1. The realistic programming of all building services works and activities and the incorporation of this programme into the main contract programme.
 - 11.4.2. The timely and adequate production, by the services sub-contractors, of drawings as described below.
 - 11.4.3. The timely and adequate provision of services related samples, patterns, mock-ups and setting out details for design team comments.

- 11.4.4. The interpretation of all building services drawings and specifications and the resolution of queries raised by the building services and other sub-contractors and, if necessary, obtaining clarification or instructions from the design team.
- 11.4.5. The day to day co-ordination of site, setting out of building services, and sequencing of installation to ensure that systems are not damaged due to premature installation.
- 11.4.6. Being present at all meetings called to discuss building services and to report on the works and progress.
- 11.4.7. The timely and realistic programming of inspections, testing, commissioning and handover of the building services works, all in accordance with the services specification, and in sufficient detail to provide for a design team option to attend during these activities.
- 11.4.8. The preparation of a realistic programme for the release of Prime Cost and Provisional Sums in the services sub-contracts, consistent with the main contract programme.
- 11.4.9. The timely and realistic programming of the provision of record drawings and maintenance manuals, in accordance with the services specifications.
- 11.4.10. Any further activities considered necessary by the Main Contractor in order to fulfil his/her/their obligations with regard to services co-ordination.
- 11.5. The specialist contractor associated with the mechanical installation shall undertake the role of Lead Services Co-ordinator. This specialist contractor shall take the lead, under the direction of the Main Contractor, in the services co-ordination activities. These activities and responsibilities include but are not limited to the following:-
 - 11.5.1. Before any installation work commences, and in time to meet programme dates, the Lead Services Co-ordinator shall meet with representatives of all relevant parties associated with the works to examine all drawings and all aspects of the detailed services co-ordination. Co-ordination meetings shall be sufficiently frequent to ensure adequate coordination of services with appropriate sequencing of installation.
 - 11.5.2. From information agreed at the co-ordination meetings, the Lead Services Co-ordinator shall develop and produce co-ordination drawings/sketches. The co-ordination drawings/sketches shall be of sufficient detail to demonstrate that all services can be installed with adequate space for access, commissioning, and ongoing maintenance. Access points for commissioning and maintenance shall be, as far as is practicable, grouped to minimise the number of points required and located in areas where they will cause the least disruption to the functioning of the building when in use.

- 11.5.3. When the Lead Services Co-ordinator completes the co-ordination drawings/sketches and agrees the proposals with all relevant parties, the co-ordination drawings/sketches shall be forwarded to the Main Contractor for comment and then issued to the design team for comment. If necessary, the Lead Services Co-ordinator shall revise the proposals until consensus with all parties is achieved.
- 11.6. The Contractor shall co-operate fully with the Main Contractor to ensure that the services co-ordination activity is successfully completed.
- 11.7. Based on the final agreed co-ordination drawings, the Contractor shall develop and produce installation drawings for the works included in his/her/their contract. The installation drawings shall be forwarded to the Main Contractor for comment and then issued to the design team for comment. If necessary, the Contractor shall revise these drawings until agreed by all parties.
- 11.8. When the installation drawings are agreed and completed, the Contractor shall develop and produce *builder's work drawings (installation stage definition)* for the services included in his/her/their contract. The builder's work drawings shall be forwarded to the Main Contractor for comment and then issued to the design team for comment. If necessary, the Contractor shall revise these drawings until agreed by all parties.

12. BUILDERS' WORK:

- 12.1. All builders' work such as the cutting of holes/chases in masonry/concrete walls and floors, the provision of foundations for plant and equipment, etc., shall be carried out by the Main Contractor. The Contractor shall, however, be responsible for providing all information required by the Main Contractor for the correct marking-off and setting out of such work.
- 12.2. Where services pass from one fire compartment to another, the integrity of the fire barrier shall be maintained. Unless otherwise indicated, the Main Contractor shall carry out remedial works, if required, to achieve fire compartment integrity.. The Contractor shall be responsible for ensuring that no damage is caused to services.
- 12.3. The Contractor shall include expansion and flexible joints for all services as necessary for cross building expansion joints.
- 12.4. Where applicable, details of walls and ceilings having a wet plaster finish shall be as listed in the Architect's schedules. Services in these areas shall be installed insofar as possible to alleviate the need for access. Where access is necessary, the Contractor shall be responsible for the correct indication and marking out of such access.

13. PAINTING:

- 13.1. Ferrous sheet materials shall receive a protective coating of paint at works after suitable preparation, or be treated with the manufacturer's approved corrosion-resisting metal finishing process. Any deterioration or damage to the manufacturer's protective coating during storage, installation and before hand-over shall be made good by the Contractor to the satisfaction of the responsible Engineer.
- 13.2. Unless otherwise indicated, the Contractor shall be responsible for decorative painting to:-
 - 13.2.1. Water storage tanks and vessels.
 - 13.2.2. Oil storage tanks as required by BS 799.
 - 13.2.3. Thermal insulation exposed to view, including that within plant rooms, except where protected by metallic foil or sheet, plastic film or a weatherproof finish. An undercoat and not less than two finishing coats shall be applied. Absorbent surfaces shall receive an initial coat of priming paint.
 - 13.2.4. Areas of deterioration or damage as described in clause 13.1.
- 13.3. The surfaces of all ferrous metalwork including pipework, hangers, supports, etc., which are not protected by galvanising, works-applied primer, or protective paint, shall be suitably prepared and painted with one coat of zinc phosphate primer. All such surfaces, with the exception of pipework that is to be insulated, shall be finished with two coats of approved quality non-metallic paint to BS 5493. Where surfaces will be subjected to temperatures above 100°C, the finishing coat(s) shall be heat-resisting paint, and the primer normally omitted. The Contractor shall ensure that:-
 - 13.3.1. Surfaces are cleaned in accordance with BS 7079 before they are painted.
 - 13.3.2. Those parts of the installation required to be left unpainted (e.g. brasswork) are so left.
 - 13.3.3. Where required services are correctly identified to ensure the use of approved paint of the correct colour to comply with BS 1710.
 - 13.3.4. Exposed threads on steel conduit (running couplers) are to be treated in accordance with manufacturers guidelines.

14. MOCK-UPS, DEMONSTRATIONS AND SAMPLES:

- 14.1. The Contractor shall allow for the provision of mock-ups, samples and demonstrations of systems and equipment as shall be requested by the responsible Engineer. Where required, provisional sums are included in the tender documentation for this purpose.

- 14.2. The Contractor shall submit samples of proposed materials to the responsible Engineer for written approval as and when required.
- 14.3. All items that require a factory acceptance test are to be approved by the responsible Engineer prior to transportation to the site.

15. RATIONALISATION OF SUPPLIES:

- 15.1. Items, fittings and accessories shall, where practicable, be the product of one manufacturer and shall be used only for the purpose recommended by that manufacturer.

16. COMMISSIONING AND TESTING

- 16.1. The Main Contractor shall notify the responsible Engineer in writing when, in their opinion, the services installation works or parts thereof are ready for testing and commissioning. The Contractor shall then carry out the tests. The Contractor shall prove to their satisfaction that all test results are in accordance with the specification and where relevant national requirements. The Contractor shall then functionally test all installations in the presence of the responsible Engineer and shall make all specified tests to the satisfaction of the responsible Engineer.
- 16.2. Should the Contractor's initial tests fail to demonstrate that the plant and equipment are properly installed and functioning correctly, the cause of the failure shall be investigated, and where required, adjustments shall be made to remedy the failure. The commissioning and functional demonstrations shall then be repeated to the satisfaction of the responsible Engineer.
- 16.3. Where it is not possible at the particular time of commissioning and testing for full load conditions to be instigated or simulated, the contractor shall repeat such operations of full load or simulation thereof at a time when this can be achieved.
- 16.4. Where portions of the work are commissioned and tested separately, the Contractor shall, upon Practical Completion or Completion of Section as defined in the Main Contract Conditions, demonstrate to the responsible Engineer that all portions are capable of proper simultaneous operation.
- 16.5. In cases where the construction programme is such that the Contractor will need to return to the portion of the building taken over and occupied by the client in order to undertake testing, balancing, adjustment, etc., the Contractor shall take all necessary precautions against, and shall be responsible for, any damage caused whilst working in such areas for that purpose.

- 16.6. Subsequent to the completion of all testing and commissioning, to the satisfaction of the responsible Engineer, the Contractor shall operate the plant and shall demonstrate that the overall systems function correctly in accordance with the requirements of the Specification. A period of at least seven days in a fully operational state shall be considered reasonable for this demonstration. During this period, the Contractor shall be responsible for the operation and maintenance.

17. PRACTICAL COMPLETION

- 17.1. Practical Completion of the sub-contract works, or agreed phase or part of the works, shall not be effected until the Contractor has fulfilled their obligations under the Main Contract conditions and in particular demonstrated to the satisfaction of the responsible Engineer that the following aspects are complete:-
- 17.1.1. All works to be complete, other than minor snags or defects, which could be reasonably completed within an agreed programme without causing disruption to the clients or their Agent's use of the Building or agreed part thereof. In respect of this clause, specifically but not uniquely, the Architect shall be the sole arbiter of what may be considered minor, reasonably completed, an agreed programme and disruption to the Employer.
 - 17.1.2. All tests and functional demonstration have been undertaken successfully
 - 17.1.3. All final copies of the record drawings, schedules, operating and maintenance manuals and test certificates have been supplied in a format agreed to the Engineer.
 - 17.1.4. All spares, keys, tools, oils, chemicals and other materials stipulated in the specification for the running and maintenance of the Engineering Systems as specified, are to have been supplied.
 - 17.1.5. All instruction of the clients (or their agents) staff to have been satisfactorily completed in accordance with the programme for handovers agreed with the employer's representative.

18. TRAINING OF CLIENT'S PERSONNEL

- 18.1. Experienced personnel to instruct the clients Employer's personnel in the operation, maintenance and servicing of all of the installations shall be provided. Also provided shall be instructions for an appropriate period commensurate with the scale and complexity of the installations and not less than three working days before the sub-contract works are handed over.

19. SYSTEMS USED BEFORE PRACTICAL COMPLETION

- 19.1. Systems may not, without the prior written approval of the responsible engineer (or nominee) be used before Practical Completion.
- 19.2. Systems to be used before practical completion for the benefit of the Main Contractor and / sub contractor must have all defective consumable elements (including lamps and tubes) replaced by new elements not more than seven days prior to Practical Completion.
- 19.3. No system shall be put into use prior to handover to the client except for testing and commissioning, unless in accordance with the following procedure:
- 19.4. 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.
- 19.5. Allow the defects liability period to commence on handover.

20. OPERATION OF SYSTEMS BEFORE THE PRODUCTION OF RECORD DRAWINGS AND/OR OPERATING AND MAINTENANCE MANUALS

- 20.1. The Contractor is required to provide attendance, at no expense to the client, and to put into service, operate 24 hours a day and maintain the systems to the client'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 responsible Engineer, otherwise qualify for practical completion.
- 20.2. In the event that the Contractor fails to provide this service satisfactorily, the client shall be entitled to make his/her/their own arrangements and recover the full cost through the Contract.

21. OBLIGATIONS AFTER PRACTICAL COMPLETION

- 21.1. Between the issue of a Certificate of Practical Completion and the Certificate of Making Good Defects relating to the whole or part of the works, the following shall be provided:
 - 21.1.1. A prompt call-back service, available at all reasonable times, to attend to any faults.
 - 21.1.2. Carry out a final test at the end of the Defects Liability Period to demonstrate to the responsible Engineer that the Specialist Works are operating efficiently and effectively and that all components are functioning correctly.

- 21.2. Carry out all work using competent, trained personnel and except where made necessary by abuse, misuse or negligence by other than the Contractor, make no charge to the client.
- 21.3. Notwithstanding the foregoing paragraph, the client can be charged the net cost of replacement of life-expired disposable parts.

22. REQUESTS FOR DEVIATION FROM SPECIFICATION:

- 22.1. Any deviation from the Specification sought by the Contractor must be made in the form of a written request and must be sanctioned in writing by the responsible Engineer to be valid.

23. BUILDING CONTROL (AMENDMENT) REGULATIONS 2014

- 23.1. The Contractor shall include for the full implementation of the Building Control Regulations 1997 - 2014 and the Building Control (Amendment) Regulations S.I. No.9 of 2014 & S.I. No. 105 of 2014. The Contractor shall include for their attendance as required to implement the inspection plan prepared by the design team and the ongoing inspections.
- 23.2. The Contractor shall notify the design team when their works are ready for inspection, during the proposed program of works. The Contractor is advised to contact the Main Contractor to establish the proposed programme of works.
- 23.3. The Contractor shall give adequate notice for the ongoing inspection prior to the completion of any individual element of the Mechanical, Electrical and Lift Installations and shall confirm that the works are in compliance with the Building Regulations and will be complete for inspection. Any defects of workmanship, materials, performance, and design of equipment, including maladjustments or other irregularities, which become apparent during the inspections, shall be rectified at the Contractor's expense.
- 23.4. The Contractor shall ensure that sufficient time is allowed in the Main Contractor's programme for each of the ongoing inspections. Throughout the execution of the works, the Contractor shall be responsible for ensuring compliance with all relevant Contract Drawings & Specifications, Building Regulations, Safety Codes and Local Authority requirements and shall notify the responsible Engineer of any infringement, which directly or indirectly detracts from the safe and satisfactory operation of the installation; whether or not such infringement relates to the works covered in this Specification or to the associated works of others.
- 23.5. The Contractor shall provide all necessary Certificates of Compliance with regard to the requirements of the Building Regulations, the Building Control Regulations 1997 - 2014 and the Building Control (Amendment) Regulations S.I. No.9 of 2014 & S.I. No. 105 of 2014 and as requested by the Engineer.

- 23.6. In addition to and accompanying the Commencement Notice, there are two statutory assignments and three statutory certificates to be completed on-line using the Building Control Management System (BCMS), on-line system. The format for these are as per the Second Schedule, S.I. No.9 2014.
- 23.7. At completion, a fourth statutory certificate is completed on-line using the Building Control Management System (BCMS) on-line system. The format for these are as per the Second Schedule, S.I. No.9 2014.
- 23.8. The Preliminary Inspection Plan is a statutory document prepared by the Assigned Certifier, and shall be submitted to the Building Control Authority by the Employer with the Commencement Notice of a minimum of two weeks and a maximum of four weeks in advance of the commencement of the works. At project completion the Inspection Plan, as implemented, shall be submitted to the Building Control Authority.
- 23.9. It is the responsibility of the Main Contractor to employ competent persons to supervise the works. The Inspection Plan shall not in any way diminish the duty of the Main Contractor to properly supervise, and any defective works, whether identified during or after the contract period, remain the sole responsibility of the Main Contractor.
- 23.10. The Main Contractor shall include with his/her/their tender submission a Method Statement and his/her/their own Preliminary Inspection Plan indicating his/her/their own inspection and supervision regime.
- 23.11. A copy of the Preliminary Inspection Plan will be included in the Architectural tender documents. The inspection requirements set out in this document do not in any way relieve, replace, or reduce the Main Contractor's duty to supervise the works.
- 23.12. COORDINATION OF TESTS, INSPECTIONS & RECORDS:
- 23.12.1. The Main Contractor shall meet and coordinate and update the Inspection Notification Framework and Preliminary Inspection Plan with the proposed construction programme and shall incorporate the agreed inspection milestones.
- 23.12.2. All elements identified in the Inspection Notification Framework are to be made available for inspection at each milestone:
- Complete,
 - Not concealed
 - Safely accessible.
- 23.12.3. The Main Contractor shall facilitate random inspections by the Assigned Certifier and / or Ancillary Certifiers as if such inspections were identified in the Inspection Notification Framework.
- 23.12.4. The Main Contractor shall provide in a timely manner all CE certificates, Declarations of Performance and test certificates for materials, products and assemblies.

23.13. ADVANCE NOTICE AND TIME FOR INSPECTIONS:

- 23.13.1. Due consideration shall be given by the Main Contractor for inspection notices. No claims for extension of time or financial claims shall be considered for delays arising out of inspection or re-inspection requirements.
- 23.13.2. The Main Contractor shall ensure advance notifications are issued with respect to works to be inspected that are identified in the Inspection Schedule. The minimum advance notice required for inspection of items of works is five working days.

23.14. RE-INSPECTIONS/FOLLOW UP INSPECTIONS:

- 23.14.1. The minimum notice required for re-inspection of items of works not complete or requiring remedial works shall be three working days.
- 23.14.2. The Assigned Certifier shall, without delay, notify the Main Contractor through the Contracting Authority / Employers Representative of any incomplete work at a given milestone identified in the Inspection Notification Framework.
- 23.14.3. The Main Contractor shall ensure that any incomplete areas, items at assigned milestones, are completed and that such works are kept available for re-inspection, or until a record of completion is furnished, as may be required by the Assigned Certifier.
- 23.14.4. The Main Contractor shall ensure that any areas of non-compliance are rectified and that such works are kept available for re-inspection, or until a record of rectification is furnished, as may be required by the Assigned Certifier.
- 23.14.5. The Main Contractor shall ensure all tests and certificates for materials, components and assemblies listed in the Inspection Notification Framework are undertaken in a timely way. Any test failure shall immediately be made known to the Employers Representative / Assigned Certifier; the materials/works in question shall be replaced / rectified and retesting shall be undertaken prior to proceeding with subsequent work.
- 23.14.6. It is the responsibility of the Main Contractor to coordinate and supervise the works and no claim for delay or cost shall arise from the requirement to re-inspect.

23.15. CONTRACTOR'S PROGRESS RECORDS:

- 23.15.1. The Main Contractor shall maintain progress records and inspection records prepared by him/her in accordance with the Method Statement submitted at tender and as set out in this document.
- 23.15.2. Contractors shall include costs in their tender for the provision of progress records as the works proceed.

23.16. METHOD OF RECORDING:

- 23.16.1. Promptly provide a copy to the Assigned and Ancillary Certifier of all progress records and inspection records prepared by the Main Contractor and the sub-contractors.
 - 23.16.2. At completion stage, the Main Contractor shall issue the Ancillary Certifier with a copy of the records prepared by the Main Contractor and the sub-contractors.
 - 23.16.3. The Main Contractor shall also retain in his/her/their own central office all records that have been prepared and the sub-contractors for a minimum period of six years.
 - 23.16.4. One hardcopy and softcopy of all records shall be issued five days in advance of the nominated completion date.
 - 23.16.5. The record should include evidence of the successful execution of the Main Contractor's method statement on supervision including tests, check sheets, photographs and memos. All evidence shall be indexed by location and date.
 - 23.16.6. Acceptance of such records shall not constitute approval or imply that their content has been examined.
- 23.17. Main Contractors shall submit the following documentation as part of their tender. Failure to do so may invalidate the tender:
- 23.17.1. Main Contractor's Competence Assessment
 - 23.17.2. Sub-Contractor/Specialist Competence (Ancillary Certifiers) Assessment
 - 23.17.3. Main Contractors Method Statement
- 23.18. Tenderers shall note that Practical Completion for a contract is contingent upon the successful registration of the works on the Building Control Management System.
- 23.19. Tenderers shall note that this project shall require a Prior Notification of Completion to be submitted to the Building Control Authority in advance of completion.
- 23.20. The Main Contractor shall provide, four to six weeks in advance of the nominated completion date, all completed and/or 'prospective' documentation and confirmations for Registration. The Assigned Certifier and the Main Contractor shall co-sign the Completion Certificate.
- 23.21. The Assigned Certifier and Main Contractor shall then lodge/upload the documentation onto the Building Control Authority system.

- 23.22. Notwithstanding any statutory duty to retain same, in advance of project completion, the Main Contractor shall issue to the Assigned Certifier a copy of all inspection records retained by the Main Contractor during the course of the Project.

24. CONSTRUCTION PRODUCTS REGULATIONS:

- 24.1. Building Regulations Technical Guidance Document Part D (TGD D) provides guidance in relation to Part D of the Second Schedule to the Building Regulations. It relates to materials and workmanship as inserted by the Building Regulations Part D Amendment 2013 (S.I. No. 224 of 2013). To ensure the quality of materials used in construction, Building Regulations Technical Guidance Document Part D requires compliance with the EU Construction Products Regulation (Regulation (EU) No. 305/2011).
- 24.2. The EU Construction Products Regulation lays down harmonised conditions for the marketing of construction products and is directly applicable in Irish law. From July 1st 2013 CE markings have been mandatory for all construction products placed on the market in the European Economic area which are covered by a Harmonised European Standard (hENs). Although other forms of certification (IAB, BBA Certs etc.) may be available for a given product or material, if a Harmonised Standard is in place then the product/material must be CE Marked and have an associated Declaration of Performance.
- 24.3. The EU Construction Products Regulations, (CPR), sets rules for placing construction products on the EU market. All Construction products placed on this market, which includes both Ireland and Northern Ireland, must comply with the CPR, irrespective of where they are manufactured. This means they must be CE marked, use harmonised standards, (hENs), to demonstrate conformity, be certified by an EU-27 notified body and have an up-to-date EU Declaration of Performance, (DoP). Reference to a BS EN on a Declaration of Performance or CE Marking is not compliant with the relevant EU Regulations.
- 24.4. To affix the CE marking to a construction product, the manufacturer is obliged to draw up a Declaration of Performance (DoP) when a construction product is covered by a harmonized standard or conforms to a European Technical Assessment. Any information about the product's performance in relation to the essential characteristics may be provided only in the form of a declaration of performance. The CE marking shall be applied to the product itself and where this should not be possible to the packaging or accompanying documents.
- 24.5. Only manufacturers or importers can place products on the market, whereas distributors, importers and manufacturers can make them available thereafter. An importer or distributor may be considered to act as a manufacturer and is thus subject to all obligations for manufacturers in cases where he places a product on the market under his name or trademark or modifies a construction product already placed on the market. Even though not expressly stated in the CPR, the DoP and all accompanying documents are considered legal documents and shall not be altered but supplied as they have been provided by the manufacturer.

- 24.6. To this end, the Contractor shall, when selecting and submitting products and equipment for use in construction works, review the manufacturer's Declaration of Performance to ensure it is suitable for their intended use and in addition shall review National Annexes and/or Standard Recommendations for guidance on appropriate minimum performance levels for specific intended uses of the proposed equipment/product.

25. ENVIRONMENTAL PRODUCT DECLARATIONS:

- 25.1. As part of the procurement and equipment submittal process the Contractor shall endeavour to select products from manufacturers who have verified environmental life cycle impacts to encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts.
- 25.2. Life-cycle assessment and environmental product declarations:
- 25.2.1. Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that at a minimum cover product stage (A1-A3) showing the impacts of manufacture and the supply chain from the "cradle to gate".
 - 25.2.2. Product-specific Type III EPD -- Internally Reviewed. Products with an internally critically reviewed LCA in accordance with ISO 14071. Products with product specific internal EPDs which conform to ISO 14025, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - 25.2.3. Industry-wide Type III EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. Products with industry-wide EPDs, which conform to EN 15804 or ISO 21930, and registered and published within EPD programmes which need to meet the requirements of International Standard ISO 14025 and at a minimum cover product stage (A1-A3) showing the impacts of manufacture and the supply chain from the "cradle to gate".
- 25.3. Environmental Product Declarations which conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- 25.4. Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification and external critical review and at a minimum cover product stage (A1-A3) showing the impacts of manufacture and the supply chain from the "cradle to gate".

SECTION 2 - GENERAL SPECIFICATION (6-)

1. EQUIPMENT SAFETY:

- 1.1. The Contractor shall be responsible for the safety of all electrical equipment including that supplied by others for installation under the electrical contract.

2. FIRE COMPARTMENTS:

- 2.1. The building is divided into fire compartments as indicated on the Architect's drawings. Where services pass from one compartment to the next, the integrity of the fire barrier must be maintained. The Contractor shall install fire barriers inside trunking and busbar systems which pass through such fire compartments (section 527, I.S. 10101). The Contractor shall be responsible for ensuring that such activities do not cause any damage to services installed.

3. POSITIONS OF EQUIPMENT AND OUTLETS:

- 3.1. The positions of equipment and outlets shown on the Engineer's drawings, unless otherwise stated, are for tendering purposes only. The exact positions shall be agreed with the Engineer and Architect.
- 3.2. The Contractor shall make a careful study of the Architect's detailed drawings and furniture layouts before commencing to mark out for work in any room. Any obstruction to the proper positioning of the outlets shall be resolved by the Contractor with the services co-ordinator to the satisfaction of the Engineer.
- 3.3. Where outlets for switches, sockets, etc., are specified to be installed in tiled walls or other regularly patterned surface, care shall be taken to ensure that the outlet boxes are positioned to the satisfaction of the Architect at no extra cost to the contract. Similar care shall be taken where luminaires are installed on finished ceilings.
- 3.4. Note that due to the nature of this building, the Contractor shall include for any item of equipment or outlet shown in a room to be positioned anywhere within that room i.e., positions will not be fixed until the furniture layout is determined.

4. WET PLASTER FINISH:

- 4.1. Walls and ceiling having wet plaster finish will be as detailed in the Architect's schedules which are available to the Contractor. Services installed in these areas shall be installed to alleviate the need for access.

5. LOCATIONS FOR SURFACE INSTALLATION:

- 5.1. Surface installations shall be provided where wall finishes are bare-faced blockwork painted or attic or plant spaces - for details see Architect's schedules.

6. LOCATIONS FOR CONCEALED WORK:

- 6.1. In all other locations apart from those adverted to in the preceding clause, the installation shall be carried out as a concealed system with conduits recessed in the walls and in the spaces above the false ceilings.

7. CONDUITS IN PATENT METAL STUD PARTITIONS:

- 7.1. Patent metal stud partitions may be used in sections of the building and because of their bearing on the installation of electrical services it is extremely important that the Contractor make himself fully familiar with the details and locations of these partitions (before submitting a tender) which may be indicated on the Architect's floor plans and detail drawings.
- 7.1.1. Wiring systems within metal stud partitions shall be in accordance with clauses 522.8.14 and 52.8.14.1 of I.S. 10101.
- 7.2. Runs of conduit shall be installed in accordance with the partition manufacturers specification and the Contractor shall be deemed to be aware of all relevant details.
- 7.3. Conduits shall enter only at the top of the partition, the metal ceiling channel of the partition being cut. Notching should not be permitted unless carried out by the person responsible for installing the stud work. The preferred conduit installation method is a set down from the true ceiling.
- 7.4. Grounds shall be provided and fixed in the partitions by the Main Contractor to which the conduit and the outlet box shall be securely fixed, the box having first been aligned and levelled. The Contractor shall be responsible for marking out the position of the conduit drops and the outlet boxes.
- 7.5. In order that the soundproofing qualities of the partitions shall not be impaired by the indiscriminate cutting of holes in them, all conduits shall be kept as close as possible to the soffit of ceiling slab and shall be so arranged as to require the minimum of interference to the plasterboard linings.
- 7.6. It shall not be permissible for conduits to enter or to pass through the partitions other than close up to the soffit of the concrete slab.

8. METHODS OF FIXING:

- 8.1. All lightweight fixings to blockwork or concrete shall be made with steel wood screws, lightly greased, and approved inserts. In damp or exposed situations, lightly greased brass screws shall be used with approved non-deteriorating plugs.
- 8.2. For lightweight fixings to ceiling tiles, plasterboards, etc., which are inaccessible to the back, approved gravity toggles or spring fixings or equivalent shall be employed.
- 8.3. All heavyweight fixings to brick or concrete shall be by means of mild steel bolts of appropriate size, or by chemical fixings, or by expanding bolt fixings.
- 8.4. Generally the size of bolts or screws shall be the largest permitted by the diameter of the hole in the apparatus to be fixed, and shall be of adequate length. When fixing any item of equipment, all bolt or screw holes provided therein shall be used and the fixing in each hole shall be secure.
- 8.5. The Contractor shall ensure that the type of fixing selected is suitable for the material being secured and for the full weight of the equipment being mounted, e.g. filled tray, luminaire complete with lamps and control gear.
- 8.6. Prior to erection on site all purpose-made mild steel brackets and rods which are not protected by galvanising shall be suitably treated to prevent rust forming and one finishing coat of grey enamel or other colour to meet the Architect's requirements at no extra cost to the contract.

9. REMOVAL OF ORIGINAL SERVICES:

- 9.1. The Contractor shall include for the making safe and careful removal of all designated redundant existing electrical services and equipment within the building.
- 9.2. Material recovered in this manner shall be presented to the Employer's representative to obtain a direction as to its disposal or retention.

10. CIRCUIT IDENTIFICATION:

- 10.1. In accordance with section 514 of I.S. 10101 labels or other suitable means of identification to identify the purpose of switchgear and control gear.

The Contractor shall include for supplying and installing permanent circuit identification tags or labels at each location where circuits are terminated i.e. socket outlets, switches, isolators, fused outlets, luminaire outlets. The positioning of the labels shall be agreed with the Engineer. The identification code shall relate to the records on the circuit charts at the switchboard or distribution board serving the circuit.

11. MATERIALS OF STEEL AND CAST IRON:

- 11.1. Conduit shall be heavy gauge welded steel hot dipped galvanised to comply with the requirements of clause 521.6 of I.S. 10101 and the I.S. EN 61386 series.
- 11.2. Conduit having an outside diameter less than 20mm shall not be used.
- 11.2.1. As per clause 521.6 of I.S. 10101, the capacity of a conduit or trunking system shall not exceed the values permitted by Annex 52A of I.S. 10101. Annex 52F of I.S. 10101 provides guidance on the selection of conduit systems.
- 11.3. As per clause 530.5.1 of I.S. 10101, equipment shall be erected according to the manufacturer's instructions in such a way that connections between wiring an equipment shall not subject to undue stress or strain resulting from the foreseen use of the equipment.
- 11.4. Conduit boxes shall be hot dipped galvanised steel and shall comply with EN 10346 series.
- 11.5. Spacer bar saddles, couplings, locknuts etc., shall be hot dipped galvanised steel and shall comply with EN 10346 series.
- 11.6. Inspection tees and elbows shall not be permitted.
- 11.7. Conduit boxes mounted outside a building shall have external fixing lugs. Boxes shall be of malleable cast iron with machine faces and brass screws for cover fixings.
- 11.8. Boxes for light switches, sockets etc., shall comply with the EN 10346 series. They shall be malleable cast iron, pressed steel, folded steel or formed steel with continuously welded sides.
- 11.9. They shall have galvanised or other approved rust inhibiting finish' and comply with the EN 10346 series.

- 11.10. In certain circumstances, boxes with formed knockouts may be permitted in flush and surface installations. Perforated knockouts shall not be acceptable in surface installations. Samples shall be provided to the Engineer for approval.

12. PVC CONTAINMENT:

- 12.1. All rigid PVC conduit shall be high impact quality to the latest IS EN 61386.
- 12.1.1. Conduit having an outside diameter less than 20 mm shall not be used. Neither shall oval conduit be used.
- 12.1.2. Conduit boxes shall meet the current IS EN 61386 and shall have brass inserts for fixing screws. Conduit boxes which support light fittings shall have the brass inserts riveted to external metal fixing lugs.
- 12.1.3. Inspection tees and elbows shall not be permitted unless through prior written agreement with the responsible Engineer.
- 12.2. All PVC trunking - surface, dado and skirting - shall be of heavy duty, high impact PVC-U material to IS EN 50085.
- 12.2.1. Trunkings may be of 1, 2 or 3 compartment type with fixed or demountable partitions.
- 12.2.2. Only components and accessories manufactured specifically for the particular trunking system shall be used.

13. FLEXIBLE CONDUIT:

- 13.1. As per clause 521.9.4 of I.S. 10101, flexible conduit systems may be used to protect flexible insulated conductors.
- 13.2. Flexible metal and PVC conduits shall be used, by approval by the responsible Engineer, where connections are made to equipment or machinery subject to vibration.
- 13.3. Pliable three-layer Class 4 conduit to EN50086 Parts 1 & 2 may be used to serve island equipment via floor chases and to serve partition systems.
- 13.4. An internal insulated earth wire shall be provided in all instances where flexible conduit is used.
- 13.5. Flexible conduit shall not be excessive in length and shall be supported with saddles where appropriate.

14. INSTALLATION OF CONDUIT AND ACCESSORIES:

- 14.1. Surface conduit shall be installed in a neat manner with suitable supports in compliance with the manufacturer's instructions.
- 14.2. Recessed conduit shall be supported with galvanised crampets and be adequately covered with cement or plaster.
- 14.3. Vertical runs shall be supported at 1.5m intervals.
- 14.4. Horizontal runs shall be supported at 1.2 m intervals.
- 14.5. Saddles shall be installed within 0.5 m of a change in direction of conduit, or proximity of termination box.
- 14.6. Draw-in boxes shall be provided at no more than 10 m intervals on straight runs and between two right hand bends or three dog-leg sets.
- 14.7. Exposed threads of steel conduit shall be painted with aluminium based paint.
- 14.8. Conduit entries shall be protected against ingress of moisture or debris during installation.
- 14.9. In exposed or wet situations conduit connections and terminations shall be water tight.
- 14.10. Conduit runs shall be approved before installation work commences and shall be at least 150 mm clear of piping and ducting of other services.
- 14.11. Conduit and adaptable boxes shall be fixed with round head brass or steel sheradised or cadmium plated screws.

15. CONDUCTORS IN CONDUIT AND TRUNKING:

- 15.1. Only insulated cables shall be installed in conduit and trunking.
- 15.2. Cabling for different services shall be installed in separate conduits.
- 15.3. Fire alarm circuits shall not share the same compartment in trunking as other services. The same applies to circuits fed from central battery systems for emergency lighting and any other emergency service circuits, unless they are wired in MICC. This will only be allowed with written approval from the Engineer.

- 15.3.1. As per clauses 528.1 of I.S. 10101, band I and band II circuits shall not be contained in the same wiring system unless the specification prescribed in the clause are facilitated.
- 15.4. As per clause 526.3.1 of I.S. 10101, cables shall not be jointed in trunking. Cables of different circuits in trunking shall be taped or bound at intervals of 3 meters for easy identification.
- 15.5. Cables exceeding 10 sq. mm shall not be installed in trunking with smaller PVC cables.
- 15.6. MICC or SWA cables shall not be installed in trunking with PVC cables.
- 15.7. Cables shall not be packed or forced into trunking in such a manner as to damage or disfigure the insulation.
- 15.8. As part of the services co-ordination process and prior to installation, the Contractor shall advise the Engineer of trunkings which will exceed their capacity (including preserving spare capacity recommended in I.S. 10101).

16. CABLES AND FLEXIBLE CORDS:

- 16.1. GENERAL:
 - 16.1.1. Only cables and flexible cords in accordance with section 521 of I.S. 10101 may be installed. They shall be in accordance with the latest Irish Standards and shall carry the Irish Mark of Electrical Conformity (IMEC).
 - 16.1.2. In accordance with section 527 of I.S. 10101, all cables are required to have a minimum rating of class DCA, S2, D2, A2, where *D* refers to resistance to fire (*A-F*, with *A* being the most resistant, and *F* being the least) and *CA* in this context stands for Cable. *S* identifies Smoke, *D* identifies Droplets, and *A* identifies the level of resistance to Acid.
 - 16.1.3. Where the appropriate Irish Standard is not yet available, cables and flexible cords complying with the latest British, VDE or CENELEC standard shall be installed.
- 16.2. DCA APPROVED 70 DEGREES THERMAL PLASTIC CABLES AND FINAL CIRCUITS:
 - 16.2.1. These shall be high conductivity stranded copper conductors with 450/750 volt grade insulation.
 - 16.2.2. Colour coding of cables shall comply with the Table 51ZC.1 of Annex 51Zc within I.S. 10101 or as already established in an existing installation.

16.2.3. Unless indicated otherwise the undernoted minimum sized cables shall be used in final sub circuits.

Lighting (1 kW max. load)	-	2.5 sq. mm PVCI
Socket outlets (4 No. max)	-	4.0 sq. mm PVCI
Cooker (Domestic type) circuit	-	16.0 sq. mm PVCI
Water heater circuit (3 kW)	-	4.0 sq. mm PVCI
Water boiler circuit (5 kW)	-	10.0 sq. mm PVCI
Boilerhouse final circuit (3 kW)	-	2.5 sq. mm PVCI

16.3. FLAT TWIN AND EARTH CABLES (DCA s2d2a2 alternative to PVC):

16.3.1. These shall be as PVC cables.

16.3.2. They shall not be installed on tray, ladder or basket.

16.3.3. Mechanical protection shall be provided when necessary.

16.3.4. They shall be clipped/fixed in position according to the manufacturer's instructions.

16.3.5. They shall not be installed externally without additional mechanical protection.

16.3.6. These cables shall not be buried directly in the ground or plaster, or concrete.

16.4. NHXMH CABLES:

16.4.1. NHXMH Cables may be installed on tray, ladder and basket.

16.4.2. Mechanical protection shall be provided when necessary.

16.4.3. They shall be clipped/fixed in position according with the manufacturer's instructions.

16.4.4. When installed externally on a wall these cables shall be provided with additional mechanical protection.

16.4.5. These cables shall not be buried directly in the ground or plaster, or concrete.

16.5. PVC/SWA/LSF CABLES:

16.5.1. These are acceptable in outside and underground locations but when used within building a DCA s2d2a2 alternative is required.

16.5.2. PVC/SWA/LSF cables shall be 600/1000 volt grade and have high conductivity stranded copper conductors. They shall comply with the latest CENELEC standard.

- 16.5.3. Terminations shall be made off with approved glands and earth bonding washers. Black PVC shrouds shall be installed on glands.
- 16.5.4. Cables installed below 300 mm shall be protected against mechanical damage by a galvanised steel piping sleeve.
- 16.5.5. Where single cables are installed, they shall be supported with approved saddles or cleats. The saddles shall prevent the cable from sagging. Fixing screws shall be sheradised or cadmium plated.
- 16.5.6. Where three or more cables are installed they shall be fixed to cable tray.
- 16.5.7. See Appendix 'Underground Cable Installation' for installation methods for cables buried in the ground.
- 16.5.8. Cables installed under made ground - roads, foot-paths etc., shall be installed in high impact ducts suitably sized to facilitate withdrawal of the cables.
- 16.6. XLPE/SWA/DCA APPROVED 70 DEGREES THERMOPLASTIC CABLES:
 - 16.6.1. The same specification applies to XLPE/SWA/DCA approved 70 degrees thermoplastic cables as apply to PVC/SWA/ approved 70 degrees thermoplastic cables.
- 16.7. MINERAL INSULATED CABLES (MICC):
 - 16.7.1. Materials:
 - 16.7.1.1. Cables shall comply with I.S. EN 60702-1 and I.S. EN 60702-2 and for employment in the context of fire resistance, the cable shall comply with I.S. EN 50200 and I.S. EN 60332-1-2.
 - 16.7.1.2. Cables shall be 600 volt class except when specified cables exceed this range then 1000 volt cables shall be used.
 - 16.7.1.3. Generally, cables shall have DCA approved 70 degrees thermoplastic outer coverings when:
 - 16.7.1.3.1. They are fixed to a surface subject to dampness.
 - 16.7.1.3.2. They are fixed to a galvanised metal such as cable tray.
 - 16.7.1.3.3. They are buried direct in the ground.
 - 16.7.1.4. Terminations shall comply with the requirements of I.S. EN 60702.
 - 16.7.1.5. The classification of pots and seals shall be suitable for the application. Where DCA approved 70 degrees thermoplastic coated cable is used glands shall be fitted with DCA approved 70 degrees thermoplastic shrouds. Before positioning the shroud the gland shall be wrapped with PVC adhesive tape.

- 16.7.1.6. Saddles and P clips shall be of approved manufacture and shall be brass with suitable DCA approved 70 degrees thermoplastic coating if required.
- 16.7.1.7. Saddles and P clips shall be fixed with round head brass screws. When fixed to cable tray round head metric brass screws (M4) and nuts (M4) shall be used.
- 16.7.1.8. Only new, dry and uncontaminated plastic compound shall be used in sealing pots.

16.7.2. Installation of MICC Cables:

- 16.7.2.1. Installation of MICC cables shall be in accordance with Annex 52B of I.S. 10101.
- 16.7.2.2. Special care will be needed to ensure that these cables are neatly installed and terminations are properly made.
- 16.7.2.3. All cable routes shall be determined by the Contractor and agreed by the Engineer before work is started.
- 16.7.2.4. Cables shall be run at least 150 mm clear of piping and ducting of other services.
- 16.7.2.5. When more than three cables are installed side by side they shall be installed on cable tray.
- 16.7.2.6. A loop shall be introduced in a cable run immediately before its entry into equipment subject to vibration. A space shall be maintained at the point in the loop where the overlap occurs.
- 16.7.2.7. Bends in cables shall be formed only by standard tools approved by the cable manufacturer. Corrugation of the copper sheath will not be permitted.
- 16.7.2.8. Where these cables are installed in the ground they shall be protected by galvanised conduit or PVC high impact piping.
- 16.7.2.9. Where they are installed below 300 mm they shall be protected with galvanised steel piping fitted with a female brass bushing.

16.8. ENHANCED CABLE:

- 16.8.1. Enhanced cable shall be PH 120 type tested to I.S. EN 50200 including Annex E2. Cable supports and/or Fasteners shall be non-combustible and shall be such that the circuit integrity afforded by the cable is maintained. To this end enhanced cables may be installed as follows:
 - 16.8.1.1. On tray or basket where the anchors/fixings are of a non-combustible construction and the cables are dressed with steel cable ties that have a 2-hour fire resistance.
 - 16.8.1.2. Within a broken galvanised steel conduit system where the saddles are fixed with non-combustible screws or bolts that have a 2-hour fire resistance.

- 16.8.1.3. Direct clipping to the structure with proprietary clips to meet the PH120 integrity of the cable.

17. LOAD BALANCING:

- 17.1. The Contractor shall include for the testing of the completed electrical services installations to ascertain and record the loading of each circuit and of each distribution board, switchboard and control panel and to modify the circuit arrangements to ensure the loads are balanced to the satisfaction of the Engineer.

18. LABELS:

- 18.1. The Contractor shall include for the supply and installation of permanent labels for all terminations, switchboards, distribution panels, isolators, connection boxes and link boxes and where specified elsewhere. Samples of the labels and method of fixing proposed shall be provided for the Engineer's approval.

- 18.1.1. Labels shall be in accordance with section 514 of I.S. 10101.

- 18.2. Labels shall be traffolyte engraved black lettering on white background or red background. The labels shall be fixed by means of or superglue directly to the surface of the device so as not to compromise its use. Alternatively, the label can be permanently screwed to the local mounting material directly beside the device.

19. NOTICES:

- 19.1. The Contractor shall include for the supply and installation of all statutory notices (safety and information types) as required.

20. ACCESSORIES:

- 20.1. Accessories shall be flush, or surface mounted to suit particular requirements.

- 20.1.1. General requirements for electrical accessories are provided in BS 5733.

- 20.2. Ferrous parts shall be adequately rust-protected.

- 20.3. Accessories mounted outside a building shall be weatherproof and boxes shall have external fixing lugs.

- 20.4. Cable ties shall be selected to conform with the type of cable being served, the weight of the cable(s), the environmental conditions, fire rating and cable manufacturers requirements.

21. TESTING AND COMMISSIONING:

21.1. GENERAL:

- 21.1.1. The Contractor shall include for fully testing and setting to work all the installations, systems and equipment included within the contract and shall demonstrate the correct and specified performance of all such items in the presence of and to the satisfaction of the Engineer and Employer's Commissioning Officer prior to practical completion as set out elsewhere in this Specification.
- 21.1.2. It will be necessary when setting up the programme to arrange for parts of the Installations to be complete and enable other sub-contractors or suppliers to carry out their testing and setting to work.
- 21.1.3. The Contractor shall ensure that sufficient time is allowed in the Main Contractor's programme(s) to carry out the testing, pre-commissioning, commissioning and handing over of the installation. The testing and setting to work set out here shall apply to all elements of the works described in this Specification and shown on the drawings.

21.2. TESTING AND SETTING TO WORK:

- 21.2.1. On completion of works or parts of the works the Contractor shall test the various installations for polarity, earthing, insulation and protection as laid down in Chapter 6 of I.S. 10101, National Rules for Electrical Installations and any other requirements called up in the Specification.
- 21.2.2. Protective devices and ring-circuit continuity shall also be tested in accordance with the National Rules (I.S. 10101).
- 21.2.3. The various sections may not all be carried out together and the Contractor shall include for testing in stages to suit the progress of the building.
- 21.2.4. Where nominated suppliers appointments includes for testing, the Contractor shall be responsible for ensuring that all tests are properly carried out.
- 21.2.5. Test certificates shall be made available to the Contractor to enable him to record the details of the tests and upon completion of the tests systems or parts of the systems a copy shall be submitted to the Engineers.
- 21.2.6. The Contractor shall serve at least seven days' notice on the responsible Engineer before carrying out the tests, to allow the Engineer or his representative to witness the tests if he so wishes.

21.3. INDEPENDENT TESTING:

21.3.1. A Provisional Sum is included in the Summary of Tender to cover the cost of independent testing which may be deemed necessary during the course of the contract. This testing shall be authorised by the Engineer.

21.4. SPECIAL TESTING ON SITE:

21.4.1. A Provisional Sum is included in the Summary of Tender to cover the cost of special testing which may be deemed necessary during the course of the contract. This testing shall be authorised by the Engineer.

21.5. PRE-COMMISSIONING:

21.5.1. During the course of the works the Contractor shall carry out on an on-going basis the pre-commissioning of the works and shall assemble all necessary handover material which will be required at hand-over.

21.5.2. The pre-commissioning shall be sufficiently thorough and systematic so as to identify together with normal site inspections any obvious installation deficiencies, design errors or omissions.

21.5.3. The Contractor shall be responsible for the rectification of the defective work. Any problems which result from design or omissions shall be referred to the Engineer.

21.6. COMMISSIONING:

21.6.1. Within the time allowed in the Main Contractor's programme(s) the Contractor shall carry out the commissioning procedures.

21.6.2. The Contractor shall provide all instruments and equipment required to carry out the commissioning. Instruments and equipment shall be of good quality and shall be approved by the responsible Engineer.

21.6.3. Where necessary the Contractor shall arrange for nominated suppliers or their representatives to be present at the commissioning.

21.6.4. The commissioning procedures shall be thoroughly and systematically carried out by the Contractor.

21.6.5. The commissioning shall be carried out at a time agreed between the Contractor, the Engineer and the Main Contractor.

22. EQUIPMENT AND APPLIANCES:

- 22.1. All equipment and appliances to be supplied under the electrical services contract shall be connected in accordance with the manufacturer's instructions.

23. DESCRIPTION OF THE WORKS:

- 23.1. The following general description is intended to give an overall view of the works and does not relieve the tenderer in any way from taking account of all parts of the tender documentation.

Installation of New package plantroom with water tank, pumps and electrical services linked to existing building

23.1.1. Electrical supply and distribution. Installation of containment, MCC and Consumer unit.

23.1.2. General Services and Small Power. Installation of sockets, spurs and isolators.

23.1.3. Lighting Services. Installation of new LED lighting.

23.1.4. Fire Alarm System. Installation of new heat detector, sounder and BGU linked to existing FAP in the Academic building.

23.1.5. Emergency Lighting System. Installation of new LED lighting.

23.1.6. Electromechanical Installations. Installation of MCC, sensors, spurs and isolators.

- 23.2. Note that the tender documentation includes both the Specification and the Drawings scheduled.

SECTION 3 - PARTICULAR SPECIFICATION

PART 3.1 - ELECTRICITY CENTRE & MAIN DISTRIBUTION SYSTEM (61)

1. LV SWITCHGEAR :

- 1.1. The main switchboard and sub distribution boards shall be manufactured in accordance with the Engineer's schematic drawings, the switchgear specification, and the approved specialist supplier's drawings. They shall be inspected by the Contractor and the Engineer at the specialist supplier's works before delivery to site. The switchgear shall be as manufactured by Davenham Engineering, M&L Limited, Control Equipment Limited and BMC Limited , or equal and approved.
 - 1.1.1. Where necessary to suit site access, distribution board locations and safe handling the boards shall be constructed and delivered to site in sections.
 - 1.1.2. The contractor shall include for the supply and installation of a unistrut support framework, where the distribution boards are intended for mounting on solid walls.
 - 1.1.3. Where dedicated cableways are not built into the distribution boards, the contractor shall include for the supply and installation of trunking headers, in accordance with Clause 521.6 and Annex 52 of I.S. 10101, over the boards, are suitably sized to ensure a non-constricted delivery and distribution of individual circuits/cores to terminals.
- 1.2. All fixtures and connections shall be tightened on site before final inspection. All units shall be securely fixed before any cables are connected.
- 1.3. Before being commissioned all units shall be cleaned and damaged paintwork repaired and identification labels fixed.
- 1.4. The main switchboard shall incorporate a digital multi-meter capable of indicating kVA, kW, KVA_r, kWh, Amps, Volts, power factor, etc. Where appropriate, per phase (and between phase) measurements shall be recorded and be capable for interfacing with a B.M.S. network. The metering shall incorporate an interface to display the range of recorded information and the associated BMS shall be capable of providing summary information such as energy consumption etc. Other distribution boards may also be so equipped as indicated on the drawings.
- 1.5. The Contractor shall include for on-site work by the specialist supplier of the switchgear, mounting and assembly of the modular compartments, modifications to switchgear terminals, gland plates, etc. to accommodate specified cable sizes. This inclusion shall also accommodate for on-site testing of the performance of the board.
- 1.6. The Contractor shall supply and install B.M.S. wiring systems from the main switchboard and from each local distribution board to the B.M.S. outstation in the plant room, termination at both ends to be facilitated by others.

- 1.7. The supply of cable end boxes, interconnections, fuses and appropriate designation **labelling** is deemed to be included as part of the respective switchboards.
- 1.8. All switchboards (MV & LV) and LV control panels shall have a rubber mat fitted to the front of board/panel, the mat shall be 12mm thick (approx.), 0.9m wide and extending to the full length of the board/panel front (and rear if necessary). The mat shall conform to EN 61111 and be as supplied by Technical Equipment Company, or equal and approved.

2. CIRCUIT INDEX CHARTS:

- 2.1. Circuit index charts contained in clear plastic sealed containers shall be adhesive-fixed inside the door of every distribution board.
- 2.2. The index shall fully identify and describe each circuit protected.
- 2.3. The index shall also identify the neutral connections for the outgoing circuits which must be connected in sequence to correspond with the phase conductor of the circuit.
- 2.4. The Contractor shall include for the supply and fixing of all circuit index charts and plastic envelopes.

3. CABLE DISTRIBUTION SYSTEM:

- 3.1. From the LV switchgear, the Contractor shall install a complete low voltage distribution network as specified hereafter.
- 3.2. Distribution cabling shall be protected against damage during installation.
- 3.3. All cables shall be permanently clipped and connected before being commissioned.
- 3.4. All cables shall be sized as shown on the drawings.
- 3.5. Cable insulation considerations shall comply with section 527 of I.S. 10101 wherein, all buildings shall as a minimum meet the requirements of Class Dca S2, d2, a2 or higher in accordance with I.S. EN 50575. In addition, cables shall be tested in accordance with I.S. EN 61034-2 and the smoke generated shall result in transmittance values of not less than 60%.
- 3.6. Cables shall be installed using cable tray, as indicated on the drawings.
- 3.7. Cables installed using cable tray may be secured with nylon cable ties. The size and spacing of the ties shall be in accordance with the cable manufacturers' requirements.

- 3.8. Single runs of cable shall be secured by claw type cleats single bolt or two bolt fixing as required, complete with studs and backstrap.
- 3.9. The arrangements route, size and types of LV distribution cables shall be as indicated on the drawings and shall be marked out on site by the Contractor for approval by the Engineer on site before the installation commences. The selection of wiring systems shall comply with part 52 of I.S. 10101. In respect to neutral conductors and their cross-sectional area(s), clause 524.2 must be adhered to.
- 3.10. Primary distribution routes are indicated on the drawings but the Contractor shall make due allowance for deviations from or detours to these routes arising from co-ordination activities or other parameters.
- 3.11. Each cable shall be manufactured for installation in a continuous length and shall not be jointed without written authorisation from the Engineer.
- 3.12. Glands for SWA type cables shall contain a plain brass slip-on earth tags shall be provided; above this cable size glands shall have an integrally cast earth lug. Shrouds to totally enclose the gland body and form an effective seal down onto the cable's overall sheathing shall be provided. Tags and lugs shall be made off to supplement earthing provided directly by glands.
- 3.13. All electrical circuits shall include a separate earth conductor (protective earth) with yellow/green outer sheath, of appropriate insulation (in accordance with section 527 of I.S. 10101).
- 3.14. Each distribution group shall be solidly bonded to the cable gland of each incoming and outgoing cable and to cable trunking. Special care shall be taken to ensure that effective electrical and mechanical connections are obtained.
- 3.15. For tendering purposes it shall be assumed that all wiring shall be brought directly to the terminals of the appropriate protective device and to the corresponding connector ways on the relevant neutral and earth bar(s) where relevant.
- 3.16. OVER-HEAD TYPE:
 - 3.16.1. The Contractor shall supply and install overhead runs of busbar trunking, as indicated.
 - 3.16.2. Busbar systems and powertrack systems shall be in compliance with clause 521.4 (I.S. 10101)
 - 3.16.2.1. Busbar trunking systems shall comply with I.S. EN 60439-2 and powertrack systems shall comply with the I.S. EN 61534 series. Busbar trunking systems and power track systems shall be selected and installed in accordance with manufacturers' instructions taking account of external influences.

4. METAL CABLE LADDER / TRAY AND FITTINGS:

4.1. MATERIALS:

- 4.1.1. Cable ladders shall be of the heavy duty type in accordance with IS EN 61537
- 4.1.2. Perforated cable tray shall be heavy duty type formed from galvanised sheet steel IEC 61084.
- 4.1.3. For tendering purposes the dimensions shall comply with the table below unless stated otherwise on drawing.

Nominal Width	Minimum Height of Upstand	Nominal Thickness of Steel Sheet	Application
100mm	50mm	1mm	Internal Installations
150mm	50mm	1mm	Internal Installations
225mm	50mm	1.5mm	Internal Installations
300mm	50mm	1.5mm	Internal Installations
450mm	50mm	1.5mm	Internal Installations
600mm	50mm	1.5mm	Internal Installations
100mm	50mm	2.5mm	External Installations
150mm	50mm	2.5mm	External Installations
300mm	50mm	2.5mm	External Installations

- 4.1.4. Bends, tees, sets etc., shall be of the same manufacture as the cable tray and of the same material.
- 4.1.5. Where cable tray is installed in corrosive atmospheres (Battery Rooms etc.) it shall be coated with insulation in accordance with section 522 and in particular, 522.5 of I.S. 10101.
- 4.1.6. Mushroom-head sheradised or cadmium plated bolts and nuts shall be used for fabricating cable tray and accessories.

4.2. INSTALLATION OF CABLE TRAY:

- 4.2.1. Cable tray shall be secured in a neat and tidy manner and shall be secured with adequate mushroom-head or round head sheradised or cadmium plated screws fixed at regular intervals not exceeding 1.0 m. At bends or tees tray shall be supported adjacent to the overlap point. Cable tray installations shall comply with section 521 and Annex 52A of I.S.10101.
- 4.2.2. Metal spacers - 25 mm minimum - shall be used to distance the cable tray from vertical and horizontal surfaces.

- 4.2.3. Changes of direction of cable tray shall be curved to ensure continuous support for all cables.
- 4.2.4. Cable tray runs shall be determined by the Contractor and agreed with the responsible Engineer before work is started.
- 4.2.5. Cable tray shall be spaced at least 150 mm clear of piping and ducting related to other services, and installation shall be such that the wiring system is in compliance with section 528 or I.S. 10101.
- 4.2.6. Joints on cable tray shall overlap by at least 100 mm. Alternatively manufacturer approved joiners can be used.
- 4.2.7. All cables installed on cable tray in horizontal and vertical planes shall be adequately secured with straps or clips at close intervals to prevent sagging.
- 4.2.8. Where cables pass through holes in cable tray. The holes shall have a bush and lock-ring arrangement.
- 4.2.9. Where welding has been employed in the fabrication of cable tray the joints shall be treated with two coats of zinc rich paint.
- 4.2.10. Manufacturers standard accessories shall be used throughout. However, where special non-standard accessories are required, they may be manufactured by the Contractor with the approval of the responsible engineer.
- 4.2.11. Cable tray shall not be cut through perforations if possible. All raw edges shall be filed and treated with two coats of zinc rich paint.
- 4.2.12. Where cable tray penetrates through floors and walls, fire barriers shall be provided by the Main Contractor, manufactured from insulating material, shall be so rated as to retain the integrity of the fire compartment and sealing of wiring system penetrations shall be in accordance with clause 527.2 of I.S. 10101.

5. CABLE TRUNKING AND FITTINGS:

5.1. MATERIALS:

- 5.1.1. Surface cable trunking shall comply with I.S. EN 50085 and be manufactured from galvanised steel with electrically deposited zinc.

5.2. The metal gauge shall conform with the following table:-

Dimensions mm		Body Gauge mm	Cover Gauge mm
A	B		
50 x 50		1.0	1.0

75 x 50	1.2	1.0
75 x 75	1.2	1.0
100 x 50	1.2	1.2
100 x 75	1.2	1.2
100 x 100	1.2	1.2
150 x 75	1.6	1.2
150 x 100	1.6	1.2
150 x 150	1.6	1.2
200 x 75	1.6	1.2
200 x 100	1.6	1.2
200 x 150	1.6	1.2
200 x 200	1.6	1.2
225 x 75	1.6	1.2
225 x 100	1.6	1.2
225 x 150	1.6	1.2
225 x 225	2.0	1.2
300 x 75	1.6	1.6
300 x 100	1.6	1.6
300 x 150	2.0	1.6
300 x 225	2.0	1.6
300 x 300	2.0	1.6

- 5.2.1. Joints shall be bonded with couplings and purpose made copper earth continuity links.
- 5.2.2. Where paint finish trunking is required, epoxy powered coating shall be used.
- 5.2.3. Manufacturers standard fittings shall be used throughout. However, where special fittings are required they shall be manufactured off site to approved drawings and to the same specification as standard items.

5.3. INSTALLATION OF TRUNKING:

- 5.3.1. Trunking shall be erected in a neat and tidy manner and shall be secured with adequate round head sheradised or cadmium plated screws fixed at regular intervals not exceeding 1.8 m and trunking installations shall comply with clause 521.6 and Annex 52A of I.S.10101.
- 5.3.2. Trunking shall be run neatly on the surface of the building(s) and truly vertical, horizontal or parallel with the features of the building.
- 5.3.3. Metal spacers - 25 mm minimum - shall be used to distance the trunking from vertical.
- 5.3.4. For horizontal runs trunking should be supported by a trapeze network so that the lid of the trunking is not required to hold up the cables. Alternatives to this are only with the written consent of the engineer.
- 5.3.5. The interior of all trunking shall be free from burrs, sharp edges and swarf.

- 5.3.6. Trunking runs shall be determined by the Contractor and agreed with the Engineer before work is started.
- 5.3.7. Trunking shall be spaced at least 150 mm clear of piping and ducting of other services, where practical.
- 5.3.8. Conduit connections to trunking shall be made with standard flange couplings and lead washers.
- 5.3.9. Cable pin racks shall have PVC sleeved pins. These shall be used on vertical runs and be provided at 3 m intervals.
- 5.3.10. Lighting trunking shall be 50 mm x 50 mm manufactured from 1.2 mm galvanised steel with matching fittings.
- 5.3.11. Connections between trunking and distribution boards shall be sized to accept cables from all used and "spare" ways.
- 5.3.12. The space factor capacity of trunking shall be 45% of the internal cross-sectional area.
- 5.3.13. Where horizontal runs of trunking pass through walls or partitions, the internal free space surrounding cables shall be fire-stopped with glass fibre, mineral wool, or other approved proprietary packing material to the full thickness of the wall. Such fire-stopping shall be carried out by the Contractor.
- 5.4. Standard flanged couplings shall be used to terminate trunking at apparatus, at adaptable boxes and at points where it is desired to connect one section of trunking to another where a standard fitting is obviously unwarranted. The practice of cutting and bending the material of the trunking to form flange attachments will not be accepted.
- 5.5. Connections between trunking and apparatus shall be by a screwed coupler and bush, or a standard flange coupling or an adapter neck, fabricated or cast. Direct attachment of trunking to apparatus will only be permitted if cable entries are provided with smooth bore bushes or grommets and the return edge of the lid of the trunking is left intact.
- 5.6. Holes in trunking shall be drilled, punched or cut by ring saw.
- 5.7. Trunking in the vertical rising ducts shall be fixed to the unistrut spacers provided by the Contractor with sheradised Whitworth cheese head screws and unistrut nuts, two per fixing. Trunking run in ceiling spaces and roof voids shall be fixed in a similar manner.
- 5.8. All compartmented tee pieces and intersection units shall have their compartments fully screened and separated from each other and the effective cross sectional areas of these branches shall not be reduced.
- 5.9. Cable trunking in vertical ducts shall be installed with the cover pointing outwards and all trunking installed in ceiling spaces shall have the cover pointing downwards, unless agreed otherwise.

- 5.10. In the areas where the unistrut inserts are available fixed to the concrete slabs, the Contractor shall be free to use them for fixing cable tray, etc., and in all other areas the Contractor shall use rawlbolt anchors for fixing hanger brackets.
- 5.11. Trunking may be fitted under false floor in some areas as indicated. This trunking shall be installed with lid facing upwards.

SECTION 3 - PARTICULAR SPECIFICATION

PART 3.2 - SMALL POWER SERVICES (62)

1. GENERAL SERVICE SOCKETS:

1.1. GENERAL

1.1.1. The wiring system shall be in accordance with section 527 of I.S. 10101 and for general service socket outlets shall be in conformance with

- Method 1 – DCA Approved 70 degrees Thermoplastic cables in conduit or trunking (section 15 and 16 (ELEC 06, section 2)
- Method 2 – NHXMH cables on cable tray (section 15 and 16 (ELEC 06, section 2)
- Method 3 – XLPE/SWA/ DCA Approved 70 degrees Thermoplastic cables on cable tray (section 15 and 16 (ELEC 06, section 2)

1.2. The Contractor shall supply and install a complete general service socket installation as indicated.

1.3. The installation shall be a dedicated trunking / conduit system with DCA Approved 70 degrees Thermoplastic cables.

1.4. Generally, conduits shall branch from the trunking and be saddled by means of spacer bar saddles to the underside of the floor slab continuing thus in the ceiling space and dropping down to the position of the sockets which may be located in the patent partition or concealed in concrete or block walls.

1.5. In all areas with corridor ceiling trunking the wiring from the distribution board shall be conveyed in the trunking to a point nearest to its final destination from whence it shall continue in conduit to the outlet.

1.6. All socket-outlets shall have a 2.5 mm² DCA Approved 70 degrees Thermoplastic earth wire, identifiable as per Table 51ZC.1 in I.S. 10101, installed with the circuit wiring from the distribution boards. Thus, each socket circuit shall have an earth conductor connecting from the earth socket terminal of the socket outlet back to an earthing bar which shall be incorporated in the distribution group.

1.7. Conduits serving general service socket-outlets on benches shall drop from the ceiling void in an agreed location and manner and connect to a spine trunking or conduit running beneath the worktop. Final connections to pedestal units shall be by means of flexible conduit.

- 1.8. Final circuits for general purpose socket-outlets shall be as indicated or as approved. The wiring system used shall be DCA Approved 70 degrees Thermoplastic cables in trunking and/or conduit as specified in Section 2 of this Specification. Cables shall be 4 mm² stranded) with 20A/30mA RCBO (Type B) protection with a maximum of 4 no. outlets per circuit unless otherwise indicated.
- 1.9. Cleaning outlets, catering outlets and isolators and other items of permanently wired equipment shall be engraved with their intended usage and labelled with the circuit reference.
- 1.10. Where metallic outlet plates are installed on plaster walls, a plastic membrane shall be inserted between plate and plaster to prevent a chemical reaction between metal and plaster and consistent with manufacturer's instructions.
- 1.11. SOCKETS:
 - 1.11.1. General service socket outlets shall be 13 amp three-pin socket and shall comply with the latest IS 411 standard. Socket outlets shall be 13A 3 pin with integral single/double pole switch and shall comply with the section 554 of I.S. 10101. Socket outlets shall have integral single pole switches unless stated otherwise. Interlocked shutters shall be incorporated in all sockets.
 - 1.11.2. Socket plates shall be metal or plastic to suit particular requirements and shall comply with the latest BSS. Metal plates shall be earthed with insulated earth leads. See Schedule XXX for types and locations.
 - 1.11.3. In accordance with clause 554.1, socket outlets for general purposes shall be mounted at a height not lower than 400 mm and not higher than 1200 mm above floor level. Socket outlets shall be mounted at 450 mm from the floor level unless particular requirements dictate otherwise . The sockets shall be as manufactured by Lewden, Legrande, Marechal, or equal and approved.
 - 1.11.4. Weatherproof socket outlets (13A externally rated, IP54) shall be provided with spring-loaded covers or screw on metal caps as scheduled. They shall comply with the latest BSS.

SECTION 3 - PARTICULAR SPECIFICATION

PART 3.3 - LIGHTING SERVICES (63)

1. GENERAL LIGHTING:

- 1.1. The Contractor shall install a complete lighting scheme in each area as indicated on drawings and specified hereafter.
- 1.2. The following specification covers general lighting circuits, general luminaires, emergency lighting circuits, emergency luminaires, illuminated signs and other specialised lighting.
- 1.3. The lighting installation is designed generally in accordance with the SLL Code for Lighting and is cognisant of the minimum requirements outlined in IS EN 12464 part 1 and 2 where required.

2. WIRING:

- 2.1. The wiring shall be in a metal trunking and/or steel conduit throughout with the trunking generally being located in the ceiling spaces, facing upwards with the lid at the top, and connected to the distribution boards in the distribution cupboards. The Contractor shall allow sufficient bends, tee sets, offsets, reducers, suitable trapeze work (where required) etc. to make the interface in a workmanlike manner to the Engineer's approval.
 - 2.1.1. Wiring systems for lighting installations shall be in accordance with section 559.5 of I.S 10101
- 2.2. Unless otherwise indicated, the branch conduits shall rise from the trunking and be secured by means of spacer bar saddles to the underside of the floor slab thence dropping where necessary to light outlet boxes in walls and ceiling spaces.
- 2.3. Final lighting sub-circuits shall be wired in 2.5 mm², stranded copper conductor LSOH insulated cables with 10A protection. The MCB/RCBO characteristic shall be selected to conform with section 533 and more specifically, clause 533.3.2.2 of IS 10101.
- 2.4. The wiring shall be so arranged that not more than two 2.5 mm² cables enter any one terminal.
- 2.5. It shall be noted that 5 amp socket outlets intended for lighting circuits only including lighting circuits within bathrooms, shall be protected by RCBOs in accordance with clause 701.415.1 of I.S. 10101.

- 2.6. The Contractor shall arrange the circuiting of the lighting systems as indicated on drawings.
- 2.7. Cables shall be installed in trunking and galvanised conduit and terminated at the Luminaire position in a 6A PCR (plug in ceiling rose) (3 or 4 pin for standard) as KLIK type or MK type or equal. Note, 5 and 7 pin DALI plug/socket arrangements must be approved through written agreement with the responsible engineer.

3. FINAL CONNECTIONS TO LUMINAIRES:

- 3.1. Where fluorescent fitting spines do not cover BESA box opes blanking plates with grommets shall be installed.
- 3.2. All luminaires shall be earthed with earth leads.
- 3.3. Where luminaires are recessed into a false ceiling the conduit shall terminate adjacent to the fitting in a KLIK socket outlet with the final connection being carried out with a 3 core circular 1.5mm² flex. Any reduction in cross-sectional area must be approved (in writing) by the responsible engineer.
- 3.4. Where an emergency light is integrated into a luminaire the ceiling outlet shall have an appropriate number of pins and the high temperature LSOH cord shall have a sufficient number of cores.
- 3.5. Where luminaires are mounted on the surface of the ceiling or wall, the circuit wiring shall terminate in a PCR (klik) connector (or through a connector arrangement that facilitates similar protection against overheating and accommodation of mechanical support) in the conduit box to which the fitting is fixed and the final connection shall be made in 3 core circular 1.5mm² high temperature heat resistant cord meeting the acceptable DCA requirements.
- 3.6. Standard DCA Approved 70 degrees Thermoplastic cables insulated cables shall not in any circumstances be used for final connections to tungsten luminaires.
- 3.7. The contractor is required to ensure that all conduit outlets are sufficiently facilitated with a bonding provision. The minimum requirement is one connection per branch conduit with 2.5 mm² DCA Approved 70 degrees Thermoplastic cables (minimum) where a separate CPC for the circuit is utilised.
- 3.8. Luminaries in suspended ceilings shall be earthed by the appropriate core in the flexible cord.

4. SWITCHES:

- 4.1. Switches shall comply with the I.S.EN 60669 series, BS 3676 and IEC 669-1, and shall be suitable for use on inductive or resistive loads and rated for 10 amps minimum. They shall be single-pole one-way unless otherwise indicated or approved and were located adjacent to each other they shall be grouped in a multi-gang single enclosure and share a common switch-plate.
- 4.2. The rocker shall be double insulated and have a quick positive action. Brass terminals shall be pillar screw type with terminal screws to facilitate ease of connection including looping in and out of the terminal.
- 4.3. Ease of fixing and alignment shall be provided by an adjustable grid, which shall cover the box aperture and an elongated fixing lug to facilitate correct alignment. The large grid shall allow wiring to be connected without fixing the cover plate and in turn allow decorating work to be completed before the final fix. All units, except architrave assemblies shall fit boxes to BS 4662 with a minimum depth of 25mm. The switch grid shall be complete with a flying earth lead for connection to the box lug.
- 4.4. All boxes shall be of galvanised steel and provided with earth terminals with bonding link to cover-plate/switch grid. Cover plates shall be clearly and permanently labelled (e.g., Traffolyte) with the circuit reference. Multi-phase switch assemblies shall be complete with internal red phase warning labels clearly indicating '400 volts'.
- 4.5. Complete samples shall be submitted to the responsible Engineer for approval before any switches are placed on order. All samples shall be complete with boxes.
- 4.6. Ceiling switches (pull chords) shall be provided as indicated and shall be rated 15 amp one way or two way to BS 3676 and I.S.EN 60669 with 51 mm centres suitable for installation in small circular conduit boxes to BS 4568.
- 4.7. Cord operated switches shall comply with EN 61558 and be supplied with a 1.5 m white pull cord and insulated grip.
- 4.8. Switches shall be mounted in accordance with clause 530.7 of I.S. 10101 at 1100mm centre from the full floor level unless particular requirements dictate otherwise.

5. LUMINAIRES:

- 5.1. Light fittings shall be as shown on the drawings and schedule appended at the rear of this Specification. All fittings shall be fitted with lamps. Diffusers and lamps shall not be erected until the Main Contractor has cleaned the building.
- 5.2. The Contractor shall provide for the supply and delivery to site of all luminaires specified under this Contract.
- 5.3. All luminaires and ancillary equipment are to be installed as per manufacturers guidelines. Any deviation from this is only with the written consent of the responsible engineer.

- 5.4. Care is warranted for the adequate ventilation and support for luminaires and any associated ancillary device (drivers / transformers. Particularly in false ceilings.
- 5.5. Where modular suspended ceilings are used the final lighting arrangement is to confirmed with the responsible engineer once the ceiling grid is in place.
- 5.6. Before placing final orders, the Contractor shall obtain approval from the Architect for each type of luminaire intended for use and shall make due allowance for submission of samples to the Architect as required. A provisional sum is included in the summary of tender for the provision of sample luminaires and demonstration of luminaires.

6. EMERGENCY LIGHTING SYSTEM:

- 6.1. The Contractor shall include for the supply, wiring, erection, and connection of a complete emergency lighting installation as indicated on the drawings, including luminaires complete with lamps and external conversion units where required.
 - 6.1.1. The Contractor or Specialist Contractor for the installation, testing, commissioning and certifying of the Emergency Lighting System shall be registered to perform those duties under the Building Emergency Safety Systems (BESS) scheme, have successfully completed a nationally approved QQI Level 6 Course for those duties.
- 6.2. The emergency lighting installation shall be provided by means of emergency lighting luminaires, to provide a system of "escape lighting" complying with I.S. 3217 and IS EN 1838. The equipment shall comply with the attached emergency luminaire specification in Appendix 5.
- 6.3. The installation shall utilise non-maintained self-contained emergency luminaires and maintained self-contained exit sign luminaires, and luminaires shall be surface and semi-recessed.
- 6.4. Wiring to the self-contained luminaires shall be taken from the adjacent lighting circuit and a local means of isolating for each luminaire shall be provided by means of a 4 pin Klik type socket and plug (coloured Red) to provide a maintained supply to all charger units.
- 6.5. The permanent supply to the battery/charger units shall be derived from the same local circuit as the general lighting in line with IS 3217.
- 6.6. The self-contained luminaire based emergency lighting system shall incorporate a testing scheme as required by IS 3217 and in this project that shall be achieved by –
 - 6.6.1. Central Test Unit(s) linked to local distribution boards.

- 6.6.2. Automatic Test System built into the luminaires – Type S (as a minimum) or Type P, or Type ER or Type PER or Type PERC – as defined in EN 62034:2012.
- 6.7. The installation shall utilise non-maintained emergency luminaires and non-maintained or exit sign luminaires, and luminaires shall be surface and semi-recessed. The system shall be central battery / static inverter type as specified in Appendix XXX. The cabling connecting central battery / static inverter unit(s) and distribution boards and emergency luminaires & exit signs shall be PH 120 enhanced fire rated cables installed on dedicated tray or trunking or fixed to the structure using fire rated clips, manufactured for that purpose.
- 6.8. The I/O interface units shall be used as a means to detect failure of normal lighting supply
- 6.9. A Provisional Sum is included in the Summary of Tender for possible extensions required to the emergency lighting system. This sum shall cover the cost of wiring and provision of luminaires involved with such extensions.
- 6.10. In areas with suspended plaster ceilings, it may be necessary in some situations to cable from the emergency luminaire to a location where there is an access point to the ceiling void and where there is a lighting junction box or local distribution boards.
- 6.11. To facilitate regular and convenient testing of emergency luminaries, the Contractor shall supply and install multi-circuit central test unit(s) complete with interface relay unit, all located at the appropriate distribution board. Note, under no circumstances may dedicated emergency lighting circuits be used. The sources for the emergency lighting supplies for each circuit must be same as the permanent supplies to the general lighting in the same circuit via the interface relay unit to the emergency luminaires. The location for the central test unit shall be confirmed before installation.
- 6.12. On completion of the work of installation the emergency lighting system, the Contractor / Commissioning Engineer shall commission, test and certify the System. The Contractor shall provide to the Engineer an inspection and test certificate as specified in IS 3217 and I.S. EN 1838, duly completed.
- 6.13. The Engineers shall be given 1 weeks' notice of the commissioning and testing of the complete installation, so that they may witness the process.
- 6.14. EMERGENCY LUMINAIRES:
- 6.14.1. The Contractor shall supply, erect and connect the luminaires complete with lamps, specified in the schedule attached to the rear of this Specification.
- 6.15. Where indicated, standard luminaires shall be converted to emergency luminaries in accordance with I.S.EN 60598-2-22: 2014 and as indicated in Appendix 5 at the rear of this Specification. Such conversions shall be carried out by the luminaire manufacturer and shall in no way affect the warranty or performance of such luminaries. The

arrangement shall be such as to provide a self-contained sustained system with an emergency lighting duration of three hours.

- 6.16. All emergency luminaires and exit signs shall be supplied complete with Compliance Certificates to EN 60598-2-22 for the particular luminaire.
- 6.17. All relevant aspects specified in the "General Luminaires" clause above shall apply to the emergency luminaires. Final connections to emergency luminaires shall be enclosed in conduit.
- 6.18. Local isolation of exit signs shall be afforded by means of a 4-pin 'Klik' outlets.

7. EXTERNAL LIGHTING:

- 7.1. The Contractor shall supply, install, test and commission a complete external lighting installation, as indicated on drawings and specified hereafter.
 - 7.1.1. External Lighting installations shall be in accordance with section 714 of I.S. 10101.
- 7.2. The luminaires shall be circuited, as indicated on drawings and shall be routed, using cable tray, trunking and conduit and ducting as required.
- 7.3. All outgoing circuits shall use 600/1000 volt grade SWA cables meeting the current DCA requirements when routed within a building sized as indicated on drawings.
- 7.4. Cables in trenches and pipe ducts shall be installed in accordance with the Appendix to this Specification.
- 7.5. Joints in cables installed underground shall not be accepted except where such joints are sanctioned by the responsible Engineer and shall be made in an approved manner, with approved jointing accessories, to the satisfaction of the Engineer, and by a qualified cable joiner.
- 7.6. Where underground pipework enters a building the radius of the pipe bend shall be of the 'slow' type not exceeding the minimum bending radius of the cable.
- 7.7. COLUMNS /BOLLARDS
 - 7.7.1. All columns/bollards are to be seated on an ample concrete bed in line with the manufacturers guidelines. Any deviation needs the written permission of the responsible engineer.
 - 7.7.2. Columns and bollards must meet the current criteria of part 714 of IS 10101.

- 7.7.3. The columns shall be anchored by an infill of concrete with a pipe set in the concrete to permit cabling to and from the column. The excavation, anchoring and backfilling of the column pit shall be to Structural Engineer's detail.
- 7.7.4. The excavation of the column pit, the supplying and laying of the foundation slab, together with the concrete infill and ultimate reinstatement, will be carried out by the Main Contractor and shall be supervised by the Contractor.
- 7.7.5. The cables shall be looped into the base compartment of the lighting columns and made off into the SP&N fuse cut-out of B.I.C.C. manufacture or equal.
- 7.7.6. The Contractor shall supply, install and connect in the base compartment of each of the columns and poles a weatherproof loop-in type fused SP&N cut-out unit, suitable for use with PVC/SWA/PVC or XLPE/SWA/PVC copper cables specified. A sample of the cut-out unit shall be submitted to the Engineer for approval before the order for them is placed.
- 7.7.7. The Contractor shall include for wiring internally in the columns between the fused cut-out and the lantern with 3 core PVC insulated and PVC sheathed flexible cables. The outside lighting contactor shall be of the long life continuously rated, quiet operation, magnetically held type.

7.7.7.1. Note, non-DCA cable is permissible in outside environments.

7.8. WALL MOUNTED LUMINAIRES

- 7.8.1. Wall mounted luminaires shall be wired by means of 4 core PVC/SWA/PVC or XLPE/SWA/ PVC cable in sizes as detailed on the drawings.
 - 7.8.2. The cables shall be wired to a splitter box, adjacent to the luminaire, within the building on the loop-in loop-out basis.
 - 7.8.3. The Contractor shall wire from the splitter box to the lantern such that the wiring system is afforded both appropriate mechanical protection while also facilitating sufficient means to avoid condensation within any associated splitter boxes.
 - 7.8.4. The Contractor shall provide an earth lug in the splitter box solidly bonded to the single wire armouring of the incoming cable.
 - 7.8.5. One of the cores of the four-core cable to the lantern shall act as an earth lug in the splitter box.
- 7.9. Excavation and reinstatement shall be carried out by the Main Contractor; cable laying and all electrical work shall be carried out by the Contractor. The Contractor shall be responsible for supervising all activities to ensure a satisfactory installation. During back-filling of trenches and at a depth set down in the relevant Appendix to this Specification for the underground cable installation, the Contractor shall supply and install a warning tape of vividly coloured heavy-gauge polythene strip boldly printed to identify the particular service and warning slabs.

- 7.10. The Contractor shall provide record drawings. During progress of the work an accurate record of cable routes in plan and cross-section shall be made giving such particulars as will allow an accurate reference to be made in the event of a fault, modification or extension. Such records shall show, amongst other data, the exact position of every lighting column/ bollard (their dimensions and types), joint, cable box, earth electrode and connections thereto and also particulars of the depth of the trench, the quantity of duct ways, the arrangement of the cables and the position of all obstructions revealed during the excavation. The cable details to be shown are the size of the conductor, number of cores, type of insulation, protection, finish and design voltage.
- 7.11. Record drawings shall be based on Architect's setting out plans. All physical features necessary to locate electrical distribution details such as the outline of buildings, roads, paths, hedges and ditches, etc., shall be shown. The routes of sewers, water mains, heating ducts and other services shall be shown where they affect the new cable routes. The route of the ESB cables shall also be shown.

SECTION 3 - PARTICULAR SPECIFICATION

PART 3.5 - PROTECTIVE SERVICES (65)

1. FIRE ALARM SYSTEM:

- 1.1. The Contractor shall include for the supply, installation, testing and commissioning of the complete fire alarm system, by a Specialist Contractor.
- 1.2. The system shall be installed, tested and commissioned in accordance with IS 3218.
- 1.3. An LXX type automatic fire alarm and detection system of the addressable/analogue
- 1.4. A P Type automatic fire alarm and detection system of the addressable/analogue type shall be provided by the Contractor. Its purpose will be:
 - 1.4.1. To reduce the loss of property in a fire by the early detection of fire and summoning aid or activating fire-fighting resources.
- 1.5. The system shall comprise control and indicating equipment, fire detectors, break glass units and alarm sounders. The system shall be configured using the loop principal enabling bi-directional communication with all detection devices. The system shall operate on a programme loaded onto the system by the specialist supplier at the appropriate time. The programme software shall be open protocol type. The cost of the programme, its setting up, downloading and debugging shall be included by the Contractor.
- 1.6. It shall be wired in 1.5 sq.mm PH120 Enhanced cable for detector circuits and 2.5 sq.mm PH120 Enhanced cable for sounder circuits, red LSF sheathed in the ceiling voids and concealed behind architectural features to serve break glass units and alarm sounders. The cabling shall be segregated throughout its routes.
- 1.7. Enhanced cable shall be PH 120 type tested to I.S. EN 50200 including Annex E2. Cable supports and/or Fasteners shall be non-combustible and shall be such that the circuit integrity afforded by the cable is maintained. To this end enhanced cables may be installed as follows:
 - 1.7.1.1. On tray or basket where the anchors/fixings are of a non-combustible construction and the cables are dressed with steel cable ties that have a 2-hour fire resistance.
 - 1.7.1.2. Within a broken galvanised steel conduit system where the saddles are fixed with non-combustible screws or bolts that have a 2-hour fire resistance.

- 1.7.1.3. Direct clipping to the structure with proprietary clips to meet the PH120 integrity of the cable.
- 1.8. Where fire alarm panels are networked together, whether by using a patient communications bus, or via the building's Local Area Network, or Campus LAN / WAN, the interface must be fault resilient. If this feature is not integral to the panel(s), the tenderer shall include for the supply and installation of the appropriate communications card in each connected panel.
- 1.9. The indicator panel shall give clear location of a fire or details of the fault. The main control/indicator panel shall be equipped with full programme and testing facilities in accordance with IS EN 54. Facilities are to be provided for signals from remote equipment. Volt free contacts are required for transmitting signals from a digital communicator to a 24 hour manned station. The digital communicator shall be included in the contract and shall also be utilised by the intruder alarm system.
 - 1.9.1. The repeater panel shall give clear location of a fire or details of the fault. It shall provide details of all zones and/or addressable devices.
 - 1.9.2. Where an associated software package is available as an option to display alarm information in graphic format, the software must be open protocol type.
- 1.10. The indicator/additional panel shall have facilities to signal and initiate action by a separate voice evacuation system, which may be installed in the future.
- 1.11. The main control panel shall have an integral printer or interface for a separate printer to provide hard copy record of events happening within the system.
- 1.12. The system shall operate on 24 volts DC and shall incorporate sealed nickel cadmium batteries. The batteries shall be sized in accordance with IS EN 54.
- 1.13. The equipment shall conform to the following standards:-
 - 1.13.1. Fire Alarm Indicator Panel - IS EN 54
 - 1.13.2. Manual Call Switches - IS EN 54
 - 1.13.3. Heat Sensitive Detector (fixed type) - IS EN 54
 - 1.13.4. Smoke Sensitive Detector (photo-electric or ionisation type) - IS EN 54
- 1.14. All devices shall be continually monitored for operation/sensitivity, a pre-alarm being raised if any device is disconnected or nears a fail safe limit due to contamination.
- 1.15. Smoke detectors, heat detector breakglass units and alarm sounders shall be installed in accordance with the siting recommendations of the standard.

- 1.16. The number of sounders on one circuit shall be limited by the system as advised by the specialist supplier.
- 1.17. In designing the system, the Contractor shall arrange the detection loops to ensure that adequate capacity is left on the loop for additional use and that the length of such loops is not exceeded due to providing coverage to the full extent of the installation.
- 1.18. The fire alarm panel shall be selected with capacity for at least one additional loop card over and above those required for the building itself.
- 1.19. Audible alarm sounders shall be of electronic siren and shall be suitable for internal or external use as appropriate to their location.
- 1.20. On escape routes, only in exceptional circumstances shall ceiling voids (whatever the depth) **not** be fitted with smoke detectors. [See IS 3218 : 2013, Clause 6.10.3.1.2.3]
- 1.21. The fire alarm system shall incorporate a test facility which shall be key operated. When the key is used, the following shall occur during testing of the fire alarm system:-
 - 1.21.1. The fact that the walk test unit has been activated shall be signalled to the central monitoring station.
 - 1.21.2. Any alarm activated during the test period will not be signalled to the central monitoring station.
 - 1.21.3. When an alarm is activated during the test, an adjustable timing relay in the unit will automatically silence the alarm sounders within the building after a preset time period.
- 1.22. The fire alarm system shall incorporate relays to trigger the operation of smoke exhaust vent devices, smoke/fire shutters etc. These shall automatically be signalled to activate when an alarm condition is registered at the fire alarm panel. A key switch shall be provided at the monitoring panel to isolate these relays during testing of the system.
- 1.23. The central monitoring panel shall incorporate relays or signalling facilities for the means of initiating action by the electromechanical and security systems.
- 1.24. Direct hard wired (in the same type of wiring as sounder circuits) connections shall be made to:
 - 1.24.1. Fire fans so to start them up and damper controls.
 - 1.24.2. Gas alarm panel(s) and to shut slam shut valves.
 - 1.24.3. Release security doors.
 - 1.24.4. Lift systems.

- 1.24.5. Catering system fire suppression system or any other fire suppression system.
- 1.24.6. Fire Smoke Dampers
- 1.24.7. Stairwell / Atrium Smoke Vents
- 1.24.8. Disabled Toilet Alarm & Disabled Refuge Alarm
- 1.24.9. Fire Door Hold Open Release
- 1.24.10. Fire Curtains / Fire Shutters
- 1.24.11. Automatic Doors
- 1.24.12. MCC Control Panels / Individual AHP & Extract Fans
- 1.24.13. Security Control Panels
- 1.25. The Contractor shall supply and install a 4-pair B.M.S. cable from the walk test unit and status relays in the fire alarm panel to the main B.M.S. outstation. These relays shall signal to the central monitoring station, the status of each fire zone, common fault/fire conditions and walk test in progress. The cable will be terminated at the outstation by others.
- 1.26. The fire alarm and detection system shall be designed, installed, tested and commissioned in accordance with the general principles and technical guidance of IS 3218. The system shall be tested and commissioned by the manufacturer and an acceptance certificate shall be issued to the Engineer upon completion.
- 1.27. A diagram or zone identification drawing shall be provided in a timber frame giving clear indication of the various fire alarm zones. This shall be wall mounted adjacent to the fire alarm panel.
- 1.28. The equipment shall be as supplied by Siemens, Fire Crest, Group 4, Chubb or equal and approved.
- 1.29. The normal power supply for the system shall be derived from the main distribution board by means of an MCB suitably labelled and supplying no other circuits. Standby power supply shall be provided by means of a secondary battery with automatic charger. The battery shall be sealed nickel cadmium type that has a long life (not less than four years) under the conditions of use likely to be experienced in the system.
- 1.30. Circuits for the system shall not be grouped together nor installed in the same conduit to trunking as circuits for other LV/ELV to telecommunication services. However, MICS cable may be run on cable tray carrying circuits for other services.
- 1.31. Manual call points shall be located as indicated or as agreed and where internal finishes permit shall be flush mounted in locations where they will be readily seen. However, where they will be viewed from the side (e.g. in corridors) they shall be surface

mounted, or semi-recessed, in order to present a side profile area of not less the 750 mm² (ref. IS EN 54).

- 1.32. Unless otherwise agreed, automatic fire detectors, audible and visual alarm devices shall be located as indicated; detectors shall be surface mounted in flush circular boxes; audible devices shall be likewise and visual devices shall be flush mounted.
- 1.33. Before commencing the wiring installation, the Contractor shall have in his possession a wiring diagram purpose made for this installation, prepared by the specialist supplier and approved by the Engineer.
- 1.34. The Contractor shall carry out commissioning of the system in liaison with the specialist supplier. The commissioning of the system shall be programme in such a way that each stage of the exercise is carried out in a logical manner:
 - 1.34.1. Inspection of installation.
 - 1.34.2. Insulation and earthing tests of all cables and wires (generally this will be carried out in the course of cable installation).
 - 1.34.3. Initial operational testing.
 - 1.34.4. Full commissioning test.
 - 1.34.5. Using a 500V d.c. test instrument, insulation tests to earth and between conductors shall be carried out in accordance with the IS 10101, by the Contractor. All the apparatus shall be disconnected so as not to damage any items of sensitive electronic circuits or equipment. All tests shall be noted in the logbook. Wiring that has been subject to a test with a 500V Megger shall be discharged to earth before being connected into electronic equipment as the electricity stored between the cores and the sheath or between the cores will be sufficient to destroy sensitive micro-circuits.
 - 1.34.6. Earth continuity and earth loop impedance tests (where appropriate) shall be made in accordance with I.S. 10101 and noted in the logbook.
- 1.35. In addition to those stated above, the system shall also comply with the following requirements:
 - 1.35.1. The system shall identify, locate and log each event using analogue addressable detectors and field devices and integral printer for hard copy, including date and time function.
 - 1.35.2. Fire detectors shall transmit "voltage out current back" digital signals directly proportional to smoke or heat present at each detector.
 - 1.35.3. Each type of device shall have its own "type" signal.

- 1.35.4. Smoke detectors operating on the photo-optical and ionisation principles shall be available. Heat detectors shall be used where smoke detectors are not suitable.
- 1.35.5. All detectors shall be interchangeable on an electronics-free facility.
- 1.35.6. All field devices shall have means to periodically test their capability to transmit a fire signal automatically.
- 1.35.7. The control system shall enable a fire decision to be made on alarm levels which conform to IS EN 54 Pt. 5 & 7 and to LPC requirements. In addition, a pre-alarm shall be given when detector output has reached a fixed predetermined percentage of these levels.
- 1.35.8. Manual call point operation shall produce an alarm within 1 second and have an integral alarm LED. Short circuit isolators shall be used to limit loss of communication to a maximum of 15 no. field devices. Faults shall be indicated on the panel.
- 1.35.9. Each detector shall have an integral LED for alarm purposes.
- 1.35.10. Conventional detectors used in the system, if any, shall be connected via a group address device.
- 1.35.11. The control unit shall have the facility to print all-event history including corrupt transmissions and detector maintenance data.
- 1.35.12. The specialist supplier shall commission the system.
- 1.35.13. Records including drawings and logbook shall be prepared and provided by the Contractor.
- 1.35.14. Interconnection with access control system to ensure fail-safe.
- 1.36. The Contractor shall include for the supply, installation, testing, commissioning, certification, and hand-over of the fire detection and alarm system and for the adequate instruction and training of the Employer's staff.

2. EARTH BONDING / SURGE PROTECTION:

- 2.1. Earthing shall be carried out in strict accordance with I.S. 10101 and the requirements of this Specification and drawings. Equipotential bonding of metallic equipment in kitchens shall also be carried out according to the IS 10101
- 2.2. The main earth rod shall be driven vertically in virgin earth, extra earth rods shall be driven and interconnected if necessary to achieve the results indicated in I.S. 10101.
- 2.3. The main earth rod(s) shall be of galvanised steel, 20 mm dia. and 2 m long.

- 2.3.1. Where dwellings are built on rock foundations or in made-up infilled ground. In such cases, a copper earth mat or bare copper strip conductor of 4.5 m length (min.) and 25 sq. mm C.S.A. shall be used as the main earth electrode. This mat or strip shall be buried in the ground at least 500 mm deep and located in a non-draining area.
- 2.4. The connection to the earth electrode shall be made using a non-ferrous clamp protected by "Denso" or similar water repellent tape as detailed on the drawings.
- 2.5. The earth rod connection shall be accessible for inspection and located adjacent to the perimeter of the building as indicated on drawings.
- 2.6. The main earthing to the main distribution board neutralizing terminal and earth rod shall be carried out using 95 mm² single core stranded PVC cable insulated (green/yellow), complying with the current edition of IS 201 carrying the "Har" mark in addition to the Irish Requirements.
- 2.7. Earthing cables used for the protection of all radial and ring circuit and for all equipotential bonding of metallic equipment shall be 2.5 sq. mm with stranded conductor and PVC (green/yellow), insulation, complying with IS 201, carrying the "Har" mark in addition to the IIRS mark, unless they form part of composite cables, i.e. twin with E.C.C. to the current edition of IS 201, carrying the Irish mark of electrical conformity (IIRS).
- 2.8. All incoming and outgoing signal and power cabling, which is part of the electrical contract (including specialist sub contractors), shall be protected by over voltage arrestors. The equipment shall be as manufactured by Dehn & Sohne or Furse. The Contractor shall submit at tender his proposal for this system.
 - 2.8.1. In general, Type 1 & Type 2 combined surge protection shall be applied to incoming supplies and to Main Switchboards, with Type 2 surge protection being applied to local distribution boards, or as indicated on drawings or specified hereafter.
- 2.9. The Contractor shall bond every 2nd raised floor pedestal to the general earthing/bonding system by looped 6 sq.mm PVCI PE to local distribution board PE bar.

SECTION 3 - PARTICULAR SPECIFICATION

PART 3.7 - MECHANICAL SERVICES CONNECTIONS (68)

1. ELECTRICAL SERVICES (NON CRITICAL):

- 1.1. The Contractor shall install and connect the controls wiring and power supplies to the items of equipment supplied and erected by the mechanical contractor. A non-exhaustive list is as follows: boiler house installation, ventilation installation(s), chiller(s), pressurisation packages, etc.
- 1.2. Unless otherwise indicated, the general allocation of responsibilities shall be as follows:-
 - 1.2.1. Power Wiring:
 - 1.2.1.1. Installation, termination, testing and labelling by Electrical Contractor.
 - 1.2.2. Controls Wiring:
 - 1.2.2.1. Specialist supply to confirm to Electrical Contractor signal cabling requirements. Installation, glanding, termination preparations to agreed location, continuity testing and labelling by Electrical Contractor. Final termination by specialist supplier.
 - 1.2.3. Controls Devices:
 - 1.2.3.1. Supply and labelling by specialist supplier. All ductwork and pipework devices. Installation by the Mechanical Contractor. Panel mounted and wall mounted devices by specialist suppliers.
 - 1.2.4. Variable Speed Drives:
 - 1.2.4.1. Supply by the Mechanical Contractor. Installation adjacent to MCC and wiring to be in accordance with the manufacturer's recommendations by Electrical Contractor. Commissioning by Mechanical Contractor.
 - 1.2.5. MCCs and Panels:
 - 1.2.5.1. Supply, offloading, positioning and commissioning by specialist supplier. Installation by Electrical Contractor.

1.2.6. Motor Sizes:

1.2.6.1. The specialist supplier shall issue a questionnaire for information required and the Mechanical Contractor shall advise the specialist supplier and the Electrical Contractor of all relevant manufacturers details.

- 1.3. The wiring installed shall be high temperature butyl/silicone rubber stranded copper conductor cables to BS 6141, insulated to 450/750 volt grade in conduit/trunking or XLPE/SWA/PVC (DCA approved) as indicated on the drawings. Cable sizes shall be as indicated on drawings.
- 1.4. The Contractor shall include for attendance on the mechanical contractor during commissioning and testing of the mechanical plant.
- 1.5. The Contractor shall note that the mechanical contractor will supply all control panels as indicated on drawings and produce all necessary wiring diagrams and drawings showing the proposed physical layout of the plant for approval by the Engineer, before an order is placed for their construction. The Contractor shall erect the control panels in locations agreed with all parties.
- 1.6. The Contractor shall provide all power items of equipment with an isolator. Isolators are specified elsewhere in this Specification.
- 1.7. To indicate tripping and running of equipment, temperature and humidity, the Contractor shall install wiring for a B.M.S. system provided by the mechanical contractor. The wiring shall be confirmed by the B.M.S. specialist supplier.

2. REFRIGERATION INSTALLATION:

- 2.1. The Contractor shall provide and supply an isolator to the location(s) shown on the drawings. The cable size shall be as indicated on the drawings.
- 2.2. The Contractor shall include for the supply and installation of a cable tray from the refrigeration unit(s) to the remote condensers. Tray size shall be as indicated on drawings.

3. ISOLATOR SWITCHES:

- 3.1. Isolation and switching shall be in accordance with part 46 and in particular, sections 462 and 464 and Annex 537A of I.S. 10101.

- 3.2. Isolating switches for the heating services and ventilation installations shall be of a rotary pattern front handle operated, complete with box to match. The materials may be high impact plastic (ABS) or metal or a combination. They shall be fit for the purpose and be capable of carrying the load.
- 3.3. Local isolating switches shall be provided as indicated. They shall be single-pole, three-pole or six-pole and of rating as indicated on the drawings. Switches shall be as approved, arranged for surface mounting and housed in enclosures of robust construction. Switches shall be weatherproof when required for outdoor locations.
- 3.4. Each isolating switch shall be fitted with a white screw fixed traffolyte label engraved in 6mm high black letter with the name of the equipment it controls.
- 3.5. A short length of DCA Approved H0-7 flex shall be fitted between the conduit box/isolating switch and the plant item terminal box in an approved manner to overcome damage from vibration. A pig-tail loop should be incorporated to ensure adequate provision in the context of maintenance.

4. ELECTRICAL SERVICES (CRITICAL FIRE PROTECTION EQUIPMENT):

- 4.1. A list of what should be considered including (non-exhaustive):
 - Automatic opening vents (AOVs)
 - Smoke vents
 - Slam shuts
 - Primer pumps
 - Pump supplies
 - Sprinkler jockey pumps
 - Fire fighter lift supplies
- 4.2. Sources to these supplies, shall be contained within locked cabinets so as to prevent unintentional opening in line with Section 537.2.5 (I.S. 10101)

Further details are to be provided by the mechanical contractor, but the general provisions outlined below are to be agreed with the responsible engineer. The general requirements of Part 56 (I.S. 10101) in the consideration of back-up power supply (as in respect to Annex 56B) or 'fail-to-safe' operation must be adhered to.

5. SMOKE EXTRACT SYSTEM:

- 5.1. A smoke ventilation system shall be installed as part of the mechanical services contract. The system shall consist principally of the activation of dedicated smoke extract fans in an emergency situation, by means of a signal from the fire alarm panel to the dedicated smoke extract fans control panel and/or by means of a manual control.

The Contractor shall provide the control panel. The manual control shall be provided at the fire mans control/switch position.

5.2. The wiring to the fans shall be in MICC cable.

5.2.1. No local isolators shall be provided. Provisions shall include loc-off and tag-off arrangements at source, where maintenance is required. The plant supplied by such circuitry shall be permanently labelled (Traffolyte) indicating where the source of supply originates from.

5.3. The control panel shall be Form 2. The supply to the control panel shall be derived from the live side of the incoming supply. The control panel and related auxiliaries shall comply with BS 5306 Part 2 (latest edition). Standby power by means of a diesel generator set shall be provided to supply the system in the event of a normal supply failure or the fire officer switching out the normal supply. The system shall comply with BS 5588.

6. STOP BUTTONS:

6.1. Emergency switching off shall be in accordance with Section 465 and Annex 46A of I.S. 10101. Devices for Emergency Stopping shall be in compliance with section 537.3.3 (I.S. 10101). Further detail is provided in Table 537A.1 and Annex 537 of I.S. 10101.

6.2. Emergency stop pushbuttons shall be provided as indicated. They shall comprise a large mushroom head actuator (red, on a yellow background), contact block, legend plate and cast aluminium enclosure. They shall be released by a key.

6.3. Devices for Emergency Switching shall have a minimum over-voltage class III with a suitable isolation symbol as illustrated in Table 537A.1.

6.3.1. Control wiring for emergency circuitry shall be facilitated through (normally) closed-circuit arrangements

APPENDIX 1

RECORD DOCUMENTATION

1. GENERAL:

- 1.1. The following specification covers the preparation and supply to the Engineer of a comprehensive Hardcopy and Digital Project Safety File (DPSF) incorporating the following:-
 - 1.1.1. Operating and maintenance manual(s).
 - 1.1.2. Record drawings.
 - 1.1.3. Testing, commissioning and proving reports.
- 1.2. Of the four sets, three complete sets of documentation shall be provided to the Client on practical completion and one complete set shall be supplied by the Contractor to the Project Safety Officer.
 - 1.2.1. The tenderer shall agree at an early stage with the client and engineer as to the form (Hardcopy or digital) of the O&M manual.
- 1.3. The documentation shall be written, assembled and completed in accordance with the requirements of EN 82079-1 : 2020, "Technical manuals", and BSRIA BG 79, "Handover Information and O&M Manuals".
- 1.4. The Contractor shall be required to demonstrate during the course of the works that adequate and accurate records are being maintained and that record documentation is being progressively compiled.
- 1.5. Where information is required from material or plant suppliers/manufacturers the Contractor shall request such details from the relevant company. The Contractor shall allow for any charges that may be required by manufacturers or suppliers for the provision of information and literature.
- 1.6. The Contractor shall issue a draft copy of the record documentation to the Engineer for approval 6 weeks before the planned practical completion of the project.
- 1.7. The final documentation shall be capable of being used without other supporting information.

2. PRESENTATION:

- 2.1. The manual(s) shall be presented in a format which allows for three levels of reader ability:-
 - 2.1.1. Non-technical (those who use or occupy the building).
 - 2.1.2. General technical (those responsible for managing the operation and maintenance of the building).
 - 2.1.3. Specialists (those who maintain the building).
- 2.2. The manual(s) shall be A4 size, hard bound, and shall comprise a loose leaf system.
- 2.3. Manual details, logos, addresses and other relevant information shall be provided on the front cover and on the spine if space permits.
- 2.4. An information sheet shall be provided at the front of the manual(s) listing the names and addresses of the principals (main contractor's engineers and mechanical and electrical sub-contractors) involved on the contract.
- 2.5. The manual(s) shall be arranged with an index and referencing system, with numbered card dividers between sections.
- 2.1. In respect to hard-copy submissions, the paper used in the final issue shall be good quality, white, 120 g/m², and the reproduction method shall be dry photocopy.
- 2.2. All documentation shall be written in English. The text of descriptive sections shall be kept concise while at the same time ensuring completeness.
- 2.3. Jargon shall be avoided. New terms shall be defined when first introduced. Abbreviations shall only be used if they have been defined or their meaning is clear from the text.
- 2.4. Illustrations, drawings and diagrams incorporated into the manual(s) shall be easily read in conjunction with the relevant text.
- 2.5. The instructions applicable to the project shall be highlighted by the Contractor on the initial copy for the Engineer's approval, and on all four final copies.

3. CONTENT AND LAYOUT:

- 3.1. The manual(s) shall follow the framework set out in BSRIA BG 79 and shall include purpose and planning information, technical documentation including record drawings, full operating instructions for each system, detailed maintenance instructions and schedules, emergency information, parts lists, modification instructions, disposal instructions, manufacturers' literature, together with procedures and results of all tests undertaken during the testing and commissioning process.

4. RECORD DRAWINGS:

- 4.1. The drawings shall be issued in CAD and PDF format A0 or A1 size and each drawing shall be clearly marked "record drawing".
- 4.2. Record drawings shall be executed by a competent draughtsman and shall contain sufficient detail to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the works.
- 4.3. Lettering on drawings shall be to an approved lettering system and the title block shall be to the Engineer's approval.
- 4.4. The title block shall not contain any revision notes or references, nor shall the drawings contain any references to existing services or similar notes.
- 4.5. The drawings shall clearly show all systems, plant, terminal points such as luminaires, sockets, isolators, etc. and distribution, circuit orientation and references. All sizes of tray, trunking and their routes shall be indicated. All plant shall be clearly referenced and shall be readily identifiable.
- 4.6. The Contractor shall ensure that any services which are buried within the structure, or underground, are precisely located on the drawings, along with the precise positions of entry of services to the building, giving their depth and the locations of the relevant pits, etc.
- 4.7. The drawings shall incorporate all building changes which may have occurred during the course of the contract.
- 4.8. The Contractor shall provide the following for inclusion in the manual(s):-
 - 4.8.1. A schedule of record drawings, including those issued by manufacturers or suppliers during the course of the works, e.g. switchgear layout and control panel wiring diagrams.
 - 4.8.2. A complete set of drawings, in numerical order, reduced to A3 size and printed on good quality paper identical to that used for the remainder of the manual(s).

- 4.8.3. Any isometric or diagrammatic drawings.
- 4.8.4. Copies of distribution board identification charts.
- 4.9. The Contractor shall provide digital record drawings to the AutoCAD Release version requested by the Engineer / Client.
- 4.10. The Contractor shall provide one copy of each of the warning signs and safety charts, which shall be heat sealed or fixed in glazed hardwood frames, for installation in locations to be agreed on site.

5. COMPLETION CERTIFICATES:

- 5.1. The Contractor shall submit the following certificates when the installation is completed and include copies in the manual(s):-
 - 5.1.1. Safe Electric certificate of entire installation.
 - 5.1.2. 4 part certificates for fire alarm and emergency lighting (Design, Installation, Commissioning and Handover).
 - 5.1.3. Lightning protection certificates (Design, Installation, Commissioning and Handover).
 - 5.1.4. Certificates from suppliers or manufacturers stating that equipment has been installed and commissioned satisfactorily and is operating in accordance with the design requirements.
 - 5.1.5. Safe Electric or appropriate governing body sub-system certificates.
 - 5.1.6. All system testing and commissioning certificates and results.
 - 5.1.7. An IOU (incomplete, outstanding or unsatisfactory work) shall be attached to a certificate in the event of any work not required at hand-over stage, and a programme agreed for the completion of works.

APPENDIX 2

ELECTRICAL SUB-SYSTEM CERTIFICATION

In accordance with the Safety, Health & Welfare at Work (General Application) Regulations, 2007 – 2012 every new electrical installation and every major alteration or extension to an existing installation shall after completion be inspected and tested by a competent person in an approved manner, and a certificate of test shall be completed verifying that the relevant requirements of these Regulations have been complied with.

After the installation has been tested and found to comply, the contractor or other person responsible for the construction of the installation, or a person duly authorised to act on his behalf, must sign a statement to that effect. The statement must be in the form of an approved certificate. Certification in accordance with the requirements of CRU and Safe Electric will be deemed to meet this requirement. In addition to the certificate, the test record sheets containing the results of tests carried out must be retained. The certificate must be completed by an authorised person having adequate technical knowledge and experience.

In accordance with the above the proposed electrical installation specified herein shall be certified as having been installed, inspected and tested in full in accordance with the CRU and Safe electric rules pertaining to an electrical installation as prescribed by NSAI IS 10101 National Rules for Electrical Installations. In this respect ALL electrical works relating to the project shall be tested and certified.

Where a new or amended ESB service is required, the completed works shall be required to have a Safe Electric completion certificate.

For electrical sub-systems, which are defined as being “any system that will be connected to the low voltage network of any installation, with the exception of portable appliances that are designed for such use” and examples of which are:

- Lift installations
- Electrical works not requiring an ESB connection
- A/C or ventilation systems
- UPS
- Datacoms works
- Specialist electrical equipment installations
- Standby generation
- Fire protection systems
- Etc.

Such sub-system contractors shall ensure that:

- a All electrical works are carried out by a qualified electrician or by an apprentice electrician under the supervision of a qualified electrician.

- b A sub-systems certificate in the form attached must be completed by the sub-systems contractor for each sub-system within his contract, where applicable. This will include sub-system works carried out by another party but forming part of the contractor's scope of work or contract. An example of this would be a fit-out electrical contractor who has a number of specialist systems suppliers, e.g., fire suppression, A/C, audio visual, under his fit-out contract but where he is linking to an existing main or sub main switchboard that has been installed and has had an Safe Electric completion certificate certified by others.
- c In addition to receiving one or more sub-systems certificates from the specialist suppliers working under his contract, the main sub-systems contractor must also complete a sub-systems certificate in respect of his work.
- d Prior to any electrical contractor making a power supply available to a sub-systems contractor, he must obtain a completed sub-systems certificate from that sub-systems contractor.

The contractor supplying a sub-systems certificate must be a registered Electrical Contractor.

APPENDIX 3

LOW VOLTAGE SWITCHGEAR

1. PROCEDURAL PROCESS:

- 1.1. The Contractor is provided with the following:
 - 1.1.1. Schematics and or Circuit schedules.
 - 1.1.2. An individual Panel (distribution board) Specification Sheet for each panel required.
- 1.2. The panel manufacturer shall provide a draft layout drawing including all relevant dimensions of the proposed panels and any amendments identified on the panel specification sheet.
- 1.3. The iterative draft processes outlined in subsections 1.1 and 1.2 are continued until agreement is achieved between the responsible engineer and the nominated panel assembler.
- 1.4. Once formal written agreement is received by the assembler including the agreed panel layout drawing and final specification sheet, the panel assembly shall commence. It is only at this stage that an order is confirmed.
- 1.5. **PANEL TESTING:**
 - 1.5.1. On completion of panel assembly, it shall be subjected to an insulation resistance test, and a suitable declaration certificate will be provided.
 - 1.5.2. A declaration that terminal torque requirements have been adhered to shall be provided.
 - 1.5.3. The agreed panel assembly is subject to passing a factory acceptance test (FAT) witnessed by the responsible engineer prior to its transportation to site. 2 weeks' notice will normally be required prior to panel assembly by the responsible engineer.
- 1.6. Installation criteria shall be agreed between the contractor, the panel assembler and the responsible engineer prior to its installation. This shall include the following consideration in a formal written format.
 - 1.6.1. Glanding arrangements (types and positions).
 - 1.6.2. Termination arrangements (use of ferrules, bolts, lugs etc).

- 1.6.3. Mounting arrangements.
- 1.6.4. Cable entries and routing within the panel.

1.7. INFORMATION ON HAND OVER:

- 1.7.1. Two copies of detailed general arrangement, single line and control wiring drawings. These drawings shall identify all components by manufacturer and type. Operating characteristics of all protective devices shall be submitted. The switchgear manufacturer shall submit full fault level analysis to the Engineer with the drawings for comment.
- 1.7.2. Copies of "as-built" general arrangement, single line and control wiring drawings.
- 1.7.3. 4 copies of completed signed and witnessed test certificates.
- 1.7.4. 4 copies of list of spares and accessories supplied (if required).
- 1.7.5. 4 copies of short circuit test certificates from an independent test house if applicable or if custom built assembly.
- 1.7.6. 4 copies of design calculations verifying short circuit strength of assembly.
- 1.7.7. Any information required in this Specification and related documents and standards.

2. STANDARDS:

- 2.1. All switchgear shall comply with the requirements set out in current editions of IS EN 60439-1 and any relevant codes of practice relating to switchgear assemblies. In addition, the switchgear shall comply with the particular requirements of the Electricity Supply Authority and with the particular requirements of this Specification.
- 2.2. Only LV switchgear approved by (NSAI) IS 10101 and the appropriate standards as applicable to all internal components within the assembly shall be utilised.

APPENDIX 4

LUMINAIRES

1. GENERAL

- 1.1. The specified luminaires must be utilised unless prior (written) agreement with the responsible engineer has been secured.
- 1.2. The party that is proposing a change to the specified luminaires shall do so at entirely their own cost.
- 1.3. The pre-approval process is outlined below (Section 2).
- 1.4. **Notwithstanding the criteria detailed in Section 2, Varming Consulting Engineers Ltd. is under no obligation to agree to any proposed change(s).**

2. PRE-APPROVAL PROCESS

- 2.1. Luminaires and equipment offered shall comply with all relevant Standards and Codes of Practice insofar as they apply.
- 2.2. Luminaires shall be supplied complete with lamps.
- 2.3. The general criteria associated with a change to the specified luminaires shall comprise of the following considerations.
 - 2.3.1. Luminaire data sheets
 - Conformance certificates from manufacturer within Europe or via an independent test-house (for a non-European jurisdiction)
 - Lamp efficacy
 - Luminaire power factor
 - Life span
 - Warranty on fittings
 - IP rating
 - IK rating (mechanical impact)
 - Luminaire suitability for the environment in which it will be installed
 - All (luminaire control) drivers shall be independently tested and shall display the ENEC European Safety Mark.

- Electrical Supply arrangements (including earthing, class I and class II (and class III where relevant))
 - Lamp colour
 - Colour rendering
 - Luminaire reflector/diffuser arrangements
 - Luminaire mounting arrangement (incorporating removable covers for maintenance where required)
- 2.3.2. Lighting design file that meets the design specification as provided by Varming Consulting Engineers Ltd. which include specifics concerning the following on the stated working plane.
- Power consumption (W/m²)
 - Illuminance (average, minimum and maximum)
 - Glare
 - Uniformity
 - Maintenance factors
 - D.L.O.R / U.L.O.R values
- 2.3.3. Lamps/luminaire availability (within the project timeline)
- 2.4. All (luminaire control) drivers shall be independently tested and shall display the ENEC European Safety Mark.
- 2.5. Contractor to confirm the ceiling type to be installed on the project prior to approval.
- 2.6. Contractor provide a working sample for review by Architect & Engineer prior to approval.

3. COMPLIANCE WITH STANDARDS:

3.1. GENERAL:

- 3.1.1. The luminaires and equipment offered shall comply with all relevant Irish and British Standards and Codes of Practice and in particular with the following insofar as they apply.

3.2. LUMINAIRES:

EN 13032-1	Light and lighting. Measurement and presentation of photometric data of lamps and luminaires. Measurement and file format
EN 13032-2	Light and Lighting- Measurement and Presentation of Photometric Data of Lamps and Luminaires- Part 2: Presentation of Data for Indoor and Outdoor Work Places
EN 60601-2-41	Medical electrical equipment - Part 2-41: Particular requirements for the basic safety and essential performance of surgical luminaires and luminaires for diagnosis
EN 60529	Degrees of Protection Provided by Enclosures (IP code)
EN 60598	Luminaires - Part 1: General requirements and tests
EN 60598-2-1	Fixed general purpose luminaires
EN 60598-2-3	Luminaires for road and street lighting
EN 60598-2-5	Floodlights
EN 60598-2-11	Aquarium luminaires
EN 60598-2-13	Ground recessed luminaires
EN 60598-2-18	Luminaires for swimming pools and similar applications
EN 60598-2-19	Air-handling luminaires (safety requirements)
EN 60598-2-21	Rope lights
EN 60598-2-22	Luminaires for emergency lighting
EN 60598-2-23	Extra low voltage lighting systems for filament lamps
EN 60598-2-24	Luminaires with limited surface temperatures
EN 60570	Electrical supply track systems for luminaires
EN 60598-2-25	Luminaires for use in clinical areas of hospitals and health care buildings
EN 60838-2-2	Miscellaneous lampholders - Part 2-2: Particular requirements - Connectors for LED-modules
EN 62031	LED modules for general lighting - Safety specifications
EN 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
EN 62471	Photo biological safety of lamps and lamp systems
EN 62560	Self-ballasted LED-lamps for general lighting services by voltage > 50 V - Safety specifications
EN 62612	Self-ballasted LED lamps for general lighting services with supply voltages > 50 V - Performance requirements
EN 62717	LED modules for general lighting - Performance requirements
EN 62722-1	Luminaires Performance- Part 1: General Requirements
EN 62722-2-1	Luminaire performance - Part 2-1: Particular requirements for LED luminaires

3.3. CONTROL UNITS, OTHER AUXILIARIES AND ACCESSORIES:

All drivers shall be independently tested and shall display the ENEC European Safety Mark.

EN 61000-3-2	Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
EN 61000-3-3	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection
EN 61347-1	Lamp controlgear - Part 1: General and safety requirements
EN 61347-2-13	Lamp controlgear - Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules
EN 62384	DC or AC supplied electronic control gear for LED modules - Performance requirements
EN 61547	Equipment for general lighting purposes - EMC immunity requirements
EN 62386-101	Digital addressable lighting interface - Part 101: General requirements - System components
EN 62386-102	Digital addressable lighting interface - Part 102: General requirements – Control gear
EN 62386-207	Digital addressable lighting interface - Part 207: Particular requirements for control gear - LED modules (device type 6)

3.4. MISCELLANEOUS:

EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
2006/42/EC	Machinery directive (Standard updated)
2014/35/EU	Low voltage directive (Standard updated)
2014/30/EU	Electromagnetic compatibility directive (Standard updated)
2002/95/EC	EC Directives on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

4. ELECTRICITY:

- 4.1. Unless otherwise indicated, all luminaires shall be suitable for use with a 1-phase 2-wire 230 volt 50 Hz earthed neutral system. The luminaires shall be designed to operate at all voltages encountered due to the fluctuations in nominal supply voltage, as stated by the Electricity Supply Board (+6 -10%).

5. ANCILLARY EQUIPMENT AND LAMPS:

- 5.1. Heat-resisting type lampholders shall be used with enclosed type luminaires, regardless of the lamp cap position, i.e. cap-up or cap-down.
- 5.2. Lampholders incorporated in weatherproof luminaires shall be of porcelain or brass.
- 5.3. Luminaires shall be supplied complete with lamps.
- 5.4. All internal wiring shall be carried out in "high temperature" flexible cables insulated with butyl silicone rubber (BS 6007) with copper conductors. The colour code shall be in accordance with I.S. 10101.
- 5.5. Lampholders for use with tubular fluorescent lamps shall be gripping type with skirt covering lamp cap and protecting earth clip, complying with IS EN 60061.
- 5.6. Tubular fluorescent lamps shall be "Warm White" type to BS EN 60081, tungsten filament lamps shall be coiled coil type complying with BS EN 60064.

6. LUMINAIRES - ALL TYPES:

- 6.1. All luminaires shall have an ingress protection (IP) rating as dictated in the lighting schedule and shall be tested in accordance with the standards outlined in this section.
- 6.2. All luminaires shall have an protection provided against external mechanical impacts (IK) rating as dictated in the lighting schedule and shall be tested in accordance with the standards outlined in this section.
- 6.3. All luminaires shall have a lamp lumen per circuit watt (LL/CW) as dictated in the lighting schedule, typical values as follows;
 - 6.3.1. 110 LL/CW minimum for toilets ,circulation areas, etc.
 - 6.3.2. 130 LL/CW minimum for offices ,administration areas, etc.
- 6.4. All luminaires shall have a unified glare rating (UGR) as dictated in the lighting schedule, typical values as follows;
 - 6.4.1. Technical drawing/paper based work UGR <16.
 - 6.4.2. Reading, writing, training, meetings, computer-based work UGR <19.
 - 6.4.3. Craft and light industries UGR <22.

- 6.4.4. Heavy industry UGR <25.
- 6.4.5. Railway platforms, foyers UGR <28.
- 6.5. All luminaires shall comply with relevant safety and environmental standards outlined in this section.
- 6.6. All luminaires and the associated control gear (i.e. the driver) are to comply with the EN 55015. The LED lighting and control gear should also comply with the relevant electromagnetic compatibility standards.
- 6.7. Luminaires shall have a colour temperature as dictated in the lighting schedule, typical values as follows;
 - 6.7.1. Domestic, communal living Warm 2000K
 - 6.7.2. Circulation areas, toilets, etc. Warm White 3000K
 - 6.7.3. Office, administration etc. Cool White 4000K
 - 6.7.4. Surgical theatres, etc. Daylight White 6000K
- 6.8. Luminaires shall have a colour rendering value as dictated in the lighting schedule, typical values as follows;
 - 6.8.1. Circulation areas, toilets, etc. >80Ra
 - 6.8.2. Food prep/display, surgical >90Ra
- 6.9. The minimum McAdam Ellipse value shall be 3 at a minimum. SDCM<3.
- 6.10. Luminaires shall have a Power Factor >0.9.
- 6.11. LED PCBs / modules shall be replaceable should a failure occur.
- 6.12. LED PCBs shall be protected with LED PROTECT (PLEDs), the failure of one LED shall not cause others in the group to extinguish. If there is a failure of a single LED other LEDs in close proximity shall brighten slightly to compensate.
- 6.13. All drivers shall be independently tested and shall display the ENEC European Safety Mark.
- 6.14. All luminaires shall have an approved type earth terminal (5 mm diameter stud) mounted on the gear tray adjacent to the mains terminal block which shall give effective earthing to the complete luminaire when connected to the system earth busbar.

- 6.15. Each luminaire shall be supplied and delivered as a complete unit including reflector/diffuser, mounting brackets and suspension kits where applicable.
- 6.16. Each luminaire shall be fully tested in accordance with the standards outlined in this section following assembly and shall be guaranteed for a minimum period of twelve months against faulty workmanship, materials and design. In such circumstances, the Contractor shall make good the defect either by repair or replacement and shall bear all associated costs including the cost of carriage on the return of the defective goods or parts and shall deliver any repaired goods to the site.
- 6.17. Full technical details of luminaires shall be made available at the time of submission of tender. The specialist supplier shall make one sample luminaire of each type available for inspection by the Engineer within one week of being requested to do so following submission of the tender.
- 6.18. The design of diffuser type luminaires shall ensure even flashing of the diffuser.
- 6.19. Recessed luminaires shall be supplied suitable for fixing to the ceiling grid and also with four standard conduit support outlets before ordering. Prior to providing a technical submittal the Contractor shall confirm the specific ceiling system being procured and installed by the Main Contractor and confirm the suitability of luminaires in conjunction with the ceiling system with the supplier.
- 6.20. Surface/suspended type luminaires shall have two standard conduit support outlets spaced at 600 mm centres, unless determined otherwise by the Contractor. Conduit boxes for suspended fluorescent type luminaires shall be provided with ball-and-socket covers spring-loaded with captive screws and earth link. Pendant conduits shall be 20 mm dia. 900 mm long and terminate in screwed dome covers affixed to the luminaire.
- 6.21. All luminaires shall be so designed that after installation, subsequent maintenance can be carried out from the underside of the luminaire following removal of the diffuser land/or coverplate.
- 6.22. Through-wiring facilities shall be available by means of knockout conduit entries in the ends of the gear housing or spine.
- 6.23. Diffusers shall be one piece, injection moulded, acrylic prismatic or opal type as specified. Polycarbonate diffusers shall be fitted in all plant areas and any areas likely to be subjected to vandalism. They shall be elastic light in weight and highly resistant to breakage. Each diffuser shall bear the manufacturer's catalogue number and trade mark or other means of positive identification.
- 6.24. Luminaires for general office and commercial use shall have a D.L.O.R. of at least 0.65.
- 6.25. The specialist supplier shall provide information to prove that luminance values shall not exceed 1000 cd/m² above 65° or 55° in special applications.

7. 4000K COLOURED NEUTRAL WHITE LIGHT LED SPECIFICATION:

- 7.1. Minimum 100 lumens per Circuit Watt
- 7.2. 50K hours lifetime and lumen depreciation of L80B50 minimum.
- 7.3. CRI>80. Colour Rendering should be 80 or above.
- 7.4. UGR<19. Glare to be less than 19
- 7.5. SDCM<3. The minimum McAdam Ellipse value is 3
- 7.6. This represents a value of 4000K +/- 75K so it can be as much as 4075K or as little as 3925K.

8. 3000K COLOURED WARM WHITE LIGHT LED SPECIFICATION:

- 8.1. Minimum 75 lumens per Circuit Watt.
- 8.2. 50K hours lifetime and lumen depreciation of L80B50 minimum target.
- 8.3. CRI>90. Colour Rendering should be 90 or above for warmer coloured light
- 8.4. UGR<19. Glare to be less than 19
- 8.5. SDCM<3. The minimum McAdam Ellipse value is 3.
- 8.6. This represents a value of 4000K +/- 75K so it can be as much as 4075K or as little as 3925K.

9. EMERGENCY LIGHTING:

- 9.1. As scheduled a number of the fluorescent luminaires shall be fitted with a self-contained, non-maintained battery and inverter pack to operate one lamp within the luminaire. The standards and characteristics of the emergency battery/inverter pack and the composite luminaire shall be as described in the Appendix attached to the rear of this Specification.

- 9.2. Where possible the emergency pack shall be mounted within the luminaire provided this can be achieved without detrimental effects to the luminaire or emergency pack and that the composite fitting can fit in the void. Where this is not possible the emergency pack shall be placed in a suitable enclosure and mounted to the body of the luminaire, or, in the case of very limited ceiling void (90 mm), adjacent to the luminaire with the appropriate connecting leads installed.
- 9.3. The specialist supplier of the composite luminaire will be required to assume complete responsibility for its compliance with the required standards and characteristics.

APPENDIX 5

EMERGENCY LUMINAIRES

1. GENERAL

- 1.1. The specified emergency luminaires must be utilised unless prior (written) agreement with the responsible engineer has been secured.
- 1.2. The party that is proposing a change to the specified emergency luminaires shall do so at entirely their own cost.
- 1.3. The pre-approval process is outlined below (Section 2).
- 1.4. **Notwithstanding the criteria detailed in Section 2, Varming Consulting Engineers Ltd. is under no obligation to agree to any proposed change(s).**

2. PRE-APPROVAL PROCESS

- 2.1. Emergency luminaires and equipment offered shall comply with all relevant Standards and Codes of Practice insofar as they apply.
- 2.2. Emergency luminaires shall be supplied complete with lamps.
- 2.3. The general criteria associated with a change to the specified emergency luminaires shall comprise of the following considerations.
 - 2.3.1. Emergency Luminaire data sheets
 - Conformance certificates from manufacturer within Europe or via an independent test-house (for a non-European jurisdiction)
 - Battery pack requirements (discharge duration, self-contained (integral), external/remote mounting requirements (if necessary))
 - Self-test communications requirements (if any)
 - Lamp efficacy
 - Luminaire power factor
 - Life span
 - Warranty on fittings
 - IP rating

- IK rating (mechanical impact)
 - Luminaire suitability for the environment in which it will be installed
 - All (luminaire control) drivers shall be independently tested and shall display the ENEC European Safety Mark.
 - Electrical Supply arrangements (including earthing, class I and class II (and class III where relevant))
 - Lamp colour
 - Colour rendering
 - Luminaire reflector/diffuser arrangements
 - Luminaire mounting arrangement (incorporating removable covers for maintenance where required)
- 2.3.2. Emergency Lighting design file that meets the design specification as provided by Varming Consulting Engineers Ltd., which include specifics concerning the following on the stated working plane.
- Power consumption (W/m²)
 - Illuminance (average, minimum and maximum)
 - Glare
 - Uniformity
 - Maintenance factors
 - D.L.O.R / U.L.O.R values
- 2.3.3. Lamps/luminaire availability (within the project timeline).
- 2.4. All (luminaire control) drivers shall be independently tested and shall display the ENEC European Safety Mark.
- 2.5. All batteries shall be manufactured the same year as the luminaire submittal is made.

3. COMPLIANCE WITH STANDARDS:

- 3.1. The luminaires shall comply with all relevant Irish and British Standards and Codes of Practice and in particular with the following:-
- I.S. 3217:2013, Code of Practice for Emergency Lighting
 - BS. EN 1838:2013, Lighting Appliances - Emergency Lighting
 - I.S. EN 13032-1:2004 / AI:2012 Light and Lighting - Measurement and Presentation of Photometric Data of Lamps and Luminaires. Part 1: Measurement and File Format

- I.S. EN 13032-2:2004 / A8:2007, Light and Lighting - Measurement and Presentation of Photometric Data of Lamps and Luminaires. Part 2: Presentation of Data for Indoor and Outdoor Work Places
- I.S. EN 50171:2001, Central Power Supply Systems
- I.S. EN 50172:2004, Emergency Escape Lighting Systems
- I.S. EN 60529:1993/A2:2013, Degrees of Protection Provided by Enclosures(IP Code)
- I.S. EN 60598-2-22:2014, Luminaires Part 2-22: Particular Requirements - Luminaires for Emergency Lighting
- I.S. EN 62034:2012, Automatic Test Systems for Battery Powered Emergency Escape Lighting
- 2006 / 42 / EU Machinery Directive
- 2014 / 35 / EU Low Voltage Directive
- 2014 / 30 / EU Electromagnetic Compatibility Directive

4. ELECTRICITY SUPPLY:

- Unless otherwise indicated, all luminaires shall be suitable for use with a 1-phase 2-wire 230 volt 50 Hz earthed neutral system (+6 -10%).

5. DESIGN:

5.1. GENERAL:

- 5.1.1. The emergency luminaires shall be completely self-contained and suitable for operation of 230V 50Hz supply.
- 5.1.2. The batteries shall be fully-sealed nickel cadmium alkaline cells capable after 24-hours charge of 3-hour emergency duration of rated output.
- 5.1.3. Each luminaire shall comprise an automatic battery charger, mains failure relay, battery, mains healthy indicator and inverter.
- 5.1.4. All components shall be adequately rated and of rugged construction to ensure reliable and fast-switching to battery supply when a mains failure occurs and to ensure that the components or charge require no maintenance during the life of the luminaire.
- 5.1.5. All emergency luminaires shall be installed in rigidly - framed steel enclosures, suitable for wall and bracket-mounting and fitted with one 20 mm entry (unless otherwise stated).

- 5.1.5.1. Battery and inverter packs provided for mounting external to the luminaires they serve shall be supplied complete within metal enclosures, or fire resisting/self-extinguishing sleeving, depending on access space available for installation and maintenance.
- 5.1.5.2. Cables from the luminaire to the enclosure greater than 1m in length shall be rated to classification PH120 as defined by I.S EN 50200:2006.
- 5.1.6. Each luminaire shall have a 10A 2-way mains connection block and M4 brass earthing stud fitted internally local to the conduit entry to facilitate connection to the supply system.
- 5.1.7. All luminaires shall be fully tested and the guarantee period (12 months minimum, 4 years for batteries) shall be stated at the time of tender.
- 5.1.8. The luminaire manufacturer shall provide documentation to confirm that the particular lamp and inverter / battery pack unit are compatible and have been fully tested in combination and that they conform to the standards stated.
- 5.1.9. The following types of emergency luminaires shall be utilised:-
 - 5.1.9.1. Battery and inverter packs installed in luminaires to operate fluorescent lamps or LEDs.
 - 5.1.9.2. Self-contained maintained emergency exit luminaires using fluorescent lamps or LEDs.
 - 5.1.9.3. Tungsten halogen (50W max.) ELV lamps in luminaires.
 - 5.1.9.4. Self-contained tungsten halogen (20W) twinlight luminaire with sealed lead acid battery.
 - 5.1.9.5. Battery and inverter packs installed adjacent to luminaires to operate Tungsten, Tungsten halogen, LED or fluorescent luminaires.

5.2. CONVERSIONS

- 5.2.1. All inverters utilised shall be fully enclosed type (either metal or plastic can).
- 5.2.2. All conversions shall wherever possible, be integral to the original luminaire only following specialist assessment, investigation and test, to ascertain the suitability for conversion from an electrical, electronic, mechanical, thermal, EMC, serviceability and safety viewpoint.
- 5.2.3. In the event that integral conversions cannot be undertaken due to any of the above reasons, remote conversions are acceptable of the piggyback enclosure type if, and only if, access to the emergency lighting equipment can be made without removal of the original luminaire from the ceiling, wall or floor.

- 5.2.4. In the event that the piggyback conversion option cannot be undertaken due to the above reason, remote conversions are acceptable of the remote enclosure type if, and only if, the interconnecting wiring between luminaire and remote gear is suitably protected mechanically and is fire rated as defined in the standards – Suitable protection shall be provided by a fully enclosed flexible conduit for routing interconnecting wiring or by a appropriate flex.
- 5.2.5. The interconnecting wiring shall be suitability sized in relation to C.S.A. (Cross Sectional Area) for the required load and distance travelled to minimise volt drop between source and load to 3% and is also electrically suitably rated for the required purpose in terms of voltage and high frequency and/or DC characteristic.
- 5.2.6. All conversions shall not affect the Ingress Protection Classification (IPXX) of the original luminaire and shall not affect the photometric performance of the original luminaire and shall also not affect the Safety Classification of such luminaire (Class I, II, III).
- 5.2.7. Overall responsibility of re-certification of the original luminaire following the conversion process specific to the EMC and LV Directive, Ingress Protection Classification, Safety Classification and performance criteria shall be the responsibility of the company undertaking the emergency conversion.
- 5.2.8. All conversions shall be undertaken off site and shall undergo complete performance and safety tests upon completion.

5.3. WIRING

- 5.3.1. Each emergency lighting point shall be connected to the feed, neutral and switch wire of the local lighting circuit. The feeds shall be taken from the distribution board through normally closed contacts of relays operated by the central test unit and extended to each emergency point on that circuit. Wiring shall be as used for the normal sub-circuit.

5.4. BATTERIES

- 5.4.1. All batteries utilised in emergency light fittings shall be high temperature Sintered Plate Nickel-Cadmium (NiCD) or Nickel-Metal Hydride (NiMH), Secondary Cell type, Rechargeable.
- 5.4.2. All batteries shall be high temperature (55deg) and shall have the rated temperature indicated on the battery casing. All batteries shall be mounted within fittings and remote packs using battery holders to ensure that no part of the battery casing is in contact with the fitting or remote pack casing.
- 5.4.3. All battery packs used in emergency lighting luminaires shall be fully encapsulated and come complete with battery disconnect male/female connector(s) to aid isolation and service. All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply

5.4.4. Sealed Lead Acid (SLA) Batteries:

5.4.4.1. All rechargeable Sealed Lead Acid (SLA) batteries used in emergency light fittings shall be maintenance free and of a sealed leak proof construction. All batteries shall be valve regulated to prevent excess build up of gas. Valves shall automatically reseal upon venting. All batteries shall be capable of operating in any orientation and meeting the required duration of 3 hours for emergency lighting at the end of five years of usage.

5.4.4.2. The Operating Temperatures for SLA batteries used in emergency lighting shall be as follows:

Charge – 15°C to 50°C

Discharge – 20°C to 60°C

All batteries used in emergency lighting (NiCD, NiMH, SLA etc.) shall be dated with the date of installation

5.5. LAMPS

5.5.1. All lamps utilised as part of the emergency lighting system shall be suitable for the required purpose and be of major brand name manufacture only. All lamps shall be professional long life variants.

5.5.2. All double-ended lamps shall be capable of being run in emergency mode in any orientation i.e. are not dependant on the cold end of the lamp being fitted in the luminaire in one specific position.

5.5.3. No “pinking” of the lamps in emergency mode shall be accepted.

5.5.4. In all emergency lighting luminaries the LED status indicator light shall be visible while the luminaire operates under normal lighting supply.

5.5.4.1. i.e. it shall be possible to see a fitting is an emergency luminaire when it is switched on and operating under normal supply.

5.5.5. All lamps operating whilst supplies are available shall be at a ballast of unity. No under-running of lamps is allowable by combination mains/emergency ballasts in normal operation – the only exception to this applies to integral conversions in small form luminaries where use of a standard ballast would lead to a temperature within the fitting that would exceed the rated temperature of components - see table below for details. The emergency lighting supplier shall confirm in writing the fitting types using combination ballasts with the OPW engineer for the project prior to production of conversions.

- 5.6. Light Emitting Diode (LED) Fittings – (Fittings Supplied By The Emergency Lighting Supplier Excluding Exit Signs)
 - 5.6.1. All LED's used, unless otherwise stated, shall be based on a full cone distribution of between 100 and 70 degrees.
 - 5.6.2. All LED fittings shall utilise LED's that provide the following minimum efficacy: **45 lumens/Watt – Usable into the Room.**
 - 5.6.3. All LED's shall be rated for operating at 25°C ambient room temperature and a Tc(max) 75°C.
 - 5.6.4. All LED's used, unless otherwise stated, shall be Warm or Neutral White.
- 5.7. LABELLING OF EMERGENCY LIGHTING FITTINGS
 - 5.7.1. Each emergency light/luminaire and exit sign shall be labelled. The label shall be clearly visible from floor level so that a fitting can be clearly identified. The printed text on the label shall be as follows: **floor number / emergency luminaire number.**
 - 5.7.1.1. e.g. **02 / 17** would indicate emergency luminaire number 17 on the second floor.
 - 5.7.2. The electrical specialist shall supply upon completion of the project a logbook for the emergency lighting system for inclusion with the O&M manuals. The logbook shall contain a list of all emergency lighting luminaires for the project by location, label number and type, included also shall be A3 NTS drawings of the building showing the location of the as installed emergency luminaires complete with label numbers.
- 5.8. CENTRAL TEST UNITS
 - 5.8.1. Central test units shall be provided within each of the lighting distribution boards.
 - 5.8.2. When the system is in test mode a 220 Volt signal shall energize the emergency lighting relays to break the feeds to emergency points and shall automatically reset after the selected test period.
 - 5.8.3. All luminaires and power packs shall comply with ICEL 1001 and I.S. 3217 and shall be in accordance with the schedule of luminaires.
 - 5.8.4. Emergency exit signs will be twin lamp with 'Running Man' logo and will be sustained
 - 5.8.5. The entire emergency lighting system i.e. CTU's, Twin Spots, Exit Signs, Bulkhead Fittings, Self contained luminaires & Conversions etc shall be from a single approved emergency lighting supplier to "OPW Standard For Emergency Light Fittings".

5.8.6. Approved emergency lighting suppliers are 'NEL', 'Emcon' or 'Profile'.

5.9. METALS AND PLASTICS

5.9.1. All metals and plastics utilised as part of the emergency lighting luminaires shall be suitable for the required purpose.

5.10. OVERLOAD AND SHORT CIRCUIT PROTECTION:

5.10.1. All emergency luminaires shall incorporate separate protection for each incoming supply line, to include the un-switched and switched supplies, integrally, within the luminaire by means of suitable fused terminal block(s) to aid safety, isolation and discrimination functions. All fused terminal blocks for the purpose of connection to the supply network shall be suitable sized for the connection in each terminal of at least 2 No. 1.5mm² cables or 1 No. 4.0mm² cable.

5.11. EXIT SIGNS

5.11.1. Decorative Blade Type: All exit signs of the decorative hanging blade variety which use top lit illumination shall have the running man, arrow and door symbols. The background colour of the blade shall be green and the running man, arrow and door symbols shall be white. All diffuser material either blade type or normal is to be made from polycarbonate.

5.11.2. All lamps operating whilst supplies are available shall be at a ballast of unity. No under-running of lamps is allowable by combination mains/emergency ballasts in normal operation.

5.11.3. Wiring within the exit sign shall not be loose or hanging and shall not be visible when the exit sign is illuminated.

5.12. INVERTER MODULES – ALL EMERGENCY LIGHTING LUMINAIRES

5.12.1. All inverter modules used in emergency lighting luminaires shall be fully encapsulated and provide for overload and short circuit protection via fused terminal block(s).

5.12.2. All inverter modules shall be continuously rated and suitable and/or specific to the emergency lamp in question. The BLF shall be clearly indicated for the specific lamp used. All invertors shall have reverse polarity protection to protect against damage to the inverter if batteries are connected incorrectly (i.e. reverse polarity).

5.12.3. All inverter modules used in emergency lighting luminaires shall be fully encapsulated by metal or plastic can such that no components or conductive surfaces at L.V. or higher tension are accessible upon removal of louver, diffuser and/or gear tray for preventive or remedial maintenance purposes.

All chargers and changeover controls shall be fully automatic and failsafe upon power failure or resumption of supply.

5.13. DEEP DISCHARGE PROTECTION:

5.13.1. Protection shall be provided to prevent emergency duration longer than that for which the unit is designed with consequent reduction of battery life.

5.14. HIGH CHARGING CURRENT:

5.14.1. Protection shall be provided to prevent continuous high charging current with consequent gassing and loss of electrolyte.

5.15. TRANSISTOR BALLASTS:

5.15.1. Transistor ballasts, for use with luminaires with fluorescent tubes, shall comply with BS EN 60924/25 : 1991.

5.16. BALLAST LUMEN FACTOR (BLF):

5.16.1. The BLFs (minimum values) for self-contained luminaires are set out in the table below.

5.16.2. All lamps operation whilst normal supplies are available shall be at a ballast lumen factor of unity. No under-running of lamps is allowable by combination mains/ emergency ballasts in normal operation.

LAMP TYPES FOR CONVERSIONS	REQUIRED MINIMUM BLF IN EMERGENCY MODE	CONVERSIONS IN SMALL FORM LUMINAIRES USING COMBINATION BALLAST MINIMUM BLF MAINS OPERATION / MINIMUM BLF EMERGENCY MODE
T5 8W	0.27	
T5 14W	0.16	
T5 28W	0.13	
T5 35W	0.10	
T5 39W	0.07	
T5 54W	0.06	
T8 18W	0.12	
T8 36W	0.10	
T8 58W	0.07	

LAMP TYPES FOR CONVERSIONS	REQUIRED MINIMUM BLF IN EMERGENCY MODE	CONVERSIONS IN SMALL FORM LUMINAIRES USING COMBINATION BALLAST MINIMUM BLF MAINS OPERATION / MINIMUM BLF EMERGENCY MODE
TC-DD/2D 16W	0.24	0.90 / 0.18
TC-DD/2D 28W	0.16	0.90 / 0.12
TC-DD/2D 38W	0.12	0.90 / 0.09
TC-D/DEL 10W	0.21	0.90 / 0.13
TC-D/DEL 13W	0.26	0.90 / 0.12
TC-D/DEL 18W	0.21	0.90 / 0.15
TC-D/DEL 26W	0.14	0.90 / 0.11
TC-T/TEL 18W	0.15	0.90 / 0.15
TC-T/TEL 26W	0.15	0.90 / 0.10
TC-T/TEL 32W	0.11	0.90 / 0.09
TC-T/TEL 42W	0.07	0.90 / 0.07
TC-L 18W	0.16	
TC-L 24W	0.15	
TC-L 36W	0.11	
TC-L 40W	0.10	
LED's	1 (Unity)	
Tungsten/ Tungsten Halogen	1 (Unity)	

Table of Required Minimum Ballast Lumen Factor (BLF) for All Conversions

Note: If conversions are to be undertaken for lamps that are not included on the above list please contact the OPW Mechanical & Electrical Engineering Section for approval of required BLF.

6. TESTING AND INSPECTING

- 6.1. The Specialist Contractor shall include for the complete testing, pre-commissioning, commissioning, certification and handover of the emergency lighting system in accordance with I.S. 3217 (current edition).

APPENDIX 5A

BSRIA TECHNICAL NOTE TN21/97 DEFINITIONS

1. DRAWINGS:

The following suggested definitions may be used to clarify the design responsibilities incumbent on those required to produce each drawing or document. These definitions are supported by drawn examples included in TN22/97 "The Allocation of Design Responsibilities Example Drawings".

1.1. SKETCH DRAWINGS

- 1.1.1. Line diagrams and layout indicating basic proposals, location of main items of plant, routes of main pipes, air ducts and cable runs in such details as to illustrate the incorporation of the engineering services within the project as a whole.

1.2. SCHEMATIC DRAWINGS

- 1.2.1. A line diagram describing the interconnection of components in a complex system. The main features of a schematic drawing should be as follows:
 - 1.2.1.1. The drawing may be a two dimensional layout with divisions to show the distribution of the system between building levels. It may also be an isometric style layout indicating the distribution of systems across individual floor levels. The drawing would not necessarily be constructed to scale.
 - 1.2.1.2. The drawing should include all functional components which make up the system i.e. plant items, pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components.
 - 1.2.1.3. Symbols and line conventions should be in accordance with a recognised source of standard symbols, such as BS1199:Part3:1987 "Recommendations for symbols and other graphic conventions".
 - 1.2.1.4. The drawing should indicate components which have a sensing and control function and should indicate the links between them e.g. building management systems, fire alarms and HV controls.
 - 1.2.1.5. The drawing should be labelled with appropriate pipe, duct and cable sizes where these are not shown elsewhere.
 - 1.2.1.6. The major components indicated on the schematic drawing should be identified so that their whereabouts in specifications and on other drawings can be easily determined.

- 1.2.1.7. If required to form part of a **commissioning specification**, the drawing should include all data essential to testing and commissioning including volumetric flow rates, design total pressure losses at equipment, locations of dampers, valves and flow measuring stations, electrical faults, levels, current ratings, short circuits capacities and tripping times.

NB: Where a design consultant is appointed to produce a scheme design for completion by a design and build contractor, only the first three of these requirements are likely to be appropriate.

1.3. DETAILED DESIGN DRAWINGS

- 1.3.1. A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design intent. The main features of detailed design drawings should be as follows:
- 1.3.1.1. Plan layouts should be to a scale of at least 1:100. Plant areas should be to a scale of 1:50 and should be accompanied by cross sections.
 - 1.3.1.2. The drawing will not include 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-ordination drawings** or **installation drawings** without major re-routing of the services.
 - 1.3.1.3. Main wireways should be represented by single line layouts, different containment types should be represented by differing line types. Symbols and line conventions should be in accordance with a recognised source of standard symbols such as BS1192:Part3:1987 'Recommendations for symbols and other graphic conventions'.
 - 1.3.1.4. The drawing should indicate the space available for major service routing in both horizontal and vertical planes.

1.4. CO-ORDINATION DRAWINGS

- 1.4.1. A drawing showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing should be as follows:
- 1.4.1.1. Plan layouts should be to a scale of at least 1:50 and accompanied by cross sections to a scale of at least 1:20 for all congested areas.
 - 1.4.1.2. The drawing should be spatially co-ordinated i.e., there should be no physical clashes between the system components when installed at the scaled-off positions shown on the drawing. In areas where tolerances are minimal, dimensions should be provided.

- 1.4.1.3. The spaces between pipe and duct runs shown on the drawing should make allowances for the service at its widest point. Insulation, standard fitting dimensions and joint widths should therefore have been allowed for on the drawing.
- 1.4.1.4. The drawing should be make allowance for those plant items specified by the designer and identified in the design specification.
- 1.4.1.5. The drawing should make allowances for installation working space and space to facilitate commissioning and maintenance.
- 1.4.1.6. The drawing should indicate positions of main fixing points and supports where they have significance to the structural design.
- 1.4.1.7. The services should be arranged in such a way that it is possible to demonstrate a feasible sequence of installation.
- 1.4.1.8. The drawing should be supported by "individual services drawings" where these are desirable for clarity.
- 1.4.1.9. Plant room layouts should be to a scale of at least 1:20 and be accompanied by cross sections and elevations to a scale of at least 1:20.

1.5. INSTALLATION DRAWINGS

- 1.5.1. A drawing based on the **detailed design drawing** or **co-ordination drawing** with the primary purpose of defining that information needed by the tradesmen on site to install the works

NB Where co-ordination drawings have not been prepared in advance, responsibility for spatial co-ordination should be allocated to the "lead" installing contractor who should be named in the tender documents. All installation requirements should then be produced taking into account the needs of co-ordination.

- 1.5.2. Main features of installation drawings should be as follows:

- 1.5.2.1. Plan layouts should be to a scale of at least 1:50 and should be accompanied by cross sections to a scale of at least 1:20 for all congested areas.
- 1.5.2.2. The drawing should be spatially co-ordinated, i.e. there should be no physical clashes between the system components when installed at the scaled-off positions shown on the drawing.
- 1.5.2.3. Allowances should be made for inclusion of all supports and fixings necessary to install the works.
- 1.5.2.4. The spaces between pipe and duct runs shown on the drawing should make allowance for the services at its widest point. Insulation, standard fitting dimensions and joint widths should therefore have been allowed for on the drawing.
- 1.5.2.5. The drawing should make allowances for installation details provided from *shop drawings*.

- 1.5.2.6. The drawing should make allowances for installation working spaces, space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements.
- 1.5.2.7. Allowances should be made for plant and equipment including those which are chosen as alternatives to the designer's specified option.
- 1.5.2.8. Dimensions should be provided where the positioning of the services is considered to be important enough not to leave to the tradesmen on site.
- 1.5.2.9. Plant room layouts should be to a scale at least 1:20 and be accompanied by cross sections and elevations to a scale of at least 1:20.

1.6. INSTALLATION WIRING DIAGRAM

- 1.6.1. Drawing showing the interconnection of electric components, panels etc. in accordance with the design intent indicated on the **schematic drawings** and incorporating the details provided on **manufacturer's certified drawings**.

1.7. SHOP DRAWINGS

- 1.7.1. Drawing prepared by a fabricator or supplier for a particular project, and which is unique to that project. examples include supplier's drawings for ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring.

1.8. MANUFACTURER'S DRAWING

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

1.9. MANUFACTURER'S CERTIFIED DRAWING

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

1.10. RECORD DRAWING

- 1.10.1. Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows:
- 1.10.2. The drawings should provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components.
 - 1.10.2.1. The drawings should be to a scale not less than that of the installation drawings.
 - 1.10.2.2. The drawings should have marked on them positions of access points for operating and maintenance purposes.
 - 1.10.2.3. The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.

1.11. BUILDER'S WORK DRAWING

- 1.11.1. Design State Definition:
 - 1.11.1.1. A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works. Most drawings (and schedules) of work to be carried out by building trade, and require to be costed at the design stage e.g. plant bases.
- 1.11.2. Installation stage definition:
 - 1.11.2.1. Drawing to show requirements for building works necessary to facilitate the installation of the engineering services (other than where it is appropriate to mark out on site).

1.12. SPECIALIST DRAWING

- 1.12.1. A generic term for those drawings which may be supplied by a specialist supplier or sub-contractor appointed to undertake design duties in relation to a specific aspect of the project.

1.13. TENDER DRAWING

- 1.13.1. Drawing produced for the purpose of obtaining competitive tenders. The tender drawings will comprise an agreed set of drawings to suit the complexity of the project, and which comply with the specific drawing definitions included in this section.

APPENDIX 19

EQUIPMENT SCHEDULE

SCHEDULE OF LUMINAIRES, WIRING ACCESSORIES, PROTECTIVE SERVICES & SUPPLIERS

NOTES:

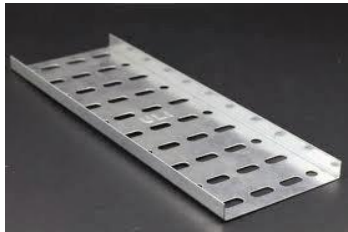
1. Alternative products/ systems to the Benchmark products/systems may be proposed but must be accepted by Varming in writing before proceeding. For such alternative products, provide full technical literature to demonstrate that the alternative proposals are of a standard at least equal to that identified and demonstrate compatibility with the design intent. This schedule must be read in conjunction with the relevant part of the Specification.
2. In these specifications trade names and or suppliers are sometimes used for the purpose of brevity and clarity of technical, aesthetic, functional, maintainability, after sales service, energy and life cycle cost intent. Such references are for the conveniences of the tenderer in clearly indicating the standard of technical, aesthetic, functional, maintainability, after sales service, energy and life cycle cost requirements sought by the specifier. The intention is not to favour one product over another or to eliminate other products or suppliers.
3. Other materials / products may be put forward for consideration as equivalent materials / products to those stated in the specification once they meet the minimum criteria are set out within the tender documents and drawings.
4. Approval for substitution of equivalent materials / products shall be given where the alternative material / product are demonstrable by the electrical specialist contractor to be equal and in full accord with the original specification and drawings and once it is demonstrated that all substitution products have equivalent technical, aesthetic, functional, maintainability, after sales service, energy and life cycle costs.
5. Equivalence of an offered substitution shall be judged on the basis of objective, clear and verifiable criteria and independent proof of similar compliance with equal standards to those specified.
6. Where appropriate the electrical specialist contractor shall be required to issue verification by means of providing a detailed technical submittal, after sales commitment dossier, drawings, data sheets, energy and life cycle costs, test reports from a recognised body, samples of the material / product substitution to the client's representative and to the Mechanical and Electrical Consulting Engineers. The electrical specialist shall implement an electronic system for managing and tracking all plant and equipment submittals. Any increased costs arising whatsoever from such any substitution in terms of redesign, time required for the employer's representative and consulting Mechanical and Electrical Engineers to review and evaluate substantial quantities or substantial detailed technical proposals for alternatives, rescheduling, health and safety issues etc. shall be borne by the Electrical Specialist Contractor.

7. Alternative suppliers / installers shall be required to prove their ability to perform their sub element part of the contract through the submission of proof of their technical and or professional capacity (education, experience, equipment, personnel etc.), including their ability to manage in an environmentally sound manner.
8. The contracting authority, through its architect who is the employer's representative in conjunction with the consulting Mechanical and Electrical engineers shall determine on a case by case basis, from a technical, aesthetic, functional, technical, aesthetic, functional, maintainability, after sales service, energy and life cycle cost perspective what constitutes an equal and equivalent standard / product. Verification shall take place only after the award of the contract, as part of the contract management regime. Sufficient time shall be allowed to check submissions and provide samples as indicated within the specification documents.
9. Fittings denoted by an E after the luminaire schedule symbol on the drawing are to be fitted with an addressable 5 hour emergency inverter pack for integration into the addressable emergency lighting system. All luminaire that require a 5 hour emergency back must be converted by the same supplier, such as Lighting Solutions, Ventilux, Profile, NEL, Em Con, or equal and approved 5 hour emergency inverter pack.
10. The Contractor shall confirm all reference number correspond to the description of the items on this schedule.
11. The Contractor shall provide samples as required and requested by the design team.

LIGHTING SERVICES

REF.	DESCRIPTION	MANUFACTURER	IMAGE
D/E	<u>50W IP66 Rated Luminaire</u> ACL Industry ACH74K Light Source: LED Colour Rendering Index: >=80 Colour Temperature: 4,000K Luminaire Efficacy: 151lm/W UGR: 22 3 hours battery pack • IP66 Surface/suspended luminaire • Maximum ambient temperature 400C • Warranty 5 years • Polycarbonate housing • 100,000hrs L80B50 • 7490 lumens • Electrical Protection "Class I" • IP66 rating	Whitecroft Supplied by Fagerhult	
Light Switches	Wall Switch Surface 5 mm Screwed Matte, 1 Gang BS Standard IP20	RS PRO	

CABLE CONTAINMENT & DISTRIBUTION BOARD

REF.	DESCRIPTION	MANUFACTURER	IMAGE
CONSUMER UNIT	Plastic Consumer Unit 63A IP65	ABB	
Steel Cable Tray	Hot dipped galvanised steel tray for securing cables. Provides mechanical protection for cabling. Separate trays to be provided to achieve cable segregation.	Unitrunk	
Steel Conduit	Steel conduit providing containment and mechanical protection for cabling.	Unitrunk	
Steel Trunking	Steel trunking providing containment and mechanical protection for general services and lighting cabling.	Unitrunk	

GENERAL WIRING ACCESSORIES

REF.	DESCRIPTION	MANUFACTURER	IMAGE
General Sockets	Metalclad Plus Grey 2 Gang Plug Socket, 13A Indoor, Type G	RS PRO	
Spur Outlets	Spur Outlet	RS PRO	
ISOLATOR	IP67 rated lockable single phase isolator	RS PRO	

FIRE ALARM SYSTEM

REF.	DESCRIPTION	MANUFACTURER	IMAGE
Manual Call Point	24V Resettable element break glass unit for activation of fire alarm system. Fully addressable unit, Coloured red with LED indicator	Apollo	
Smoke Detector	24V Optical smoke detector, with LED indicator To be supplied with suitable mounting base Fully addressable unit	Apollo	
Heat Detector	24V Heat detector unit, with LED indicator To be supplied with suitable mounting base Fully addressable unit	Apollo	
External Sounder/Strobe	IP65 rated 24V external strobe & sounder device Sound pressure level up to 100dB Fully addressable unit	Apollo	
Interface (I/O) Unit	I/O Unit allows for connection of external devices to fire alarm system Fully addressable unit	Apollo	
Sounder/Strobe Detector Base	24V Strobe/Sounder Base for mounting of detection devices, emits a flashing strobe and alarm upon activation of the system. Sound pressure level up to 91dB	Apollo	