NORTHWICK PARK HOSPITAL

Design, Supply, Delivery, Installation and Commissioning of BB-Block LV Switchgear Replacement

Workmanship Specification

22/09/2022

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WORKMANSHIP SPECIFICATION

Project Name:
Design, Supply, Delivery, Installation and Commissioning of
BB-Block LV Switchgear Replacement

at
Northwick Park Hospital
Harrow

Northwick Park Hospital NHS Trust
Watford Road
Harrow
HA1 3UJ

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Section 1000000 – General conditions

1006000 PARTICULAR CONDITIONS

1006001 Information provided by others

Instructions, drawings, or other information required to be provided by the CA will be provided in due time upon written request provided that such information is not requested unreasonably distant from nor unreasonably close to the date upon which it is necessary.

Provide written requests to the CA in good time for any information required.

1006002 Provide everything necessary

Provide everything necessary for the proper execution and completion of the Works in accordance with the intent and meaning of the contract documents.

Details of construction or materials that have not been referred to in the specification or drawings but the necessity for which may reasonably be implied or inferred from the said specification or drawings or which are usually or essential to the completion of all works in all trades, shall be provided and installed with no additional costs.

1006003 Supply of information

The CA shall provide supplementary information from time to time as may be necessary to enable the completion of the Works in accordance with the contract conditions. Allow for such progressive release of further information by the CA during the course of executing the Works.

In order to facilitate the orderly and timely production of all further information that shall be considered necessary, submit to the CA for approval a programme indicating the progressive release of such information to enable the completion of the Works in accordance with the contract conditions.

The CA shall issue all the drawings that are considered necessary to enable the preparation of co-ordinated installation and shop drawings.

1006004 Alternative manufacturer's equipment

Alternative manufacturers' equipment and materials shall be equivalent in every respect to that specified.

Submit to the CA a separate compliance statement for each such alternative to demonstrate the proposed alternative is fully equivalent to the specified item. The statement shall include:

1. Company details
2. Full technical data and performance characteristics
3. Certification attained
4. Details of any implications or consequential amendments to the design and/or construction / installation of other parts of the Works
5. A complete and precise statement of the effects on cost. Relevant cost savings will be deemed to have allowed for all consequential costs associated with amendments of other parts of the Works. Identify additional costs arising from necessary changes to the details of the installation, including changes to the design and drawings, as well as any associated ancillary equipment
6. Effects on construction, programme, maintenance, cost in use or other differences
7. Confirm equivalence in quality, operation and space requirements to those items which have been specified by name.
8. The impact on Part L compliance including the CO_2 Target Emissions Rate and the final 'as constructed' CO_2 Buildings Emissions Rate.

Include for all necessary measures to ensure alternative manufacturer's equipment and the total installation is equivalent to that specified.

Where alternative equipment or materials offered have been accepted by the CA, either prior or post to the award of the contract, undertake and be responsible for the redesign of all services and builder's work affected by these equipment changes. No additional costs or extension or delay to the programme will be allowed.

The acceptance of any alternatives shall be at the discretion of the CA, who is not bound to accept any alternatives. Alternatives that would involve significant changes to other work will not be considered.

Alternative offers will only be considered if accompanied by a compliant tender.

1006005 Selection of manufacturers/suppliers

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

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

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "or approved" equivalent alternatives may be selected and shall be submitted to the CA for approval.

Where manufacturers, suppliers or installers of products are identified by name, or names, but reference is made to "or approved" equivalent the submitted tender must include the named or one of the named suppliers. Alternatives may be selected and shall be submitted to the CA for approval, separately.

1006006 Coordination

All aspects of the Works require detailed co-ordination to avoid any possible clash or conflict with other trades and disciplines.

Undertake such co-ordination in relation to the Works.

No extra cost or claim will be allowed due to conflict of works or installations, where full liaison with other trades and disciplines would have prevented such an occurrence.

Initiate co-ordination meetings with all other trades and disciplines and undertake all surveys that are necessary. Minute these meetings and submit to the CA no longer than one week after the date of the meeting. The minutes shall be suitably detailed to cover all matters raised and indicate which party requires to action matters.

Identify at an early stage and report prior to commencement of the works, any conflict in the positioning between engineering services, the structure or architectural elements. Ascertain if structural tolerances have been exceeded, and service voids reduced, and take site on-site dimensions. Advise the CA of any proposed corrective action to resolve any conflicts.

When any new, revised or updated architectural, structural or services information is issued by the CA under the authority of an Instruction, examine such information and if necessary modify the works accordingly to prevent any clashes or abortive work due to such instruction.

No extra cost or claim will be allowed to cover any clashes or abortive work that result from not requesting an explanation or seeking clarification in respect of any such revision. Any remedial works shall be carried out at no cost to the contract.

Be responsible for the co-ordination of the installation of services and take account of all other works and trades either during or prior to their incorporation into the works.

Where minor clashes of services occur on site that were not foreseeable at the design or co-ordination drawing stage then these clashes or minor co-ordination matters shall be resolved by discussion and agreement with other trades and disciplines. The CA shall be informed of the action to be taken by an approved means.

No instructions will be issued to cover such minor clashes.

1006007 Site dimensions and levels

Use a laser leveling system to install all building services installations wherever possible and co-ordinate the measurements with all other trades and disciplines to prevent any clashes.

Obtain all dimensions and levels on site for the actual setting out of the works. Ensure these dimensions are available before proceeding with the Works.

Do not take dimensions from drawings by scaling. Where dimensions are indicated on the drawings check these on site, as appropriate, to ensure construction and manufacturing tolerances can be accommodated.

As the development advances measure on site all works by others that may foreseeable affect the Works. These dimensions shall be incorporated into the drawings or marked up on revised drawings if already issued.

No extra cost or claim will be allowed for any errors arising from inaccurate setting out or failure to check actual site dimensions. Reimbursement will be sought for any abortive expenditure.

Any comments, discrepancies or divergences that will / may affect the Works shall be brought to the attention of the CA in adequate time to avoid delay or abortive expenditure.

1006008 Setting out

Ensure all items of plant and equipment can be installed in the available space and that there is adequate access to install plant to its final position in a safe manner.

Install the Works so as to be accessible for safe operation, maintenance, repair and future replacement. Deviations from the drawings to achieve this shall be agreed with the CA and written approval obtained before installation work commences. Final position and size of access doors shall be agreed with the CA.

Ensure uniform, neat and symmetrical arrangements of wall, floor and ceiling mounted equipment. Agree with the CA all necessary horizontal and vertical alignment before installation work commences.

Amend any errors arising from inaccurate setting out or lack of site co-ordination at no additional expense to the contract.

1006009 Site modifications

Site modifications to plant, equipment or assemblies shall not be undertaken without approval from the CA.

Authorised site modifications shall be in accordance with manufactures' recommendations and instructions.

Ensure that all modifications undertaken comply with the relevant standards and all test certification obtained.

1006010 Dimensions

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

Dimensions should not be scaled from drawings.

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

Equipment should not be ordered or manufactured using dimensions indicated on the Tender drawings.

1006011 Terminal locations

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

Agree with the CA the room terminals that are subject to final positioning on site.

Allow for the movement of all such terminals up to a radius of 2.0 m from the positions shown on the drawings.

Confirm with the CA the mounting heights before commencing work on site.

1006012 Maintainability

Demonstrate that all plant and equipment incorporated into the Works can be safely and easily maintained in full compliance with Health and Safety legislation, CDM requirements, British Standards and (where applicable) Health Technical Memoranda.

Ensure that all access panels/doors are unobstructed and that adequate space is provided for future replacement of plant or parts.

1006013 Access for maintenance and operation

Design, co-ordinate, supply and install all access platforms, access covers, gratings, ladders, stairs, rails and protecting elements required for future maintenance and operation of the Works.

The installations shall be structurally stable and safe in use. Detail design drawings shall be provided together with builders work information and submitted for review prior to fabrication and installation. Drawings and calculations shall also be submitted to the structural engineer for comment.

Walkways and stairways shall be in accordance with BS 5395 Parts 1 and 3 (Stairs, ladders and walkways) and BS EN ISO 14122 (Safety of machinery – Permanent means of access to machinery). Include all toe plates, railings, guards and infills necessary to ensure a safe installation.

Flights of stairs shall not exceed 16 risers. Longer stairways shall be provided as equal flights separated by landings.

Handrails, platforms and walkways shall be designed for heavy duty. External and plant room installations shall be of the open mesh type fabricated from mild steel sections hot dip galvanised after manufacture in accordance with BS EN ISO 1461. Bolts, nuts washers and other fastenings shall be hot dip galvanised or zinc plated.

External installations shall be finished with a polyester powder coating in a BS or RAL colour advised by the CA.

1006014 Notice of operations

Work that requires interruption or interference with the operation of any existing services or buildings shall not be commenced without prior written permission of the CA.

1006015 Noise and nuisance

Ensure that the Works are undertaken with as little noise as possible.

Ensure no nuisance by noisy working is caused to the Employer or occupants of premises next to the site boundary

Take all necessary precautions to prevent nuisance from smoke, rubbish and other causes.

Fit all compressors, percussion tools and vehicles with effective silencers of a type recommended by the manufacturer of the equipment.

1006016 Suppressors

Ensure all internal combustion engines used in the execution of the Works are fitted with efficient suppressors in the ignition system in accordance with the recommendations of British Standards so as to prevent electrical interference to radio or television receiving equipment in the vicinity.

All temporary electrical installations, such as motors or the like, shall be prevented from creating such interference and shall be fitted with suppressor equipment in accordance with British Standards and to the satisfaction of the CA.

1006017 Working hours

Working hours shall be as defined in the Trust working standards

1006018 Disposal of waste and materials

Disposal of waste and materials shall be accordance with the Site Waste Management Plans Regulations.

Remove from the site any rubbish and debris arising out of the execution of the Works on a daily basis.

Do not discharge any oil, noxious liquids or gases.

All water discharged shall be reasonably free from impurities.

Ensure all debris, dirt and redundant items created by the Works are removed from the site.

Ensure adequate waste facilities are provided to ensure all waste is sorted out on site appropriately, segregated and disposed of for recycling / reclamation where possible.

Ensure that chemicals, solvents and other liquids are disposed of safely and are only discharged to drain in compliance with Environment Agency, local statutory and local authority requirements.

Ensure all onsite materials and activities are carried out to avoid any damage to local wildlife, plant life and/or habitats.

The Works shall be thoroughly cleaned, all splashes, deposits, temporary markings, coverings and rubbish shall be removed leaving the site and Works in a fit condition for occupation / use and to the satisfaction of the CA.

1006019 Storage

Provide sufficient weatherproof, safe and secure storage for all materials and equipment.

Equipment and materials shall be offloaded, stored and transported about the Works in accordance with manufacturer's recommendations.

Open ends on all ductwork, tubes, conduit, trunking and associated equipment shall effectively be plugged, capped or sealed whilst in storage and during transportation to site. Provide racks to prevent distortion of pipes, conduit and similar materials.

1006020 Protection and packaging

Ensure that all plant, equipment and materials and particularly prefabricated portions of the Works are properly packaged and protected against damage during delivery, storage and until fully, finally and properly incorporated into the Works and set to work.

Submit to the CA a method statement in regard to the protection proposals for both stored and installed plant, equipment and materials prior to commencement of the works on site.

All materials and equipment and materials shall be offloaded, stored and transported in accordance with manufacturer's recommendations.

All plant, equipment and materials shall be protected against ingress of water and dust, formation of condensation, extremes and rapid changes of temperature, building works and operations of others.

Provide racks to prevent distortion of pipes, conduit and similar materials.

All electrical equipment and components shall be kept dry and free from dust.

Cover all items with polythene sheeting except when being worked upon.

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

After removal of any temporary protection paint parts liable to corrosion.

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

Protect all finished items from damage. Install items such as grilles, diffusers, light fittings, and switch accessories etc. as near to completion as practicable.

Any plant or equipment subject to incorrect storage or inadequate protection will be deemed unacceptable for incorporation into the works and new plant or equipment will be required as a replacement. Plant, equipment and materials suffering deterioration or damage shall be replaced prior to handover at no additional cost to the contract.

1006021 Confidentiality

No information related to the contract works shall be given to the press or other media without the written permission of the CA or Employer.

1006022 Photographs

Provide progress colour photographs in digital format of the Works taken at intervals to be agreed with the CA. Prior to the commencement of the Works agree with the CA the format of the photographs to be submitted to the CA.

Photographs shall not be published or otherwise circulated without the permission of the CA and no unauthorised photographs of the site or the Works or any part thereof shall be taken except with the permission in writing of the CA

Photographs shall be taken at the following locations:
1. All plantrooms and electrical switchrooms

2. All services risers
3. Each floor as the 1st fix installation of the Works proceeds
4. Any other locations agreed with the CA prior to commencement of the Works.

Provide photographic details of all engineering services, which are concealed within the building before final concealment.

As instructed by the CA provide photographs of all areas in which the Works are to be installed prior to the commencement of the Works to record the condition of:
1. Existing services
2. Concrete Bases
3. Services Containment
4. Generators
5. Tree and Hedge removals
6. Fixed equipment

All photographs are to be numerically identified and cross- referenced to marked up plans showing the position, direction and field of view for the respective photograph.

Progress photographs shall be submitted to the CA within one week of being taken and shall have the date and time when taken digitally displayed on the photograph

1006023 Materials used

Deleterious materials shall not be utilised on any part of the Works.

Check with manufacturers and suppliers of products and materials that products do not contain any such deleterious materials. If any specified product contains such material notify the CA in writing and request an alternative specification of product, manufacturer or supplier.

Use the best information available to ensure deleterious materials are not incorporated into the Works either directly or within products, whether or not specifically specified.

All materials supplied shall be a type that will not support bacteria.

The following deleterious materials shall be excluded from the Works:
1. Materials in which chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or HFA's have been used as blowing agents.
2. Halon or any other substances causing ozone depletion.
3. Chlorofluorocarbons (CFC) and hydrochlorofluorocarbons (HCFC) based refrigerants. (All refrigerants shall be zero ODP).
4. Asbestos or products containing asbestos.
5. Urea formaldehyde or materials which may release formaldehyde.
6. Materials comprised in whole or part of man-made and/or naturally occurring mineral fibres which have a diameter of 3 microns or less and a length of 200 microns or less or which contain fibres not sealed or otherwise not stabilised to ensure that fibre migration is prevented.
7. Lead where the metal or its corrosion products may be directly ingested, inhaled or absorbed.
8. Lead-based paints or primers
9. Polyurethane or polyisocynate foam
10. Polychlorinated biphenyls (PCBs) or similar compounds
11. Pentachorophenol, lindane or tributyltin (TBT) oxide
12. Extruded polystyrene other than low ozone depletion materials
13. Materials manufactured with any form of animal hair.
14. Materials that support bacteria.

Substances publicised by the Health and Safety Executive, Building Research Establishment, British Standards Institution or other authorities or professional bodies as being deleterious to Health and Safety shall not be incorporated into any part of the Works.

All jointing materials shall be of a type approved by the respective authority.

Warrant that deleterious materials are not incorporated in the Works and provide a written compliance statement to the CA prior to commencement of the Works.

Notify the CA, in writing, as soon as reasonably practicable of any material designated by the Building Research Establishment, British Standards or codes of practice as deleterious at any time during the contract

1006024 Advertising

No form of advertising will be allowed on any part of the site or the Works without written CA approval.

1006025 Patent rights

Indemnify against all claims, costs or expenses in connection with any patented, copy-righted or protected articles supplied and used on or in connection with the Works.

Any payments or royalties payable in one sum or by installments shall be included in the contract price and paid to whom so ever they may become due.

In the event of any claim being made in connection with such patented or protected articles, conduct any negotiations or litigation in connection with such claim at own expense.

1006026 Beneficial use of installations

Systems may not be used before practical completion without prior written approval of the CA.

Systems used before practical completion not for the benefit of the Employer must have all defective consumable elements (including lamps and tubes) replaced by new not more than seven days prior to practical completion.

Maintenance shall be carried out in accordance with manufacturers' recommendations. Final manufacturer guarantee periods shall not be affected and a written guarantee to this effect shall be obtained.

If required prior to practical completion and after the issue of a written instruction by the CA, operate the installations or any part of them, provided that such operation is practicable and does not prejudice the responsibilities and obligations under the contract. All labour and other direct operating charges arising from the use of such installations will be reimbursed at daywork rates or where no such rates are applicable at reasonable rates to be agreed with the CA beforehand.

1006027 Interference with traffic

Maximum facilities for access and transit shall be provided in all works that may interfere with the traffic on the roads, paths and footways. Should any part of the Works be executed in such a way as to cause unnecessary obstruction to traffic with neglect to remove or remedy the same forthwith when called upon to do so, then any obstruction shall be removed and the costs recovered.

1006028 Defects liability

Liability for making good defects in the installations shall be for a period of twelve months from the date of issue of the certificate of practical completion for the installations.

If as part of liability for defects, it is necessary to replace or renew any portion of the contract Works, the defects liability period in respect of that portion of the contract Works shall be deemed to commence from the date of such replacement or renewal.

If the replacements or renewals are of such a character as may affect the efficiency of the contract Works or any portions thereof, the CA may require that new tests be carried out to demonstrate that the plant is continuing to work satisfactorily.

Take all precautions in the remedying of defects in the contract Works to minimise the risk of damage to the buildings, the decorations, the fittings and the equipment. In the event of such damage occurring bear the cost of replacement or making good, subject to the proviso of being granted the benefit of any settlement in respect of such damage accepted by the insurers under the insurance policies taken out in accordance with the requirements of the contract.

Agree with the CA a programme for the carrying out and the completion of any work not finally finished at the time of the contract Works being offered for acceptance and which does not prejudice the issue of a practical completion certificate. This work may be requested to be executed out of normal hours and no additional costs will be accepted for this action.

Prepare and submit records of failures or malfunctions of any part of the Works during the defects liability period, together with remedial action taken, subsequent re-testing and the results.

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

Rectify all defects due to materials or workmanship or other faults that occur, including those notified by the Employer or CA, during the defects liability period with the minimum of delay and at no additional cost to the contract.

Produce prior to practical completion a written statement for the approval of the CA that sets out the how the defects which arise during the defects liability period will be rectified to ensure that disruption to the Employer's use of the building is kept to a practical minimum. This work may be required to be executed out of normal hours and no additional costs will be accepted for so doing.

Inform the CA in writing when all defects are finally rectified so that an inspection may be undertaken by the CA.

1006029 Right of access during defects liability period

Right of access will not be unreasonably withheld, at all reasonable working hours and at own risk and expense, to any part of the contract Works for the purpose of inspecting the working of the installations or to the records of the working and the performance thereof for the purpose of examining the same and taking notes from.

Subject to CA approval, that shall not be unreasonably withheld, undertake any tests considered necessary at own risk and expense.

Liaise closely with the Employer's staff during the defects liability period and all necessary remedial works and/or rectification of defective materials and equipment shall generally be carried out in such a manner as to avoid or minimise shut-down time and inconvenience to the Employer

1006030 Rationalisation of components

Similar items of apparatus and equipment shall be made and provided by the same manufacturer where practicable and corresponding parts of all apparatus and equipment shall be interchangeable to reduce the need for different attention and spares.

1006031 Software

Obtain on behalf of the end user all appropriate licences, permissions, copyright waivers, rights of use and the like from the owners of the software rights. Ensure that the end user is properly registered with the software supplier for support and appropriate updating.

Application software shall be in compliance with BS 7649.

Provide back-up copies of any software and two back-up copies of all software items, as commissioned.

1006032 Software time function

Ensure all equipment utilizing a time and/or date function, supplied and used on the project, meets the following conformity requirements:

1. All time and date set functions in either software or firmware shall use a minimum 64 bit integer to determine the current time and date as well as any processes or events that rely on time and/or date settings
2. No value for date will cause any interruption or adverse effect in performance
3. Where existing equipment is re-used, the date and time based functionality and performance must be verified to ensure it utilises a minimum 32bit integer to determine the current time and date as well as any processes or events that rely on time and/or date settings. Correct time and date functionality shall be maintained for a minimum of 25 years after practical completion
4. Leap years must be recognised as a leap year

1006033 Fire precautions

Take all reasonable fire precautions in respect of stores, workshops and other installations. Where it is necessary to use any naked flame or welding equipment in executing the Works and where combustible materials are in use, adequate protection shall be given to other adjacent materials and personnel. Suitable fire extinguishers shall be readily available at the position where such work is proceeding.

1006034 Fuel for testing

Fuel for testing and operating the Works will be included within the contract price and due allowance made within the tender

1007000 PRICING AND COSTS

1007001 Basis of contract

The contract shall be
• on a lump sum based on the specifications and drawings and accordingly shall not be subject to re-measurement.

The contract price shall include everything necessary for all design, co-ordination, installation, supervision, services, operations, materials, consumables, labour and plant necessary for and incidental to the proper construction, completion, testing, commissioning and adjustment of the Works to the satisfaction of the CA and in accordance with the conditions of contract, the specifications and the drawings.

1007002 Prime cost sums

The term Prime Cost Sum shall mean the nett cost paid for an item or items of equipment or material or work executed.

Where prime cost sums are included these shall be at the disposal of the CA who shall give written instructions for their expenditure and the CA shall have the power to nominate persons or firms to execute work or supply goods against such sums.

All prime cost sums shall be adjusted by the CA in the final account, the work undertaken or goods supplied against such sums being charged on the basis of the net accounts of the installers or suppliers, plus the percentage addition stated in the tender to cover profit.

1007003 Provisional sums

Include in the contract price the provisional sums detailed in the forms of tender. Any part or the whole of these sums unexpended will be deducted from the final amount due.

1007004 Design costs

The costs for undertaking the design activities and production of information during the design stage shall be stated in the tender.

1007005 Overtime and allowances

Include for all necessary overtime in the contract price to complete the Works in compliance with the contract programme.

Payment will be made for the extra cost of overtime only if a prior written CA instruction to work such overtime has been issued together with agreement to accept the costs involved.

1007006 Schedule of rates

A quantified schedule of rates shall be prepared and submitted within 4 weeks of request

A quantified schedule of rates accepted by the CA shall only constitute part of the contract in the following respects:

1. The descriptions of the works and the rates and prices contained therein shall be used for the purpose of adjusting variations
2. The quantities contained therein shall be used to facilitate the preparation and the checking of interim applications for payment
3. The provisional and prime cost sums contained therein shall be subject to adjustment in accordance with the rules and procedures contained in the contract conditions.

Failure to provide sufficient information to satisfy the CA of the accuracy of the schedule of rates shall entitle the CA to impose a schedule of rates for the Works. All costs associated with the preparation and issue of this schedule of rates shall be at the installer's cost.

1007007 Dayworks

Where authority is given for work to be executed on a daywork basis, original vouchers giving the fullest particulars of hours worked, names of craftsmen and labourers, description of work executed and materials and plant used, must be forwarded to the CA through the contract procedures not later than the end of the week following that in which the work has been executed.

The daywork sheets shall be numbered in sequence, and all sheets are to be signed by the agent/foreman responsible and site representative of the CA. Such signatures are only to be taken as certifying that the time, materials and plant are correct, and shall not be held to justify a claim that the work shall be so charged or that it cannot be measured and priced according to the terms of the contract.

The value of work accepted by the CA to be paid on a daywork basis shall be calculated in the manner and in accordance with the rates quoted in the daywork Schedule.

1007008 Instructions and variations

Instructions will be issued in writing and confirmed in a similar manner. Oral instructions have no effect unless confirmed in writing.

Submit to the CA, within 10 working days of the receipt of written instructions, the cost of each variation showing the quantities and rates applicable for all materials, etc employed in accordance with the schedule of rates. No work will be certified for payment until this information is provided.

In order to avoid delays arising from the uncertainty or misinterpretation of instructions issued put in place procedures for dealing with instructions and in particular requesting for clarification where the instruction is not clearly understood.

1007009 Submission of final account

As a minimum requirement immediately after the practical completion of the contract Works, submit a draft final account in duplicate to the CA using the contract procedures for checking purposes together with all the necessary supporting documents.

During the course of the Works progressively submit valuation of variations, omissions and provisional work forming part of the Works and where appropriate in accordance with principles defined in this sub-clause,

The basis for the determination of such valuation shall be the Quantified Schedule of Rates prepared and submitted at the time of tender and accepted by the CA.

All valuations as aforesaid prepared shall be submitted using the contract procedures to the CA for approval.

1008000 QUALITY

1008001 Quality control

Prepare a method statement to indicate fully the quality control programme for the Works and indicate clearly the role of the CA in that programme.

The objective of the quality control programme shall be:

1. Full compliance with the ISO 9001 standards and procedures
2. Full compliance with the specification in regard to materials and workmanship
3. Establishment of standards that will be acceptable to the CA by means of a sample installations prior to full scale erection of all major elements and trades required
4. Submission to the CA for agreement of any samples of proposed manufacturer's items to be utilised in the Works prior to ordering
5. Establishment of method statements defining quality standards

The quality control system will be subject to audit at any time during the duration of the contract.

The CA shall issue a quality control instruction where the installation fails to meet the standard required in the specification.

Where the installation fails to meet the required standard submit written proposals for compliance.

The quality control system shall include a suitable methodology and recording procedure which shall enable the personnel responsible for any work to be identified.

1008002 Defects

Prepare a system of recording defects in order to assess and monitor. The defects register should record:

- Reference
- Description of the defect
- Remedial works proposed
- Agreement to remedial works proposed
- Confirmation of defect clearance

The defects register and the relevant responses in dealing with them shall be monitored by the CA to establish whether the number of defects is deemed excessive and if steps need to be taken to improve performance.

1008003 Inspection before concealment

Whenever work requiring inspection or testing is subsequently to be concealed, 7 days' notice shall be given to the CA so that inspections may be made or tests witnessed before concealment.

Failure to give due notice may necessitate the uncovering of the work and reinstating it at no extra cost or claim or extension to the programme or allowance for delay.

Record drawings of any services to be concealed shall be issued to the CA at the time notice is given.

1009004 Workmanship and materials

All materials, equipment and workmanship shall be of the best quality and in accordance with the specification and drawings.

All equipment and materials to be installed shall be new unless otherwise indicated.

All equipment shall be installed in accordance with the manufacturer's written instructions and recommendations.

All materials considered by the CA to be unsound or not in accordance with the specification shall immediately be removed and properly replaced to the satisfaction of the CA at no additional cost.

All work carried out imperfectly or with faulty materials must be immediately removed and properly replaced to the satisfaction of the CA at no additional cost.

Where manufactured items are not specified by name submit with the tender all necessary details of proposed items. The CA shall approve these items before their use is permitted.

1009000 MANAGEMENT OF THE WORKS

1009001 Site staff

Appoint a fully qualified engineer-in-charge / co-ordinator (or one mechanical and one electrical which is most suitable for the size of the project – to be agree with the CA) to ensure constant management and supervision of the Works for the duration of the contract.

The person(s) shall not be a site operative and shall have full authority to act in connection with the contract Works and communicate at all levels. This person(s) shall be available either part-time or full-time, whichever is most suitable for the size of the project as agreed with the CA.

Nominate an engineer who will be responsible for all drawings and technical information production.

Curriculum Vitae of all key staff shall be submitted with the tender documents. Any change made to such appointments shall be agreed with the CA and maximum possible notice shall be given.

If the CA is of the opinion that any member of the site staff has been guilty of a serious breach of his duties, he may by notice require that person to be replaced within two weeks of the notification.

1009002 Design management

Employ a design manager throughout the design process who shall have the full authority to make decisions. The design manager shall be suitably qualified to the satisfaction of the CA.

The design manager shall attend all design team meetings as required and be a participating member of the overall team during the development of the design

Once construction has commenced the design manager shall be involved until such time as all the production information has been completed and the contract Works are generally under construction.

Appoint the appropriate staff and necessary skills to undertake the design activities to the satisfaction of the CA.

Curriculum vitae of all key design staff shall be submitted with the tender.

Any change made to the appointment of design staff shall be agreed with the CA with maximum notice being provided.

Throughout the design stage be actively involved with the Employer's design team

Undertake and prepare any such design information required by other design team members to enable their element of the work to be detailed.

During the design and production information stages the CA will monitor by such means considered necessary the performance in the development of design and in the production of the detailed design and co-ordination drawings.

Should any part of the design not meet the required standard of the CA then modify and re-issue such work to the required standard at no additional cost or delay to the programme.

On completion of the contract design stage activities and prior to commencing the production information submit to the CA a statement of compliance that the design of the systems will meet the specification design and performance intent.

Submit a statement to the CA signed by a "competent person" prior to commencement of works on site that the systems can be properly prepared and commissioned and agrees with the intent of the design.

1009003 Programme

Within 2-weeks of the award of the contract provide a detailed programme produced by means of bar charts and full network analysis if so requested, clearly illustrating how the overall programme will be achieved within the contract period stated elsewhere, in particular identifying and if necessary justifying the following:

1. The latest dates for release of final information required from the CA.
2. The period required for the production, approval and issue of builder's work information, co-ordination, installation and shop drawings.
3. Allow adequate time for the production of drawings and builder's work information and for the subsequent checking and approval of same by the CA. The actual activities of production, adjustment, resubmission and review must be identified and a blanket time allowance will not be acceptable.
4. The period required for the testing and commissioning of the services. Separate testing and commissioning activities must be identified and a separate programme prepared.
5. The period required for operating the systems, load simulation tests, final adjustment, environmental testing and instructing the Employer's staff.
6. The period required and latest dates for the production, approval and issue of record drawings and operating and maintenance instruction manuals.
7. The periods required for each phase and engineering service on a floor by floor or zone by zone and plant room by plant room basis.
8. The proposed order dates manufacturing period and proposed delivery to site for each item of major plant to be clearly defined.
9. Any long delivery items shall be identified within one month of appointment and a detailed method statement prepared to schedule the action to ensure the delivery to site in adequate time to meet the contract requirements.

All information required above shall be agreed with the CA before inclusion in the proposed programme.

1009004 Progress

Ensure the Works programme is maintained up to date and redraft, without delay, in any circumstance arise that affect the progress of the Works and submit to the CA.

Provide progress reports to the CA every 2-weeks in addition to any other information required under the contract conditions.

Progress reports shall include, but not limited to, the following information:

1. Date of order and delivery of all major plant and equipment.
2. Materials and equipment on site or installed.
3. Site labour employed.
4. Activity breakdown indicating target percent progress and actual percent progress for each activity monitored against the contract programme.
5. Latest schedule of information required indicating required / received dates and highlighting critical path items.
6. Status of utility services with connection dates for each service.
7. Latest progress indicated on a copy of the programme. The programme shall include a base line activity bar for each activity and a separate progress bar to each activity bar
8. Any proposed alteration to the programme. Alterations shall be identified clearly prior to the activities being undertaken and shall be in accordance with the contract.
9. Copies of snagging/defects lists verifying that inspections are being undertaken.

Record progress of the Works weekly on a copy of the programme.

Maintain a set of the latest drawings, which shall form the basis for the record drawings, marked up as the works progresses. These shall be available for inspection by the CA at any time.

If at any time the execution of the Works falls behind the contract programme formulate corrective measures and notify the CA of these intended measures prior to their being adopted.

1009005 Ordering

Orders for plant, equipment and materials, as required, shall be placed to maintain the necessary progress of the Works. If requested provide copies of such orders to the CA within one week of request.

Notify the CA of any discrepancies in sufficient time so as not to jeopardise the contract programme and allow any instructions to be issued and implemented.

Prior to placing orders, be satisfied that all orders fulfil the requirements of the contract documentation. This shall include, but not limited to:

1. Performance and technical criteria
2. Compatibility between items of plant and systems
3. Dimensional co-ordination between building fabric, structure, items of plant and other engineering services

No claims will be accepted as a result of failure to be properly satisfied to these requirements.

Prepare an ordering schedule for submission to the CA that shall indicate the following data:

1. Item of material or plant
2. Manufacturer
3. Date of order and reference number
4. Acknowledgement of order and reference
5. Delivery period quoted
6. Date required on site
7. Off site testing date
8. Allowable programme float
9. Date delivered to site

Update and modify and submit the ordering schedule on a regular basis as agreed with the CA. Indicate on the schedule any possible problems and when delivery to site has been achieved.

1010006 Continuity of the works

No undertaking is given that the works will necessarily be able to proceed continuously and no claim will be entertained for discontinuity of work due to the necessity to conform to the contract programme.

1010000 SUBMITTALS AND APPROVALS

1010001 Submittals

The CA shall review all drawings and manufacturers details prior to any orders being placed.

The final details including all technical aspects and calculations where applicable shall be submitted in a clear, definable and easily read format with the specified technical details, notes and performance data clearly shown in the English language. Where drawings are to be examined the manufacturers' details shown on the drawings must have been previously reviewed or only partial approval/comment will be granted.

Submit a separate compliance statement for each item of plant or equipment identifying all technical details and performance characteristics and that required to be achieved as specified.

All reviews of submittals will be carried out in the offices of the engineer, Lakes Join Grandly Ltd, and include for all costs and make all necessary arrangements for reviews of submittals to be undertaken in this manner. All meetings in this respect shall be held in the offices of the engineer, Lakes Join Grandly Ltd. Agree with the CA where samples of materials offered for review are to be sent.

The drawings, calculations and submittals shall be issued progressively as agreed in advance with the CA for review.

Each package shall contain all drawings, design calculations, support information, method statements, manufacturer's literature, builder's work information, etc necessary to facilitate an independent review. All documents (excluding drawings) submitted for review must be adequately bound.

All correspondence related to the examination and review procedure shall be directed through the office of the CA.

Unless stated otherwise elsewhere allow 21 working days from the date of receipt by the engineer for review or comment or otherwise on all submittals.

1010002 Review of submittals

The CA will examine the submittals for compliance, in principle, with the design intent.

Such examination shall not relieve any responsibilities and obligations under the contract.

Examination of any submittal by the CA shall not mean that the CA is responsible for the correctness of the drawing or submittal or its suitability for purpose. These responsibilities shall remain as defined elsewhere and as the contract.

The drawings, calculations and submittals shall be issued progressively as agreed in advance with the CA to facilitate examination.

Allow adequate time in the programme for submittals with due allowance for incorporation of comments and resubmission in order not to cause delays.

Each package shall contain all drawings, design calculations, support information, manufacturer's literature, etc necessary to facilitate an independent review. All documents (excluding drawings) submitted for examination must be adequately bound.

All documents shall be clearly identified with a 'status' during the course of the project.

The following categories shall be used:

1. **Preliminary** - Submittal presented for informal comment as appropriate. Any comment, or lack of comment, is not to be construed or implied as giving approval.

2. **Information** - Submittal presented for information only and no comments required
3. **For Review** - To be reviewed and examined by the CA
4. **Construction** - For construction purposes

Revised items on drawings shall be indicated by 'clouds' around the changes and annotated with a revision number/letter.

All drawings shall require the approval of the installer's design manager to verify that the drawing has been developed from an approved design and that the information does not conflict with the requirements of other design disciplines.

All documentation submitted shall be accompanied by a certificate indicating that it has been checked and approved by the installer's design manager.

Only drawings that have been reviewed, and incorporate the comments by the CA may be progressed to 'Construction' status. Should it become necessary to revise the drawing its status must be changed to *'For Review'* and re-submitted.

On receipt and examination of any submittal the following conditions shall apply:

A Reviewed. Fabrication, manufacture or construction may proceed

B Reviewed. Fabrication, manufacture or construction may proceed subject to incorporation of comments indicated. If compliance with the comments cannot be achieved amend and re-submit.

C Rejected with or without comments. In this case the submittal does not comply and is to be re-submitted after correction.

Where drawings and submittals are reviewed subject to comments indicated these comments shall be incorporated immediately and re-submitted to the CA prior to issue for construction.

Where drawings are revised and updated during construction these shall be issued to the CA for examination of the revision only, the revision being clearly marked.

Builder's work information and installation drawings shall not be reviewed in detail but shall be examined by the CA for general suitability.

Record drawings are to be prepared as the Works progress and shall be examined in the same manner as stated above unless stated otherwise. Allow 20 working days from receipt by the Engineer for review and comment.

1010003 Mistakes in submittals

Be responsible for any error, discrepancy or omission in any submittal, presentation or drawing prepared or where others have prepared these for submittal. Responsibility will not be relieved whether or not such submittal has been presented to the CA and examined and/or approved and/or issued on a CA instruction.

The said indemnity shall be subject to the proviso that such error, discrepancy or omission is not due to any inaccurate data, drawing or information provided by the employer or by the CA on his behalf.
Reimbursement will be sought for any abortive expenditure that the Employer, CA and/or other trades and disciplines may incur in placing reliance on any such error, discrepancy or omission.

1010004 Schedule of drawings and submittals

Within one month of the contract appointment prepare a drawing schedule of all proposed drawings and submittals required for comment. The schedule shall indicate as a minimum the following information:

1. Drawing number and revision number
2. Drawing title and service
3. Scale
4. Latest date required on site and/or for manufacturing purposes
5. Date required for final comment
6. Date for submission for comment
7. Date of commencement of drawing production

As agreed with the CA revise and update the drawing schedule as necessary on a regular basis during the contract period.

In planning the production of drawings and other submittals take into account the time required for:

1. Submission to the CA
2. Examination by the design team
3. Alterations and re-submission in the event of the initial submission not being accepted
4. Final issue for construction purposes

Indicate the full extent of all submittals required to be submitted for comment. The submittals shall be grouped so as to support the main issue of drawings for a particular part of the building or building engineering service.

Incomplete submittals will not be examined until fully re-submitted, as they will be considered inadequate and misleading.

1010005 Calculations

All calculations produced in respect of design responsibilities must be co-ordinated and presented in a logical format that can be easily understood.

All calculations shall be prepared to a recognised and agreed format and must be indexed.

The use of computer programs in the preparation of designs shall be carefully controlled. All software programs shall be verified and their use agreed with the CA prior to commencement of design tasks.

Software used in calculating the energy performance of buildings, as required under Part L of the Building Regulations, shall be as approved by DCLG and agreed with the CA prior to commencement of use.

Where unverified software is used its use must be declared and the initial outputs justified by full and complete hand calculations.

Calculations that are preliminary in nature, i.e. do not form part of the final submittal, are to be referenced independently and clearly indicated 'Preliminary'.

Submittals shall clearly state the methodology, formulae, design criteria, assumptions and all design margins used in the calculations.

Where necessary calculation sheets shall be accompanied by an annotated layout drawing identifying terminals, fittings and the particular sections of ductwork or pipework.

Each calculation sheet, drawing or schedule shall clearly identify the originator, date of production, checker (who signs or initials) and date of check.

Each set of calculations shall further require the approval of a Chartered Engineer to verify that the design is in accordance with the specification and design intent.

Allow at least 21 working days from date of receipt by the engineer for examination of the calculations and submittals.

Incomplete submittals will not be examined until fully re-submitted, as they will be considered inadequate and misleading.

The costs for the preparation of all necessary calculation shall be included in the tender return.

1010006 Equipment performance details

Submit details of the equipment selected and approved for inclusion into the Works. The format and content of the information to be submitted shall be as agreed with the CA.

The details shall include but not limited to the following information :

1. Plant item description, reference identification and serial number
2. Electrical input rating - *kVA, Volts, Phase*
3. Operating mode
4. Starting characteristics - *starter type, current, starts/hour and starting time*
5. Performance characteristics - *full load current and power factor*
6. Operating noise levels
7. Operating and shipping weight
8. Technical performance

1010007 Manufacturers technical data

The tender drawings have been prepared based on the current catalogue information of the equipment specified elsewhere.

Revisions or modifications of the physical characteristics of the equipment sometimes occur between the published catalogue information and the final information issued on the manufacturing drawings. When such revisions or modifications arise incorporate these and their effects on other parts of the Works onto the installation drawings and where necessary the final builder's work information.

Review the manufacturer’s references at the earliest opportunity and bring any anomalies to the attention of the CA in writing.

No extra cost or claim or extension to the programme or delay will be allowed for such modifications to the drawings or the Works as a result of such manufacturing changes.

1010008 Equipment and plant performance guarantees

Where equipment and plant performance data and duties are identified in the specification check and ensure that the equipment (where the manufacturer is named and/or a figure number is quoted) is capable of the stated duty or performance in all respects.

Obtain a written undertaking from the selected and approved manufacturer that all aspects of the defined specification will be achieved and submit to the CA prior to the installation of the equipment and plant.

More than one clause of the specification may cover the total performance of the equipment and therefore ensure that the supplier obtains or has seen all sections of the specification prior to giving the written guarantee of performance.

1010009 Technical information and queries

Complete and submit a technical query request to the CA where clarification on any technical issue is required.

For the purposes of clarity the use of raising technical query requests is intended to foster a pro-active approach to dealing with genuine queries. In this respect the issue of a technical query shall include the installer’s suggested solution to the query for the consideration of the CA.

If in the opinion of the CA a technical query is deemed to be inadequate in any way the CA shall have the sole discretion to reject the technical query until such time as adequate information is provided by the installer.

No claims for additional costs and/or extension of time shall be considered through the lack of information provided by the installer and/or the rejection of technical queries.

Ensure that technical query sheets are raised at least two weeks prior to the requirement for a response.

Prepare a schedule to record the progress of technical queries and ensure it is maintained up to date. An agreed referencing system shall be adopted for all technical queries and each query shall have the following information:

1. Unique reference
2. Brief description of query
3. Date raised
4. Date response required

1010010 Preparation of drawings

Prior to preparing any documents agree with the CA a document numbering system.

All drawings for the works shall be prepared on a computer aided draughting system AutoCAD or compatible, producing drawings in standard .dwg format.

The AUTOCAD software used to produce drawings shall be approved prior to commencement of drawing production.

Where a building information modelling (BIM) system is utilised, Revit or compatible, all derived files will be supplied in .dwg, .dwf and .xls compatible format as appropriate.

All drawings and models will maintain a common base coordinate point and rotation angle to enable reconstruction of models for co-ordination overlay.

Scales used on drawings shall be selected from industry standard scales to clearly convey the proposals with legible annotation.

Drawing units are to be metric with one unit being one millimetre.

Drawings sheets shall be “A” size to ISO 216 standard and include a title block, typically in the lower right hand corner.

As a minimum drawing title blocks will include company name, project name, drawing title, drawing scale, drawing number,drawing revision and date.

All drawings shall include a layering system to industry recognised classification (BS1192 Part 5, Uniclass or similar industry standard).

All drawings shall be read in conjunction with the structural engineering and architectural drawings and ensure that work is being carried out in accordance with the latest issue of the relevant drawings, assuming authority has been issued.

Published drawings will include all bound externally referenced data and be audited and purged of extraneous data prior to distribution.

The medium for transfer of information shall be high quality CD-R. with two disks being supplied for each batch of drawing data.

A pen plot of the drawing is to be supplied with the CD, this ensures that they have a plottable drawing which if plotted with the correct pens produces a workmanlike drawing.

The CA will decide on the medium to be used which will be film, tracing paper or plain paper dependent upon the type of drawing being commissioned or the longevity required. Electronic plots may also be provided in .dwf format or .pdf format as agreed with the CA.

Scales used on drawings shall be selected to convey clearly the proposals.

Ensure the notation on all documents produced follows the same conventions as the tender documentation. Agree additional notation with the CA before preparing any documents.

1010011 Revisions of drawings

Where revisions take place either under the authority of a CA instruction, or by written agreement with the CA or when revised architectural, structural or services information is issued, all drawings shall be modified accordingly and shall be re-issued for construction purposes subject to examination by the CA. The issue of revised drawings shall be in accordance with and with regard to the agreed programme for construction and where time is available re-issues shall be grouped together, as agreed with the CA.

Providing all revisions are properly incorporated into the drawings and the final installation is correct according to the drawings, then the final issue of these drawings may be used in conjunction with the draft set of marked up prints kept on site, as the basis for the record drawings.

1010012 Method statements

Submit method statements to the CA prior to commencement of the contract works.

Provide the following method statements in addition to those stated elsewhere:

- Health and safety statement to include:
  a. Management procedures.
  b. Any significant and unavoidable risks that might arise as a result of executing the Works.
  c. An outline of the health and safety procedures to be undertaken to safeguard the operatives and of any person who may be affected by the Works.
  d. A copy of the company's health and safety policy document including risk assessment procedures
  e. Accident records for the last five years
  f. Details of any Health and Safety Executive enforcement action
  g. Details of staff responsible for health and safety on this project with details of their qualifications and duties.
- Management procedures to be adopted for the project.
- Managing and resourcing of design duties and responsibilities including design capability.
- Commissioning and testing procedures and management.
- Quality control management and procedures. The method statement must:
  a. Indicate the quality control programme
  b. Demonstrate compliance with the contract in regard to materials and workmanship.
  c. Demonstrate the establishment of standards by means of sample installation and submission of samples prior to installation.
- Statement outlining the management team, stating the definition of each person's role, and the commitment to the project including:
  a. The curriculum vitae and references for each of the key personnel that will be used on the project.
  b. A line management diagram starting at the site supervisors and rising through the management levels.
  c. Details of both site and office based staff.

1010013 Samples

Furnish free of charge as stated or as may be required by the CA such samples of material and workmanship proposed to be used in the Works.

Samples shall include all alternative finishes available if required.

If the samples submitted do not, in the opinion of the CA, meet the requirements or fail to satisfy the terms of the specification, the CA may obtain samples elsewhere of the articles or materials from the same source without prejudice to their right to reject part or all of such articles or materials should they not prove equal in all respects to the samples they obtain or provide.

In the case of articles of special construction, working drawings may be temporarily substituted for the samples, if preferred. Such drawings when approved will be retained by the CA until the articles concerned are supplied, as a sample.

The samples submitted and approved, shall remain the property of the Employer until the completion of the contract.

Equipment shall not be placed on order until the approval of the CA has been obtained.

Samples shall be available for inspection at site and held on site for future reference for the duration of the contract.

1010014 Form and number of submittals to be provided

All submittals shall be issued to the CA

The number of copies and format of information to be provided shall be as follows:

1. Initial copies for comment shall be in print format and CAD format
2. Number of initial copies in print format for comment to be 2No
3. Final copies for comment shall be in print format and CAD format
4. Number of final copies in print format for distribution to be 4No
5. Initial copies of record drawings for comment shall be in print format and CAD format
6. Initial copies of record drawings in print format for comment to be 2No
7. Final copies of record drawings shall be in print format and CAD format
8. Final copies of record drawings to be 2No

1011000 OBLIGATIONS AND RESPONSIBILITIES

1011001 General

The section outlines the responsibilities and obligations to be undertaken relating to the Works. The listing is not exhaustive and does not relieve any responsibilities stated or implied within the contract documents or elsewhere in the specification.

Undertake responsibility for all works detailed in the contract, engineering specification and shown on the drawings.

Detailed design responsibilities are as stated elsewhere, in addition to those activities normally undertaken through the custom and practice of the industry.

Comply with the obligations as designers under all Health and Safety Regulations.

The schedule below outlines the responsibilities and obligations to be undertaken relating to the engineering services works. The listing is not exhaustive and does not relieve any responsibilities stated or implied within the contract documents or elsewhere in the specification.

1011002 General requirements

1 Undertake specific detailed design tasks as indicated elsewhere in the specification

2 Complete the design development.

3 Provide the following drawings as defined elsewhere in the specification:
- Detailed design drawings
- Co-ordinated working drawings
- Installation drawings
- Manufacturer's drawings
- Record drawings

4 Incorporate details provided by others into any design development and installation information.

5 Fully re-evaluate and take full responsibility for all parts of the design and building elements that may be affected by acceptance of alternative plant selections

6 Undertake the responsibility for resolving final spatial co-ordination.

7 Modify the final detailed spatial co-ordination for approved alternative equipment or materials.

8 Undertake the co-ordination of the engineering services, with each other and with the building structure and fabric.

9 Undertake all on-site co-ordination with all other trades, disciplines, manufacturers and suppliers.

10 Carry out all on-site co-ordination with all other trades, disciplines, manufacturers and suppliers

11 Undertake the role of lead co-ordinator and agree principles of co-ordination with all parties concerned. Incorporate details provided by others into the design

12 Carry out final detailed location and dimensioning of second fix equipment based on architectural information

13 Provide all necessary co-ordination and installation drawings in order that the Works can be planned, installed, commissioned and maintained

14 Prepare detailed electrical wiring diagrams of all equipment supplied showing all interconnections between equipment to enable all necessary wiring to be undertaken

15 Notify the necessary Statutory Authorities (Building Control, Fire Officer, Environmental Health etc) in respect of all tests and demonstrations required. Arrange all necessary attendance, documentation to ensure full approval.

16 Demonstrate that all plant and equipment incorporated into the works can be safely and easily maintained in compliance with current legislation.

17 Provide compliance statements for all selected plant and equipment demonstrating full compliance with the specification prior to order and commencement of the Works. Highlight for review all non-compliances.

18 Prepare such reports, calculations and details as required for submission to any appropriate authority including the co-ordination of such information by suppliers, specialists, etc needed to be included in any submission.

19 Supply, deliver to site, unload (including lifting and hoisting), store, protect and co-ordinate movement of all plant, equipment and materials required for the contract works

20 Inspect all plant, equipment and materials as delivered or where specified at the manufacturer's works. Inspection and/or tests to be carried out at the manufacturers' works jointly with the CA for equipment as stated elsewhere. Include for the travel and other expenses of the CA for the inspection and/or tests to be carried out at the works

21 Fix and install correctly all plant, equipment and materials and ensuring that all associated works are correctly executed.

22 Prepare construction programmes for the Works as stated elsewhere and for design activities.

23 Obtain final quotations for incoming services based on final agreed building loads.

24 Provide suitable accommodation, workshops, stores and clearing away on completion

25 Fix and install correctly all plant, equipment and materials and ensuring that all associated works are correctly executed

26 Check software engineering and programming is completed so that systems function in the prescribed manner.

1011003 Building Regulations Part L

1 Advise on the impact of any changes during the course of the Works that may result in the final CO_2 Buildings Emissions Rate not achieving compliance.

2 Assist and collaborate with others in liaison with Statutory Authorities with respect to Building Regulations approvals and compliance. Prepare supporting documentation.

3 Evaluate and assess the impact of all proposed alternative equipment or materials on the final 'as constructed' CO_2 Buildings Emissions Rate not achieving compliance. Submit a report to the CA.

4 As instructed by the CA prepare a report in consideration of any additional works associated with the Works that may be a consequence of the 'as constructed' CO_2 Building Emissions Rate for Part L not achieving compliance. Identify costs, programme and method statement for executing the additional works.

1011004 Builders work

1 Check the provisions for, and adequacy of builder's work information previously issued prior to the award of the contract

2 Check the spatial requirements and adequacy of builders work information previously issued by others for utilities works.

3 Seek utility company comments on the spatial requirements and builder's work associated with the provision of incoming services

4 Provide final builders work details based on the installation, manufacturing and shop drawings to facilitate the installation of the works. To include fully dimensioned drawings showing both size and position of builder's work making due reference to the structural engineering and architectural final dimensioned detailed drawings.

5 Detail all access requirements including access to false ceilings and ducts for maintenance. Provide fully dimensioned and annotated drawings

6 Undertake the redesign of the associated builder's work for approved alternative equipment or materials which subsequently varies the works in any way whatsoever.

7 Undertake the detailed design and location of brackets and supports. Details of all types of brackets and supports including fixing details and load calculations shall be submitted to the CA for comment prior to installation.

8 Undertake the design of all steelwork, brackets, hangers, clips etc., plinths and inertia bases necessary for support of plant and services (unless indicated otherwise)

9 Select and detail sleeves, inserts, frames, fixing anchors etc., and any other items required to be cast or built into the structures by others, including coordination of positions.

10 Undertake the detail design and co-ordination of all access platforms, access covers, gratings, ladders, stairs, rails and protecting elements required for future maintenance and operation of plant/equipment. Provide fully dimensioned and annotated drawings

11 Undertake and detail all fire stopping and sleeving systems for the Works where they pass through fire compartments together with the installation of fire barriers where a fire rated partition is penetrated.

12 Design of details for the weatherproofing of all services passing through external elements of the building.

13 Detail the final requirements for access to ceiling voids and builder's work ducts for maintenance and operation

14 Undertake and detail all acoustic stopping associated with the Works

1011005 Mechanical

1 Undertake the detailed design and final location of drain and vent points and pipework gradients

2 Design of adequate provision for movement of services and systems due to thermal expansion and contraction, hydraulic pressures and building movement, including cold draw calculations and proving of expansion loops in lieu of expansion equipment.

3 Undertake the detailed design and location of expansion anchors and guide locations. Details of all expansion anchors and guides, including fixing details, load and thrust calculations shall be submitted to the CA for comment prior to installation.

4 Final locations of valves, dampers and required access requirements based on the final equipment selection and co-ordinated installation drawings

5 Calculate all final fan and pump system resistances based on the final equipment selection and co-ordinated installation drawings

6 Undertake the detailed design and sizing of refrigerant pipework between items of equipment provided under the contract works based on the final equipment selection and co-ordinated installation drawings

7 Calculate system water capacities and quantities of chemical additives based on the final equipment selection and co-ordinated installation drawings

8 Design of all necessary temporary facilities for flushing, commissioning, etc

9 Undertake the final sizing, selection and determination of final locations of commissioning sets including any proportioning of mains losses, etc based on the final equipment selection and co-ordinated installation drawings

10 Final selection of system(s) pressurisation units and expansion vessels based on the final equipment selection and co-ordinated installation drawings

11 Final sizing of sections of ductwork between terminal units and diffusers to ensure the specified acoustic criteria and duct velocities

12 Final selection and location of control dampers, control valves, etc to achieve the specified function and to suit the characteristics of items served and final system configurations based on the final equipment selection and co-ordinated installation drawings. To include access requirements.

13 Final selection and location of control valves to suit pipework and authority of controls based on final installation drawings

14 Final design of flues to include the incorporation of the requirements of the respective manufacture, building control, environmental health officer and current legislation eg clean air act.

15 Determining the extent and design of trace heating systems for frost protection of relevant services and temperature maintenance on domestic hot water systems

16 Final detailing and design of fire rated ductwork systems complying with testing standards and the obtaining of statutory approvals

17 Final detailing and confirmation of the location and sizes of duct connections to external louvers

18 Design and selection of sound attenuation equipment to satisfy the particular performance requirements of the specification and the spatial allowances based on final plant/equipment selection and final co-ordinated installation drawings

19 Design of final acoustic requirements or modification of equipment to attain the particular performance requirements of the specification.

20 Final selection of all anti-vibration mountings to suit the particular application of the mounts

21 Undertake the redesign of the final acoustic requirements associated with approved alternative equipment or materials which subsequently varies the Works in any way whatsoever.

22 Design of sprinkler installations including provision of hydraulic calculations. Undertaken by an approved designer and all in accordance with LPC Rules and legislative requirements.

23 Provide a report confirming that the results of the leakage tests are in compliance with the specified ductwork leakage requirements.

24 Design of sprinkler installations including provision of hydraulic calculations. To be undertaken by an approved designer and all in accordance with LPC Rules and legislative requirements.

1011006 Automatic Controls/BMS

1 Undertake the detailed design of automatic controls systems insofar as it is required to meet with the operational, functional and spatial requirements of the specification.

2 Responsible for the full compatibility of the plant and equipment with the controls system and specified function.

3 Prepare detailed BMS point schedules, wiring schematics, control panel labelling details and equipment schedules for the complete Works

4 Design and incorporation of all interfaces (including relays or other devices or modifications to hardware and/or software)

5 Undertake the dimensioning and final installation details of automatic control panels to suit the detailed requirements of the agreed supplier of the controls equipment including provision of safe operating and maintenance clearances and ensuring acceptable cable entries/exits in the final location

6 Final locations of test points, control sensors, detectors, thermostats, etc

7 Sizing of cable terminations on all items of equipment

8 Preparing detailed electrical wiring diagrams of all equipment supplied showing all interconnections between equipment to enable all necessary wiring to be undertaken

9 Capacity, location, routes and design of electrical containment systems including conduit, trunking, tray etc associated with the automatic controls and BMS

10 Verify all cable sizes, voltage drops, discrimination and fault handling of cables based on the installation drawings, selected plant equipment and actual installed cable lengths. For the purposes of clarity, the BMS/controls specialist shall include as part of their tender the costs for providing cable sizes based on this clause. No additional costs will be allowed for changes in cable size as a result of action due to this clause.

11 Ensure that software engineering and programming is completed and undertaken so that systems function in the prescribed manner

1011007 Electrical

1 Selection of fuse sizes installed in plug tops appropriate for the rating of the connected equipment

2 Design of cable or cable containment terminations on to electrical equipment

3 Dimensioning and final installation details of electrical switchgear including provision of safe operating and maintenance clearances and ensuring acceptable cable entries in the final location

4 Undertake the detailed design of earthing and bonding requirements for electrical engineering services, mechanical engineering services, architectural and structural elements requiring earthing and bonding

5 Design of fixing, connections and bonding details as required for final installation of lightning protection systems

6 Check that cable size selections as specified are not invalidated by the selection of alternative routes during installation or selection of alternative manufacturers.

7 Undertake the detailed sizing, location, routes and design of all electrical containment systems including trunking, conduit, tray, etc and supporting structures to include fire stopping provisions.

8 Verify cable sizes, voltage drops, discrimination and fault handling of cables based on the installation drawings, selected equipment and actual installed cable lengths for specialist systems eg CCTV, access control,etc. For the purposes of clarity, the installer shall include as part of their tender the costs for providing cable sizes based on this clause. No additional costs will be allowed for changes in cable size as a result of action due to this clause

9 Undertake the final detailed design of the fire alarm system including component and cabling requirements to meet with particular manufacturer's recommendations, the engineering specification and requirements of Statutory Bodies, standards and codes

10 Undertake the final detailed design of the lightning protection system in accordance with the engineering specification requirements and current code of practice and standards.

11 Design of fixing, connections and bonding details as required for final installation of lightning protection systems.

12 Undertake a study to determine compliance with G5/4 and IEC 61000-2-4 (electromagnetic compatibility). Assimilate all relevant technical data including the final selected equipment from all parties prior to the study being undertaken. Issue a report on the study findings in due time to suit the requirements of the programme for the Works.

13 Provide a report confirming the final metering strategy as installed.

14 Verify spatial requirements, routes and anchor points for cable pulling.

15 Verify cable sizes, voltage drops, discrimination and fault handling of cables based on the installation drawings, selected equipment and actual installed cable lengths for all necessary systems

16 Undertake a study to determine compliance with G5/4 and BS EN 61000-2-4 (electromagnetic compatibility).
- Assimilate all relevant technical data including the final selected equipment from all parties prior to the study being undertaken.
- Issue a report on the study findings in due time to suit the requirements of the programme for the Works.

1011008 Commissioning

1 Test, commission, regulate and set to work the Works

2 Design all necessary facilities required for setting to work commissioning and testing of the completed installations

3 Appoint an independent specialist commissioning contractor responsible for the testing and commissioning

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

5 Review all designs to ensure that systems are commissionable. Provide a statement on appointment and prior to commencement of the Works. Highlight for review by the CA any considerations in respect of commissioning.

6 Incorporate into the systems design the essential components and features necessary to enable the proper preparation and commissioning of the building services.

7 Produce comprehensive commissioning method statements including procedures, logic diagrams and risk assessments for the pre-commissioning checks, setting to work, commissioning, system proving and environmental testing of the Works

8 Produce flushing, chemical cleaning and water treatment method statements, logic diagrams and programme for integration into the building contractor's construction, commissioning and finishes programmes.

9 Produce a detailed commissioning programme for integration into the building contractors' construction and finishes programmes.

10 Establish procedures with all parties to allow the demonstration of normal, emergency, shutdown and standby mode operation of plant and systems.

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

12 Produce record pro-forma documentation relating to the commissioning and testing of plant and systems

13 Co-ordinate the activities of all specialised personnel, including manufacturer's together with providing necessary attendance

14 Measure and reconcile both internal and external noise levels to verify compliance with the design criteria

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

16 Maintain a log of all significant activities during the testing, commissioning and system proving process

17 Ensure that all plant and system settings are recorded

18 Provide a report signed, by a competent person confirming, prior to installation that all system designs can be commissioned

19 Provide and submit a report for every test, demonstration, balance or commissioning activity witnessed, together with an engineering appraisal on the performance, either on or off-site.

20 Provide a final commissioning report detailing the results of the commissioning and commenting on the performance of systems signed by a competent person. The report to confirm that each installation is correctly tested and commissioned and achieving the specified performance.

21 Demonstrate that the equipment is capable of the performance and method of operation specified

22 Demonstrate that the overall and complete systems perform correctly in the required manner and as intended by the specification.

23 Ensure that the commissioning and testing complies with the requirements of the Building Regulations Part L and that the procedures follow the guidance and recommendations of the documents stated in the Regulations. Prepare and submit all necessary submissions as required to obtain compliance.

1011009 Handover

1 Prepare log book(s) in accordance with the requirements of the specification and Building Regulations

2 Appoint an independent specialist author for the production of operating and maintenance manuals. Identify four specialists as part of the tender return.

3 Prepare operation and maintenance manuals in accordance with the specified requirements.

4 Ensure that information needed for inclusion in the operating and maintenance manuals is obtained as the works progress. Identify individual sources of information.

5 Produce record drawings. Modify the record drawings as the works progress so that all alterations from the installation drawings are recorded as work proceeds.

6 Modify and update operating details to reflect commissioning results.

7 Record all water, gas and electricity meters on completion of the works

8 Prepare planned preventative maintenance schedules for 12 months from practical completion

9 Instruct the Employer's staff in the use, operation and maintenance of the installations

10 Fully operate and maintain the installations in accordance with the Employer's normal occupational requirements prior to practical completion

11 Prepare a schedule of all spare parts require for the works including recommendations of any others not stated in the specification

12 Prepare a schedule of all tools require for the works including recommendations of any others not stated in the specification

13 Handover all tools, spares, keys, etc

1011010 During the 12 months after practical completion

1 Assess the need for and undertake fine tuning of the Works. Required visits will be as stated elsewhere in the specification.

2 Ensure that all plant and system settings are recorded following fine tuning activities

3 Programme and plan fine tuning activities in advance and agree. Prepare programme in advance and agree with CA.

4 Arrange for the relevant parties to be retained and appointed to provide input to fine tuning activities

5 Ensure that fine tuning activities are planned with regard to the health and safety of occupants and such that any disturbance to them is minimized

6 Provide a mechanism by which the Employer can provide feedback on the performance of the building both before and after fine tuning

7 Attended meetings to deal with issues arising from fine-tuning of the Works.

8 Ensure that BMS trend logs are maintained for the whole of the 12 month period and can be readily accessed by the CA.

1011011 Existing services

1 Remove the existing services as stated in the specification

2 Prepare method statement(s) for the removal of the stated existing services to include risk assessments, permit to work requirements, temporary works and methods of removal.

3 Prepare method statement (prior to commencement of works) for the maintenance of existing services.

4 Maintain all existing services during the duration of the contract including the provision of any additional work and materials necessary

5 Determine and define any physical site restrictions, constraints and hazards which may affect the undertaking of visual inspections, including health and safety matters, prior to commencement of the Works.

6 Identify special training requirements for surveys of existing installations

7 Survey the existing installations for adequacy, safety, condition, maintainability, hazardous substances/materials etc. Assess the general condition of each of the services, based on visual inspection, indicating any faults or defects found and recommended where further specialist investigation is required.

8 Survey the existing services installations to determine function, size, material, safety, maintainability and location with respect to existing structure and architecture

9 Determine the presence of deleterious materials relating to the services

10 Survey the existing structure and incorporate the survey data into the installation information. Include dimensional data, structural data and topographical data

11 Record survey information by amending the installation drawings and/or preparing new drawings

12 Identify any parts of the services, based on visual inspection, that do not appear to comply with current statutory regulations, codes of practice, or normal good practice.

13 Undertake an assessment relating to the prevention and control of legionella

14 Record survey information by amending the installation drawings and/or preparing new drawings together with necessary supporting detailed reports and photographic material

15 Advise on the requirement for any urgent works or required action as a result of non - compliance and any parts of the services installation found to be potentially hazardous.

16 Identify special training and other requirements that should be satisfied before commencement of the Works

17 Producing record drawings for the complete existing services

18 Survey the existing structure and incorporate the survey information into the installation information

1012000 LOCAL AUTHORITY AND BUILDING REGULATIONS

1012001 Statutory authority approvals

Make full and formal submissions to Building Control/District Surveyor at the earliest opportunity to ensure the approval of the Statutory Authorities for the proposed installation works.

Notify the District Surveyor, Building Control Officer and Fire Officer directly in respect of all tests and demonstrations relevant to life safety installations, and include for all necessary attendance, documentation, etc., to ensure full Statutory Authority approval of the installation.

Include for all fees and charges legally required under such Act of Parliament, Regulations or By-Laws in respect of the Works.

1012002 Authority notices

Documents requiring the Employer's signature shall be forwarded to the CA in time to meet the contract programme in order for the necessary test and supply arrangements to be made.

No additional costs or extension to programme shall be allowed due to reconnections, revisits etc by supply authorities or failure to programme the works.

1012003 Bye – laws notices

Observe and comply with the requirements of all Statutes and Bye-Laws and serve notices on the Authorities having control of the road surfaces before the same are broken up and likewise serve notices on the owners of sewers, drains, water, gas or other mains, electric cables, tramways and other services or things, which may in any way be affected by the execution of the Works. Inform all necessary parties when work necessitates such notices to be given.

1013000 HEALTH AND SAFETY

1013001 General requirements

Comply with the requirements of all relevant health and safety legislation and regulations including the Construction (Design & Management) Regulations (CDM) 2007 and the corresponding Approved Code of Practice.

Comply with all CDM procedures required by the CDM co-ordinator and the Principal Contractor.

Provide all necessary information to the Principal Contractor including any method statements in accordance with the requirements of the CDM Regulations prior to the commencement of works on site.

Provide relevant information about the works that might affect the health and safety of any person.

Allow for providing all necessary general health, safety and welfare facilities unless it has been specifically agreed that certain facilities will be provided by others.

Ascertain the sufficiency and accuracy of information provided by, or on behalf of, the Employer and advise where any additional information or clarification is required.

Where design activities are undertaken or there is involvement in the design of any elements of the contract works co-operate with and provide information to the CDM co-ordinator in accordance with the designer's duties under the CDM regulations.

Appoint a “competent person” on the site to manage health and safety during construction.

Ensure, so far as is reasonably practicable, that all persons employed on, or visiting, the site are adequately informed, instructed, trained, supervised and equipped such that they are able to carry out their duties without risk to safety or health.

Take all necessary steps to ensure that only authorised persons are allowed into any construction area.

Prepare all necessary information for the production of a health and safety file for the works in accordance with the requirements of the CDM Regulations and in the format defined by, or agreed with, the CDM Coordinator and/or Client. Ensure and coordinate the provision of information for the health and safety file by all sub-contractors, specialists and suppliers. Provide the health and safety file information in adequate time to allow this to be coordinated and handed over to the Client at practical completion of the works, unless otherwise agreed

1013002 Pre-construction information and construction phase plan

Comply with the requirements of the project health and safety pre construction information.

The health and safety information provided in the tender documentation or within the pre-construction information is limited to highlighting significant risks to health and safety identified during the design and is not intended to identify all health and safety risks with which a competent contractor should be familiar.

Produce the construction phase plan in accordance with the requirements of the CDM Regulations prior to the commencement of the works on site.

The development of the construction phase plan shall not be limited to those particular risks identified in the pre-construction Information but shall include consideration of all reasonably foreseeable risks. The plan shall include the arrangements for the management of the construction works and for monitoring compliance by all persons with the requirements of relevant statutory provisions.

The construction phase plan must be adequately developed, as far as is reasonably practicable allowing for any phasing of works, etc., in sufficient time to allow it to be submitted for approval prior to the commencement of any works on site. In the case of phased works the health and safety plan relating to the work content of any phase must be adequately developed and submitted for approval prior to the commencement of any work within that phase of the project.

Ensure that all sub-contractors are issued with copies of the pre-construction health and safety information including details of all identified significant hazards and relevant information prior to the submission of their tenders and that they price for compliance.

Ensure that all sub-contractors complete appropriate assessments of the risks to health and safety in respect of their works as required under the latest applicable statutory legislation, including The Management of Health and Safety at Work Regulations and the Control of Substances Hazardous to Health Regulations.

The construction phase plan shall be reviewed and revised as necessary in line with any information received or any changes in the requirements of the contract works. Any changes shall be promptly advised to all relevant parties.

Ensure, so far as is reasonably practicable, that all sub-contractors, employees and self - employed persons under your control who are at work on the construction of the project comply with the requirements of the construction health and safety plan.

1013003 COSHH Regulations

Comply with the latest Control of Substances Hazardous to Health Regulations.

Provide with the tender a method statement on the steps proposed to meet the requirements of the Regulations

Undertake COSHH assessments for all activities and substances provided or used on site to assess their potential health hazards. Copies of all relevant COSHH assessments must be issued to the operatives concerned and strictly monitored. Particular attention must be given to the use of glues and sealant.

Where the use of substances falling within the scope of the Regulations forms part of the contract works notify the CA in writing, together with the additional costs, if any, of use of non-hazardous alternative.

Ensure during the course of the contract works, and under all circumstances, that all substances falling within the scope of the Regulations are positively so identified at all times and that they are transported, handled, stored, used and disposed of in strict accordance with their manufacturer's/supplier's recommendations.

Where use of substances falling within the scope of the Regulations are required for the operation and maintenance of the completed contract works, ensure that suitable facilities are available for the on-site storage of such substances and that all necessary warning/instruction notices are provided at the point of their storage and use.

Provide any special protective clothing, eye protection and similar safety equipment for the operation and maintenance of the Works and in sufficient quantity for one year operation.

Undertake the necessary training of the employer's staff in the use, handling, storage, transport and disposal of the substances concerned prior to handover.

Ensure that the type, use and control of the substances have been fully and correctly identified in the operating and maintenance manuals/health and safety file.

1013004 Asbestos

No material or goods containing asbestos shall be incorporated in the contract works.

At practical completion of the contract works certify that no asbestos or asbestos related materials have been incorporated or by any sub-contractor employed.

1013005 Risks to health and safety

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

1014000 BUILDERSWORK

1014001 Builders work provided

Where major structural and/or architectural facilities or provisions, for engineering services may have already been indicated check that these are correct, satisfactory and adequate for the purpose and confirm same in writing to the CA within 2-weeks of the award of contract.

Where the preliminary builder's work facilities issued prior to the award of contract are not correct or insufficient advise the CA immediately and obtain further instructions.

No additional cost or time extension will be allowed for modifications to the Works due to failure to adequately check the existing or preliminary builders work facilities and provisions.

Revise, supplement and/or issue final information, drawings/details for the actual contract works requirements.

Where alternative equipment or materials has been offered that the CA has accepted and which subsequently varies the works in any way whatsoever, then undertake the redesign of the associated builder's work. No claim for additional costs or delay to the completion of the works will be allowed.

1014002 Builders work responsibilities

The requirements for and responsibilities with regard to builder's work items are in addition to that normally provided as is normal custom and practice in the building industry.

Confirm and amplify any information provided by the CA.

Provide the specified builders work drawings/details and issue same for construction in compliance with the agreed programme.

Provide all builders work information in sufficient time, including necessary approvals, to comply with the agreed programme requirements. No additional cost or time extension will be allowed arising from failure to comply.

Prepare all other necessary builders work drawings required for the execution of the works, making due reference to the structural engineering and architectural final dimensioned detail drawings. Drawings shall be fully dimensioned drawings showing both size and position of builder's work.

Provide all necessary supporting steelwork, brackets, clamps and fixings necessary for the complete installation.

Ensure that all items of works undertaken or materials provided under this contract, are included in the contract price, and also that any such item, including builders work information and materials supplied, are incorporated into the works in accordance with the agreed programme.

All materials provided for fixing by others shall be included in the contract works cost and supplied in accordance with the programme.

1014003 Marking out of builders work holes on site

If agreed with the CA, mark on site actual locations of minor non-structural holes through walls, partitions, floors etc and also chases in non fair-faced walls, etc for conduits, pipes and the like in preference to providing drawings of such builder's work requirements.

The CA shall inspect all marking out on site prior to work commencing.

Establish a method of working with the CA to ensure the works may proceed without hindrance.

The maximum size for a non-structural hole for marking on site shall be 150mm x 150mm

1014004 Structural steelwork

No structural steelwork shall be cut, drilled or welded without written approval from the CA prior to the commencement of the work and shall require application in writing with all necessary drawings/details.

Fixings to steelwork shall be of the clamp type.

All fixings to steelwork shall be of the correct size and type for the fixing load applied and the type shall be approved prior to commencement of the works.

1014005 Pre-cast concrete

Holes shall not be cut in precast concrete without written approval from the CA and under no circumstances cut holes in pre-stressed concrete.

1014006 Builders work drawings

Drawings to be provided shall be as follows:

- Details of all bases for plant formed in concrete, brickwork or blockwork to a scale of not less than 1:20
- Details of all attendant builders work, holes, chases, etc for conduits, cables and trunking etc and any item where access for a function of the installation is required to a scale of not less than 1:50
- Details of all purpose made brackets for supporting service or plant/equipment to a scale of not less than 1:50
- Details of all accesses into ceilings, ducts, etc at a scale of not less than 1:50
- Details of all special fixings, inserts, brackets, anchors, suspensions, supports etc at a scale of not less than 1:20
- Details of all sleeves, puddle flanges, access chambers at a scale not less than 1:20

Submit all necessary load and thrust calculations with drawings/details.

1014007 Scope of builders work

The following schedule states in general terms the requirements for and responsibilities with regard to builders work items in addition to that normally provided as is normal custom and practice in the building industry.

Work element	Work in this contract	Work by others
Pipe, duct and cable sleeves through walls, floors, slabs etc.	Supply and install all necessary sleeves of a suitable material and fire rating for the application.	Cut hole or form/cast hole for sleeves and provide lintel and then "make good" builders work around sleeves (after final positioning) with cement or mastic materials as necessary all to the required fire rating / properties.
Puddle flanges	Supply all puddle flanges and hand-over to others for fixing	"Cast in" at correct position during construction of wall
Pipe and duct penetrations through the building envelope	Carry out final weatherproof flashing over pipe or duct angle flange	Provide or cut hole. On ducts through roofs provide and fix timber or metal up-stands.

Fire dampers	Supply fire damper frame and hand to others for fixing. Supply and install fire damper.	Prepare holes or form/cast hole, provide lintel and fix fire damper frame supplied by others. "Make good" around damper frame to provide correct fire barrier.
Duct and louvre connections to walls	Supply and install all louvres	Form hole and install timber or angle iron frame and "make good".
External louvres	Supply and hand over to others for installing all louvres. Fixing details shall be agreed between all parties prior to louvres being ordered.	Install all louvres supplied by others including weatherproofing and providing mastic seals where required.
Concrete bases and plinths	Provide all necessary dimensions and details for work by others. Supply and install holding down bolts. Where equipment fixings are drilled into bases, undertake drilling and "making good" after installation.	Prepare bases to required tolerances for equipment with pockets for holding down bolts. "Make good" around holding down bolts after installation by others.
Inertia pads and inertia block bases	Provide all necessary dimensions and details for work by others. Where neoprene inertia materials are to be provided in concrete bases supply and hand over materials to others for correct fixing and final construction of base. On inertia block bases hand over framework (including holding down bolts and AV mounts) for others to fix and fill the inertia block with concrete and "make good".	Install inertia materials supplied by others in the final construction of the base. For inertia block bases receive the framework from others (including holding down bolts and AV mounts) Fix and fill the inertia block with concrete and "make good".
Steelwork bases	Provide all necessary dimensions and details for work by others. Supply and hand over steelwork bases, plinths, channel support steels for fixing and weatherproofing by others.	Fix and weatherproof.
Secondary steelwork for support	Provide all necessary dimensions and details for work by others. Provide suitable steelwork for permanent fixing by others onto the main building steelwork frame or concrete frame where large spans of steelwork are required for support. On short lengths of secondary steelwork under 2m long undertake	Undertake permanent fixing of steelwork supplied by others. If "casting in" fixings are required prepare the hole and "make good" around fixing supplied by others.

	permanent fixing onto the structure, provided that drilled fixings are allowed. If "casting in" fixings are required preparing the hole and "making good" around fixing shall be by others.	
Anchor points and guides	Provide all necessary dimensions and details for work by others. Hand over to others for fixing permanently to the building structure unless steelwork supplied is used for the anchor point or guide fixing.	
Drainage under this contract within building	Terminate all drainage works at appropriate connections within the lowest slab level for final connection by others.	
Underground drainage and external drainage	By others	
Underground drainage and external drainage	Undertaken as part of contract Works	
Final connections to manholes	By others	
Final connections to manholes	Undertaken as part of contract Works	
Trenches and back-filling for drainage and/or distribution services	By others	Undertake formation of trenches and associated back-filling to the approval of the installer of the associated services
Acoustic enclosures	Supply, fix, weatherproof and "make good" acoustic seal around enclosure providing tolerances are within the normal building allowances.	
Anti-vibration mountings	Install Anti-vibration mountings Undertake direct drilling fixings if applicable.	Make final fixing to building structure and "make good" any holding down pockets.
Sound attenuators	Supply and install in formed plantroom(s) wall or floor openings.	"Make good" around attenuator with acoustic non-setting mastic.
Fire extinguishers	Provide and fix all fire extinguishers	
Fire extinguishers	Supply fire extinguishers for fixing by others	Receive fire extinguishers from others and fix
Conduits and electrical cabling chased into building fabric	Install and test conduits/cabling and protective coating.	Prepare wall chase (s) and make good around conduit or cabling after installation and testing of cabling and protective coating by others.
Manhole covers and frames	Supply and handover to others for fixing	Undertake fixing and "making good"
Pipework and cabling entrances to and exits from	Supply and handover pipe ducts for installation by others	Install pipe ducts under and into building for services installed by

buildings below ground		others. Make waterproof seal around installed services.

1015000 DRAWING DEFINITIONS

1015001 General

This section outlines definitions used to clarify the extent of information appropriate to different drawing types.

1015002 Tender drawings

The tender drawings primarily describe the design intent of the Works, the working principles of the systems, general arrangements, principles of services co-ordination and the intended methods of installation.

The drawings are accordingly part diagrammatic with runs of piping, ducts, cable, conduit and the like being shown to small scale and not necessarily indicating exact installation positions.

The drawings shall also provide sufficient information:

- To facilitate the preparation of an estimate and tender
- To enable all other participants to appreciate the inter-relation of the works with other trades and disciplines
- When read in conjunction with the architectural and structural engineering drawings to enable the preparation of the final or supplementary builder's work information, co-ordination, installation and shop drawings incorporating manufacturing drawings and final details of specified or selected plant and equipment.

The drawings indicate equipment, pipework, ductwork, cable tray routes and trunking, in sufficient detail to show how all the engineering services can generally be accommodated and coordinated with each other, the architecture and the structure. These drawings are provided for information purposes only. The installer shall be responsible for all detailed co-ordination of building services.

Any dimensions are stated for elements that have a visual impact on the completed Works.

The drawings will not necessarily show dimensions required to construct the works nor will they accurately locate every item of equipment or plant ancillary which does not influence the visual impact of the completed works. The decision of the CA as to what has a visual impact shall be final.

Confirm mounting heights with the CA before commencing the work on site.

Co-ordination drawings do not detail the building fabric or structure whether new or existing nor are they based on survey drawings or installation drawings of any other party or consultant.

Obtain all information required to produce the co-ordination and installation drawings or requirements at no cost.

Where it is necessary to survey an existing building or existing structure or services within that building to prepare coordinated installation and shop drawings undertake responsibility for obtaining that information. The cost of obtaining that information must be included in the contract price.

In the case of new services installations within a 'shell and core' type development allow for all costs associated with obtaining all necessary details of the base services systems

from the relevant contractor's and/or design team for incorporation into the shop and installation drawings.

Plant and equipment is shown based upon the manufacturers' catalogue information and is subject to verification or revision when manufacturers' drawings are available.

Interpret the design intent of the tender drawings and reflect same in the co-ordination and installation drawings subject to the comments of the CA. Where differences occur between the tender and the co-ordination and installation drawings these differences shall be deemed to be included in the contract price for the Works and no additional cost shall be allowed due to any variation in layout, arrangement or detail unless the deviation is specifically covered by an CA Instruction before the production of the drawings.

Where sprinkler installations are provided, the information shown on the tender drawings will indicate the design intent but this must be subject to verification by the approved installer who shall accept full responsibility for the design in accordance with the LPC Rules.

Where medical gas and BMS installations are provided the information shown on the drawings is subject to verification by the approved installer who shall accept full responsibility for the design

1015003 Sketch drawings

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

1015004 Concept schematic drawing

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

1015005 Detailed schematic drawing

A line diagram describing the interconnection of components in a system showing the engineering principles. The main features of a schematic drawing are:

- A two-dimensional layout drawing with divisions to show the distribution of the system between building levels. Or an isometric style layout indicating the distribution of systems across individual floor levels. The drawing is not necessarily constructed to scale.
- Includes all functional components that make the system work eg plant items, pumps, fans, dampers, valves, strainers, terminals, electrical switchgear, distribution and components.
- Symbols and line conventions in accordance with industry recognised standards for symbols and other graphic conventions.
- Labeled with appropriate pipe, duct and cable sizes.
- Indicate components that have a sensing and control function including their interrelationship, eg. building management systems, fire alarms etc.
- Components indicated on the schematic drawing identified for cross-referencing purposes.
- Include all data essential to testing and commissioning including volumetric flow rates, design total pressure losses at equipment, locations of dampers, valves and flow measuring stations, electrical fault levels, current ratings, short circuit capacities and tripping times, etc.

1015006 Technical design drawing

A drawing showing the extent of the services installations. The main features of technical design drawings are:

- Plan layouts to a scale of at least 1:100.
- The drawings shall show the extent and type of services terminals visible within the space
- Approximate locations of horizontal and vertical service runs shall be shown
- Plant and distribution system sizes, particularly those affecting spatial allocation, while acknowledging that these may need some adjustment and refinement in the preparation of the detailed design drawings and equipment schedules
- Pipework and electrical containment should be represented by single line layouts. Ductwork should be represented by either double or single line layouts as required to demonstrate that the routes indicated are feasible.
- Symbols and line conventions in accordance with industry recognised standards for symbols and other graphic conventions.

1015007 Detailed design drawing

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

- Plan layouts to a scale of at least 1:100.
- Plant areas to a scale of at least 1:50 and accompanied by cross-sections.
- The drawing will not indicate the precise position of services, but it should be feasible to install the services within the general routes indicated. It should be possible to produce co-ordinated working drawings or installation drawings without major re- routing of the services.
- Pipework and cable containment represented by single line layouts.
- Ductwork represented by either double or single line layouts as required demonstrating the routes indicated are feasible.
- Symbols and line conventions in accordance with industry recognised standards for symbols and other graphic conventions.
- The drawing should indicate the space available for major service routing in both horizontal and vertical planes

1015008 Co-ordinated working drawing

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 co-ordinated working drawings are:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- The drawing should make allowances for installation working space and spave to facilitate commissioning and maintenance.
- The drawing should be spatially co-ordinated i.e. there should be no physical clashes between the system components when installed.
- Critical dimensions, datum levels and invert levels should be provided together with dimensions in areas where tolerances are minimal.
- Spaces shown on the drawing should make allowance for the service at its widest point eg spaces between pipe and duct runs. Allowances for insulation, standard fitting dimensions and joint widths should be included on the drawing
- Make allowance for those plant items specified by the designer and identified in the design specification.
- The drawing should indicate positions of main fixing points and supports where they have significance to the structural design.
- The drawing should demonstrate a feasible sequence of installation of the services.
- The drawing should be supported with individual services drawings for clarity.
- Plant room layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

1015009 Installation drawing

A drawing based on the detailed design drawing or co- ordinated working drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features of installation drawings are:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- A spatially co-ordinated drawing, ie no physical clashes between the system components when installed at the scaled-off positions shown on the drawing.
- Make allowance for inclusion of all supports and fixings necessary to install the works.
- Make allowance for the service at its widest point for spaces between pipe and duct runs.
- Allow for insulation, standard fitting dimensions and joint widths on the drawing.
- Make allowance for installation details provided from shop drawings.
- Make allowance for installation working space; space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements.
- Make allowance for plant and equipment including those that are chosen as alternatives to the designer's specified option.
- Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen on site
- Plant room layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

1015010 Installation wiring diagram

Drawing showing the interconnection of electric components, panels etc in accordance with the design and incorporating the details provided on manufacturer's drawings.

The information shall indicate maximum electrical loading for each supply cable; cable termination facilities; and cable identification and all terminal numbers.

1015011 Manufacturer's drawing

Drawing provided by a manufacturer, fabricator or supplier for a particular project, and which is unique to that project and indicates a project specific representation of the product, components or plant items to be supplied. Examples include ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring, pre-fabricated plant customized plant and equipment etc.

1015012 Manufacturer's certified drawing

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

1015013 Record drawing

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

- Provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components.
- Use a scale not less than that of the installation drawings.
- Have marked on the drawings the positions of access points for operating and maintenance purposes.
- The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.
- The location, including level if buried of public service connections provided within the contract, no matter who installed them, together with the points of origin and termination, size and materials of pipes, line pressure, flow and other relevant information.
- Location and depth of all buried services

- Schematic drawings of each system indicating principal items of equipment, zoning, means of isolation, etc in sufficient detail to understand the system operation and the inter-connections between various systems
- The layout, location and extent of all piped services showing pipe sizes, together with all valves for regulation, isolation and other purposes, drain cocks, test points, gauges, flow or pressure switches and other instruments.
- Location, identify, size and details of all equipment and controls equipment served by, or associated with, each of the various services.
- The layout, location and extent of all air ducts, including those formed in builder's work or otherwise outside the contract, showing dampers and other equipment, acoustic silencers, grilles, diffusers, other air terminals, balancing dampers, access panels, fire dampers, turning vanes, hand holes, test holes, gauges and instruments. Each duct and terminal shall be marked with its size and air quantity flowing. Each terminal unit or grille shall have its duty clearly shown as recorded from the commissioning results.
- The location and identity of each room including space housing plant, machinery or apparatus.
- Detailed general arrangements of all boiler houses, machinery spaces, air handling plant rooms, tank rooms, electrical switch-room and other plant or apparatus, including the location, identity, manufacturer, size and rating of each item.
- All necessary sections, elevations, isometrics and schematics of the plant spaces.
- Control and wiring diagrams shall be provided incorporating details of each instrument and equipment item and written description of the sequence of operation of each system. All diagrams shall include full details of internal panel wiring and connections to field mounted items.
- Layout, location and extent of electrical switchgear, distribution boards cables and termination points.
- Detailed general arrangements of all switch-rooms, riser cupboards, service trenches, transformer chambers, generator rooms and other plant or apparatus, including the location, identity, manufacturer, size and rating of each apparatus
- Details to show inter-connections between the works and equipment or systems provided by others to which wiring and connections are carried out as part of the works
- Detailed wiring drawings and diagrams for all systems showing origin, route, cable containment size, type and number of conductors, length termination size and identification, and measured conductor and earth continuity resistance of each circuit. Indicate if cable/conduit is surface mounted, concealed in wall chase, in floor screed, cast in-situ, in false floor, above ceiling void, etc.
- Logic flow diagrams for each individual control or monitoring specification and for each engineering system to illustrate the logical basis of the software design

1015014 Builder's work drawing and information

Drawings and/or schedules, appropriate to the stage of design development showing the requirements for architectural and/or structural provisions necessary to facilitate the engineering services and allow their integration into the project. Such information includes the position and sizes of all access covers, panels and doors required in the building structure and fabric for proper safe access for and to plant for installation, maintenance, inspection and future replacement.

Design stage
A drawing and/or schedule to show the provisions required to accommodate the engineering services that significantly affect the design of the building structure, fabric and external works. The information also indicates the work to be carried out by building trades eg. plant bases, major openings and major structures for plant and equipment.

This will be appropriate to the stage of design development and maybe based on preliminary, non-manufacturer specific plant selection.

Installation stage
Drawings to show requirements for building works necessary to facilitate the installation of the engineering services and as described elsewhere.

1015015 Controls logic diagrams

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

Switchgear, starter and control instrumentation panel drawings

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

1016000 RECORD DOCUMENTATION

1016001 General

Be advised that great importance will be placed upon quality, accuracy, clarity and completeness of the record documents and upon these being made available promptly.

Practical completion will not be granted unless an approved copy of the record documentation has been prepared, and is available for handover to the Employer.

Comply with the requirements of the CDM Regulations in providing the appropriate input to the health and safety file for the Works.

Comply with the requirements of the Building Regulations in providing all necessary documentation and information.

Provide record documentation, as detailed elsewhere, to include but not limited to:

- Record drawings and schedules
- Plant room and switch room drawings, schedules and schematics
- Operating and maintenance manuals
- Blank maintenance logs
- Building log book information

Ensure record documents clearly record the arrangements of the various sections of the works as actually installed and identify and locate all component parts.

The record documents shall set out the extent to which maintenance and servicing is required and how, in detail, it should be executed. Sufficient, readily accessible and proper information shall be provided to enable spares and replacements to be ordered.

Correlate record documents so that the terminology and the references used are consistent with those used in the physical identification of the component parts of the installations.

Demonstrate as required throughout the execution of the contract works that complete and accurate records are being maintained and that the record documents are being progressively compiled as the work on site proceeds.

The Employer shall have sole copyright to all documents produced specifically for the manual. The Employer shall be entitled to produce copies of all parts of the manual for his own use. If the Employer transfers ownership or responsibility of the installations he shall be entitled to transfer his copyright of documents included in the manual.

1016002 Record drawings

Record drawings of the complete Works shall be provided at practical completion.

Record drawings of the final "as installed" layouts shall be issued in draft form to the CA for examination 4 weeks prior to the testing and commissioning period to allow checking for accuracy.

Record drawings will be prepared in CAD format as agreed with the CA prior to production of the drawings.

All drawings shall be suitably layered, with different services on each layer. A detailed list of layers, external references or equivalent (if used) and list of files shall be provided with the discs. If the drawings were produced from CAD drawings provided by the CA, the same layering system shall be used.

The drawings shall be produced in full size metric units.

Once approved the complete set of record drawings shall be revised as necessary to incorporate testing and commissioning data where applicable, and the final set(s) of record drawings and computer discs shall be handed over at practical completion.

Issue at practical completion the complete approved package of record drawings in the following numbers:

CAD disk(s) 2 no sets of complete record drawings
'white' prints 2 no sets of complete record drawings

Each CD shall be labelled and CD jewel cases shall be labelled identifying project title, issue date and index of contents.

Valve charts, electrical distribution charts in panels and the like, shall be issued for examination at agreed dates to allow adequate time for manufacture and installation prior to practical completion.

Where portions of the work are to be concealed, draft copies of record drawings shall be supplied to the CA before the work is concealed in order to facilitate checking and examination.

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

Each record drawing shall show the following information:

- The name of the contract and, where appropriate, the zone or floor designation.
- Description of drawing, drawing reference and scale.
- Name and address of the contractor and the consulting engineer.

The completed drawings shall be signed as record drawings.

Each record drawing shall be endorsed with the words 'Record Drawing' in the bottom right hand corner adjacent to the title block.

Mark up 'as installed' details weekly and before any work is hidden from view.

Failure to undertake the above procedure for the preparation of record drawings and leaving the production of such drawings too late in the construction/commissioning period will result in practical completion not being granted by the CA.

1016003 Plant room and switch room drawings, schedules and schematics

Provide good quality plant and switch room drawings, schedules, schematics and instructions and hang in the respective plant room or any other appropriate location or where directed by the CA.

Protect surfaces of such information by pressure lamination and hang using suitable fixings and provide backboards if necessary.

A sample shall be submitted for approval prior to commencing production.

Provide information as stated elsewhere and include:

- All information required under statutory or other regulations
- Location of all incoming service isolating and metering facilities
- Emergency operating procedures including details for emergency call out service
- First aid instructions for treatment of persons after electrical shock
- Schematic drawings of installations showing
  a. location, identification and duties of equipment.
  b. location of controls devices.

c. circuit layout.
- Controls schematics
- Valve schedules showing reference, type, location, application/service and normal operating position

Prior to being fixed, plant and switch room drawings, schedules, schematics and instructions shall be submitted for review by the CA. The review procedure shall be as for record drawings as stated elsewhere and all items shall be fixed prior to practical completion.

1016004 Operating and maintenance manual specialist

Employ a specialist to prepare the operating and maintenance manuals in accordance with the requirements of this specification.

Submit details of the proposed specialist to the CA for approval prior to commencement of the Works.

1016005 Operating and maintenance manual requirements

Agree format and contents of the operating and maintenance manuals with the CA prior to commencement of the Works.

Provide the operating and maintenance manuals in the following form:

- Paper format - encase the manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers
- Electronic format stored on CD

Provide copies of the operating and maintenance manual as follows:

- Provide 2 draft paper format copies for comment
- Provide 2 final paper format for Client use
- Provide 2 final electronic format copies stored on CD for Client use

Submit a draft copy of the operating and maintenance manual to the CA for comment 4-weeks before the contract completion date and prior to the testing and commissioning.

The draft copy of the manual shall conform to the required format and contain all the information identified in this specification with the exception of any information not available at that time (such as commissioning results). The draft copy of the manual shall be contained in temporary loose leaf binder(s) and clearly display the word “DRAFT”.

Once approved a draft copy shall be handed over prior to instructing the employer's staff in the operation and use of the services installations. This copy shall contain all testing and commissioning data and test results, actual control set points and the like in draft form.

Prior to practical completion provide copies of the final manual which shall include all testing and commissioning results and final plant duties and control settings, etc. in a typed form.

All CD’s and other electronic forms of delivery media associated with the manual shall be clearly labelled with:

- A heading stating “O&M manual” and disc number if more than one disc
- Details of the premises and systems covered
- The issue number of the manual and date of release

Retain a copy of all the delivered record documentation for at least one year after practical completion. If requested by the Employer or CA during this period, provide additional copies subject to a charge.

Undertake the following activities:

- Liaise with the CDM co-ordinator and any other parties associated with the production of the Health and Safety File to ensure that the required information is complete and that the method of presentation and terms used are consistent.
- Liaise with members of the design team to obtain all information necessary to convey a thorough understanding of the design intent and operating principles of the installations.
- Liaise with designated contractors and specialist subcontractors to obtain all necessary details of the installed systems and equipment to enable safe and proper operation and maintenance.
- Liaise with specialist equipment suppliers as necessary to ensure that clear operating and maintenance instructions are included in the manual.
- Prepare additional written, diagrammatic and/ or pictorial information as necessary for the operation and maintenance of the engineering services installations
- Re-draft and restructure information provided by others as necessary so as to ensure consistency with other parts of the manual and other sections of the Health and Safety File.
- Submit periodic reports to the CA on the progress of the preparation of the operation and maintenance manuals.
- Collate all the information into a co-ordinated, indexed and cross-referenced document
- Provide all necessary materials required for the production of the draft and final editions of the operation and maintenance manuals.

Be responsible for the correction of any errors or omissions in the manual.

All aspects of the manual shall comply with relevant requirements of the CDM Regulations for the provision of information for the Health and Safety File.

Where appropriate, the maintenance procedures and frequencies detailed in the manual shall be in accordance with details provided by the manufacturer for specific items of equipment. Where specific requirements are not pertinent, the procedures and frequencies shall be as recommended by HVCA or BSRIA.

Care shall be exercised to ensure that maintenance procedures and frequencies described in manufacturers' printed details are accurately reflected in the text of the manual and appropriate for the application.

Identify from the CA the intended maintenance strategy for the works and the level of technical competence and user ability of the personnel likely to be employed. The manual shall be written in a style to suit the abilities of all users. Where necessary, prepare separate sections to suit the following levels of competence:

- non-technical – eg building manager or caretaker requiring simple directions for basic operations.
- general technical – with broad-based maintenance skills required for routine maintenance, inspections etc and detailed analysis of system operation.
- specialist – in individual fields and with respect to particular items of equipment.

1016006 Operating and maintenance manual layout

The manual shall conform to the following minimum standards:

- All documentation shall be in English as spoken and written in the United Kingdom.
- All units of measurement shall be metric, conforming to the SI system.
- The text of descriptive sections shall be concise and complete avoiding possible ambiguity or misunderstanding. All information shall be pertinent to the specific installations. Irrelevant material or material of a general nature shall not be acceptable. Where generic standard clauses are used as the basis for certain parts of the manual, they shall be edited to ensure that all text is relevant to the Works.

- Jargon shall be avoided. All 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.
- The imperative mode shall be used for instructions regarding operation, maintenance, disassembly etc.
- Illustrations, drawings and diagrams incorporated into the manual shall be easily read in conjunction with the relevant text
- The covers shall be substantial, of adequate size, distinctive and of sufficient strength to protect the contents for the life of the installation. The method of binding shall give a permanent anchorage along the left-hand side whilst allowing the text to be flat without damage to the spine.
- The manuals shall be prepared using an approved typeface using good quality A4 paper suitable for direct insertion into the manuals
- The front cover and where appropriate the spine, shall have the information clearly displayed in permanent lettering
- The manual shall have an alphabetical index or indexes. The indexing and cross-referencing in other parts of the manual shall be arranged to provide easy access to required information.
- Dividers between sections shall be stepped, overlapping printed card. The divider shall be labeled to identify the section of the manual that it proceeds.
- All pages comprising the manual shall be subsequently numbered according to each section (i.e. section 1 pages numbered 1/1, 1/2,etc., section pages numbered 2 2/1, 2/2etc.)
- Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.

1016007 Operating and maintenance manual content

The manual shall be arranged as follows unless an alternative format and contents are agreed with the CA prior to issue of the draft document:

Front cover and fly sheet

General details to be shown on all volumes shall include:
- Document title - Operating and Maintenance Manual
- Employer name and logo
- Premises name
- Services referred to in the manual
- Volume reference where the manual runs to more than one volume
- Description of contents (eg General Information and Design Details)

Spine details

Spine details shall be shown on all volumes and include:
- Services referred to in the manual
- Volume reference where the manual runs to more than one volume
- Description of contents (eg General Information and Design Details)

Title pages

- Premises name and address (authenticated postal address, phone, fax, e-mail etc)
- Services referred to in the manual
- Full name and address of the Employer
- Date of completion and date of handover of the services to the Employer
- Date of issue
- The author's reference number of the manual
- Name and address of the author of the manual

Contents and index

- The contents list for the whole manual shall comprise a master list of main headings of each section for each volume of the manual, for cross reference. Copies of this master contents list shall be included in the master contents list for the Health and Safety File.
- Detailed contents for the particular volume shall include a structured contents list showing main headings and details of contents of each section in that volume, with paragraph numbers and page numbers.
- Detailed contents for each section are to be located at the front of each section of the manual, giving a detailed, structured list of the contents of the respective section.
- Index comprising a comprehensive alphabetical index for all sections of the manual

Section 1 General information and introductory overview

The information contained in this section shall include:

- Full name, address, telephone and facsimile numbers, website address and email address of the design team and all installing contractors, sub-contractors and specialists for the works
- Full name, address, telephone and facsimile numbers, website address and email address of all public utilities and local authorities
- Any limitations on the use of the manual
- Record of amendments to manual schedule (including space for future records)
- Description of how to use the manual
- List of all supplementary documents
- Distribution list and locations of all copies of the manual
- Scope including a brief description of which systems and details are included in the manual

Section 2 Contractual and legal information

The information contained in this section shall include:

- Details of ownership, leases etc defining areas of responsibility for operation and maintenance
- Construction / handover dates including installation start date(s), practical completion date and end of defects liability date
- Details and copies of all manufacturers' guarantees or warranties together with maintenance agreements offered by sub-contractors or manufacturers. Include expiry dates.
- Insurance inspection reports. Documents pertinent to Employer's / User's liability
- Local and public authority consents. To include permissions required for access, alterations etc
- Safety and fire certificates. Certificates confirming that the premises and installed systems may be safely utilised. These shall include examination certificates by competent persons for pressure systems etc, together with written schemes of examination for pressure systems.
- Software licence information.
- Copies of Energy Performance Certificates

Section 3 Health and safety

- Features or characteristics that may produce a hazard. Flammable, toxic or otherwise deleterious substances necessary for the operation of systems; restricted access; pressure systems etc
- Known hazards against which protection can be provided
- Mandatory requirements relating to safety. To include details of all systems and equipment requiring periodic inspection/ examination/ testing to comply with relevant regulations, approved codes of practice etc
- Relevant safety precautions. To include procedures to minimise the risk of damage or injury from recognised hazards. Requirements for special manual procedures, permits to work etc.
- Details of recommended first aid equipment to be maintained on the premises.

Section 4 Emergency information

Contact information for:

- Utility supplier emergency services (gas, water, electricity)
- Provider of emergency call out service
- Installer's emergency staff
- Security/fire systems
- Location of first aid equipment
- Emergency control locations
- Water main stopcock(s)
- Gas shut –offs
- Electricity isolation points
- Specific systems/plant

Section 5 Description of services and design intent

- A schedule of the floor areas of each of the building zones categorised by environmental servicing type
- Description of the whole building and intended use
- Design philosophy including all design criteria
- A full description of each of the installed systems and items of equipment. To include as a minimum a written explanation of the following:
  a. Scope
  b. Intended purpose
  c. Plant and distribution locations; divisions of main zones; etc, cross-referenced to schematics
  d. Function
  e. General design parameters
  f. Installed capacities
  g. System capacities (based on commissioning results)
  h. Restrictions of the systems
  i. Planned operational efficiency and most economic mode of operation
  j. Expected service life
  k. Manufacturers information concerning correct operation

Section 6 Equipment schedules

System by system schedules of all plant, equipment, valves, distribution boards etc stating as minimum:

a. Component type
b. Unique asset number
c. System
d. Location
e. Number off
f. Duty and size
g. Performance figures
h. Manufacturer and supplier
i. Manufacturer's model and/or reference number
j. Manufacturer's serial number and nameplate details
k. Original order number for the particular plant/equipment item

Each item of plant/equipment must have a unique asset number cross-referenced to the record drawings and schedules.

Section 7 Systems operation

Descriptions of the operational and control strategies to include:

- Control and operating strategy for each system
- Outline of general operating mode including summer and winter operation
- Start-up and shut down procedures. Description of procedures for whole system and individual items of plant, from fully off to fully operational, including interlocks etc.
- Interlocks and inter-dependencies between plant and systems.

- Procedures for emergency shut down and operating procedures for standby plant.
- Means of making safe potentially dangerous plant
- Precautions necessary to overcome known hazards when operating each system, bringing into operation all standby equipment included in each system
- Instructions on fault finding and emergency in case of plant malfunction or equipment failure control sequences for all systems installed
- Details of all software provided and procedures for updating and/or modifying software operating systems and control programs
- Instructions for the creation of control procedure routines and graphic diagrams where applicable

Section 8 Energy management

- Energy management strategy to enable energy consumption to be monitored and controlled.
- Metering philosophy. To include a schedule of the building's energy supply meters and sub-meters. Indicate for each meter, the fuel type, its location, identification and description, and instructions on their use.
- Carbon emissions and the comparable performance benchmarks / target figures for energy consumption and energy costs. *(Design assessments to be in accordance with Building Regulations)*
- The measured air permeability of the building
- Forms for recording plant running hours, energy consumption and energy costs.

Section 9 Maintenance

Maintenance instructions for each item of plant, co-ordinated from manufacturer's details and recognized industry guidelines including:

- frequency and recommended routine maintenance activities
- guidance on the nature of deterioration and defects to look for
- dismantling and re-assembly instructions
- adjustment , calibration and testing instructions
- special tools needed for maintenance *(cross referenced to the particular item)*
- test equipment and auxiliary services
- reference to spare parts and replacements
- Programme and frequencies for planned preventive maintenance.
- Comprehensive schedules identifying:
  a. routine periodic checks on plant / system status and condition.
  b. periodic verification of accuracy of controls, instruments etc.
  c. routine visual and physical checks, measurements and certification of continuing fitness for purpose and safety.
  d. routine checks / changes to plant / system components / settings to compensate for wear, operational requirements, experience in use etc so as to ensure continuing optimum performance.

Recommended frequencies and procedures for routine lubrication of moving parts, including generic specification for lubricants.

Procedures for fault finding and identifying causes of abnormal operation of plant / equipment.

Section 10 Spares and tools

- Schedule of types of replaceable assemblies, components etc particular to specific plant.
- Schedule of specialist tools / equipment particular for specific plant and necessary for undertaking work at height etc.
- Separate parts lists shall be provided for each item detailed in the equipment schedule.
- Schedule of normal consumable items
- Recommended stocking levels

- Schedule of personal protective equipment necessary for operation / maintenance activities / tasks

Section 11 Drawings

- A schedule of all engineering services record drawings for the Works. The information to include drawing title, number, source, revision, date, system detail, file/storage location. The schedule to include space to record future modifications and dates.
- An A3 size reduced copy of all record drawings together with an index.
- An A3 size reduced copy of all plantroom and switchroom drawings, schematics and schedules
- Legend for all colour-coded services
- Schematic drawings of each system, indicating principal items of plant, equipment, valves, etc.
- A schedule of all manufacturers' drawings for the Works. The information to include drawing title, number, source, revision, date, system detail, file/storage location. Schedule to include space to record future modifications and dates.

Section 12 Testing and commissioning data

- Copy of report(s) confirming that the Works were satisfactorily commissioned signed by a competent person(s)
- Copies of all test certificates, records, commissioning and performance test records for the Works. All certification shall be signed and witnessed.
- Method statements for the testing and commissioning procedures undertaken including description of equipment used.
- Copies of calibration certificates for all test equipment.
- Schedules of all fixed and variable equipment settings established during commissioning.

Section 13 Manufacturers' data

- Schedule of all manufacturers and suppliers indicating company name, address, telephone and facsimile numbers, email address(es), website address and equipment unique asset number. (Sorted in company order alphabetically)
- Product (manufacturer's) data/ literature for all items of equipment and plant installed. The information to be project specific and include detail drawings, electric circuit details and operating and maintenance instructions.

Section 14 Materials and substances

- Register of harmful substances. Details of any materials that could be hazardous to health, used in connection with or otherwise relevant to operational or maintenance activities.
- COSHH details
- Register of recyclable materials
- Methods for safe disposal or destruction of any parts, materials or components.

Provide a data sheet for each material known to constitute a potential hazard, with detailed procedures for its safe, authorized disposal.

Section 15 Modification information

- Provide details of allowances made by plant manufacturer or system designer for modifications
- Provide space in manual to record future modifications.

1016008 Building log book

The contractor shall be shall be responsible for compiling the building log book where necessary.

Prepare and submit to the party responsible for compiling the building log book all necessary information for inclusion in the document to meet the requirements of the Building Regulations and in accordance with CIBSE TM31 Building Log Books – A guide and templates for preparing building log books.

Clearly, there are direct links between the building log book and the operating and maintenance manual, record drawings etc. The building log book information is an additional requirement to the responsibilities for the production of record documentation as stated elsewhere.

Practical Completion will not be granted if the required information is not issued.

1018000 COMPLETION AND HANDOVER

1018001 Handover requirements

As a pre-requisite to Practical Completion in respect of the contract works or part thereof, demonstrate to the satisfaction of the CA that:

- All the contract works are complete. With the exception of minor snags or limited defects as agreed with the CA that could be reasonably completed within an agreed programme without causing disruption to the Employer's use of the building or part thereof.
- All spares, keys, tools and other consumables as stated elsewhere have been supplied and handed over to the Employer.
- The instruction of the Employer's staff in the use and correct operation of the installation has been completed satisfactorily. In particular, safety devices and controls demonstration.
- All commissioning and testing completed including the issue of a final commissioning reports signed by an approved competent person
- A complete demonstration of the contract works including fully functional operational controls tests undertaken in the presence and to the satisfaction of the CA.
- All necessary certification by the Employer's insurers has been completed.
- All approved record documentation including record drawings, operation and maintenance manuals, etc is approved and issued
- All information required for the health and safety file is issued to the satisfaction of the Planning Supervisor.
- All necessary Statutory Authority approvals have been undertaken and written confirmation established
- Completion and issue of building log book information in accordance with Building Regulations.

Should adequate record documentation not be available Practical Completion will not be granted.

1018002 Reading of meters

On completion of the Works record readings of all water, gas and electricity meters and forward to the CA.

1018003 Recommended spares

Before practical completion submit to the CA a schedule of spare parts as stated elsewhere and recommend any that should be obtained and kept in stock by the Employer for maintenance of the installations included in the Works.

Submit the schedule of spare parts six weeks before practical completion

The schedule shall be priced in detail and include the following information for each item:

- Manufacturer's current price (including packaging and delivery to site)
- Quantity to be provided
- Manufacturer's reference for the item
- Referencing to the plant and equipment installed
- Purpose

Identify the items that are additional to those specified and included in the contract price.

Submit to the CA a quotation, priced in detail, for the additional items.

1018004 Supply of spare parts

Two weeks prior to practical completion provide all specified spare parts and the additional items if so instructed by the CA.

For each spare part provided include for and undertake to:

- Check that each spare part is suitable for the replacement of the corresponding part supplied with the plant and equipment installed
- Reference to the plant and equipment information in the operating and maintenance manual so purpose is clear
- Label and reference in accordance with the schedule of spare parts
- Paint, grease and pack as necessary to prevent deterioration during storage

All spares shall be contained where practicable in protective containers.

1018005 Recommended tools

Prior to practical completion submit to the CA a schedule of tools and portable instruments as stated elsewhere and recommend any that should be obtained and kept in stock by the Employer for maintenance of the installations included in the Works.

Submit the schedule of tools and portable instruments six weeks before practical completion

The schedule shall be priced in detail and include the following information for each item:
- Manufacturer's current price (including packaging and delivery to site)
- Quantity to be provided
- Manufacturer's reference for the item
- Referencing to the plant and equipment installed
- Purpose

Identify the items that are additional to those specified and included in the contract price. Submit to the CA a quotation, priced in detail, for the additional items.

1018006 Supply of tools

Two weeks prior to practical completion provide all specified tools, keys and portable instruments and the additional items if so instructed by the CA.

Include for and undertake to:
- Check that each item is suitable for the intended application
- Label and reference each item identifying purpose and the plant or equipment
- Paint, grease and pack as necessary to prevent deterioration during storage

All tools, keys and portable instruments shall be secured and contained in lockable cabinets that will be located as agreed with the CA.

1018007 Inspection by employer's insurers

Where indicated elsewhere installations, equipment, plant or materials are to be inspected by a representative acting for the Employer's insurers. The installations, equipment, plant or materials shall satisfy the insurance company's requirements in all respects.

Provide a programme for the inspection and certification and inform the CA when the installation or equipment is ready for examination.

Ensure all necessary information is provided to enable the insurers to approve the design before manufacture.

Arrange for the attendance of the insurance company's representative at agreed stages of manufacturer and installation and provide all necessary attendance, access and facilities for inspecting and testing as is required.

No equipment or installations subject to inspection and certification will be accepted on behalf of the Employer unless a satisfactory certificate has been received from the insurers.

The Employer will place an order with the insurance company and all insurance company charges will be included in the contract price

All other costs associated with such inspections shall be included in the contract price.

1018008 Instruction of employer's staff

At a time to be agreed with the CA and prior to practical completion instruct the Employer's staff in the use, correct operation and general maintenance of the Works and be satisfied that such staff is competent to take over the installation on completion. Include adequate periods to instruct the Employer's staff in the operating and maintenance of the Works.

Submit to the CA for approval a detailed training programme and method statement for the training of the Employer's staff 4-weeks before commencement of training.

During such periods of instruction undertake and be responsible for the correct operation and maintenance of the installations.

Employ the services of relevant specialists and suppliers necessary for this purpose and provide each person with a comprehensive set of teaching notes and diagrams.

All the associated training equipment required by the trainer(s) to enable the training to be demonstrated effectively shall be provided.

For all instruction periods maintain training records which shall be submitted to the CA on completion. All attendee names shall be recorded and signatures obtained from all attendees confirming they have understood the training given. A schedule of names shall be provided within the operating and maintenance documentation.

All health and safety issues relating to the Works shall be brought to the attention of all attendees.

All attendees shall be provided with the appropriate Personal Protective Equipment (PPE).

Provide each person with a comprehensive set of teaching notes and diagrams.

'Formal' presentations shall be carried out over 'half day' periods.

As an indication, the training for operating staff should include, but not be limited to:

- Building services system scope (demonstrated with the aid of schematics and/or other drawings/visual aids). To include an overview of the purpose and normal operating functions of the Works and explaining the philosophy and method of control used.
- Demonstration and training (by controls Specialist) of the building control system.
- An electronic projector style 'walk through' of the operation and maintenance manuals, highlighting important areas of health and safety together with all other items of importance.
- Highlighting, demonstrating and providing delegate experience in all maintenance procedures identified in the O&M Manuals.
- Physical tour(s) of inspection of the Works illustrating aspects covered in the 'classroom' and the location of essential isolating points of all incoming services.
- Explaining and illustrating all operator alarms, their possible causes and actions required.
- Explaining all known and typical fault scenarios which are capable of being recognised and/ or rectified by the operators.
- Identifying and demonstrating all safety equipment and interlocks including all interlocks with other suppliers' systems /equipment.
- Identifying the noise levels in the various areas and highlighting the need for any protection required.
- Specifying and illustrating any hazards associated with the Works and the methods employed to deal with them.

- Providing instruction on the correct operation of plant items and the safe limits of their operation.
- Explaining the mode of operation and sequence of events resulting from both power failure and fire alarm conditions.
- Demonstrating any alarms and explaining they're meaning and possible causes.
- Highlighting any associated hazardous maintenance materials which may require special disposal considerations.
- Highlighting the signs, cause and effect of known/ possible breakdown or fault conditions.
- Indicate and demonstrate (where practicable) arrangements made for access and removal of specific items of equipment or key large or heavy subassemblies / components.
- Demonstration of the safe day to day running and maintenance of all systems, plant and equipment.
- Providing sufficient expertise to address delegate questions.

The training for the operation of the controls, monitoring or BMS installations shall include as a minimum:

- Initial training at the works of the controls supplier including hands on experience of equipment and software similar to the installation.
- Instruction on the procedures for testing and routine inspection of sensors and actuators to enable the operator to assess the nature of faults and extent of remedial action required.
- The provision of all appropriate reference and training manuals.
- Complete initial instruction prior to commissioning of the installed system.
- Site instruction on the installed system.

Together with the controls and commissioning specialists, be available for an agreed period as agreed with the CA to assist the Employer's personnel in the operation of the various systems following practical completion and occupation of the buildings.

All costs associated with the instruction of the Employer's staff and required attendance following practical completion shall be included in the contract price.

1018009 Operation of systems prior production of record documentation

Provide attendance, at no expense to the Employer, to put into service, operate 24 hours a day and maintain the systems to the Employer's requirements, including the provision of suitable competent labour, in the event that the record drawings and/or maintenance manuals are not available when the Works would, in the opinion of the CA, otherwise qualify for practical completion.

Failure to provide this service satisfactorily the Employer shall be entitled to make his own arrangements and recover the full cost through

1018010 System demonstration

Subsequent to the completion of all testing and commissioning to the satisfaction of the CA, when directed by the CA operate the plant and demonstrate that the overall systems function correctly in accordance with the requirements of the specification.

Full running and operation for a period of at least 4-hours shall be considered reasonable for this demonstration and this period shall be allowed in the programme.

During this period be responsible for the recording of results and the operation and maintenance of the plant. If appropriate, use this time to instruct the Employer's staff in the operation and maintenance of the systems.

Provide an operational report of the demonstration and print out of the conditions maintained within the space for the required demonstration period.

1019000 MAINTENANCE

1019001 Provision for 12 months maintenance

Include within the tender a separate cost item for 12 months maintenance from the date of practical completion.

Include for:

- Planned preventative maintenance of the Works to maintain the systems in efficient working order including routine checks, adjustments, lubrication and replacement of consumable spares, etc
- Preparation of work schedules and recording activities
- Providing breakdown and emergency cover
- Planned shut-downs for maintenance to be undertaken
- Employing of all necessary specialist maintenance required for the Works
- Attendance on and supervision of specialist maintenance required for the Works
- Carrying out all necessary safety checks
- Carrying out system proving of the works to include the measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values
- Monitoring and recording of all energy consumption during this period
- Water sampling including laboratory analysis and monitoring of heating, chilled, domestic water systems
- Liaison with the Employer

Submit with the tender a method statement outlining how the above is to be undertaken.

One month before practical completion submit to the CA a detailed planned preventative maintenance programme for the Works.

1019002 Proposal for annual maintenance contract

Submit within 4-weeks of request a supplementary proposal for an annual maintenance contract.

The proposal should include for:

- Planned preventative maintenance to maintain the installations in efficient working order including routine checks, adjustments, lubrication and replacement of consumable spares, etc.
- Preparation of work schedules and recording activities.
- Providing breakdown and emergency cover.
- Planning and undertaking shut-downs for maintenance works.
- Employing of all necessary specialist maintenance.
- Attendance on and supervision of specialist maintenance.
- Carrying out all necessary safety checks.
- Carrying out system proving of the works to include the measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values.
- Water sampling including laboratory analysis and monitoring of heating, chilled, domestic water systems.
- Monitoring and recording of all energy consumption during this period
- Liaison with the employer.

The proposal should set out the terms of the offer, the work to be carried out, the guarantees of performance and the price of the first 12 months after Practical Completion of the contract works or section thereof.

The proposal will not necessarily be considered as part of the contract works and the Employer does not undertake to accept it.

1019003 Maintenance of existing services

During the progress of the Works fully maintain all existing services.

Submit a method statement to the CA prior to commencement of the Works outlining how the existing services are to be maintained including all planned and preventative maintenance measures.

All costs shall be included in the contract price to maintain the existing services at all times during the duration of the contract. Include and provide any additional work and materials.

Any existing services that are disturbed or damaged by the Works are to be reinstated fully in accordance with the standards of quality as defined in the specification and to the satisfaction of the CA. Submit to the CA a method statement outlining the method and procedures for the remedial and reinstatement works.

Any shut down of existing services to undertake remedial and reinstatement works shall be to an agreed procedure and as agreed with the CA.

1020000 EXISTING SERVICES

1020001 General

The existing services are to be retained or modified in accordance with this specification and drawings.

Existing services shall not be interfered with, nor interrupted in any way without the prior written permission of the CA.

Be responsible for any damage entailed and make good any such damage to the satisfaction of the CA at no extra cost.

1020002 Scope of existing services

The existing services comprise:
Generator, fuel delivery system and electrical distribution cables

1020004 Risks to health and safety

The nature and condition of the existing services cannot be fully ascertained before commencement of the works.

The Employer or the CA do not guarantee the accuracy and sufficiency of the information provided. Undertake responsibility to obtain any information required to undertake the works and ensure the safety of all persons.

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

The following risks are or may be present:
Live electrical systems

1020005 Making safe of existing services

Submit to the CA method statement(s) prior to commencement of works for the making safe of the stated existing services prior to removal including:

1. Risk assessments
2. Permit to work
3. Temporary works
4. Method of removal
5. Requirements for making safe
6. Compliance with current statutory regulations, codes of practice or normal good practice

Method statements should address the particular needs of the site and should detail the planned sequences and methods of making safe and removal of the existing services. The proposed working methods should be assessed to determine whether a number of method statements are required, particularly where the operations are phased.

Method statements should be prepared in such a way that they enable supervisors and managers to ensure that persons on site are made aware of how the work should be carried out including the sequence of operations, the plant and types of equipment to be used and the precautions to be taken, as appropriate

1020006 Investigations and surveys

Undertake investigation and surveys to determine the nature of the site, existing services, local conditions and restrictions likely to effect the execution of the Works prior to commencement of the works.

Determine and define any physical site restrictions, constraints and hazards which may affect the undertaking of visual inspections, including health and safety matters.

Surveying should be undertaken in a planned, safe manner. Caution should be exercised and continual alertness should be maintained.

Assess the general condition of the existing services, based on visual inspection, and recommended if further specialist investigation is required. Examine available record drawings and documentation of the site, structures and engineering services. Discuss specific maintenance and operational procedures with the maintenance staff and operators of the existing services. Prepare a report and submit to the CA.

Take photographs of the existing installation and equipment to be removed at a quality agreed with the CA and in sufficient detail to show the condition of the equipment prior to removal.

Prior to commencement of the works survey the existing services installations to determine the necessary information in order to make safe and removal. The survey should establish:

- Extent of decommissioning;
- Condition of services with respect making safe and removal
- Function
- Size
- Material
- Location with respect to existing structure and architecture
- Safety
- Hazardous substances/materials
- Risk and presence of legionella
- Presence and removal of refrigerants
- Sequence of removal
- Presence of deleterious materials relating to the services.

On completion of the survey prepare a report and submit to the CA.

Advise on the requirement for any urgent works or required action as a result of non-compliance and any parts of the services installation found to be potentially hazardous.

Identify special training and other requirements that should be satisfied before commencement of making safe and removal of the existing services.

No claim for lack of knowledge will be allowed.

1020007 Maintenance of existing services

Fully maintain the following existing services during the progress of the Works:

Submit to the CA prior to commencement of the contract works the following:

1. Method statements outlining the method and procedure to be used for the maintenance of the existing services
2. A planned maintenance programme for the existing services
3. Details of permit to work procedures

Provide any additional work and materials necessary to maintain these services at all times during the duration of the contract works.

Any existing services disturbed by the Works are to be reinstated fully in accordance with the standards of quality defined in the specification and to the satisfaction of the CA.

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1020008 Connections to existing services

Connections to existing services shall be undertaken out of normal working hours and agreed with the CA and Employer.

Prior to undertaking the work submit to the CA for approval method statement(s) to include:

1. All necessary risk assessments
2. Permit to work procedures
3. Temporary works
4. Method and procedures for connection
5. Programme
6. Requirements for making safe
7. Compliance with current statutory regulations, codes of practice or normal good practice

1020009 Decommissioning activities

Decommissioning shall include activities that, where appropriate, take into account any earlier decommissioning work which was not completed.

Decommissioning activities shall include:

- isolation, earthing, spiking and cutting of high voltage cables at points outside the demolition area
- isolation of low and medium voltage cables not rendered dead by the actions taken above
- disconnection of cables crossing the demolition area from buildings that are not to be demolished
- disconnection and separation of emergency/standby battery systems;
- removal of bulk process or other chemicals, including battery acids and oils
- draining and purging of all pipework and vessels
- draining and purging of vessels and systems that have contained flammable or noxious gases *(any such systems should be left vented to the atmosphere and ensuring that accumulation of fluids cannot occur)*
- draining of all substantial heads of water
- isolation of water and gas supplies at points outside the demolition area, or removal of a section of the pipework and the fitting of blanks or plugs
- removal or elimination of substances that can give rise to biological, chemical, explosive or radiological hazards

1020010 Removal of existing services

The approval of the CA shall be sought prior to the removal of any existing services.

Provide to the CA prior to commencement of the contract works:

1. Method statements outlining the method and procedures to be used for the removal of the existing services including
2. Risk assessments
3. Health and safety procedures
4. Details of permit to work procedures
5. Programme for the removal of existing services
6. Details of temporary works to be provided
7. Waste management strategy

Prepare or contribute to, as required by the CA, a waste management plan in accordance with the Waste (England and Wales) Regulations 2011 or the Waste Management (Scotland) Regulations 2011 as appropriate.

Place an emphasis on re-using existing equipment where possible and carefully remove and store any equipment identified as being suitable for re-use such that the equipment suffers no damage during its removal or storage.

Where equipment is identified to be re-used or offered to the client for re-use provide all necessary protection to that equipment. Any damage to that equipment during removal or storage shall be compensated at full market value.

Take photographs of the installation and equipment to be removed at a quality agreed with the CA and in sufficient detail to show the condition of the equipment prior to removal. Do not remove any of the installation or equipment prior to agreement that the photographs are of suitable quality and detail.

Take account of the effect of existing services on other parts of the building where a full removal is not being undertaken. Undertake the coordination of the engineering services removal ensuring that no conflict with other trades occurs.

Section 2000000 – General information, standards and design criteria

2001000 GENERAL INFORMATION

2001001 Metric and imperial conversions

Some dimensions and units in metric have been converted from imperial units and approximated to the nearest practical dimension, i.e. 12 inches has been converted to 300mm. Due allowance shall be made for these conversions. Metric sizes have been used in this specification for both metric and imperial components. In certain instances only imperial components are available and generally the imperial size has been converted to the metric equivalent size

2001002 Units of measurement

The units of measurement shall be:

Measurement	Unit	Unit abbreviation
Temperature	Degrees Celsius	° C
Pressure	Kilo Pascal or Pascal	KPa or Pa
Volume flow rate	Litres per second or cubic metres per second	l/s or m^3/s
Velocity	Metres per second	m/s
Speed	Revolutions per minute	rpm
Capacity	Litre	l
Heat flow	Kilo Watt	kW
Area	Square metre	m^2
Length	Metre or millimetre	m or mm
Density	Kilogram per cubic metre	kg/ m^3
Mass/weight	Kilogram	kg
Force	Newton	N
Power	Kilowatt	kW
Current	Ampere	A
Voltage	Volts	V
Illumination	Lux	lux
Frequency	Hertz	Hz
Noise	Decibel	dB
Energy	Kilowatt hour	kWh
Resistance	Ohm	ohm
Reactive	Volt - Ampere or Kilovolt - Ampere	VAr or kVAr
Capacitance	Farad	F

2002000 STANDARDS AND REGULATIONS

2002001 General requirements

This specification is not intended to replace any published or accepted standard of compliance pertaining to the works.

2002002 Standards and regulations

The complete services installation and components shall, unless stated otherwise, comply with the appropriate British Standard (BS and/or BS EN)) or Code of Practice (CP) and where no BS or CP is applicable the Agreement Certificate for the particular item.

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

All product and materials shall have product conformity certification (eg BSI Kitemark, BSI Safety Mark or CARES scheme) or product approval (eg British Board or Agrement Certificate)

All products shall have a recognised ‘CE’ mark attached.

Certificates of compliance with British Standards, BSI Certification Schemes, and/or other Quality Assurance Schemes, shall be provided to the CA when requested.

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

In the absence of specific design, performance or installation standards being stated seek the instructions of the CA prior to commencement of the Works and with adequate time so as not to cause delay.

Comply with all statutory obligations where applicable, including, but not limited to, the following:

1. British Standard Specification (BS) and European Standards (BS EN).
2. British Standard Code of Practice (BSCP).
3. CIBSE Guides to Current Practice and Technical Memoranda
4. Institution of Engineering and Technology (IET) Wiring Regulations (BS 7671).
5. Institute of Plumbing and Heating Design Guide (IPHE).
6. Water Supply (Water Fittings) Regulations
7. Water Byelaws
8. The Building Regulations
9. Loss Prevention Council (LPC)
10. Building Research Station (BRE) digest recommendations
11. Building Services Research and Information Association (BSRIA) recommendations and guides
12. Local Bye-Laws and/or Regulations.
13. Manufacturers’ instructions and recommendations for installation/testing
14. Government (formerly PSA) specifications
15. Health and Safety at Work Act
16. CDM Regulations
17. Health Technical Memoranda (HTMs)
18. Health Building Notes (HBNs)
19. HSE Approved Code of Practice documents and guidelines
20. Radiocommunications Agency

When new editions are published during the construction, the instructions of the CA shall be sought regarding any modifications or changes necessary.

References to BSI documents shall be to the versions and amendments listed in the British Standards Catalogue and in subsequent issues of BSI News up to one month prior to the tender issue date.

Reference to a British Standard shall mean all parts or sub-sections of that standard unless stated otherwise.

The tender shall be based on the regulations and standards current one month prior to the issue date of tenders.

2002003 Copies of standards

The installer shall produce on site when requested by the CA any Code of Practice or British Standard applicable to the Works.

Some of the recently published Codes of Practice contain the following clause:

"In this Code the word "shall" indicates a requirement that is to be adopted in order to comply with the Code while the word "should" indicates a recommended practice."

2002004 Pressure directive

All pressure equipment and assemblies with a maximum allowable pressure greater than 0.5 bar shall comply with the European Community (EU) Pressure Equipment Directive (PED) 97/23/EEC. Pressure equipment shall include vessels, piping, safety accessories and pressure accessories. Assemblies shall mean several pieces of pressure equipment assembled to form an integrated, functional whole.

Pressure equipment shall be marked as a minimum with:

1. Unique identification of the manufacturer
2. Unique identification of model and serial number
3. The year of manufacture
4. Maximum/minimum allowable pressure limits
5. CE marking

Provide a declaration of conformity for all pressure equipment and submit copies to the CA prior to installation into the Works. Provide copies as part of the record documentation.

Equipment must be:

1. Designed for adequate strength taking into account internal/external pressure, ambient and operational temperatures, static pressure and mass of contents in operating and test conditions, corrosion and erosion, fatigue, etc.
2. Provided with means to ensure safe handling and operation and of examination, draining and venting.
3. Provided with protection against exceeding the allowable limits of pressure.
4. Where necessary, pressure equipment must be designed and fitted with suitable accessories to meet damage-limitation requirements in the event of external fire.

Ensure all components or sub-assemblies in their finished assembly are used within their safe operating range and correctly installed and tested.

Ensure that adequate instructions are provided by the manufacture for the safe installation, testing and operation.

Instructions shall be provided to ensure for the safe maintenance and operation of the equipment when in operation.

Pressure equipment and assemblies below the specified pressure / volume thresholds must be safe and designed and manufactured according to good engineering practice.

2002005 ATEX Directive

All equipment and protective systems used in potentially explosive atmospheres shall comply with the ATEX Directive 94/9/EC.

Equipment meeting the requirements of the Directive shall have the CE symbol clearly affixed to indicate compliance.

All equipment, protective systems and components must bear the specific marking of explosion protection as required by the ATEX Directive in addition to the CE marking.

Provide an EU Declaration of Conformity prior to delivery to site as stated elsewhere.

Where a product is subject to several directives, which all provide for the affixing of CE marking, provide to the CA an EU Declaration of Conformity, prior to delivery to site, as evidence that the product conforms to the provisions of all necessary directives.

2002006 EU declaration of conformity

As requested by the CA and prior to delivery provide an EU Declaration of Conformity for all equipment. The declaration shall state the following as a minimum:

1. The manufacturer or their authorised representative
2. Description of equipment
3. The harmonised standard(s) that have been applied
4. The signatory who has been empowered to enter into commitments on behalf of the manufacturer
5. The last two digits of the year in which the CE marking was affixed

Where only a Declaration of Incorporation for component parts of the assembly can be provided advise all aspects to be considered to enable others to provide a Declaration of Conformity

2002007 Electromagnetic compatibility

All equipment and systems installed shall provide electromagnetic compatibility within the system and with any other systems installed in the same area.

All systems and buildings shall be assessed for protection to, and such protection shall meet the requirements of:

BS EN 61000	Electromagnetic compatibility (EMC)
BS EN 55015:2006+A2:2009	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 60870	Telecontrol equipment and systems
BS EN 55024:1998+A2:2003	Information technology equipment. Immunity characteristics. Limits and methods of measurement
BS EN 12015	Electromagnetic compatibility. Product family standard for lifts, escalators and passenger conveyors. Emission.
BS EN 12016:2004+A1:2008	Electromagnetic compatibility. Product family standard for lifts, escalators and passenger conveyors. Immunity.

All equipment shall meet the requirements of the appropriate electromagnetic compatibility standard.

All electrical and electronic apparatus shall comply with the EMC Regulations 2006 and must carry the CE Marking to demonstrate compliance.

2004000 DESIGN CRITERIA

2004001 General

The design of the engineering services is based on the parameters and design data stated in the following clauses and these shall not be changed or amended without prior written notice from the CA.

2004003 Atmospheric corrosivity

The external atmospheric environmental corrosivity category shall be C3 as defined by BS EN ISO 12944 and ISO 9223.

Categories as defined by BS EN ISO 12944 are as follows

Corrosivity category	Corrosion risk	Examples of typical environments in a temperate climate *(informative only)*	
		Exterior	**Interior**
C1	Very low		Heated buildings with clean atmospheres, eg offices, shops, schools, hotels.
C2	Low	Atmospheres with low level of pollution. Mostly rural areas.	Unheated buildings where condensation may occur, eg depots, sports halls.
C3	Medium	Urban and industrial atmospheres, moderate sulphur dioxide pollution. Coastal areas with low salinity.	Production rooms with high humidity and some air pollu-tion, eg food processing plants, laundries, breweries, dairies.
C4*	High	Industrial areas and coastal areas with moderate salinity.	Chemical plants, swimming pools, coastal ship- and boatyards.
C5-I	Very high (industrial)	Industrial areas with high humidity and aggressive atmosphere.	Buildings or areas with almost permanent conden-sation and with high pollu-tion.
C5-M*	Very high (marine)	Coastal and offshore areas with high salinity.	

2004025 Internal lighting

The levels of maintained horizontal illumination shall be:

Room or area	Illumination level (lux)	Minimum uniformity across working plane (minimum to average)	Minimum reflectances (%)		
			Walls	Ceiling	Floor
Generator Container	250				

Lighting illumination levels shall be designed to meet but not significantly exceed the maintained illuminance levels as recommended by the Society of Light and Lighting.

All luminaires with fluorescent and other discharge lamps shall be equipped with high frequency ballasts.

Contractor proposals based on 6 month cleaning regimes will not be accepted.

2004026 External lighting

External lighting shall be installed so as to minimize the upward light component

All external lighting shall be timer and daylight sensor controlled

The external lighting shall not exceed the following average levels of illumination:

Area/space	Illumination level (lux)	Minimum uniformity (minimum to average)
Circulation and approach areas	50	

2004027 Emergency lighting

Emergency lighting installations shall comply with the requirements of BS 5266 and BS EN 1838 The levels of illumination for a period of 3-hours shall be as follows:

Area/space	Illumination level (lux)	Minimum uniformity (minimum to average)
Generator Container	100	

2004030 Lightning protection

Lightning protection shall comply with BS EN 62305

2004031 Fire alarm systems

The fire alarm system shall comply with BS 5839.

The fire alarm system shall be to Type L1 or where applicable, the fire alarm shall be in accordance the recommendations of the fire engineering strategy.

2004043 Spare Capacities

The electrical infrastructure shall include spare capacity as follows: 25%

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The engineering services installations shall be designed to include the following spare capacities: 25%

All low voltage switchboards shall have spare cubicles containing a minimum of two 800A MCCB or ACB's as spare for future connections. A reasonable spare shall be provided for future expansion.

- All final distribution boards and motor control centre panels (MCCPs) shall have provision to accommodate an additional 25% MCCB/MCB for future expansion
- The Building Management System (BMS), components, and installation shall incorporate at least 25% expansion without redundancy

2006000 GENERAL WORKMANSHIP AND STANDARDS

2006001 Working temperatures, operating and test pressures of services

Equipment, pipework, fittings, valves, coils, vessels and other pipeline ancillaries including joints and jointing methods shall be suitable for the working temperature and operating pressures of the systems applicable. Working pressures of materials and plant shall be de-rated where appropriate to suit the operating temperature in accordance with the manufacturer's recommendations and the appropriate British Standard or Code of Practice.

In addition to the above operating requirements they shall also be suitable to withstand the test pressures defined elsewhere without damage and undue stress.

A schedule of working temperatures, operating pressures and test pressures shall be submitted for approval before any orders are placed.

No material or equipment shall be used where the maximum de-rated operating pressure or test pressure is at its limit and would not adequately withstand a fluctuating increase in system pressure of at least 10%.

2006002 Consistent material supplies, quality and finish

Materials shall be of a consistent manufacturer and standard. Each type of material item, or range of material items shall therefore be of a single manufacture.

Unless specifically stated, material items shall be of the same finish and/or quality and/or grade as the system within which they are installed.

2006003 Materials and equipment

Materials, equipment and expendable sundries shall be supplied and purchased new from and no second hand, reconditioned or overhauled equipment shall be allowed.

Ensure all plant, equipment and materials are protected against damage or adverse weather conditions until practical completion. Any plant equipment or materials that have been subjected to damage, incorrect storage or incorrect installation will require to be replaced at no cost to the contract.

2006004 Access facilities

All access facilities shall be located such that they are easily accessible, fit for their purpose and in compliance with health and safety regulations. Health and Safety of maintenance staff must be considered.

No plant or equipment is to be installed in such a manner that it cannot be routinely and regularly maintained in a safe manner. No plant is to be installed such that longer term maintenance or the replacing of parts is impractical or likely to cause undue expenditure. No plant access points are to be obstructed.

Access requirements are generally described and detailed elsewhere in the specification but the following minimum requirements must be provided.

Plant and Equipment
Access facilities shall be provided to all items of plant and equipment. The requirements for access shall be established with the manufacturer and indicated as clear unobstructed space on the co-ordinated installation drawings.

Walkways, access platforms, ladders and lifting gear shall be provided if necessary.

Access is required for:

1. Regular maintenance, fabrication or adjustment.

2. Replacement of parts
3. Monitoring plant conditions
4. Cleaning

Prior to practical completion demonstrate to the CA that all plant and equipment have adequate access facilities.

Ductwork Systems
Provide access where frequent cleaning shall be necessary in the form of 450mm x 380mm access panels at a minimum of 3m intervals, positioned to enable internal cleaning of all ductwork components. On horizontal ducts the bottom of the opening shall be level with the bottom of the duct to enable easy sweeping out.

Access panels shall be so positioned as to enable cleaning personnel to easily reach the inside of the duct.

Provide access for inspection of ancillaries concealed in ductwork, including but not limited to:

1. Control dampers
2. Fire dampers
3. Control devices
4. Turning vanes
5. Heating/cooling coils (both sides)
6. Provide access to plant connections including but not limited to:
7. On inlet ducts to wall or roof mounted extract fans
8. Either side of axial flow fans
9. External louvres
10. Access for testing including provision of test holes
11. Access for commissioning/testing - ensure all control dampers are easily accessible, provide access panels in ceilings if necessary.

Pipework Systems
Provide access for venting and draining

Provide access for water treatment additions

Access for commissioning/regulating - Ensure all commissioning stations, strainers and isolating valves are easily accessible, provide access panels in ceilings if necessary.

Locate all ancillaries including control valves, isolating valves in positions where routine access is easily achieved.

Access for cleaning and rodding wastes, stacks, vents and drains

On new sanitation pipework access shall be provide at the head of horizontal runs of soil and waste pipes, on top of stub stacks, on vertical pipes passing between floors, on horizontal suspended pipes above ceilings and immediately prior to connecting to existing soil and waste stacks. Where alterations to the building comprise existing access points provide alternative suitable access.

Access points shall take the form of proprietary bolted or screwed fittings with seals.

2006005 Services installed in ducts, trenches, subways etc

Engineering services included in the works shall be installed generally as detailed or stated elsewhere and to recommendations in BS 8313 for accommodating services in ducts.

2006006 Facilities for the removal of equipment

Services connections to equipment, and plant, shall be made with decoupling adjacent to the equipment such that any removable section, cover or the complete unit can be readily

removed or withdrawn without the removal or disturbance to large sections adjacent services systems.

In addition it shall be possible to isolate and drain down any item of equipment without isolating large sections of the remaining system.

2006007 Removal of pipework

Pipework shall be installed with sufficient flanged and/or union joints to facilitate easy removal of any part of the system at a future date. Flanged and/or union joints shall be provided at intervals not greater than 16m along all straight runs of pipework.

In plantrooms, services ducts, false ceilings and other similar areas, flanged and/or union joints shall be provided at suitable locations to facilitate removal of pipework in sections.

2006008 Prevention of electrolytic action

Metal pipework conveying water shall be protected from electrolytic action by the installation of non-conductive or fibre type nipples to mechanically separate copper pipes from galvanised tanks or galvanised steel pipework.

In the case of acidic water, approval shall be obtained of the protection required to avoid possible corrosion due to electrolytic action.

2006009 Prevention of dezincification

Brass fittings shall not be used where there is a risk of dezincification or stress corrosion.

Approval shall be obtained prior to ordering materials that may be affected by dezincification and the correct materials shall be used throughout the system.

2006010 Services crossing building expansion joints

At points where services cross the building expansion joints flexible connections, compensators, or expansion joints shall be provided to accommodate the building movement within the services installation unless it can be demonstrated that there is sufficient flexibility in the pipework installation.

Brackets and supports each side of the flexible joint shall be so arranged that the services crossing the building expansion joint remain symmetrical and correctly aligned.

2006011 Frost protection of pipework and services

Pipework in exposed positions shall be protected from possible frost damage by means of thermal insulation of adequate thickness and suitable finish.

Where thermal insulation is not practicable or insufficient to prevent freezing electrically heated tracing cables around the pipework shall be provided, in addition to thermal insulation, controlled by a clamp on type thermostat and wired to an adjacent electrical supply point.

The protection of pipework against frost damage shall comply with BS 6700:2006+A1:2009

Trace heating shall be provided to the following:

1. External chilled water services
2. External above ground mains water services
3. External above ground cold water services

Trace heating shall consist of self-limiting heating tape. An external air temperature thermostat shall energize the tape when the temperature falls below 2°C. A permanent electrical supply and field wiring shall be provided from the nearest motor control centre or distribution board.

2006012 Protection of buried services

Wrapping 2 coats of petroleum jelly impregnated tape or similar approved material around the pipe and pipeline ancillaries shall protect services of ferrous metal and copper that are buried directly within the ground or surrounded or bedded in concrete.

2006013 Site Personnel Records of Works and Identification of Work

The Quality Assurance Procedures undertaken by the Contractor, and his Specialist Traders where applicable, shall include a suitable methodology and recording procedure, which shall enable the craftsman or workman responsible for any work to be identified.

For example: The Contractor shall keep on site an up-to-date set of as installed drawings upon which shall be marked in ink the work done by each pipe fitter.

The records shall be incorporated into the record documentation.

2006014 Rubber matting

Black rubber strip floor matting shall be installed in front of switch panels and control panels. The matting shall be manufactured in accordance with BS 921 and neatly cut to the dimensions required and laid in an approved manner.

2006015 Welding

General
The CA will place a strong emphasis on the standard of welding and the associated quality control procedures in order that the welding meets the required standards in all cases.

All welding shall be executed by competent qualified/certified welding operators fully experienced in the type and size of welding being carried out.

All welds shall be permanently marked with the welder's individual identification code placed adjacent to each completed weld. A log of all welders, their qualifications and a record of the work carried out by them shall be kept on site at all times and shall be available for inspection.

Any weld not permanently marked with a welder's individual identification code shall be examined by an independent inspection authority to include both visual and non-destructive testing. Should testing fail the weld shall be cut out and replaced at no cost to the contract.

An approved independent inspection authority acting as sole arbiter shall carry out all visual and non-destructive examination. Personnel engaged in radiographic, magnetic particle or ultrasonic examination and interpretation shall hold appropriate NDE certification which shall be submitted to the CA prior to commencement of the Works.

To enable the independent inspection authority to realistically cost their work the installer shall, during the tender period, send to the Independent Inspection Authority all necessary information to facilitate costing. Details of the independent inspection authority shall be submitted with the tender.

Prior to completion of the Works submit to the CA a statement signed by the independent specialist responsible for welding examination and non-destructive testing stating compliance with the requirements of the specification.

All examination and testing of welds together with the resulting remedial work shall be at no additional cost to the contract.

Care shall be taken during welding operations that the welding metal or flux does not project into the bore of the pipe. Welds shall be of good clean metal, free from slag inclusions and porosity, of even thickness and contour, well fused with the parent metal, annealed and finished smooth.

Where tack welds are used to secure alignment, there shall be four equally spaced and to the same standard as the final weld, this is, they shall have full penetration at the throat, vee or fillet and be of a length equal to twice the pipe wall thickness.

Manufactured welding fittings shall be used as far as possible and shall be black mild steel butt welded type complying with the relevant standards.

Immediately on completion every weld shall be painted with zinc chromate paint.

Standards and codes
All welding shall be in accordance with all relevant standards and codes, including but not limited to:

BS EN 287-1	Approval testing for welders for fusion welding – Steels
BS EN 970	Non-destructive examination of fusion welds – Visual examination
BS EN 1435	Non-destructive examination of welds – Radiographic examination
BS EN 1714	Non-destructive examination of welded joints – Ultrasonic examination
HVCA TR5	Welding of carbon steel pipework – Code of Practice
BS 2633	Specification for class I arc welding of ferritic steel pipework for carrying fluids
BS 2971	Specification for class II arc welding of carbon steel pipework for carrying fluids
BS EN ISO 9934	Non-destructive testing. Magnetic particle testing

Welder approval
All welders shall hold valid welder approved certification. A welder approval certificate shall be valid for such period as defined by the issuing body.

Copies of current welding certificates for all welders shall be presented for examination by the CA before any works are commenced.

Only certified welders providing acceptable samples shall be permitted to weld.

Welders holding BS EN 287-1 certification shall be limited to the range of approval stated on the certificate with regard to welding process, welding position, material groups, pipe wall thickness and pipe diameter.

Prior to commencement of the Works, welders shall perform sample welds for the inspection by an approved independent specialist in accordance with necessary standards. Each welder shall carry out the Abbreviated Tests specified in Appendix III of the HVCA: TR5 Document to the satisfaction of the Independent Inspection Authority.

The welder's qualifications shall be in accordance with BS 2971 or BS 2640 as applicable and their approval tests in accordance with BS 4872 Part 1. Welder qualifications shall be reviewed and approved by the independent inspection authority. A current HVCA Test Certification is acceptable in lieu of the foregoing.

For pipework in category 2 of the Pressure Equipment Directive 97/23/EC, welding procedures shall comply with EN 288 part 3 or ISO 15614. Welder qualifications shall comply with BS EN 287 part 1.

Approval testing does not exempt compliance with the fault limitations shown in BS 2971 or BS 2640.

Failure to satisfy the independent inspection authority as to the competence of any welder craftsman shall result in that craftsman being tested in accordance with BS 4870 and BS 4871 as applicable prior to that craftsman commencing or continuing to work. Failure of any craftsman to complete such tests to the satisfaction of the independent inspection authority shall result in that craftsman ceasing all welding work.

Weld quality
All welds shall be visually examined to BS EN 970 on the outside surface and, where practicable, in the bore with the aid of optical instruments if necessary by an approved independent specialist.

Inspection reports detailing welding inspection activities formed during that period shall be submitted to the CA at weekly intervals.

Non-destructive examination shall be used progressively during the installation of the Works as part of quality control.

Non-destructive examination reports shall indicate either the acceptance or rejection of welds. Test reports including radiographs where appropriate shall be submitted to the CA. Remedial action shall be agreed with the CA before commencement of these works.

Over and above the testing of each welder's work a number of random tests shall be carried out. Non-destructive testing shall be undertaken on approximately 10% of all butt weld joints and 5% of all other joints. Non-destructive testing shall be evenly distributed over the whole of the Works and shall be evenly split between all welders employed on the Works.

Installed welds to a maximum number of 3% of total or 10 number shall be removed to enable a thorough inspection to take place.

10% of all gas and oil pipework joints shall be radio-graphically tested, subject to the specific requirements of relevant standards.

Should any weld fail then a further 15 welds shall be subject to radiographic testing.

Should any of the second batch of welds fail then the CA shall have the right to instruct the cutting out and replacement of all welds and the replacement of all welders previously employed on site at no additional cost. The installer shall take all necessary measures, subject to agreement with the CA, in order that subsequent welding shall be in compliance with the required standards.

If a considerable proportion of welded joints by a particular operator are found to be unacceptable, all welds by this welder shall be completely removed and replaced at no additional cost.

The number of random tests shall also apply to all welds completed off-site by pre-fabricators.

Failure of any one welder’s work shall result in 10 more of their welds being tested as selected by the independent inspection authority or CA. Failure of any of these shall result in all of that person’s work being tested at the installer’s own cost.

If the installer introduces different welder craftsmen after the stipulated number of tests on welds have been undertaken the installer shall at his own cost have at least 5 samples of each such craftsman’s work tested.

A statement shall be submitted to the CA prior to practical completion to confirm compliance with the welding quality requirements of this specification. The statement shall be signed by the independent inspection authority.

Radiographic Testing
Radiography shall be limited to the examination of butt welds.

Radiographic non-destructive tests shall be carried on a percentage of all welds as stated and selected at random during the course of construction by the inspection authority and agreed with the CA.

Radiographic examination shall be undertaken in accordance with BS EN 1435.

The regulations regarding ionising radiation hazards to site personnel and the public must be adhered to. Permission from the HSE must be gained at the commencement of the Works,

A method statement, clearly defining the preparation and methodology of the tests shall be submitted to the CA for approval prior to the testing.

The radiographic testing shall be evenly distributed over the whole of the works and shall be evenly split between all welders employed on the works on a pro-rata basis.

Radiographic test operators shall be qualified to PCN Level 2 or ASNT Level 2 and shall be approved by the independent inspection authority along with examination reports.

Submit examination reports to the CA.

Ultrasonic Testing
Where radiographic testing is prohibited on site, ultrasonic testing shall be undertaken in lieu. Where the use of ultrasonic examination is agreed it shall be undertaken in accordance with BS EN 1714

A method statement, clearly defining the preparation and methodology of the tests shall be submitted to the CA for approval prior to the testing.

All ultrasonic testing operators shall be qualified to PCN Level 2 or ASNT Level 2. The independent inspection authority shall review all ultrasonic testing operator qualifications and examination reports.

Submit examination reports to the CA.

Magnetic particle examination
Where the use of magnetic particle examination is agreed, it shall be undertaken in accordance with BS EN ISO 9934-1.

10% of all fillet welds made in ferrous materials shall be examined by magnetic particle inspection. Similarly, 10% of fillet welds made in non-ferrous materials shall be examined by Dye Penetrant Inspection (DPI).

All magnetic particle and dye penetrant inspection operators shall be qualified to PCN Level 2 or ASNT Level 2. T

The independent inspection authority shall review all magnetic particle and dye penetrant inspection operator qualifications and associated examination reports.

Submit examination reports to the CA.

2006016 Brazing and bronze welding

The CA will place a strong emphasis on the standard of brazing and the associated quality control procedures in order that the required standards are achieved in all cases.

Brazing and bronze welding shall be executed by competent qualified/certified operators fully experienced in the type and size of work being carried out.

Brazers shall hold a valid certificate of competency issued by an approved body. Brazers without valid certificates and those without relevant brazing work experience within the preceding three months shall undertake an approved competency test, witnessed and

certified by an approved body. A copy of certificates shall be submitted to the CA before any works are commenced.

A log of all brazers, their qualifications and a record of the work carried out by them shall be kept on site at all times and shall be available for inspection.

If so requested by the CA, and prior to commencement of the Works, brazers shall perform samples at all sizes for the inspection of the CA. Only certified brazers providing acceptable samples shall be permitted to undertake the works.

Copper joints shall be silver soldered, brazed or bronze welded to suit the operating temperature and pressure and shall comply with BS EN 14324.

In addition the recommendations of the HVCA and Copper Development Association shall be adhered to.

Welding rods, brazing filler materials, fluxes etc, shall comply with relevant British Standards.

Brazers shall permanently identify each of their joints with their own unique mark which will withstand site conditions without damaging system or component performance. Methods of marking shall be approved by the CA prior to commencement of the works.

During the installation of the Works the CA shall select at random installed brazed joints to a maximum number of 3% of total or 10 number and the installer shall remove these to enable a thorough inspection to take place. In the event of finding a faulty joint a further 10 joints made by the relevant brazer shall be cut out and tested. Should any of the second batch fail then the CA shall have the right to instruct the cutting out and replacement of all brazed joints and the replacement of all brazers previously employed on the site. Cutting out and consequential rectification works shall be carried out by the installer at no expense.

Visual examination and non-destructive testing of joints shall be carried out by an independent specialist approved by the CA prior to commencement of the works.

Section 6000000 – Electrical engineering services

6201000 Containment systems

6201001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

6201002 Cable ladder rack

Cable ladder rack shall be installed where required for the support and accommodation of larger cable systems.

The rack shall be of proprietary manufacture, from a recognised company and shall be a complete system, with all fittings etc. The material and finish shall be glavanised steel.

Site manufactured fittings will not be accepted.

The rack shall be sized to accommodate all necessary cables,allowing space between cables and having due regard for grouping and cable current ratings.

The rack shall be installed as a complete system and supported as detailed on drawings using steel channel and fixing clips, brackets, etc. The channel and fixings shall be of the same finish as the rack. Where the finish has been damaged during erection, it shall be repaired or touched up with a paint system to match the original finish.

Supports are to be designed to take the full weight of the rack and cables, along with any imposed loads such as wind etc and imposed loads produced during installation and cable pulling. When the rack is finally installed and loaded, deflection between supports shall not exceed the manufacturers' recommendation.

6201003 Perforated cable tray

General
Perforated cable tray shall be formed from plain steel sheet which has been hot dip galvanised after fabrication to BS EN ISO 1461, unless otherwise specified. Tray shall have a minimum coating weight of 275 g/m2.

Cable tray shall have the dimensions and finish as specified on drawings or in associated particular information.

Standard Dimensions of Cable Tray

Nominal Width	Minimum Height of Upstand	Nominal Thickness of Steel Sheet	Application
100mm	12mm	1mm	Internal
150mm	12mm	1mm	Internal
225mm	12mm	1.5mm	Internal
300mm	20mm	1.5mm	Internal
450mm	20mm	1.5mm	Internal
600mm	20mm	1.5mm	Internal
100mm	12mm	2.5mm	External
150mm	12mm	2.5mm	External
300mm	20mm	2.5mm	External

Bends and Tees
Bends shall be of the same material, thickness and finish as the cable tray and shall have an inner radius of 50mm and a straight length of 100mm at each end.

No perforations shall be made in the circular portion of the 100mm and 150mm bends. On 225mm and 300mm bends perforations shall be made only a line set at 45º. On 450 and 600mm bends perforations shall be made only along lines set at 30º and 60º.

Tees shall be of the same material, thickness and finish as the cable tray. The distance measured between a point of intersection and at the end of the fitting shall be 100mm.

Fixing Screws
Mushroom-head steel roofing bolts and nuts complying with BS 1494 Part 1 shall be used to fix together adjacent sections of cable tray and/or accessories. The head of any fixing screw shall be presented to the surface of the tray on which the cables are to be fixed.

Installation
Cable tray shall only be cut along a line of plain metal, ie not through the perforations. All cut edges of galvanised cable tray shall be prepared and treated with 2 coats of a zinc rich paint.

Site fabrication of accessories shall be kept to a minimum and manufacturers' standard items shall be used. Where special sections are required, the material, thickness and finish shall be as specified for standard items.

Where welding has been employed in the fabrication of cable tray and/or accessories the area around the joint shall be mechanically prepared and thereafter treated with zinc chromate primer or zinc rich paint according to the original finish of the metal.

Holes cut in cable tray for the passage of cables shall be provided with securely fixed bushes.

A minimum clear space of 20mm shall be left behind all cable tray.

Fixings for cable tray shall be disposed at regular intervals not exceeding 1200mm and at 225mm from bends, tees and intersections. The maximum deflection between supports on a fully loaded cable tray shall not exceed 1/110 of the span between supports.

Fixings shall be fabricated from mild steel flat bar. When used with galvanised cable tray, fixings shall be hot-dip galvanised, unless only bending and drilling is required in the manufacture when galvanised mild steel flat bar may be used. Hot-dip galvanising shall comply with BS EN ISO 1461.

6201004 Cable basket

Cable basket shall be manufactured from electro plated zinc steel wire and shall be supplied with all associated accessories.

Cuts in cable basket shall be carried out with the manufacturers recommended tools. Cut sections to create bends, tees etc, shall be bolted together such that the structural rigidity shall be the same as for a manufactured section.

Where bends in cable basket are formed on site, the radius of those bends or tees shall be sized to accommodate twice the largest installed cable.

Where cable basket is used to carry cables such as Cat 5e, Cat 6, Cat 6a, or any other gigabit speed IT cabling, the basket shall be lined with a suitable barrier to prevent cable compression.

Cable basket shall not be used in external environments or where extremes of temperature and moisture may be present.

Only proprietary fixings designed specifically for use on cable basket shall be used.
A minimum clear space of 20mm shall be left behind all cable basket.

Support system fixings for cable basket shall be at distance no greater than 1200mm apart and at 225mm from bends, tees and intersections. The maximum deflection between supports on a fully loaded cable tray shall not exceed 1/110 of the span between supports.

The support system shall be fabricated from mild steel flat bar or channel.

6201005 Steel trunking

Steel trunking shall mean general service trunking, multi compartment trunking, lighting trunking, dado and skirting trunking and floor trunking. Where necessary, specific requirements are given in associated particular requirements.

Unless otherwise specified the whole of the various installations specified herein shall be carried out in galvanised steel trunking complying BS EN 50085.

Underfloor and flush floor trunking shall comply with BS 4678-2

General trunking shall be the return flange type.

All trunking shall be supplied with appropriate screw fixed lid. Where security fixings are required, they shall be identified elsewhere in this specification. Verify type of security screws before procurement.

Lighting trunking shall only be used for its intended purpose and shall be supported in accordance with it's manufacturers recommendations. Galvanised lid shall be installed unless the CA accepts the use of plastic lid.

The trunking installation shall be suitable for the environment and be protected against corrosive or polluting substances, extremes of temperature and excessive solar radiation.

Only manufactured bends, tees, intersections, stop ends, hangers, joints and all other fittings shall be used. No site or workshop fabricated fittings or accessories shall be permitted. Ensure fittings are the same class and finish as associated trunking system

Inverted trunking, including lighting trunking shall be supplied with cable restrainers.

Where but joints are made in trunking runs, these shall be fully supported so that the joint is not subjected to strain.

Where conduits terminate into trunking, this shall be via a brass bush and coupling.

As soon as galvanised trunking is fixed in position all exposed cuts and scratches shall be painted with one coat of zinc rich paint.

All trunkings shall be checked for debris before wiring is commenced and cables shall not be drawn into any section of the system until the system is complete.

All joints shall be fitted with copper bonding links.

All bolts shall be installed so that no cables can snag on them.

Where cables leave the trunking system, a suitable edge protection shall be provided to stop cuts and abrasion of cables.

Trunking shall be supported at regular intervals not exceeding 1.2m on horizontal runs and 1.5m on vertical runs. Where the trunking manufacturers recommendations are more onerous, they shall be applied instead of the distances given above.

Accessories such as switch boxes and adaptable boxes shall be connected to the trunking system via couplings and bushes.

6201006 PVC and uPVC Trunking

PVC trunking shall mean general service trunking, "mini" trunking, multi compartment trunking, dado and skirting trunking as well as PVC floor trunking. Where necessary, specific requirements are given in associated particular requirements.

Unless otherwise specified the whole of the various uPVC trunking installations shall be carried out with products manufacturered to BS 4678-4.

Trunking shall be supplied form one source so that variations in colour are avoided.

Lighting trunking shall only be used for its intended purpose and shall be supported in accordance with the manufacturers recommendations.

The trunking installation shall be suitable for the environment and be protected against corrosive or polluting substances, extremes of temperature and excessive solar radiation.

Only manufactured bends, tees, intersections, stop ends, hangers, joints and all other fittings shall be used. No site or workshop fabricated fittings or accessories shall be permitted. Ensure fittings are the same class and finish as associated trunking system. No joints cut with hacksaws shall be permitted.

Inverted trunking, including lighting trunking shall be supplied with cable restrainers.

Where but joints are made in trunking runs, these shall be fully supported so that the joint is not subjected to strain.

Where conduits terminate into trunking, this shall be via a uPVC bush and coupling.

Any sections with scratches or abrasions in the trunking shall be replaced by the contractor.

Conduit which has manufacturers or distributors codes marks or other information either stamped or printed on it shall not be used.

All trunkings shall be checked for debris before wiring is commenced and cables shall not be drawn into any section of the system until the system is complete.

Where cables leave the trunking system, a suitable edge protection shall be provided to stop cuts and abrasion of cables.

Trunking shall be supported at regular intervals not exceeding manufacturer's recommendations

6201007 Steel conduit

Unless otherwise specified the whole of the various installations specified herein shall be carried out in heavy gauge galvanised screwed conduit complying the BS 4568 Parts 1, BS EN 50086 and BS EN 61386.

Resistance to ingress of water and against ingress of solid foreign bodies shall be to the stated rating to BS EN 60529.

The conduit installation shall be suitable for the environment and be protected against corrosive or polluting substances and excessive solar radiation.

Ensure fittings are the same class and finish as associated conduit system

No conduit less than 20mm diameter or larger that 32mm diameter will be permitted.

The end of conduits shall be cut square and the length of screw threads shall be sufficient only to allow the ends of the conduit to butt solidly in all couplings and against the shoulders provided in conduit boxes.

The ends of all conduits shall be carefully reamed to remove all burrs or sharp edges after the screw threads have been cut. All dirt, paint or oil on the screwed threads of the conduit and accessories shall be carefully removed immediately prior to erection.

The number of running joints in conduit shall be kept to a minimum and where installed locknuts shall be used to secure the sockets.

Where conduits terminate in switch-fuses, fuse-boards, adaptable boxes, etc., they shall be connected thereto by means of smooth bore male brass bushes, compression washers and sockets. Where a conduit terminates on a sheet steel enclosure a flanged coupler shall be used.

All bends are to be made on site to suit conditions and not more than two right angle bends or runs exceeding 15 metres will be permitted without the interposition of a draw box. No tees, elbows, sleeves, either of solid or inspection type will be permitted.

Immediately conduits are fixed in position all exposed threads, scratches and bends shall be painted with one coat of zinc rich paint.

All conduits shall be swabbed through before wiring is commenced and cables shall not be drawn into any section of the system until all conduits and draw boxes for that particular section are fixed in position.

All conduits shall be concealed unless specifically indicated otherwise, i.e. in roof spaces, above suspended ceilings, under floors, in flooring screeds, cast insitu, and in chases cut or cast into walls and/or concrete ceilings.

Where a concealed installation is called for, all conduits shall be chased into walls and concealed in the ceilings and floor screeds as far as the structure of the building will permit. Conduits installed in chases shall be fixed by means of crampets and painted 2 coats bitumastic paint prior to the chases being filled in.

Deep boxes or extension rings on standard circular conduit boxes shall be used where necessary in order to bring the front face of each box flush with the surface of the ceilings and walls.

Conduit runs shall be determined by the installer and approved before any work is started. Conduit shall be run at least 150mm clear of plumbing and mechanical services.

Conduit runs shall be planned to obviate the need for draw-in-boxes, but where the use of them is unavoidable they shall be accessible at all times and be fitted with covers.

Conduit run on the surface shall be run vertical, horizontal or parallel with the features of the building.

Conduit buried in concrete shall have at least 35mm depth of cover over its entire length. Conduit buried in plaster shall have at least 5mm depth of cover over its entire length.

Where conduit is buried in the carcass of a building or in the ground, all open ends shall be temporarily plugged or wrapped in ‘Denso’ tape to prevent ingress of foreign matter, moisture or water.

Where conduit buried in concrete crosses an expansion joint in the concrete, it shall be wrapped with ‘Denso’ tape for a distance of 300mm on each side of the joint. The coupling method for protecting the conduit against stresses due to expansion shall be approved by the CA.

Conduit shall be supported at regular intervals not exceeding 1.2m on horizontal runs and 1.5m on vertical runs. On surface runs, any section of conduit run shall be supported by at least two saddles and shall not rely on the integrity of any conduit box or connection to any other containment or accessory for support.

At each distribution board and multi-gang switchbox the conduit provided must be of the capacity to accept all cables, which could be connected to outgoing ways, whether they are installed at this stage or in the future.

Conduit systems shall be sized in accordance with the details given in Appendix A of Guidance Note No. 1 published by the IET. The cable capacities given in this document shall not be exceeded (note that protective conductors can be ignored in capacity calculations, so long as cables can be easily installed and removed).

Wire pulling lubricant shall not be used. The CA reserves the right to require all cables pulled in with any lubricant to be removed and replaced and conduits cleaned out.

Where surface conduit is specified, it shall be fixed by means of distance saddles and shall terminate in deep pattern conduit boxes. Surface conduits shall not be bent or cut to enter

accessories. If a suitable accessory is not obtainable, the accessory shall be mounted on an approved backing piece of sufficient thickness to align the conduit entry with the surface conduit

6201008 Steel Adaptable Boxes

All draw boxes and junction boxes shall be of ample size to permit the cables to be drawn in and out. They shall be of sheet steel and shall be of square or rectangular pattern. Circular draw-in or junction boxes shall not be used. At all lighting points and switch points, the conduit shall terminate in suitable boxes provided with internal lugs to permit the back plates of the fittings or switches to be attached to them by metal threaded screws.

In damp situations, box lids must be fitted with rubber gaskets and external boxes must be filled with non-setting cold plastic compound.

All spare ways in junction boxes, etc., left for future extensions shall be fitted with brass stopping plugs.

Adaptable box minimum size shall be 100mm x 100mm x 50mm unless otherwise indicated.

Connections to motors and appliances

Conduit shall not be connected direct to a motor, or other appliance liable to vibration, but shall terminate in a through type conduit box or adaptable box at a convenient position adjacent to the motor.

The cable shall be continued in a short length of flexible metallic conduit or composite PVC/metal foil conduit that shall be fixed to the motor terminal box.

An independent stranded copper cable protective conductor shall be run through all such flexible conduit and shall be connected to the motor earth terminal at one end and to a M 3.5 screw tapped into the side of the connected box at the other. The cable is to be sized in accordance with the requirements of BS 7671.

6201009 Condensation management in steel conduit installations

Install conduit systems to ensure internal condensation does not affect the operation of associated circuits. Provide drainage points in accordance with BS 7671.

Where conduit passes through external wall between two areas of different ambient temperatures or in other locations likely to cause condensation, install a conduit or adaptable box. After wiring fill box with inert, permanently plastic compound with high insulation value.

6201010 PVC Conduits and Accessories

All PVC conduits shall be high impact PVC complying with BS 4607, BS EN 50086 and BS EN 61386. The minimum size of conduit shall be 20mm external diameter.

PVC conduit which has manufacturers or distributors codes, marks or other information either stamped or printed on it shall not be used.

Light gauge conduit may be used for protected pre-cast and in-situ concrete work where builders' traffic is minimal.

Heavy gauge conduit shall be used for surface installation and where it is laid in floor screeds.

Conduits shall be jointed and terminated utilising the appropriate rigid PVC components detailed below or standard conduit entry electrical equipment. Jointing will conform to one of the following techniques:
Permanent Adhesive
The solvent cement supplied by the conduit manufacturer shall be used to produce a rigid sealed connection.

Flexible Adhesive
A non-hardening adhesive supplied by the conduit manufacturer shall be used to produce a flexible sealed joint where allowance is necessary for longitudinal movement (e.g. expansion couplers).

Bends and sets in conduit will be made in accordance with the manufacturers' instructions. The radius of the bend shall not be less than 2.5 times the outside diameter of the conduit or such greater radius that will facilitate easy drawing-in of cables.

PVC conduits shall not be used in situations where ambient temperatures are likely to exceed 70ºC or where the normal working temperature of conduits and fittings will exceed 60ºC. Conduits shall not be installed adjacent to steam or hot water pipes. Adequate allowance shall be made for longitudinal expansion and contraction of the conduits under normal working temperature variations as follows:

Expansion couplers should be used on straight runs exceeding 6.0m with a loose or flexible type joint (b above) at the long spout end of the coupler. Special consideration shall be given to the fixing of accessories where this may prevent natural conduit movements. Oversize or slotted fixing holes may be necessary or the introduction of expansion couplers.

Conduits shall be saddled at not more than one metre intervals.

6201011 PVC Conduit Boxes

PVC adaptable boxes shall be of moulded or fabricated PVC of square or oblong shape complete with PVC lids secured by two M4 round or pan headed screws. All adaptable boxes and lids of the same size shall be interchangeable. No adaptable box smaller than 75 x 50mm or larger than 300 x 300mm shall be employed. Boxes shall be of adequate depth in relation to the size of conduit entering them.

Conduit shall be terminated at adaptable boxes, fuseboards, switches, socket-outlet or other equipment not possessing push-in or threaded spouts by means of the appropriate size adaptors. All cemented joints are to be made to a depth not less than the diameter of the conduit being used.

6201012 Protective conductors in PVC trunking and conduit

A separate circuit protective conductor shall be provided within non-metallic conduits and trunking. The conductor shall have green/yellow LSF insulation and shall be sized in accordance with the requirements of BS 7671. A protective conductor may be common to more than one final circuit providing it is sized for the worst circuit conditions.

An earthing terminal shall be provided at every switch and outlet position for connection of a circuit protective conductor as required.

6201013 Excavation and laying of cables, external

Underground cables shall be laid direct in trenches unless otherwise indicated.

When cable trenches are opened all cables shall be laid and the trenches shall be backfilled within 24 hours. At all times adequate safety precautions shall be taken around open trenches and arrangements made to prevent damage to cables.

Trenches shall be excavated to provide the minimum cover specified elsewhere. Turf and topsoil and any reusable paving/sets etc shall be removed carefully and preserved for reinstatement in their original positions.

Minimum cover for cables

Cables shall be covered to a minimum depth as given in the NJUG standard Volume 1.

Where damage is caused during excavation to drainage and other services, this shall be reported immediately to the CA. Approval shall be obtained from the CA before backfilling the trench.

The excavation shall be kept free of water and properly shored up in a manner pre- approved by the CA. Other services uncovered shall be adequately supported by slings or other means and protected.

Before cables are laid, the bottom of the trench shall be evenly graded, cleared of loose stones and then covered with a 75mm layer of sand.

Power cables shall be pulled in over adequately spaced cable rollers and the resulting surplus cable shall be snaked across the width of the trench. In straight run trenches cable crossing is not permitted except where cables branch from the main run. At each draw-in point, joint or junction box the cable shall be left slack. Cables shall not be pulled taught to straighten them after laying.

Cables stockings shall be used for cable hauling. In order to ensure that the strain is taken on the cores as well as the sheath when cables are laid with a cable stocking, a solid plumbed hauling end shall be made. The only permissible exceptions to this requirement are the lengths of up to 9 metres not pulled into a thrust boxing.

Where more than one cable is laid in a trench the cables shall be spaced apart in accordance with their current rating but subject to the minimum spacing specified elsewhere. The minimum distance between cables and segregation from other services shall be as specified elsewhere. When this is not possible 50mm thick concrete or stone tiles shall be used as separators.

Minimum spacing of cables

Cable type	HV	LV	Telephone	Co-axial	Gas, Water and other piped services
	mm	mm	mm	mm	mm
HV	50	300	300	300	300
LV	300	25	150	150	300
Telephone	300	150	50	50	250

After laying, the cables shall be covered with sand to ensure a 50mm cover after tamping. Warning covers as specified shall be laid over the cables and the trench filled in and compacted. Cable warning marker tape shall be laid across the full width of the trench at 100mm below finished ground level (see clause 2.3.14 and table 3E for colour details.)

Reinstatement shall be effected by backfilling in 100mm layers and hand ramming the first two layers. Power compactors may be used for the remaining layers. The turf, slabs, etc shall be replaced and the level of the finished reinstatement shall not protrude more than 25mm above the normal ground level. All soils shall be properly compacted and where required by the CA, a compaction test shall be carried out in accordance with the method set out in BS 1377: Part 9, 1990.

All cable ends shall be sealed in a manner recommended by the cable manufacturer.

6201014 Cable warning covers

Interlocking cable warning covers shall be provided for cables laid direct in the ground. The material and dimensions of the covers shall be as specified on drawings.

The location of all directly buried cables shall be marked by concrete slab markers, 600mm square and 100mm thick.

Each HV and LV cable run shall be marked at the point where it leaves the plinth, sub-station, feeder pillar or other current controlling device, and shall be marked at approximately every

60 metres along the cable run with an additional marker at each change of direction of the cable run.

Cable markers shall be installed flat in the ground immediately above the cable with approximately 25mm projecting above the surface. When site fabricated, impress the words 'HV CABLE' or 'LV CABLE' together with a cable reference number as required on each cable marking slab. The letters shall be approximately 100mm high and 75mm wide overall with strokes 12.5mm wide and 6mm deep.

Cable Warning Covers

Service	Material for Cover	Number and Diameter of Cables	Dimensions of cover (length & width)
LV	Earthenware	One not exceeding 50mm One exceeding 50mm or two not exceeding 37.5mm	225 x 150mm 300 x 225mm
HV	Reinforced concrete	One not exceeding 50mm One exceeding 50mm	1m x 150mm 1m x 175mm

The location of each underground cable joint shall be marked by a concrete slab placed over the joint with approximately 25mm of slab projecting above the ground. When site fabricated the word 'JOINT' shall be impressed by the installer on each slab in letters approximately 100mm high and 75mm wide overall with strokes 12.5mm wide and 6mm deep. Joint locations shall also be precisely located on as build drawings, dimensioned from some easily identifiable fixed point on the building.

6201015 Cable ducts and draw pits

All cable ducts shall be formed from 100 or 150 diameter uPVC piping, as detailed elsewhere. Ducts shall be laid in continuous lengths with integral joints and shall form a watertight system to prevent the entry of ground water into the duct system (this watertight requirement is not applicable to short ducts for road crossings).

Ducts shall be uPVC to BS EN 1401, complete with vehicle loads, encasement, concrete and draw pits, fittings, etc to make a composite system. All duct routes shall be shown on the installers drawings and agreed on site with the CA prior to installation.

Cable ducts shall only each contain one distribution cable (with any associated pilot or control cables), but for systems such as street lighting etc, multiple cables may be drawn into a duct, so long as the cables do not take up more than 30% of the duct section, the cables can easily be withdrawn and the effect of grouping is allowed for in the current rating of the cables.

All duct and tape colours and identification shall comply with the proposals set out by the National Joint Utilities Group (NJUG). Table 1 in NJUG publication “Guidelines on the positioning and colour coding of underground utilities’ apparatus” details the specific requirements

The NJUG code is not retrospective and older installations installed before the code was adopted may not conform to the current colour scheme.

Cables installed on private property may not follow the guidelines in this document. The owner concerned should be contacted for information on the colour code applying in these cases.

Abandoned ducts are sometimes used for other purposes. Ensure systems are fully identified and traced out before any work is carried out.

Ducts shall be laid to be self-draining to the cable pits and a drainage connection shall be made to the surface water drainage system.

Ducts shall be kept clear of gas and water pipes, drains, sewers and electrical plant. In order to allow the use of ‘tapping’ machines on gas and water mains that may be adjacent wherever possible at least 150mm clearance shall be given to these and any other services. No

clearance shall be less than 25mm where services cross, the minimum clearance shall be 50mm.

Ducts shall be laid to provide the minimum cover and spacing specified.

Where it is necessary to deflect from a straight line or to vary the depth, as in passing from footway to carriageway or in entering an underground chamber, a lateral set not exceeding 25mm in a length of 750mm or a vertical set not exceeding 25mm in a length of 1.5 metres shall be given to the joints.

Ducts shall be plugged or capped before and after each test. uPVC plugs or caps shall be inserted at the ends of each section of duct to prevent entry of soil or stones.

Ducts shall be cleared in the presence of the CA with a mandrel not smaller than the internal diameter of the duct minus 12.5mm followed by a circular wire brush 12.5mm greater in diameter than the duct just before any cables are drawn in.

6201016 Sealing of duct entries to buildings (including service pipes)

After all cables have been installed, both duct ends shall be sealed using mastic or expanding foam to form a vermin, gas, water and fire barrier. The fire rating of the seal shall be as necessary to match the fire rating of the local building structure.

Spare ducts shall be sealed with end caps and mastic to form a vermin, gas, water and fire barrier.

Cables shall be identified where they come into and out of ducts and all labels shall be legible and visible after duct sealing is complete.

6202000 Cabling systems
6202001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

All cables shall be colour coded in accordance with the requirements of BS 7671 (taking account of the latest revisions regarding colour compliance. If the contractor is in any doubt as to the colour coding required, particularly with the installation of new cabling within an existing building, then the installer shall seek written confirmation from the CA).

Low-voltage cables shall have a voltage designation as shown below:

Cable type	Standard designation	Voltage rating
PVC insulated and unsheathed	6491X	450/750V
PVC insulated and sheathed	6241Y	300/500V
PVC insulated and sheathed	6242Y	300/500V
PVC insulated and sheathed	6243Y	300/500V
PVC insulated and sheathed	6181Y	300/500V
LSOH insulated and unsheathed	6491B	450/750V
LSOH insulated and sheathed	6242B	300/500V
LSOH insulated and sheathed	6243B	300/500V
PVC insulated and sheathed	3182Y	300/500V
PVC insulated and sheathed	3183Y	300/500V
PVC insulated and sheathed	3184Y	300/500V
LSOH insulated and sheathed	3182B	300/500V
LSOH insulated and sheathed	3183B	300/500V
LSOH insulated and sheathed	3184B	300/500V
PVC insulated, single wired armoured, PVC sheathed	6942X (PVC/SWA/PVC)	600/1000V
PVC insulated, single wired armoured, PVC sheathed	6943X (PVC/SWA/PVC)	600/1000V
PVC insulated, single wired armoured, PVC sheathed	6944X (PVC/SWA/PVC)	600/1000V
XLPE insulated, single wired armoured, PVC sheathed	(XLPE/SWA/PVC)	600/1000V
XLPE insulated, single wired armoured, PVC sheathed	(XLPE/SWA/PVC)	600/1000V
XLPE insulated, single wired armoured, PVC sheathed	(XLPE/SWA/PVC)	600/1000V
XLPE insulated, single wired armoured, LSF sheathed	6942B (XLPE/SWA/LSF)	600/1000V
XLPE insulated, single wired armoured, LSF sheathed	6943B (XLPE/SWA/LSF)	600/1000V
XLPE insulated, single wired armoured, LSF sheathed	6944B (XLPE/SWA/LSF)	600/1000V

Abbreviations:
1. PVC – Polyvinylchloride
2. LSOH – Low smoke and zero halogen
3. LSF – Low smoke and fume
4. XLPE – Cross linked polyethylene

Notes:
1. PVC insulated as well as PVC insulated and sheathed cables shall not generally be used.
2. PVC insulated, single wire armoured, PVC sheathed cables shall only be used where cables are either buried in the ground or contained in ducts likely to be saturated with water.
3. LSOH shall mean low smoke cables which burn with zero halogen content and shall not limit the contractor to using Prysmian cables.

Reduced neutral conductors in multicore cables are not acceptable. Conductors shall be copper unless otherwise specified.

CY, SY and YY type cables shall only be allowed where verifiable cable data stating current (A) rating in appropriate scenarios, thermal constraints applying to that rating, volt drop in mV/A/m and conductor resistance in ohms/km is available before installation.

Comply with the requirements of Regulation 522.6.6, 522.6.7 and 522.6.8 with regard to cables concealed in walls or partitions. In addition to requirements elsewhere in this specification, unskilled labour shall not be permitted for cable installations.

Note: PVC conduit shall not be accepted under Regulation 522.6.6 (iv)…

"*be mechanically protected against damage sufficient to prevent penetration of the cable by nails, screws*"

…as a suitable method of providing mechanical protection under this contract unless agreed with the client during the tender period.

The contractor shall not make any assumptions as to whether or not a buildings electrical installation will be under the control of a skilled or instructed person once in use.

All cables shall be of one manufacture only and shall be delivered to site with appropriate seals if the cable is likely to suffer from water or frost damage. Where cables are supplied on drums, stored for long periods and subject to extremes of temperature, the cables shall be uncoiled and stored in a manner which eliminates the risk of thermal damage to the insulation.

Labels on cable drums shall indicate the manufacturers name, size, description, BS number, classification, length, grade and date of manufacture.

All cable types shall be certified and marked in accordance with the British Approvals Service for Electric Cables (BASEC)

Records shall be kept of all high-voltage cable drum numbers and supporting information. This information shall be indicated on the record drawings indicating the precise location of each length of cable.

Copies of the manufacturer's cable test certificates shall be included in the operating and maintenance manual.

Where conductor sizes are not indicated in the specification and/or the associated drawing(s) they shall be selected in accordance with BS 7671 for the current rating required by the circuit loading, the type of cable, the ambient temperature, the conditions of installation and the maximum voltage drop permissible.

6202002 Unarmoured cables

PVC and LSOH insulated and unsheathed cables drawn into conduit and trunking

LSOH insulated cables shall be manufactured to BS 7211. PVC insulated cables shall be manufactured to BS 6004.

Cables shall only be drawn into a conduit system when it is complete, permanently fixed and thoroughly swabbed out.

The cables shall be looped progressively from point to point and joints will not be permitted. Cables for different voltage bands shall not be installed in the same conduit and trunking systems unless specifically stated in project particular information.

The installation of cables in any conduit shall be in accordance with manufacturers' instructions and BS 7671. Cables shall be installed in conduit and trunking in accordance with IET guidance; however cables in conduit shall occupy no more than 65% of the available space and in trunking, no more than 55%.

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Cables shall be drawn in such a manner that it is possible to withdraw any number from the conduit without disturbing the remainder. Wire pulling lubricant shall not be used.

The CA reserves the right to require all cables pulled in with any lubricant to be removed and replaced and conduits cleaned internally.

PVC and LSOH insulated and sheathed cables

Insulated and sheathed cables shall be installed on either cable tray, cable basket or trunking. Cables may also be clipped direct to building fabric as well as concealed within the building fabric in accordance with BS 7671.

Please note that where concealed in the building fabric, the depth of cables and method of mechanical protection may introduce the need to protect the circuit by either RCD or RCBO.

The installation of cables shall be in accordance with manufacturer's instructions and BS 7671.

6202003 Armoured cables

1. XLPE/SWA/PVC cables shall be manufactured to BS 5467.
2. PVC/SWA/PVC cables shall be manufactured to BS 6346.
3. XLPE/SWA/LSF cables shall be manufactured to BS 6724

The armouring for multi-core cables shall consist of a single layer of galvanised steel wires complying with BS EN 10257-1. Single core cables shall have non-magnetic armour, such as aluminium wire or strip.

Where cables are buried direct in the ground or laid in ducts, they shall be installed and covered in accordance with the National Joint Utilities Group (NJUG) Standard Volume 1.

Where cables are installed on cable ladder, tray, basket or fixed directly to the building fabric, they shall be securely fixed in accordance with BS 7671. Where cables are exposed to direct sunlight or extremes of temperature, they shall be provided with suitable containment or solar shading as appropriate.

6202004 Flexible cables and cords

All flexible cables shall comply with BS 6500 and shall be 450/750V grade PVC insulated and sheathed in normal temperature situations, with various other insulation and sheath properties in 300/600V grade to BS 6141 for higher operating temperatures. The minimum conductor size shall be 1.0mm2.

In addition to those flexible cable types listed under general requirements, the following flexible cables and cords may be used in the appropriate situation and subject to authorisation by the CA.

1. 60°C rubber insulated braided twin and three core.
2. 60°C rubber insulated and sheathed.
3. 60°C rubber insulated oil-resisting and flame retardant sheath.
4. 85°C rubber insulated HOFR sheathed.
5. 85°C heat resisting PVC insulated and sheathed.
6. 150°C rubber insulated and braided.
7. 185°C glass fibre insulated single core twisted twin and three core

The application of the above temperature and constructional features of cables shall be to suit the relevant item of electrical equipment and its operational temperature.

Where an earthing conductor is required for the earthing of metalwork in apparatus and luminaires, it shall be contained within the flexible cord.

Flexible cords for use with lighting pendants and electric lighting fittings

All flexible cables and cords shall comply with BS 6500 and BS 6004. Cables shall be 300/500V grade PVC, rubber or LSF insulated and sheathed as appropriate.

Flexible cords for use with luminaires employing tubular fluorescent lamps or apparatus operating at normal room temperature shall be PVC insulated and sheathed and shall comply with BS6500.

The application of the temperature and constructional features of cables shall be to suit the relevant item of electrical equipment and its operational temperature.

Where an earthing conductor is required for the earthing of metalwork in apparatus, it shall be contained within the flexible cable or cord.

Flexible cables and cords shall be secured at each end with proprietary retaining clamps.

6202005 Mineral insulated cables (MICS)

MICS cables shall comply with BS EN 60702 and be either LSF sheathed or bare copper as specified elsewhere in this document.

All persons employed to make terminations on MICS cables shall have attended a course of instruction and they shall demonstrate, if so requested, to the CA their ability to make a satisfactory seal prior to commencing work on the site.

Where terminations are made to flush accessory boxes within a plaster finish cable clamps fixed to the accessory box and firmly gripping the cable seal may be used in lieu of the brass gland.

Where glands are terminated in equipment without screwed entries, a lock washer and back nut shall be used.

Where cables are exposed, shrouds shall be fitted over the glands. These shrouds shall be the same colour as the sheath.

All circuits with inductive loads supplied by MICS/LSF cabling shall be fitted with voltage surge suppressors in accordance with the manufacturer's recommendations.

Jointing
If a run of MICS cable is of a length that exceeds the maximum to which the cable can be manufactured, a through joint will be permitted. Such a joint shall be made with an adaptable box into which shall be fitted a fixed base mechanical clamp type connector of approved design.

Installation
Where MICS cables are not installed on cable tray they shall be fixed by either bare or LSF coated copper clips (as appropriate to the type of cable) of an approved design at a maximum of 375mm centres on vertical runs and a maximum of 200mm centres on horizontal runs.

Where MICS cables pass through floor slabs or other structural work, they shall be protected by short pieces of heavy gauge galvanised steel conduit. The conduit shall be plugged with non-setting cold mastic compound after the MICS cables have been installed.

Where MICC cables without LSF outer sheath run across or pass in close proximity to steel or other conducting building material, water pipes etc the cable shall be bonded to the said materials at intervals to ensure that no difference in potential can exist. Spacing saddles shall be installed to prevent the cables from contact with dissimilar metals.

All cables shall be installed in a neat and workmanlike manner, being dressed into shape and free from corrugations and damage to the sheaths. All cables shall run vertically on walls and at right angles or parallel to floors of the room or areas served. On no account shall diagonal or arbitrary routes be permitted.

Minor runs of not more than two MICS cables may be fixed direct to non-fireproofed structures, masonry and concrete. In all other situations, they shall be run on cable tray.

Multiple runs of MICS shall be laid neatly on perforated cable tray of an approved type, spaced from the tray by multiple fixing cleats recommended by the manufacturer.

All cable routes shall be agreed by the CA before work is started. Cables shall be run at least 150mm clear of all plumbing and mechanical services. The use of conduit and/or cable trunking to enclose conductors shall be kept to the minimum.

Where an MICS cable is connected to a motor or other appliance liable to vibration, the cable shall be taken direct to the terminal box. A coil of one turn to a radius of not less than 100mm shall be formed in the cable to take up their relative movement between the machine and the solid base.

6202006 Soft skin fire performance cables

Soft skin fire performance cables are those types capable of continuing to operate when exposed to fire. All soft skin cables used on the project shall comply with BS 7629 and BS EN 50200. All cables shall have insulation complying with BS 7655 to standard EI5.

Where cables using solid inner cores are used, these cables shall be installed without kinks. Any kinked cables shall be replaced throughout their length.

Each termination shall be complete with suitable gland and shroud.

Where cables are used for fire alarm installations, the colour shall be agreed with the CA prior to commencing any installation. Do not assume that red sheathed cables will be accepted.

Cables shall be supplied by the same manufacturer throughout the project when used on a common system.

Care shall be taken when terminating soft skin cables to ensure cores are not compressed together

6202007 ELV cables for data and communication use

Cables for data and communications use shall be in accordance with the operational requirements of the system to which they are installed. Where cables run in the proximity of LV cables, they shall have insulation to the same standard.

Where ELV cables are installed in areas of high moisture, extremes of temperature or exposed to direct sunlight, they shall be protected by suitable containment.

All cables shall be installed in accordance with BS 7671.

6202008 Cable installation & support

Cable support intervals

All distribution and final circuit cabling shall be supported on a cable support system complying with the manufacturers recommendations. Where no recommendations are available, support at the following maximum intervals (dimensions in millimetres) may be acceptable as agreed with the CA.

Cables conforming to BS 6346, BS 5467 and BS 6724:

Overall cable diameter not greater than	Non-armoured Vertical	Horizontal	Armoured Vertical	Horizontal
9	400	250	400	250
9 to 15	400	300	450	350
15 to 20	450	350	550	400
20 to 40	550	400	600	450
40 to 60	900	700	900	700
60 upwards	1100	1100	1300	1100

Cables conforming to BS EN 60702:

Overall cable diameter not greater than	Horizontal	Vertical
9	600	800
9 to 15	900	1200
15 to 20	1500	2000

Cable Bending Radii

Cables conforming to BS 6346, BS 5467, BS 6724 and BS EN 60702 shall have the following minimum internal bending radii, unless the manufacturer specifies some greater radius.

Insulation	Finish	Overall Diameter	Multiplying Factor for Minimum Bending Radii
Rubber, PVC or XLPE circular or circular stranded copper or aluminium conductors	Non armoured	up to 10 10 to 25 25 and above	3 4 6
	Armoured	all	6
PVC or XLPE solid aluminium or shaped copper conductors lifts 2000V	Armoured or non-armoured	all	8
XLPE insulated above 2000V	Armoured	all	12
Mineral	Copper with or without PVC or LSOH sheath	all	6

6202009 Cable glands

All cable glands and terminations shall maintain the IP rating and integrity of the enclosure they terminate into. Unless otherwise specified elsewhere, mechanical cable glands shall be brass to BS 6121. Where proprietary forms of gland made of nylon or similar plastics material are available, they may be used with unarmoured cables.

Indoor glands shall be BS 6121 type CW and outdoor glands type E1W minimum. All glands shall be fitted with close fitting shrouds of the same colour as the cable sheath.

All cables shall be identified at each gland and termination as specified elsewhere.

6202010 Cable jointing and terminations

All joints and terminations shall be made by qualified cable jointers, using jointing materials, components and workmanship recommended by the cable manufacturer and jointing accessory manufacturer. The manufacturers, instructions shall be followed at all times.

Cable ends shall be cut immediately prior to jointing or terminating. Cables left unconnected for more than 24 hours shall be sealed to permanently prevent the ingress of moisture. All XLPE and LSF sheathed cables shall be sealed using proprietary shrink on end caps.

All necessary precautions shall be taken to ensure that strands are not damaged when stripping cable cores. Strands shall be twisted together and mechanically secured at terminations. Under no circumstances shall the number of strands be reduced at any termination.

Prior to jointing or terminating, the armour of all armoured cables shall be cleaned.

Where connections are made to equipment and switchgear without integral cable clamping terminals, insulated compression lugs shall be used for bolted terminal connections.

For core sizes 10mm2 and above, all compression connections to components shall be made using tools that cannot be released unless the correct degree of compression has been achieved.

Core terminations shall be securely bolted via lugs to equipment using washers and proprietary shake-proof devices.

The bunching of more than two cores at clamping terminals or bolted connections shall not be permitted.

All cables shall be marked at each end at both sides of penetrations or transits and at any joints to provide adequate identification.

At all joints and terminations all cores, including multi-core spare cores shall be connected. Any unused core of multi-core cables shall be bonded at both ends to earth.

All compression joints for copper conductors shall comply with relevant standards.

6202011 Cable installation

Cables shall be run neatly on the surface by means of cleats or on cable ladder rack or tray, or laid in floor trenches or drawn into ducts or buried in the ground, as indicated by the CA.

Cable routes shall be agreed with the CA prior to commencement of work.

Cables shall be run at least 150mm clear of plumbing and mechanical services and below heating and hot water pipework.

Cables passing through structural floors or walls shall have galvanised sleeves, wrapped with a non-combustible tape and grouted in position.

Cables and cable containment systems installed in escape routes shall be in accordance with BS7671 Regulation 422.2.1, 422.2.2 and 422.2.3

Cables shall be installed in accordance with good installation practice.

Cables shall not be installed or removed from the drum unless the ambient temperature and the temperature of the cable are above 0°C and have been so for the previous 24 hours. Where cables have been subjected to temperatures below 0°C, care shall be taken to ensure that they are above that temperature before they are removed from the drum.

Take all necessary precautions to prevent damage to cables during installation.

Where cables are installed in situations where works by others are incomplete, take all reasonable precautions to protect the cables against damage arising from the execution of such other works.

In the event of damage to the sheath or armouring of a cable, the cable shall be replaced throughout its entire length.

All cables shall run directly from point to point without joints.

Where a cable changes direction, whether in a horizontal or a vertical plane, the radius of the bend in the cable shall not be less then the minimum laid down in BS 7671 and/or the relevant British Standard and shall comply with the manufacturers guidance, however the bending radius of cables during installation shall be kept as large as possible.

Three-phase groups of single-core cables carrying alternating current shall be laid, in trefoil formation and touching each other. Where this is not possible, the disposition to be adopted shall be agreed with the CA before installation is commenced.

All cables shall be pulled into position in such a manner as to avoid any damage whatsoever to the cable or its sheath. Cables shall wherever possible, be pulled directly from the top of the

drum, which shall be supported throughout the operation in such a manner that it is completely free to rotate.

Where circumstances make removal of the cable from the drum before pulling into position unavoidable, the cable shall be laid out neatly on a smooth clean area of ground completely free of debris or anything likely to cause damage to the cable. In such cases, 'figure-eights' shall be avoided wherever possible, and care shall be taken to avoid subjecting the cable to twisting.

An adequate number of cable rollers, each of which shall be undamaged and completely free to rotate, shall be used to support the cable during pulling, in such a manner that no part of the cable can touch the ground, the trench bottom or sides, or the walls of buildings. Cables shall not be dragged over concrete or other surfaces.

The number and positioning of rollers at bends in the route shall be such as to ensure that the minimum bending radius for the cable is not approached.

Cables shall, wherever possible, be pulled into position by hand, using an adequate number of operatives suitably positioned along the length of the cable.

Winches whether power driven or hand operated, and other mechanical aids shall only be used with the prior authorisation of the CA.

Wherever possible, cables which are intended to be winched into position shall be fitted by the manufacturer with a suitable pulling eye, firmly attached to all of the conductors, before being dispatched to site.

Whenever a winch or similar appliance is used, an approved tension gauge shall be fitted into the haulage line between the winch and the cable. The pulling tension must at all times be within the limit advised by the cable manufacturer, which shall be communicated in writing to the CA before the operation is commenced.

Cable stockings, when used, shall be of an approved pattern and the correct size, with swivel eye, in perfect condition, and shall be fitted with care to avoid damage to the cable sheath.

When a cable stocking has been used on a XLPE or LSF sheathed cable and the sheath, after removal of the stocking, shows signs of having been stretched, the cable shall be left for 30 minutes to recover. At the end of this period, if the sheath has not completely returned to its original position, the cable end shall be cut back by an amount equal to the length of the stocking plus 300mm, then immediately resealed.

During the course of pulling operations, the cable shall not be allowed, under any circumstances, to twist or rotate about its longitudinal axis because of excessive pulling tension or for any other reason.

Whenever the length and arrangement of a cable run is such that excessive tension would be likely to be needed to nose-pull the cable into position, the continuous bond method shall be employed. A wire pulling bond equal in length to twice the cable length, to which the cable shall be securely attached at intervals not greater than 1.8 metres. Snatch blocks shall be used at bends in the run to ensure that the pulling tension is taken by the bond and not by the cable.

Whenever a cable is cut, for whatever reason, the cut ends of both portions shall be immediately re-sealed. LSF and XLPE cables shall be sealed by means of an approved plastic cap embracing the armour wires and outer sheath.

All cable drums shall be handled with care to ensure that they are not damaged. All handling shall be carried out using sufficient and adequate plant and equipment.
All empty cable drums shall be stacked neatly in such a manner as not to obstruct access to, or about, the site or the operations of other trades.

Empty cable drums shall be removed promptly from the site and, in any case, not more than seven days after the cable has been removed from them. At no time shall more than three empty drums be stored on the site unless the CA has agreed otherwise.

Any cable joints shall be enclosed in a permanent joint chamber with removable cover in accordance with the requirements for draw-in pits.

Any work carried out requiring the use of split ducts shall be carried out in such a manner as to permit future cable withdrawal.

In rising ducts open to access, all non-armoured cables shall be protected against mechanical damage by the installation of a 300mm high mild steel 'kick-shield' suitably fixed at floor level. The 'kick-shield' to be of a suitable robust nature and treated against corrosion.

6202012 Inspection and testing

After installation and connection, all cables shall be inspected and tested for continuity and insulation resistance in accordance with the requirements of BS 7671. All results shall be recorded by the installer and approved by the CA.

6202013 Identification of cables

Except in the case where it is terminated in full view on to a clearly labeled switch, starter, distribution board or similar piece of apparatus, or on to a motor or other item of equipment the function of which is evident, each and every cable end shall be provided with an approved means of identification. In particular, this requirement shall apply to all cables terminating on the back, or in the base, of a cubicle type or similar switchboard or control panel and in any case where the function of the cable is not immediately obvious.

The means of identification shall be one or other of the following, or an approved alternative:

An engraved plastic label securely fixed to the cable sealing box (the cable sealing box must not be drilled or damaged however).

An engraved trafolyte label fixed to the cable with plastic cable ties.

A proprietary cable identification method with numbered/lettered ferrules on a label fixed to the cable.

Self-adhesive embossed plastic labels will not be accepted as permanent.

The cores of all control cables shall be individually identified at terminations, by means of approved plastic ferrules bearing indelible characters, in accordance with the numbering on the relevant wiring diagrams.

All cables run above ground shall be identified by means of engraved or stamped plastic label at intervals not exceeding 30 metres. The labels shall bear details of the cable size, number of cores, function, and reference number (if any) and shall be securely attached to the cables with cable ties

All cables run underground shall be identified at joint positions, in draw pits, and elsewhere at intervals not exceeding 30 metres. The labels shall bear details of the cable size, number of cores, function, and reference number (if any) and shall be securely attached to the cables with cable ties

All identification numbering shall be agreed with the CA before use and shall be clearly recorded on the 'as built' drawings and in the cable schedules.

6200000 ELECTRICAL SERVICES WORKMANSHIP AND STANDARDS

6203000 Low voltage modular wiring systems

6203001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Modular wiring systems shall meet the requirements of BS 7671, BS 8488 and BS EN 61535 both in their design, construction, function and installation.

Where the contractor proposes to use a modular wiring system, samples of all component types and cables shall be made available for the CA's inspection prior to procurement.

LV modular wiring systems shall be any system designed to operate at a nominal supply voltages of 230/400V.

Systems shall be fully designed, manufactured and tested in the suppliers factory so that the no re terminating of system cables or components is required on site.

Where components of the system are found to be incorrectly designed or manufactured, they shall be replaced by new fully constructed and tested items.

Where components or cables are damaged on site, they shall be replaced and not repaired.

Cables shall be properly sized before manufacture so that no cable within the system has more than 1 metre of spare length.

Cables emanating from the main distribution hubs to final accessories or luminaires shall be no more than 3 metres in length.

Cables installed in ceiling voids shall be supported in accordance with BS 7671. Cables laid on the back of ceilings or supported at each end shall not be accepted.

Where cables associated with modular wiring systems are installed in walls or partitions, they shall comply fully with BS 7671 Regulation 522.6.6 and 522.6.8

Where modular wiring systems are used to provided electrical services to escape corridors, their installation shall comply fully with BS 7671 Regulation 422.

Modular wiring systems shall be designed, manufactured and installed to allow for and to monitor harmonic content in the neutral conductors where that harmonic content can reasonably be expected.

All cables used in modular wiring systems shall be BASEC approved.

6203002 Referred documents

The works shall comply with the referred documents and standards. A full listing of referred documents is stated elsewhere in this specification. Where a standard comprises several parts all parts shall apply unless otherwise stated.

6204000 Testing and certification – general

6204001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

The electrical installation shall be inspected and tested as required by BS 7671 and shall then be fully commissioned and left working.

Provide all labour (including specialist), special instruments, materials, fuel, lubricants, coolants, tools, plant and equipment required to carry out the pre-commissioning, commissioning and the performance testing of all elements.

The CA may request tests, at the installers or suppliers premises, of all or any of the materials and equipment used in the Contract Works in any manner he may deem necessary to ensure conformity with the specification. The results of such tests shall in no way relieve the Installer of his responsibilities to ensure that all materials and equipment installed in the works are entirely suitable for the applications and conditions of operations.

The testing of elements under the various sections of the specification may be required to be carried out in parts, or as a whole.

All tests shall be carried out to the complete satisfaction of the CA.

All instruments shall be calibrated immediately prior to commencement of the testing and shall be re-calibrated in accordance with the manufacturer's recommendation during the course of testing, as necessary. Copies of the calibration certificates shall be provided with the test results.

Test instruments used to measure the external impedance (Ze) of the installation shall be capable of reading as low as 0.001 ohms.

The installer shall demonstrate the installation or any portion thereof, which has been set to work, complies with the requirements of the specification.

Any defects of workmanship, materials, performance, maladjustment, non-compliance with the specification, or other irregularities which become apparent during the tests shall be rectified by the installer, at no additional cost to the contract and the tests repeated at the installers expense until the whole is proved free from defects and in complete working order. All systems shall be left sound and correct.

Publish a programme of the proposed inspections and testing works and detail requirements for the CA to witness such inspections and tests at least fourteen days prior to the beginning of such works.

The Installer shall provide to the CA, full settings, data and works of all equipment and systems at least fourteen days before beginning such works. The CA shall have the right to comment on such proposals.

6204002 Approval and acceptance

After receipt of the results of satisfactory tests, the CA shall authorise the Installer to proceed with the commissioning and system performance tests.

The Installer shall give the CA fourteen days written notice to his intention to demonstrate and seek 'approval' for any item or system.

The Installer shall allow for giving such notice and making adjustments, setting up and other preparations for testing and for witnessing such tests.

6204003 Protective device certification

All protective devices except fuses shall be tested to ensure operation within their design parameters and compliance certificates issued accordingly. This test may be carried out off site at the discretion of the CA for devices over 63A provided that each individual protective device can be clearly identified with its certified performance data.

6204004 Personnel

Carry out testing work using experienced electrical operatives who are fully trained in the use of the equipment and the requirements of the test. The CA may request evidence of competence for those carrying out testing.

Testing and commissioning of major items of proprietary plant shall be carried out by manufacturer's personnel. The Installer shall be responsible for arranging their programme of works to allow the CA to witness tests as required.

The CA shall ensure that all testing work carried out by such specialist manufacturers is carried out to his, and the CA's satisfaction and in such a way that it does not prevent him proceeding with the overall commissioning of the installation.

6204005 Inspection, test and electrical installation certificates

Inspection and test certificates shall be dated, numbered and clearly referenced to the item tested by means of serial, chassis or other manufacturer's reference number permanently marked in a conspicuous position on the item concerned.

The Installer shall issue an electrical installation certificate as required in BS 7671 at the practical completion of the works.

6204006 Works tests

The CA shall have the power to inspect at the makers' works, during manufacture and after completion, all or any manufactured material, apparatus or equipment ordered by the installer for incorporation in the Works and to require tests to be carried out in the presence of his representative in order to prove that the said material, apparatus or equipment meets the requirements of this Specification. All costs incurred in carrying out such tests and inspections shall be included in the contract and shall be borne in full by the installer.

The installer shall be responsible for ensuring that the CA is advised in writing whenever material, apparatus or equipment is ready for inspection and/or test at his own or his suppliers' premises. At least five days notice shall be given and due allowance shall be made for this period of notice in drawing up the programme of works.

The CA shall have the right to reject any material, apparatus or equipment which, as the result of inspections and/or tests may be found to be defective or unsatisfactory in any respect, or not in accordance with the requirements of the specification, and to require the installer to repair, adjust, modify or replace the defective items before dispatch to site. If the defective item be adjudged by the CA to be unsuitable for repair, adjustment or modification, then it shall be replaced by a completely new item at the expense of the installer.

No inspection or testing by the CA or his authorised representative nor the witnessing of satisfactory tests nor the authorising of dispatch to site shall in any way relieve the installer of any of his obligations under the contract, nor shall it in any way limit the right of the CA to reject such items after delivery to site if they subsequently prove to be defective or unsatisfactory or unsuitable for their intended purpose.

The installer shall be responsible for ensuring that all materials, apparatus and equipment required for the execution of the works are ordered sufficiently early to ensure delivery to site at the correct time as required by the construction programme. It shall be the responsibility of the installer to ensure that adequate time is available for inspection and/or testing by the CA, including the giving of required due notice. No materials, apparatus or equipment subject to inspection and/or test will be recognised as complete and ready for dispatch until after such inspections and tests have been satisfactorily carried out and no

claim for delay will be allowed unless the CA has failed to carry out inspection or to waive inspection after being given the specified period of notice.

6204007 Site tests

The CA shall have power to inspect all work in progress and upon completion or substantial completion and to require the installer to carry out tests in his presence or in the presence of his authorised representative in order to prove that all work carried out and all material, apparatus and equipment installed are wholly satisfactory and fully meet the requirements of this Specification. All costs and charges associated with or arising from such inspections and tests, including costs incurred by the installer in carrying out the prescribed tests and in attending upon the CA whilst tests and inspections are in progress shall be deemed to have been included in the contract price and shall be borne in full by the installer.

Upon completion of the electrical installation, or any substantial section thereof, the installation or that section and all of the associated electrical equipment shall be subjected to the tests specified in the relevant British Standards together with such other tests as may be required by the CA in order to prove compliance with this Specification. When no relevant British Standard exists, or the appropriate British Standard fails to specify tests, tests shall be carried out to the requirements of the CA.

The installer shall record all the details, measurements and data as required in the relevant standards. All test results shall be written at the time of test in blue ink and signed by the tester and any witness. Alterations or corrections shall be made by crossing out not by over-writing the previous data. No test results shall be corrected with correction fluids or similar correction media. Where the installer is unable to provide the original test certificates as described above, the tests shall be repeated at the installers cost.

The installer shall provide the original and a copy of the inspection and test sheets, together with any supportive documentation required by the relevant standards, to the CA within two days of the tests being carried out.

The inspection and test documentation shall indicate all of the test instrument details including the manufacturer, type, date of calibration, scale used and the recorded results/tolerances.

The result of each and every inspection and test carried out in accordance with the provisions of this Specification, whether or not witnessed by the CA shall be accurately recorded on an approved form of test certificate signed by the person in charge of the testing procedure. Test results shall be written at the time of test in blue ink and signed by the tester and any witness. Alterations or corrections shall be made by crossing out not by overwriting the previous data. No test results shall be corrected with correction fluids or similar correction media. Where the installer is unable to produce test results as described above the test shall be repeated at the installers cost.

An additional copy of every test certificate relating to site tests of the completed installation or parts thereof shall be included in the operation and maintenance manual.

The installer shall give at least fourteen days notice to the CA when the works or substantial sections thereof, will be completed and ready for inspection and test and before covering such works.

The CA shall have the right to reject any material, apparatus or equipment which, as the result of inspections and/or tests may be found to be defective or unsatisfactory in any respect, or not in accordance with the requirements of the Specification, and to require the installer to repair, adjust, modify, or replace the defective item. If the defective item be adjudged by the CA to be unsuitable for repair, adjustment or modification, then it shall be replaced by a completely new item at the expense of the installer.

No material, apparatus, equipment or installation shall be covered or otherwise permanently concealed from view until the CA has had the opportunity to inspect it and

either has formally waived his right to inspect it or has given written authorisation for covering to proceed following satisfactory tests and/or inspection.

6204008 Commissioning

Following the satisfactory conclusion of final inspections and tests on completed sections of the works, the installer shall duly commission each section of the electrical installation and leave it in full working order. For the purpose of this specification, the term 'commissioning' shall be deemed to include:

- The energising of electrical distribution circuits and equipment that have previously been inspected, tested, and found satisfactory and capable of being energised with complete safety.
- The setting of electrical protective devices and systems, where relevant, in accordance with the directions of the CA or, failing such directions, in accordance with sound engineering practice.
- The starting up of all electrically powered plant and equipment, including that supplied and installed under other contracts, as detailed in the annexed schedules.
- The verification of the performance of all such plant and equipment by the carrying out, where required, of further tests and the making of all necessary adjustments so as to obtain optimum performance.

Mere compliance with the requirements of this section of the Specification shall not by itself in any way relieve the installer of any of his obligations under the contract.

No approval given by the CA in connection with the commissioning process, whether by way of approval of procedures carried out or proposed, or approval of results obtained shall in any way relieve the installer of the contractual and statutory obligation to ensure that all connections and adjustments are made correctly and that the installations and equipment are handed over in a complete safe and satisfactory condition. Where required commissioning shall be carried out by the equipment manufacturer's commissioning engineers.

No connections or adjustments shall be made to plant or equipment that has already been commissioned and set to work, except with the prior consent of the CA.

All commissioning procedures shall be carried out in a safe and satisfactory manner and in accordance with the provisions of the Electricity at Work Regulations, the Health and Safety at Work Act, and the Electricity Safety, Quality and Continuity Regulations (where appropriate), to the complete satisfaction of the CA.

The CA shall have power to require that the whole of the plant, equipment and installations, or selected parts thereof, be re-inspected and, if necessary, re-test immediately before the end of the contractual maintenance period, and the installer shall be responsible for making all necessary arrangements with the Employer.

All commissioning documentation and certificates shall be included in the operation and maintenance documentation.

6240009 Periodic inspection and testing

Include recommendations within the operating and maintenance manuals that the installation be inspected and tested in accordance with BS 7671 and include a recommended maximum period before re test based on the advice given in BS 7671 guidance notes.

6321000 Switchboards

6321001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

The switch board assembly shall be suitable for connection to the supply system as stated in the design criteria.

6321002 Rated voltage

The rated voltage of all switchgear and distribution boards shall be not less than 500 volts ac between phases.

6321003 Switch board assembly

The assembly shall be designed and constructed to withstand the thermal and mechanical stresses set up by short-circuit conditions from a source fault level as stated elsewhere.

The numbers, sizes and ratings of units incorporated within the switch board shall be as indicated on the drawings and schedules.

The assembly shall be a CE marked, ASTA certified, multi-cubicle, type-tested assembly (TTA) to BS EN 61439-1 with Form 4 segregation in accordance with BEAMA Installation recommendations. The type of Form 4 segregation is stated elsewhere. A copy of the specific certification shall be provided to the CA and included in the operational and maintenance manuals.

The assembly shall be manufactured from high grade, machine folded/welded, zinc coated, sheet steel of not less than 2mm thickness and be provided with a 50mm high (minimum), removable rolled mild steel plinth.

The assembly shall have characteristics appropriate to the conditions upon which the design is based. Equipment shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

The assembly shall be capable of supporting the weight of a person walking on the enclosure without damage.

Doors shall be provided with neoprene gaskets and door mounted equipment shall be restricted to instruments, control switches and switch operating handles. Door handles shall have an integral cylinder lock and two keys shall be provided for each lock. Keys shall be fully labelled and handed to the CA at practical completion.

Each section of the assembly shall be divided into compartments on a modular basis, to ensure that future alteration and/or additions of equipment can be accomplished without difficulty (i.e. bolted removable divisions, not welded).

The assembly shall be readily extendible at either end, with pre-drilled busbars and removable busbar chamber end panels. The layout shall be selected to provide the shortest practicable switch board length.

Removable un-drilled gland plates not less than 3 mm thick shall be provided. Gland plates for single core cables shall be non-magnetic.

Connections from the busbars to the live side of functional units shall be shrouded to IP 2X minimum, with warning labels.

Outgoing circuits shall be arranged and separated such that connections can be made and maintenance carried out on any piece of equipment, without disturbance to another.

Removal of any covers for cabling outgoing circuits shall not expose any live parts. An integral secondary barrier shall be provided.

Full segregation shall be maintained between circuits operating at different voltages. All terminals shall have clear covers marked with the operating voltage.

Suitable windows shall be provided at key locations for thermo graphic testing of bus bars. Each window shall be provided with a bolted metal cover.

Heavy duty, galvanised cable tray shall be provided to support cables at the rear of the enclosure.

The assembly shall include air circuit breakers, moulded case circuit breakers, fuse-switch-disconnectors, switch-fuse-disconnectors or disconnectors, as specified elsewhere. Unless otherwise stated, feeders shall be triple-pole with removable bolted link neutral. Cable boxes shall be manufactured to accept the incoming cable arrangement stated elsewhere.

Where a source of generation is to be installed and connected to the installation, the source shall be provided with overcurrent protection on the a.c. side.

Generation systems shall only be connected into the system on the live side of the main switchboard.

Generation systems shall comply with the requirements of BS 7671 and shall constitute any of the following:

- CHP
- CCHP
- Solar voltaic
- Standby generation
- Wind turbines
- Water turbines

All feeder equipment shall be ASTA certified, independent operated, capable of being locked in the OFF position and suitable for uninterrupted duty in the closed position at rated loads.

The contractor shall undertake a full protection study based on the selected equipment to include HV/LV discrimination and all downstream LV discrimination. The study shall be verified and adjustments made if necessary at least 1 week before practical completion.

Each switch board shall be provided with a circuit schedule identifying each individual circuit giving reference, description, rating of protective device and connected load.

The schedule shall be typed on an A4 sheet, framed and securely fixed to the switch board and adjacent wall as appropriate.

6321004 Busbars

The assembly busbar and dropper/riser system shall be housed in a separate earthed metal chamber, with the main busbar located at the top of the switchboard. Busbars and droppers shall be ASTA certified for the fault rating and continuous rating stated.

As a minimum, the neutral busbar shall have the same rating as the phase busbars. However, subject to confirmation from the CA the busbar may be uprated to cater for the potential presence of harmonic currents.

Where specified, the busbar system shall be arranged for the neutral earthing of the supply transformer to be made within the switchboard. Removable links shall be provided for testing purposes.

Busbars shall be manufactured from hard drawn, high conductivity copper.

Busbars shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin as noted above.

Where specified, busbars shall be insulated throughout their length by PVC tape or sleeving with industry standard colours. Tape shall comply with BS EN 60454-3 and sleeving with BS EN 60684.

All busbar joint surfaces shall be tinned or plated and all joints shall be bolted with vibration resistant fixings.

Busbar supports shall be non-hygroscopic, anti-track, and flame retardant. Busbar supports shall be strong enough to withstand, without damage, the forces set up by any thermal expansion and forces created by fault currents.

Means shall be provided to prevent arcs or arc products occurring on one busbar from affecting the other busbars.

Access to busbars and connections shall only be possible by the use of tool and covers shall be fitted with engraved laminated labels with the legend 'BUSBARS' in 10mm (min) black lettering.

6321005 Earthing

A suitably rated copper earth bar in accordance with BS EN 61439-1 shall be provided throughout the length of the switchboard. It shall be pre-drilled to each end for future extension and removable end plates shall be provided.

The earth bar shall be drilled to accommodate all protective conductors and the incoming supply cable earth as well as an external earth bar.

All protective conductors shall be connected to the earth bar by brass nuts and bolts, with flat and spring washers. All connections shall be labelled at their termination point at the earth bar.

A main earth termination point shall be provided inside each incomer compartment.

All equipment and metalwork, including gland plates, shall be connected to the switchboard earth bar. All hinged doors and removable covers shall be bonded by separate flexible earth conductors.

An earth connection shall be made to each gland and/or armour clamp where cables terminate at the assembly.

The earth bar shall be manufactured from HDC Copper.

6321006 Identification of switch boards

Identification and warning labels shall be in accordance with BS 5499:Part 1.

Switch boards shall be permanently identified. Labels shall be of a laminated plastic material attached to the apparatus by screws. Lettering shall be black on white labels and the wording shall be agreed with the CA.

The main control switch or circuit-breaker shall be labelled, 'DISCONNECTOR' and numbered 1, 2, etc., if there are two or more incoming supplies. The characters shall be at least 10mm high and 1.5mm thick.

On all other labels the characters shall be at least 4mm high and 0.5mm thick.

A warning label shall be fixed to the front of the switch board

6321007 Labels and diagrams

All switchgear/ fusegear/ disconnectors and distribution units, etc., shall be clearly marked with engraved laminated plastic labels, secured by screws to the cases, clearly indicating the service, voltage and phase of the circuit or apparatus controlled.

A diagram showing the details, rating and function of each switch, size and number of cores of all outgoing cables, location, size and rating of all distribution boards fed from that switchboard and the phase of each outgoing circuit shall be provided at each switchboard.

These diagrams shall be mounted in glazed frames or similar of an approved design and the layout and mounting shall be approved by the CA prior to installation.

6322000 Panel boards

6322001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

The panel board assembly shall be suitable for connection to the supply system as stated in the design criteria.

Panel boards for the purposes of this specification are defined as wall mounted MCCB or fuse boards intended to provide re-distribution and circuit protection of distribution cables between switchboards and distribution boards.

In smaller installations, panel boards may be used as switchboards if stated on drawings or in particular elements of this specification.

6322002 Rated voltage

The rated voltage of all switchgear and distribution boards shall be not less than 500 volts ac between phases.

6322003 Panel board assembly

The assembly shall be designed and constructed to withstand the thermal and mechanical stresses set up by short-circuit conditions from a source fault level as stated elsewhere.

The numbers, sizes and ratings of units incorporated within the panel board shall be as indicated on the drawings and schedules.

The assembly shall be a CE marked, ASTA certified, multi-cubicle, type-tested assembly (TTA) to BS EN 61439-1 with Form 4 segregation in accordance with BEAMA Installation recommendations. The type of Form 4 segregation is stated elsewhere. A copy of the specific certification shall be provided to the CA and included in the operational and maintenance manuals.

The assembly shall be manufactured from high grade, machine folded/welded, zinc coated, sheet steel of not less than 1.5mm thickness.

The assembly shall have characteristics appropriate to the conditions upon which the design is based. Equipment shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

Doors shall be provided with neoprene gaskets. Door handles shall have an integral cylinder lock and two keys shall be provided for each lock. Keys shall be fully labelled and handed to the CA at practical completion.

Removable un-drilled gland plates not less than 2 mm thick shall be provided. Gland plates for single core cables shall be non-magnetic.

Connections from the busbars to the live side of functional units shall be shrouded to IP 2X minimum, with warning labels.

Outgoing circuits shall be arranged and separated such that connections can be made and maintenance carried out on any piece of equipment, without disturbance to another.

Removal of any covers for cabling outgoing circuits shall not expose any live parts.

Full segregation shall be maintained between circuits operating at different voltages. All terminals shall have clear covers marked with the operating voltage.

The assembly shall include moulded case circuit breakers, fuse-switch-disconnectors, switch-fuse-disconnectors or disconnectors, as specified elsewhere. Unless otherwise stated, feeders shall be triple-pole and neutral. Cable boxes shall be manufactured to accept the incoming cable arrangement stated elsewhere.

Where a source of generation is to be installed and connected to the installation, the source shall be provided with overcurrent protection on the a.c. side.

Generation systems shall only be connected into the system on the live side of the main switchboard and not panel boards.

All feeder equipment shall be ASTA certified, independently operated, capable of being locked in the OFF position and suitable for uninterrupted duty in the closed position at rated loads.

The contractor shall undertake a full protection study based on the selected equipment to include HV/LV discrimination and all downstream LV discrimination. The study shall be verified and adjustments made if necessary at least 1 week before practical completion.

Each panel board or panel shall be provided with a circuit schedule identifying each individual circuit giving reference, description, rating of protective device and connected load.

The schedule shall be typed on an A4 sheet, framed and securely fixed to the panel board or wall as appropriate.

632204 Busbars

As a minimum, the neutral busbar shall have the same rating as the phase busbars. However, subject to confirmation from the CA the busbar may be uprated to cater for the potential presence of harmonic currents.

Busbars shall be manufactured from hard drawn, high conductivity copper.

Busbars shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin as noted above.

Busbar supports shall be non-hygroscopic, anti-track, and flame retardant. Busbar supports shall be strong enough to withstand, without damage, the forces set up by any thermal expansion and forces created by fault currents.

Means shall be provided to prevent arcs or arc products occurring on one busbar from affecting the other busbars.

Access to busbars and connections shall only be possible by the use of tools.

6322005 Earthing

The earth bar shall be drilled to accommodate all protective conductors and the incoming supply cable earth as well as a connection to an external earth bar.

All protective conductors shall be connected to the earth bar by brass nuts and bolts, with flat and spring washers. All connections shall be labelled at their termination point at the earth bar.

A main earth termination point shall be provided inside each compartment.

All equipment and metalwork, including gland plates, shall be connected to the panel board earth bar. All hinged doors and removable covers shall be bonded by separate flexible earth conductors.

An earth connection shall be made to each gland and/or armour clamp where cables terminate at the assembly.

The earth bar shall be manufactured from HDC Copper.

6322006 Identification of switch panels

Identification and warning labels shall be in accordance with BS 5499:Part 1.

Switch panels shall be permanently identified. Labels shall be of a laminated plastic material attached to the apparatus by screws. Lettering shall be black on white labels and the wording shall be agreed with the CA.

The main control switch or circuit-breaker shall be labelled, 'DISCONNECTOR' and numbered 1, 2, etc., if there are two or more incoming supplies. The characters shall be at least 10mm high and 1.5mm thick.

On all other labels the characters shall be at least 4mm high and 0.5mm thick.

A warning label shall be fixed to the front of the switch panel.

6322007 Labels and diagrams

All switchgear/ fusegear/ disconnectors and distribution units, etc., shall be clearly marked with engraved laminated plastic labels, secured by screws to the cases, clearly indicating the service, voltage and phase of the circuit or apparatus controlled.

A diagram showing the details, rating and function of each switch, size and number of cores of all outgoing cables, location, size and rating of all distribution boards fed from that panel board and the phase of each outgoing circuit shall be provided at each panel board.

These diagrams shall be mounted in glazed frames or similar of an approved design and the layout and mounting shall be approved by the CA prior to installation.

6323000 Distribution boards

6323001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

All distribution boards shall be type-tested and comply with BS EN 61439-1 and BS EN 60439-3. They shall be suitable for surface mounting, have lockable doors (supplied with two keys) and be controlled by an on-load integral disconnector. Keys shall be labelled and handed to the CA at practical completion.

All distribution boards shall be fitted with miniature circuit breakers as specified elsewhere. Where spare ways are provided they shall be fitted with blanking pieces.

All neutral and earth connections shall be made to bars within the distribution board, each connection having an individual terminal. The neutral shall have a removable link to facilitate testing.

The earth bar shall have the capacity to connect to an external earth bar.

Where specified elsewhere a separate isolated secondary earth bar shall be provided within the enclosure. This earth bar shall be of similar size to the protective earth bar but shall be insulated from the remainder of the assembly.

The connections to the neutral and earth bars shall be made to correspond with the order of the phase connections.

All conductors terminating at distribution boards shall be appropriately marked with cable ring markers indicating the circuit number and where appropriate phase connection.

All covers, doors and access plates into the distribution boards shall be gasketed to achieve a minimum protection as follows: -

- Internally IP32
- Externally IP65

Access for cabling shall be from the front only. Shrouding to IP2X shall be fitted to prevent accidental contact with live parts. Warning labels shall be provided.

Each distribution board shall be provided with a circuit schedule identifying each individual circuit giving reference, description, rating of protective device and connected load.

The schedule shall be typed on an A4 sheet, laminated and securely fixed to the inside face of the distribution board door.

An engraved designation label shall be fitted to the front of the board.

6323002 Identification of distribution boards

Identification and warning labels shall be in accordance with BS 5499:Part 1.

Distribution boards shall be permanently identified. Labels shall be of a laminated plastic material attached to the apparatus by screws. Lettering shall be black on white labels and the wording shall be agreed with the CA. The characters shall be at least 10mm high and 1.5mm thick.

On all other labels the characters shall be at least 4mm high and 0.5mm thick.

A warning label shall be fixed to the front of the switch board

6324000 Consumer units

6324001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Consumer units shall only be used in domestic installations.

All consumer units shall comply with BS EN 61439 and BS EN 60439 They shall be suitable for surface or flush mounting and be supplied in either insulated or metal enclosures as indicated on the drawings or in particular information.

All consumer units shall be fitted with miniature circuit breakers as specified elsewhere. Where spare ways are provided they shall be fitted with blanking pieces.

All neutral and earth connections shall be made to bars within the consumer unit, each connection having an individual terminal. The neutral shall have a removable link to facilitate testing.

The connections to the neutral and earth bars shall be made to correspond with the order of the phase connections.

All conductors terminating at distribution boards shall be appropriately marked with cable ring markers indicating the circuit number and where appropriate phase connection.

Consumer units shall be supplied without any openings in their enclosure. Semi punched circular knock outs are acceptable in metal consumer unit enclosures provided all are intact unless removed to allow cable entry. All knock outs shall be fitted with grommets where cables pass through.

Insulated consumer units shall be provided with the facility to remove pre formed cut outs designed to accommodate cable entry. These shall only be removed to accommodate cables.

Any consumer unit enclosure which has knock outs or cut outs removed and not used for cable transit shall be replaced.

Consumer units shall have a main terminal rating of 25mm^2 CSA.

Main switch disconnectors shall be a minimum 100A rated.

Split load consumer units shall incorporate a 63A or 80A 30mA RCD for earth fault protection unless indicated differently in particular information.

Overload and short circuit protection shall be via individual MCB’s on each of the outgoing circuits.

Access for cabling shall be from the front only. Shrouding to IP2X shall be fitted to prevent accidental contact with live parts. Warning labels shall be provided.

Each consumer unit shall be provided with a circuit schedule identifying each individual circuit giving reference, description, rating of protective device and connected load.

Each consumer unit shall be fitted with a label giving emergency contact details for the installing company.

6325000 Enclosures

6325001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Enclosures shall mean any protective cabinet or cover installed to prevent access to live parts or equipment as specific to a project.

Unless stated otherwise the enclosure protection shall be at least:

- Internally IP32
- Externally IP65

Ferrous parts of indoor enclosures shall be adequately rust protected and shall be finished with an electrostatically applied, powder coated finish.

Outdoor enclosures shall be provided with a hot-dip galvanised coating complying with BS EN ISO 1460 or a sheradized coating complying with BS 4921. A decorative finish is not necessarily required unless identified in particular requirements.

Provision shall be made for locking or padlocking of enclosure covers as necessary.

Fixing holes in indoor type enclosures of apparatus may be inside or outside the enclosure. Outdoor type enclosures shall have external fixing lugs.

6326000 Switched fuses and fused switches

6326001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Switched fuses and fused switches shall be rated for fault make, load break, BS EN 60947-3 utilisation category AC22 for distribution feeders and AC23 for motor feeders.

Switched fuses and fused switches shall be fitted with suitably rated BS 88 HRC fuse links.

Disconnectors, switched fuses and fused switches shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

Each feeder device shall be in a separate compartment with a hinged door interlocked with the disconnector, so that the door cannot be opened when the device is closed or locked open.

Positive drive ON/OFF indicators shall be provided.

The following mechanical interlocks shall be provided on all compartments or enclosures equipped with a disconnector: -

It shall not be possible to open the door with the disconnector in the ‘ON’ position.

It shall not be possible to open the door with the disconnector padlocked ‘OFF’.

The door may be opened only when the disconnector is fully opened and the operating handle is in the ‘OFF’ position.

When the door is open, clear, unambiguous indication of the disconnector position shall be given on the fixed parts of the device.

The ON/OFF positions of operating handles shall be identical for all types of disconnector on the assembly

All exposed live terminals shall be shrouded to IP2X and provided with warning notices. Opening the device shall not expose any live parts. An integral secondary barrier shall be provided.
Spare space on assembly tiers shall be arranged to allow the simple addition of a feeder device in the future.

In the event that part of an assembly tier is empty, spare 100A fuse-switch-disconnectors shall be fitted to fill the spare space.

All disconnectors, switched fuses and fused switches shall be clearly labelled.

Where individual items of switchgear are to be grouped together, or where it is reasonable to do so, they shall be formed into a composite switchgear panel. Floor mounted units are preferred.

All apparatus (including associated equipment and accessories) shall be fixed independently of the system or wiring. All fixing screws or bolts shall be of steel. Where the apparatus has a protective coating of zinc, or is mounted outside a building, the bolts or screws shall be zinc plated (electro-galvanised) complying with BS EN ISO 2081.

6326002 Ironwork for switch frames

Framework for the mounting of loose switchgear, distribution boards and similar equipment shall be of mild steel plate, section and bar or hot rolled hollow sections complying with BS EN 10210-2, or slotted angles complying with BS 4345.

Black hexagon bolts, screws and nuts complying with BS 3643 may be used.

Framework mounted within a building shall be wired-brushed or shot-blasted, cleaned and given a brushed coat of zinc chromate primer and two coats of finish to match the switchgear. Manufacturers' standard finishes will be accepted for slotted angles, but all metal exposed by cutting shall be prepared and finished to match the paint finish applied by the manufacturer.

Framework mounted outside a building shall be of galvanised mild steel plate, section and bar or hollow section, or galvanised slotted angles complying with BS 4345. Bolts, nuts and screws shall be galvanised or zinc plated (electro-galvanised). Untreated areas of metal, e.g. cut ends, holes and areas damaged by welding, shall be given a coat of zinc rich paint.

6326003 Identification of switched fuses and fused switches

Identification and warning labels shall be in accordance with BS 5499 Part 1.

Switched fuses and fused switches shall be permanently identified. Labels shall be at least 4mm high and 0.5mm thick.

6327000 Circuit breakers and RCD's

6327001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

6327002 Air circuit breakers (ACB)

ACB's shall be ASTA certified and in accordance with BS EN 60947-2. ACB's shall be horizontal, draw-out type, with stored-energy, independent, quick make and break, trip-free operation, with anti-pump. ACB operating mechanisms shall be manual or motor loaded with manual loading facilities, spring stored energy type, as specified in the particular requirements of this specification. Trip circuits shall operate at voltages recommended by the manufacturer.

ACB's shall be full load rated for continuous use under normal operating conditions. They shall be capable of operating at their maximum setting 24 hours a day continuously.

ACB's shall be either triple-pole and neutral or four-pole, as specified elsewhere in this specification or on drawings.

ACB's shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

ACB's shall have service, test and isolated positions and be capable of being locked in the OFF position. In the isolated position, all circuits shall be isolated. In the test position, only the control circuit shall be made.

Automatic, lockable safety shutters shall be provided to prevent access to live terminals in the disconnected or test positions. Interphase barriers shall be provided to prevent arc propagation. Interlocks shall be provided to ensure that the circuit breaker is open during connection and disconnection.

A test block shall be provided at the unit front to allow secondary injection testing of all relays and tripping circuits without the disconnection of any wiring.

ACB's shall be complete with auxiliary contacts and terminals for the required controls and indications, together with all appropriate transformers and fuses.

Air Circuit breakers shall have mechanically operated 'ON/OFF' and 'CHARGE/DISCHARGED' indication.

ACB's of the same rating shall be interchangeable. ACB's of a different rating, but of the same frame size shall not be interchangeable.

Where alternate or dual supplies are present, ACB's shall incorporate Castell interlocks as necessary. This shall also include any ACB's used as a means of coupling busbars.

Protective relays shall be provided for each incoming ACB. Overcurrent protection shall be inverse definite minimum time (IDMT) relays. Restricted earth fault protection shall be by high-stability circulating current relays and Class X current transformers, of suitable characteristics. The installer shall allow for the full setting up and testing to the satisfaction of the CA of all protective relays

Where the associated power transformer is cast resin or silicone insulated type the ACB shall trip on high winding temperature.

Each ACB shall be provided with an operating handle for racking the ACB in and out for isolation, etc.

All ACB's shall be clearly labeled.

6327003 Moulded case circuit-breakers (MCCB)

All MCCB's shall be to BS EN 60947-2 and of the current limiting type.

MCCB's shall be of the quick-make and break, independent, trip-free type with mechanical ON/OFF/TRIPPED indication

MCCB's shall be full load rated for continuous use under normal operating conditions. They shall be capable of operating at their maximum setting 24 hours a day continuously.

For switchboard mounting MCCB's shall be the cubicle mounting type with door mounted padlocked rotary type operating handle. They shall be of the fixed pattern with fully shrouded fixed contacts. Interlocks shall be provided to prevent the opening of the front cover with the operating handle in the 'ON' position.

MCCB's shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

The operating mechanism shall operate all poles simultaneously during opening, closing and tripping operations.

Each pole of the MCCB shall be provided with thermal element for inverse time delay protection and magnetic element for short-circuit protection. The thermal release shall be adjustable and fitted with a lock-off facility.

Ensure that demonstrable discrimination is achieved between the up and down stream devices. Selection of MCCB's on the cascade principle will not be accepted.

MCCB's shall be of a type suitable for the fitting of motorised operators or shut trip devices.

All MCCB's shall be clearly labeled.

6327004 Miniature circuit breakers (MCB)

Minature circuit-breakers (MCB) shall comply with BS EN 60898-1, and have a minimum rated short circuit capacity (Icn) of 10kA unless otherwise specified.

MCB's shall be full load rated for continuous use under normal operating conditions. They shall be capable of operating at their maximum setting 24 hours a day continuously.

MCB's shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

Three-phase MCB's shall trip all phases on any fault condition.

Provision shall be made to enable the operating mechanism to be padlocked in the 'OFF' position.

6327005 Residual current devices and residual current breakers with overload protection (RCD and RCBO)

Residual current devices (RCD) shall comply with BS EN 61008 (RCD) or BS EN 61009 (RCBO).

RCD's and RCBO's shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

The units shall be double or triple-pole as required and mounted enclosed within the distribution board panels or purpose made enclosure.

RCD's (ie: devices with no overload or short circuit protection) shall only be used where appropriate overload and short circuit protection is provided by other means and then only with the agreement of the CA. The contractor shall not rely on overload or short circuit protection provided by others to justify the use of RCD's

The RCD/RCBO shall automatically open the protected circuit on an earth leakage fault between phase and earth equal to or greater than the fault current sensitivity rating of the device.

The sensitivity ratings of the RCD/RCBO shall be as indicated on the schematic diagrams and where specified shall be adjustable between the ranges stated. As a minimum the rating for RCD or RCBO's protecting final circuits shall be no more than 30mA, shall operate in less than 40mS and pass a current of no more than 5 times the circuit protection rating.

The operating mechanism shall be independent trip-free and shall not be able to be held closed against an earth fault. The units shall be complete with a test button and trip re-set device.

Devices that require testing more than once per year to remain operational shall not be used.

The RCD/RCBO shall have positive contact indication whereby the opening of the device is clearly indicated by a mechanical indicator. This indicator shall be linked to the device main contacts to show the positive opening of all poles.

6328000 Fuses

6328001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Cartridge fuse-links shall comply with BS EN 60269-1 (BS 88). Cartridge fuse-links shall have a Utilisation Category of gG for general applications, including motor circuits. Category gM fuses shall only be used on motor circuits. Category ‘a’ breaking range fuses shall not be used.

Where fuses are used in electrical distribution systems, 2 spare fuses of each size and configuration installed shall be handed to the CA on project completion.

6329000 Contactors

6329001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Contactors shall comply with BS EN 60947-4 and be rated AC3.

Contactors shall be of the multi-pole double-break, fully shrouded, block pattern, with replaceable main and auxiliary contacts. Operation shall be from a separate source. Each contactor shall incorporate auxiliary contacts and the control circuit shall operate at a voltage not exceeding the phase/neutral voltage. Where more than five triple-pole contactors are used, a separate control transformer shall be provided.

Contactors shall be capable of withstanding calculated operational and fault currents as well as calculated power frequency stress voltages and voltages of atmospheric origin, the latter subject to the decision to install surge protection.

Where contactor noise is required to be minimal d.c. operated contactor coils shall be used.

Where contactors are independently mounted, they shall be totally enclosed in a metal case with hinged and/or bolted on covers. Contactors mounted within a cubicle shall be housed within a separate compartment.

All contactor control wiring passing through any adjacent switchgear shall be contained within an internally mounted metal duct/conduit.

6330000 Protection against voltage disturbances

6330001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Appropriate surge protection shall be fitted to protect against the effects of voltage disturbances both from internal and external sources. Where surge protection is not installed, the installation and all connected equipment (including portable appliances) shall comply with the requirements of table 44.3 in BS 7671.

Surge protection devices shall comply with BS EN 61643. Where installed for protection against lightning strike, they shall in addition comply with BS EN 62305-4.

6330002 Voltage disturbances from an external source

Transient over-voltages can be imported into a building through the cables entering it. Transient overvoltage surge protection shall therefore be installed on all cables either entering the building such as power supply cables, telephone and data cables. In addition, transient overvoltage surge protection shall be installed to protect cables leaving the building and supplying power or data connections to satellite installations or electronic equipment mounted outside of the building.

6330003 Voltage disturbances from an internal source

Where required, internal transient overvoltage surge protection shall be installed as indicated on drawings and in particular requirements.

Transient over-voltages can be generated within a building from a number of sources including large inductive loads, inductance and capacitance of long cable runs or lightning strikes directly on the building. Appropriate surge protection shall therefore be installed at switch boards, panel boards or distribution boards throughout the installation as indicated on drawings and in particular information.

6331000 Metering

6331001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

6331002 Utility meters

Provision shall be made to accommodate the requirements of the energy suppliers meters.

6331003 Meter tails

Meter tails shall comply with BS 7211, be no longer than 1 metre (unless specifically agreed with the Distribution Network Operator (DNO)) and be XLPE insulated LSF sheathed of the size and rating noted in the schedules or on the drawings.

6331004 Main switch board or panel board

The main switchboard or panel board shall be equipped with a multifunction digital panel meter displaying the following:

1. Instantaneous single and three phase voltage
2. Peak single and three phase voltage
3. Instantaneous phase current (all phases)
4. Maximum demand phase current (all phases)
5. Power factor
6. Cumulative energy use in kWh
7. Real time energy use in kVA
8. Real time energy use in kW
9. Real time reactive power use in kVAr,
10. Total harmonic distortion expressed as a percentage (THD)
11. Time and date

All the functions, which the meter is capable of displaying, shall be continuously transmitted via either an RS 485 interface or via TCP/IP LAN connection to the BMS. All associated wiring within the switchboard or panel board is to be carried out by the Contractor or the switchboard manufacturer and shall be routed to a terminal rail located within a compartment accessible when the switchboard is live without giving access to live parts other than those associated with the meter installation.

Meters will be supplied as part of the switchboards or panel boards and connected to the BMS by the BMS contractor. All necessary CT'S and voltage terminals to the same will be located in a segregated compartment from the ACB and MCCBs.

Current transformers shall comply with BS. 3938, and shall be a high accuracy specification. All instrumentation shall comply with the current edition of all appropriate British Standard publications
The instrumentation shall be flush mounted within the panel front of the switchboard, located immediately above the switches with which it is associated.

Current and voltage transformers shall be mounted within separate chambers within the switchboard or panel board. Transformers shall conform to BS EN 60044.

All meter shall conform to BS EN 62053 and to DIN 43700 style, minimum size 72mm square.

Ancillary fuses shall be labelled with the functions and operating details including fuse type and rating. All auxiliary wiring shall be labelled by permanent slip on numbered ferrules. Terminal blocks and terminations shall be similarly identified.

Meter board where required shall be 20mm thick resin bonded chip board.

6331005 Energy metering strategy

Energy metering shall be installed on all downstream distribution boards, chiller plant, electric humidifiers, motor control panels and mechanical services panels to comply with the metering strategy and as indicated on drawings. As a minimum, this shall provide the capability to identify energy used by all lighting and a minimum of 90% of the connected electrical load. The metering installation shall comply with the requirements of CIBSE TM39.

6332000 Power factor correction

6332001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Power factor correction equipment shall be suitable for operation from the supply voltage and frequency, including the tolerances specified in the particular requirements of this specification

Power factor correction equipment shall be provided to correct the power factor to the value specified in the particular requirements of this specification.

The complete power factor correction equipment assembly shall comply with all applicable requirements of this specification and shall incorporate adequate provision for connection to the general earth system.

Power factor correction equipment intended to be applied centrally or to specific groups of motors shall comprise a sufficient number of capacitor units to make up the specified capacitance, accommodated in a suitable cabinet or in a series of modular cubicles assembled together to form a composite unit, together with a control relay, switching equipment, protective fuses and means of isolation, all assembled and connected to as to control automatically the switching 'on' and 'off' of the capacitors in response to changes in the load power factor.

Each assembly and all of the equipment within it shall be so arranged that every item of apparatus is readily accessible for adjustment where this may be necessary, and for maintenance.

Each assembly shall be complete with incoming isolating switch of appropriate rating, HRC fuses, a set of insulated copper busbars rated for the total capacitive load, suitably rated contactors for the automatic switching of the capacitors in stages and a suitable control relay of approved design. Connection links shall be provided to permit easy removal or relocation of units and provision shall be made for extension at one or both ends of the busbar system.

Capacitors shall be of an established, proven design and two copies of type test certificates shall be submitted to the CA for comment.

Each capacitor unit shall comprise a balanced three phase system of capacitors.

Each capacitor stage shall be protected by BS EN 60269 fuses and be switched by a separate, block type contactor rated for capacitor switching duty (BS EN 60947 4 1).

Capacitors shall be self-healing type to IEC 60831-1. Capacitors shall consist of elements wound from metallised polypropylene film, vacuum processed and encapsulated in hermetically sealed containers. Each capacitor shall have overpressure operated disconnect fuse elements, in addition to overcurrent protection.

Capacitors shall be provided with discharge resistors to achieve full discharge within 60 sec. of disconnection. Capacitors shall have low loss per kVAr and be rated for a line current not less than 1.3 times the rated current. Means shall be provided to identify a failed capacitor or bank of capacitors. Units of equal capacitance shall be interchangeable

Space shall be left in the power factor correction equipment for the installation of de-tuning reactors should their use prove necessary in the future.

The control relay shall be suitable for operation from the existing current transformer(s) installed for the purpose in the main low-voltage switchboard as required by the P.F.C. manufacturer.

A microprocessor based reactive power controller shall be provided to control switching of the capacitor banks and allow rotation of use of the banks to uniformly distribute usage.

The controller shall ensure:

1. Automatic disconnection of all capacitors in the event of mains failure, with a two minute delay before re-connection
2. Target power factor setting adjustable from 0.8 lag to unity
3. Time delay between switching of stages to ensure capacitors are sufficiently discharged before re-energisation and to prevent hunting
4. Push button operated manual override incorporating time delay as above
5. Adjustable switching programmes
6. Incorporate normally open volt-free contacts for BMS indication of common alarm
7. Visible LED indication of capacitor stages
8. Disconnection on mains failure

Shrouding and large, clearly visible warning labels shall be provided within the enclosure to warn personnel of the need to discharge the equipment prior to any work.

Cable glands or sealing boxes shall be provided for the connection of incoming supply and control cables as specified.

Harmonic filters shall be provided where required to protect against damage from harmonic currents.

6341000 Light switches

6341001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

All low voltage lighting switches shall have interiors of the AC ‘quick-make, slow-break’ pattern, generally rated at 20 amp and manufactured in accordance with BS EN 60669 where relevant.

All switches shall be 1 way, 2 way or intermediate, as required, and in cases where they are grouped together and connected to the same phase, they shall be ganged together and mounted in a multi-gang box with a common switch plate.

All extra low voltage switches where fitted shall only be used as part of a proprietary system of equipment. No mixing of different manufacturer’s equipment will be permitted.

The finish shall be as indicated in the particular requirements of this specification and confirmed prior to order.

For all exterior situations, and in roof plantrooms, watertight switches shall be used comprising AC quick make and break pattern interiors with galvanised exteriors.

Where more than one phase is present at a light switch, the cover plate shall be engraved to indicate that 400V is present.

All switch plates shall be positioned from finished floor level in accordance with the mounting heights stated in the particular requirements of this specification.

6342000 Industrial socket outlets

6342001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Industrial socket-outlets shall comply with BS EN 60309 and unless indicated otherwise in the particular requirements of this specification, shall be switched. They shall be of the three, four or five pin shuttered female type mounted in appropriate boxes. All sockets shall be to a minimum of IP44 unless indicated otherwise in the particular requirements of this specification.

Sockets shall be colour coded to reflect the voltage they operate at.

1. Yellow shall be used where 110V is present
2. Blue shall be used where 230V is present
3. Red shall be used where 400V is present.

Socket outlets for general use or for use by ordinary persons shall be protected by 30mA RCD or combined RCBO devices which operate within the stated requirements of BS 7671.

Socket outlets for specific purposes shall be labelled with their use. Labels shall be clearly visible when a plug top is inserted and shall be durable such that they will not fade through exposure to sunlight or suffer due to abrasive wear. Where adhesive labels are used, the adhesive shall not degrade over time or exposure to sunlight, water or extremes of temperature.

All socket outlets shall be positioned from finished floor level in accordance with the mounting heights stated in the particular requirements of this specification.

6343000 Fused connection units

6343001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Connection units shall comply with BS 5733 and unless otherwise specified shall be double-pole switched and incorporate a BS 1362 fuse. They shall be mounted as required in the appropriate box.

All outlets shall incorporate red pilot lights. The pilot lights shall be recessed into the front plate of the outlets and shall comprise red lens, neon tubes and resistors in completely sealed units.

Connections for use with flexible cord shall have a cord outlet hole in the front or side of the font plate, with suitable flexi-grip enclosing for the cord.

Where the purpose of the connection unit is not clearly associated with the equipment it serves, a suitable label shall be fitted to indicate its function. Labels shall be durable such that they will not fade through exposure to sunlight or suffer due to abrasive wear. Where adhesive labels are used, the adhesive shall not degrade over time or exposure to sunlight, water or extremes of temperature.

The finish shall be as indicated in the particular requirements of this specification and confirmed prior to order.

All fused connection units shall be positioned from finished floor level in accordance with the mounting heights stated in the particular requirements of this specification.

6344000 Double pole switches and isolators

6344001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Double pole switches and isolators of 20A, 32A or 50A capacity (for interior non industrial use) shall comply with BS EN 60669. They shall be mounted as required in the appropriate box.

All double pole switches and isolators shall incorporate red pilot lights. The pilot lights shall be recessed into the front plate of the outlets and shall comprise red lens, neon tubes and resistors in completely sealed units.

Double pole switches and isolators for use with flexible cords shall have a cord outlet hole in the front or side of the front plate, with suitable flexi-grip restraint for the cord.

Where the purpose of the double pole switch or isolator is not clearly associated with the equipment it serves, a suitable label shall be fitted to indicate its function. Labels shall be durable such that they will not fade through exposure to sunlight or suffer due to abrasive wear. Where adhesive labels are used, the adhesive shall not degrade over time or exposure to sunlight, water or extremes of temperature.

The finish shall be as indicated in the particular requirements of this specification and confirmed prior to order.

All double pole switches and isolators shall be positioned from finished floor level in accordance with the mounting heights stated in the particular requirements of this specification.

6347000 13A socket outlets

6347001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

13 amp socket-outlets shall comply with BS 1363 and, unless otherwise specified, shall be switched. They shall be of the three-pin shuttered type mounted in appropriate boxes. The moulding shall possess high track-resisting qualities and conform to BS 1322.

The finish shall be as indicated in the particular requirements of this specification and confirmed prior to order.

Socket outlets for general use or for use by ordinary persons shall be protected by 30mA RCD or combined RCBO devices which operate within the stated requirements of BS 7671.

Socket outlets for specific purposes shall be labeled with their use. Labels shall be clearly visible when a plug top is inserted and shall be durable such that they will not fade through exposure to sunlight or suffer due to abrasive wear. Where adhesive labels are used, the adhesive shall not degrade over time or exposure to sunlight, water or extremes of temperature.

Where high protective conductor currents may exist, dual earth terminal socket outlets shall be installed.

All socket outlets shall be positioned from finished floor level in accordance with the mounting heights stated in the particular requirements of this specification.

6351000 Lighting – General requirements

6351001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Luminaires shall be suitable for their location.

Each type of luminaire other than decorative shall be supplied with a complete set of photometric data. For the purposes of this project, decorative luminaires shall only refer to those providing accent or ambience lighting and shall not form part of the general functional lighting design.

Where luminaires are supplied with prismatic or opal diffusers or controllers, they shall be UV and temperature stabilised to avoid degradation. Polypropylene luminaires or diffusers shall not be used.

Switch start fluorescent luminaires shall not be used.

LED luminaires shall be provided with photometric data in the same format as conventional lamps so that direct comparisons can be made.

6351002 Construction

Luminaires shall be rigidly constructed in corrosion-proof materials and designed not to distort when suspended or installed.

Lamp holders shall be formed of insulated high temperature mouldings rigidly mounted on the luminaire body.

The cable terminations shall be fixed in the lampholder in such a way that the plunger contacts maintain free movement and no strain is placed on the cables.

All luminaires shall be finished pure white internally.

All low voltage tungsten capsule or dichroic lamp luminaires shall be of a construction suitable to dissipate the heat generated by the lamp without causing damage to the supporting ceiling.

Luminaires that are for decorative purpose shall be to an approved finish although the general standard of construction shall be of that already indicated.

All luminaires shall be supplied incorporating full provision for support, located in the appropriate places and allowing full adjustment of mounting, compressing, fusing holes and brackets as most suitable.

The luminaire enclosures shall permit full access to any component for maintenance without unnecessarily disturbing other components and without the removal of the luminaire or adjacent finishes.

Each luminaire shall incorporate provision for circuit cable and conduit entry comprising an entry standardised to BS 4568 and 20mm conduit piercing, made in the centre of the luminaire or control box back, singly for square luminaires, but dual in-line for linear luminaires. Luminaires for mounting on suspended ceiling shall have their entries together on a detachable plate mounting the main terminal block such that each luminaire can be readily detached without disturbing the looping-in circuit wiring system. A plug and socket system shall be used for this purpose.

All high pressure discharge luminaires shall have lamp covers fitted or be supplied with lamps which will not shatter on lamp failure.

All diffusers and prismatic controllers shall be of a material which does not suffer from ultra violet degradation.

Photometric data for all luminaires used in the installation shall be provided.

6351003 Control gear and wiring

All discharge control gear shall be designed for continuous operation.

All control gear shall be rigidly mounted and shall be provided with shrouded terminals. The wiring within the luminaires shall comprise of high temperature PVC insulated stranded copper cables of such diameter that there is negligible volt drop.

A terminal block shall be provided for the incoming supply cables and the metallic content of the luminaire shall be electrically connected to an earthing terminal. Each terminal block shall have an integral fuse.

Discharge and fluorescent lamp ballasts shall be of the high frequency electronic type, suitable for luminaire daylight control and dimming. They shall also be suitable for automatic presence/absence switching without causing a reduction in lamp life. Each ballast shall have individual control connections and shall be enclosed in a resin filled sheet metal canister. Ballasts for tubular low-pressure discharge lamps shall comply with relevant British Standards.

Capacitors shall be of coiled metallised film construction and enclosed within insulant filled sheet metal canisters. They shall be rupture and leak-proof and shall comply with BS EN 61048 and BS EN 61049.

All ballasts shall be high temperature with a rating of 120°C and capacitors shall be rated at100°C.

6351004 Internal wiring

All wiring to the control gear shall be carried out in a minimum of 0.75mm^2, high temperature PVC insulated conductors, with a continuous rating of 105ºC. The wiring shall end in a jack plug type fused terminal block mounted on the gear tray. The lamp holders to be bi-pin push-on type, with lamp clips mounted on the canopy or alternatively end caps supported from the luminaire housing.

Luminaires shall not be through wired unless specifically designed for the purpose.

6351005 Luminaire selection and design

Luminaires shall be selected and set out as detailed on the drawings and as stated elsewhere.

The emitted luminous flux from enclosed light source(s) of each luminaire shall be controlled and redistributed by an efficient optical system which shall effectively direct the light towards the working plane and away from the normal viewing angles, and reduce the subjective luminosity (glare).

6351006 Luminaire noise

All luminaires shall be designed to keep within the noise criteria specified in the relevant British Standard.

6351007 Lamp holders

Lamp holders for use with bayonet cap or Edison screw lamps shall be category T2 to BS EN 61184 and shall be suitable for use with the type of lamp cap specified. Ceiling roses shall comply with BS 67 and shall be complete with halo. BS lamp holders shall be of the type that have isolated contact pins when the lamp is removed.

All lampholders shall be capable of accepting compact fluorescent lamps with either bayonet cap or Edison screw connectors as appropriate.

Lamp holders for use with linear and compact fluorescent lamps shall be bi-pin type complying with BS EN 60400.

Lamp holders for use with low voltage tungsten halogen lamps shall be suitable for the temperatures generated by the associated lamp.

Lamp holders for use with compact fluorescent lamps shall be capable of withstanding the heat generated by the associated lamp on a continuous operation basis without suffering any thermal or ultra violet related damage.

Pendant drops prepared by the installer shall include moulded insulated cord grip, skirted lamp holders. The cable terminals shall be fixed in lamp holder so that the operation of the 'plunger' contacts shall not move the terminals. Lamp holders shall be fitted with skirts that allow compact fluorescent alternatives to be used. All lamp holders and ceiling roses shall be self-finished in white.

All lamp holders incorporated in enclosed luminaires shall have suitable thermally rated construction for continuous operation.

6351008 Lamps

All luminaires shall be complete with the correct number and size of lamp indicated on the layout drawings, and lamps shall be suitable for the nominal voltage applicable. At handover all lamps shall be new.

Tungsten filament lamps shall not be used. Compact fluorescent alternatives are to be used where conventional lamp holders are installed.

Fluorescent lamps shall be to BS EN 60081 and BS 1853: Part 2 and amendments, and of the appropriate colour as specified elsewhere.

Where mixed batches of lamps are used, the contractor shall ensure colour variances do not occur. Where not specified elsewhere, all linear and compact fluorescent lamps shall be colour 4000K

Metal halide lamps shall be of the ceramic filament type to reduce the risk of colour drift common to this type of lamp.

All high-pressure mercury vapour lamps shall comply with BS EN 60188 and shall be suitable for burning in a horizontal and vertical position.

Where circuits supplying high pressure discharge lamps of any kind are protected by MCB, the operating characteristics and rating of the MCB shall be suitable for the load.

All low-pressure sodium lamps shall comply with BS EN 60192

Low voltage tungsten capsule or dichroic lamps shall only be used where no other reasonable alternative is viable.

6351009 Luminaire Efficacy

All luminaires including LED luminaires shall have an efficacy of not less than those quoted in the HM Government Non Domestic Building Services Compliance Guide – Current Edition

6351010 Plug-in ceiling roses (PCR)

All luminaires recessed into suspended ceilings shall be connected by means of a PCR. The PCR shall be mounted on a circular conduit box and shall comprise a three-pin or four-

pin 2 amp socket and plug with a coarse screw moulded plug retaining cover. The PCR shall be located within 500mm of the luminaire and connected via a suitable flexible cord.

Four-pin PCR's shall be utilised for luminaires with integral emergency lighting facilities.

6351011 Flexible cables and cords

All flexible cables and cords shall comply with BS 6500 and BS 6004. Cables shall be 300/500V grade PVC, rubber or LSF insulated and sheathed as appropriate.

The application of the temperature and constructional features of cables shall be to suit the relevant item of electrical equipment and its operational temperature.

Where an earthing conductor is required for the earthing of metalwork in apparatus and luminaire, it shall be contained within the flexible cable or cord.

Flexible cables and cords for use with lighting pendants and electric lighting fittings

Flexible cords for use with lighting pendants employing compact fluorescent lamps shall be heat resisting PVC or Butyl rubber or EP rubber insulated and shall comply with BS 6500 Table 12 or 14.

Flexible cords for use with luminaires employing tubular fluorescent lamps or apparatus operating at normal room temperature shall be PVC insulated and sheathed and shall comply with BS6500 Table 6 or 11.

6351012 Lighting installation

Modular wiring systems shall be permitted provided that compliance with BS7671 (current revision) can be established.

Modular systems shall be wired using cables suitably rated to run in containment with general wiring. Cables are to have LSF outer sheath. Where systems utilise a marshalling box for radial distribution to luminaires, switches and PIRs, the cables between the items shall be supported so as to not lay on the back of ceilings.

Modular systems shall be factory assembled with no terminating of plugs/sockets etc on site. Excessive cable loops will not be accepted. The system cable lengths shall be measured carefully prior to order to ensure cables lengths are not excessive.

For conventional installations, final connection of wiring to luminaires shall commence from the outlet box into which the hard wiring is terminated on suitable thermally rated terminals. Final connection to fluorescent luminaires shall be as specified for flexible cords. The installer shall take all necessary precautions to prevent overheating of cables and components, which shall be suitable for the operating temperatures involved. On no account shall hard PVC wiring be drawn into luminaires. All wiring connections shall be terminal type with suitable thermally rated insulation. Single Screw type connectors must on no account be used.

All discharge and fluorescent luminaires shall be fitted with integral cartridge fuses incorporated in the mains connector block which shall be moulded plastic insulated pattern.

Surface mounted luminaires shall be mounted direct on to flush conduit installations, where a terminal circular conduit box shall be provided. Where surface conduit has been provided the luminaire shall be fixed direct to the ceiling soffit and connected via a side or end entry conduit box.

Suspended luminaires (non-decorative) shall be supported by one of two methods. Either 20mm steel conduit attached to the ceiling outlet box with a ball socket pattern ceiling plate or via a hooked conduit plate and galvanised jack chain. A braided copper link shall be fitted inside the ceiling plate to ensure earth continuity where a ball and socket connection is used.

Recessed luminaires shall be attached directly to the suspended ceiling where permitted. Where the ceilings are plaster, the installer shall install suitable flanged trims to the openings prior to plastering. Recessed luminaires shall be connected via a PCR and flexible cable installed on a conduit outlet box within 500mm of the luminaire. 1m of flex shall be allowed for the luminaire connection to allow some later movement in the ceiling grid.

Where low voltage dichroic (or similar) luminaires are to be provided within timber ceilings, fireproof panels shall be fixed by the installer above the luminaire, whenever the space between the top of the lamp holder and the timber is 200mm or less.

External luminaires and vapour-proof luminaires shall be installed with suitable gaskets on all openings to ensure the integrity of the installation. All fixings and supports in these situations shall be zinc plated, brass, or stainless steel as stated on the drawings or elsewhere.

Reflectors and louvres shall only be installed when all dirty trades work is completed and the contractor shall take care not to get fingerprints, marks, etc on the reflective surface (gloves may be required).

At the time of practical completion, the installer shall clean all luminaires thoroughly to remove dust and fingerprints and ensure all lamps are in working order and of the correct wattage and type specified.

6351013 Maintenance factor

The criteria for maintenance factor is given in section 2004000

6352000 Floodlighting

6352001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Specifically, this section should be read in conjunction with the section on lighting general requirements.

Floodlights shall be constructed in such a way as to ensure they are capable of continuous operation. Where control gear is incorporated within the luminaire body, suitable heat sinks shall be provided which may be incorporated into the luminaire body itself.

Floodlights shall be installed in the orientation approved by the manufacturer. Where it is intended to install floodlights in an inverted position, approval of this proposal shall first be obtained from the equipment manufacturer.

High pressure discharge floodlights used in areas where the loss of illumination during re strike periods in unacceptable, shall be fitted with pilot lamps as indicated on drawings or in the particular requirements of this specification.

6352002 Floodlights with symmetric distribution

Floodlighting with symmetrical distribution reflectors shall not be use externally due to their poor control of the upward light component. Where used internally, symmetric floodlights shall be carefully mounted so as to optimize their output.

Symmetric floodlights shall not be offered or installed as alternatives to asymmetric floodlights.

6352003 Floodlights with asymmetric distribution

Floodlighting with asymmetric distribution shall be used externally. Luminaires shall be carefully positioned to maximize the effect of the asymmetric reflector and to minimize the upward light component.

The contractor shall allow for a separate commissioning exercise by a suitably qualified lighting professional during the hours of darkness to demonstrate the correct positioning.

6357000 Linear fluorescent luminaires

6357001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Specifically, this section should be read in conjunction with the section on lighting general requirements

6357002 Batten luminaires

Batten luminaires shall be fitted with acrylic or polycarbonate prismatic controllers. Bare batten luminaires shall not be used unless specifically stated in the particular requirements of this specification, or on accompanying drawings.

Polypropylene controllers or diffusers shall not be used.

6357003 Surface modular luminaires

Surface modular luminaires shall be of steel construction with a pure white finish unless stated otherwise in particular requirements of this specification or on drawings.

Where fitted with mirror or satin louvres, these shall be fully fitted types which allow no light leakage around the body edges.

6357004 Recessed modular luminaires

Recessed modular luminaires shall be of steel construction and fully boxed with a pure white finish unless stated otherwise in particular requirements of this specification or on drawings.

Luminaires shall be supplied with all mounting accessories and shall only be supported (lay in type) from the ceiling grid if the ceiling is designed for this purpose.

Where fitted with mirror or satin louvres, these shall be fully fitted types which allow no light leakage around the body edges.

6358000 Self-contained emergency lighting

6358001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Specifically, this section should be read in conjunction with the section on lighting general requirements

Emergency lighting installations shall be as shown on the drawings and as detailed in the particular requirements of this specification. The system shall conform to BS 5266-1 and BS EN 1838 (also numbered BS 5266-7).

Luminaires for use on emergency lighting systems shall comply with BS EN 60598-2-22. Self-contained luminaires shall be ICEL approved and suitable for 3-hour operation.

All luminaires shall be purpose made manufacturers equipment, properly tested and certified by the manufacturer. On-site conversion of mains luminaires with emergency battery kits by other manufacturers will not be acceptable.

Emergency lighting shall be provided in all areas necessary, including exits and external escape and assembly areas.

The installation shall comply with BS 7671 Requirements for Electrical Installations.

6358002 Self-contained emergency luminaires

Where mains luminaires are converted to emergency operation using inverter and battery packs, they shall be factory fitted in accordance with ICEL recommendations and the manufacturer's requirements. In particular, attention shall be paid to the location of the batteries with regard to the effects of high temperatures from luminaire control gear, etc, and that charge indicator LED's are clearly visible with the luminaire in position.

If converted luminaires involve the use of remote mounted batteries or inverter packs; these shall preferably be mounted within 500mm of the luminaire within steel enclosures fixed to the soffit or walls, or on a suitable bracket. Cabling between inverter/battery packs and luminaires shall be the same as wiring for central battery systems. Inverter/battery packs shall not be laid unfixed on the back of ceilings. A readily removable access opening shall be provided for local access to battery packs mounted remotely in voids.

Wiring to self-contained luminaires shall be the same standard as the local normal lighting circuits. A local key test switch shall be provided in a convenient location for each emergency lighting circuit.

6858003 Self-contained “self-test” emergency lighting

Where self-test luminaires are specified, the fittings shall employ an indicator system based on LEDs. The LED colours used and sequencing of fault indication shall be common throughout the project so as to avoid confusion during maintenance.

6358004 Centralised and remote monitoring of emergency lighting

Centralised, remote and TCP/IP based monitoring systems where installed shall be compatible with, and capable of monitoring self-contained luminaires. They shall be manufactured and installed to comply with the requirements of BS5266 and BS EN 62034.

The system shall be capable of monitoring fittings up to 1km away from the control panel or access point. Systems shall be modular to allow for the expansion of the system in future and shall be capable of monitoring at least 10,000 luminaires with information recorded per luminaire.

The system shall be capable of running automatic testing procedures in accordance with current legislation.

Failure of any individual device within the system will not cause failure of any other part of the system to operate.

Systems shall be capable of raising alarm both audibly, visually and remotely for system faults, lamp fail, lamp removal, test fail and test fail to start.

6358005 6.6 Commissioning

The whole system shall be tested by a person deemed competent by the installer and by the enforcing authority or the CA.

A test certificate in accordance with BS 5266 Part 1 Appendix A, shall be issued to the CA for including in the operating and maintenance documentation.

6360000 Internal LED luminaires

6360001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Specifically, this section should be read in conjunction with the section on lighting general requirements

6360002 Supply LED luminaires complete with photometrics for the complete luminaire package tested at 25°C ambient. Photometrics for component LED drivers, independent of the proposed luminaire will not be accepted.

Photometrics produced at lower temperatures will not be accepted unless the luminaire is intended to be installed in a location which is intentionally and permanently cooled to a lower level.

6360003 LED luminaires shall be designed specifically to be used with the associated driver. Luminaire bodies designed originally for use with fluorescent or compact fluorescent lamps and control gear shall not be used.

6360004 LED luminaires shall not exhibit any noticeable flicker and shall have an operating frequency in excess of 600Hz.

6360005 Glare from LED luminaires shall meet the same criteria as for fluorescent and compact fluorescent luminaires such that in application they meet the unified glare rating (UGR) in the relevant SLL Guide for their intended use.

6360006 LED luminaires shall be of the latest generation at the time of purchase. Provide evidence that the luminaire and any part of it, including the LED driver and array was manufactured not more than 3 months prior to the date of purchase.

6360007 Where alternatives are offered, provide evidence that the alternative offer matches or exceeds the original luminaire in terms of LED efficiency, luminaire lumen output at 25°C ambient, spacing to height ratio and glare control.

6361000 External LED luminaires

6361001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Specifically, this section should be read in conjunction with the section on lighting general requirements

16361002 Supply LED luminaires complete with photometrics for the complete luminaire package tested over a range of -10^{o}C to +20^{o}C. Photometrics for component LED drivers, independent of the proposed luminaire will not be accepted.

Photometrics produced at lower or higher temperatures will not be accepted unless the luminaire is intended to be installed in a location for which the test temperature is relative.

6361003 LED luminaires shall be designed specifically to be used with the associated driver. Luminaire bodies designed originally for use with fluorescent, compact fluorescent, or high pressure discharge lamps and control gear shall not be used.

6361004 LED luminaires shall not exhibit any noticeable flicker and shall have an operating frequency in excess of 600Hz.

6361005 LED luminaires shall be of the latest generation at the time of purchase. Provide evidence that the luminaire and any part of it, including the LED driver and array was manufactured not more than 3 months prior to the date of purchase.

6361006 Where alternatives are offered, provide evidence that the alternative offer matches or exceeds the original luminaire in terms of LED efficiency, luminaire lumen output at prescribed ambient temperature, spacing to height ratio and glare control.

6370000 Earthing

6370001 General requirements

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Where pipes etc are to be bonded, the cable shall be connected to an adjustable metal clamp complying with latest standards for use with variable sizes of water and/or gas pipe.

Approved warning labels shall be fixed to each earth termination or bonding connection to structural steel, water or gas pipes etc, durably marked with the words *'Safety Electrical Connections – Do Not Remove'.*

Where metal conduit, trunking, cable sheaths and/or armouring is employed as part of the earthing system all joints, terminations and connections shall be constructed to afford a low impedance path for fault currents. All joints and connections shall be suitably protected to prevent deterioration caused by bi-metallic or other corrosion. The cross sectional area of the material shall comply with the requirements of BS 7671.

Mechanical joints between aluminium and copper shall have the joint faces lightly coated with a suitable compound to prevent corrosion, before the connection is made.

The armouring of plastic sheathed cables shall terminate in a suitable compression gland fitted with a purpose made earth tag. A suitable protective conductor shall connect the earth tag to the apparatus earthing terminal. The earth tag shall be manufactured from a high conductivity material compatible with the cable gland.

The armouring of metal sheathed cables shall be securely clamped to the gland at the cable termination with a purpose made bolted clamp. A suitably sized protective conductor shall be installed to connect the armour clamp or gland to the apparatus earthing terminal.

For an outdoor termination, the armouring shall be suitably protected to prevent corrosion.

Where metal sheathed and/or armoured single core cables are employed, bonding conductors shall be installed at each end of the cable run and connected to the apparatus earthing terminal. These bonds shall effectively connect the sheaths and/or armouring of the single core cables where they leave trefoil formation. Cable glands in such circumstances shall be lightly insulated to prevent circulating sheath currents. Where the cable run does not exceed 10m, only one bond shall be installed, to earth the cable sheath and/or armouring.

Metal sheaths and/or armouring of multi-core cables connected to a cubicle-type switchboard shall be effectively connected to the switchboard earth bar as described elsewhere in this specification.

Where armoured multi-core cables are terminated on a unit motor starter panel or local disconnector a separate protective conductor shall connect the incoming and outgoing armouring to the starter panel or disconnector earthing terminal. Similarly, the motor frame shall be connected to the cable armouring or the starter panel or local disconnector whichever is more convenient.

Where flexible conduits are installed a suitable green/yellow LSF insulated protective conductor shall be installed and connected to the equipment at each end of the flexible connection.

The earth terminal of all socket-outlets shall be connected to the protective conductor of the final circuit. Where the protective conductor is formed by conduit, trunking or the metal sheath and/or armouring of cables the earth terminal of the socket-outlet shall be connected to an earth terminal in the box or enclosure associated with the conduit, trunking or cable.

Joints in cable runs will not be permitted.

6371000 Main earth terminals

6371001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

A main earth bar, mounted on insulators, shall be located in a convenient position in the switchroom and shall be drilled to accept copper tape and insulated standard conductors. The earth bar shall be rated in accordance with BS 7430 with a minimum size of 60mm x 6mm. It shall be at least 500 mm long.

The main earth bar shall be provided with two 100% rated main earthing lead connections. Disconnecting test links shall be provided to allow periodic testing of a live installation. The requirements of the main earth bar shall be as detailed elsewhere.

Where a combined HV/LV earthing system is installed, copper tape shall be run to connect the transformer frames, HV switchgear frames, any fences, gates, etc., and the LV switchgear frames.

6372000 Dedicated earths

6372001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Where a ‘dedicated’ earth system is specified it shall be derived directly from the main earth bar and only connected to earth at that point and at no other point throughout its entirety. The connection shall be made through a disconnecting test link. A white engraved label with the legend “dedicated earth” (along with its specific application) in 25mm orange lettering shall be provided in a prominent position above the test link.

The ‘dedicated’ earth connections shall be made using cream coloured LSF insulated single core cables of the sizes detailed in BS 7671.

Protective earth functions must take priority however and any combined ‘dedicated’/protective conductor shall be coloured green/yellow.

6373000 Earth electrodes and pits

6373001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Earth electrodes shall be copper clad steel, complete with all drive type heads, connectors, and cable clamps. The number, locations and depth of installation shall be as shown on drawings or in particular information within this specification.

Each earth rod shall be protected by a purpose made enclosure that is accessible for testing and maintenance purposes.

Where the earth rod is internal to the building, the enclosure can be formed in the floor structure, with a load bearing cover. It shall be of a proprietary manufactured sealed type, to prevent water ingress. The rod shall pass through a 75mm diameter tube that has been cast into the floor structure. The top of the 75mm diameter tube shall be sealed with a non-hardening mastic compound and a sealing gland assembly to prevent the ingress of water into the earth pit.

6374000 Earthing for HV/LV transformers

6374001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Where the transformer(s) are owned by the DNO, a measured external earth loop impedance shall be obtained for the LV earth before the work on site commences. The proximity of the HV earthing arrangement to any planned LV earthing arrangement shall be determined and where necessary, the power frequency stress voltage during a HV fault to earth shall be calculated in accordance with BS 7671 Regulation 442.2.

Where the transformer(s) are part of a private network, the earth system shall comprise of either low resistance earth electrodes or a suitable low resistance copper earth mat. The arrangement of earth networks shall be shown on the appropriate drawing and may include combined HV and LV earthing or separate systems, depending on the requirements of the site.

All extraneous metalwork associated within the HV and LV installations shall be bonded to the appropriate system.

For LV earth networks, the earth electrode system(s) shall consist of driven copper clad steel rods or copper strips laid in formed trenches. The earth resistance shall not exceed 1 ohm before interconnection with the building metal work, cable armour, etc.

Transformers installed internally within buildings shall have their LV earth network bonded to slab re bar.

Insulated stranded cables shall be run to the transformer neutrals via the LV switchboard neutral busbar and to the earth electrodes.

For HV earth networks, the earth electrode system(s) shall also consist of driven copper clad steel rods or copper strips laid in formed trenches. The earth resistance shall not exceed 1 ohm before interconnection with the transformer core.

The size of all cables and tapes shall be as detailed on the drawings

6375000 Equipotential and supplementary bonding

6375001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Equipotential and supplementary bonding shall be installed in accordance with BS 7671.

Equipotential bonding in bathrooms shall be carried out regardless of the fact that circuits are protected by RCD or RCBO to ensure the installation remains safe in the event of RCD or RCBO failure.

6377000 Protective multiple earthing (PME)

6377001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Where a PME earthing terminal is provided by the DNO, the consumers PME bonding shall be installed between the earthing terminal and all other incoming metallic services, at a point as close as practicable to the point where each service enters the building.

Metalwork forming part of a telegraphic, telephone or signaling circuit need not be bonded as part of the safety earth system.

The minimum size of the consumer PME bonding is related to the size of the service cable and shall be as required by the PME regulations.

The earthing connections shall be made using single core cables with LSF insulation coloured green/yellow.

Approved warning labels shall be fixed to each connection suitably marked with the words ‘Safety Electrical connection - Do Not Remove’.

The final termination of the PME terminal will be carried out by the DNO.

6378000 Lightning protection

6378001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

Lightning protection systems shall be designed, installed and tested in accordance with the requirements of BS EN 62305 and BS 7430.

The system shall comprise of an air termination(s), down conductor(s), testing joint(s), earth termination(s) and earth electrode(s). Steel reinforcing in columns may be used subject to the main contractor confirming there are:

1. Sufficient vertical paths to earth to allow compliance with BS EN 62305
2. Sufficient metalwork enclosed within the structure so that touch voltages during a lightning strike will be below the maximum level given in BS EN 62305.

The materials for the component parts of the lightning protective system shall be those detailed in BS EN 62305. Care shall be taken in the selection of bonding clamps to prevent corrosion from the action of dissimilar metals.

The installer shall take full account of the environmental conditions at the site and the materials used in the building construction to supply a lightning protection system that will provide trouble-free life of at least 25 years.

All components shall be from one manufacturer.

The installer shall submit technical details of the system, including fixings, materials, etc to the CA for comment on the architectural and coordination issues associated with the installation.

Metallic roofing and cladding shall be verified as being electrically continuous and bonded to the lightning protection system.

Dependent on the type of system specified elsewhere, all metallic projections and plant or equipment on or above the main surface of the roof structure shall either be bonded to the lightning protection system or provided with a secondary metallic structure mounted either adjacent or above the equipment which will then be connected to the lightning protection system. All bonding connections shall be covered in grease to prevent corrosion.

Conductors shall be run parallel and perpendicular to the structure.

Any extended metal running vertically through the structure shall be bonded to the lightning conductor at the top and bottom, unless the clearances are in accordance with BS EN 62305.

Where the foundations or piles, etc. are being used as the earth termination network for the lightning protection scheme, reference electrodes shall be installed for periodic monitoring of the condition of the network.

All underground joints shall be carried out using an exothermic process and protected against corrosion. Above ground joints shall be made using gunmetal or phosphor bronze fittings and fixtures. All above ground joints shall be accessible for inspection.

Joints between dissimilar metals shall be protected by proprietary inhibitor paste and taped with bitumastic bandage to prevent corrosion as agreed with the CA.

Any building weatherproofing shall not be impaired.

Testing joints shall be provided in a convenient position for testing, approximately 1 metre above ground level.

Earth electrodes shall consist of metal rods or tapes or a combination of both as directed by the CA.

Earth impedance testing shall be carried out during the construction so as to ensure earthing impedance for each earth complies with BS EN 62305 and BS 7430.

Bonds to extraneous metalwork shall be carried out individually to each element such that the disconnection of any bond shall not affect the earthing of any other element of the system.
The method of connections to structural steelwork shall be agreed with the structural engineer and CA prior to commencement of the works.

The installer shall test the continuity of the structural steel work throughout the building and provide additional bonding where necessary.

On completion of the installation, the whole system shall be tested in accordance with BS EN 62305. Copies of the test results shall be forwarded to the CA for approval.

The installer shall allow for a retest of the system prior to the expiry of the defects liability period and as agreed with the CA.

Section 7000000 – Electronic engineering services

7301000 Fire alarm systems

7301001 General

Comply with the requirements of this and other sections of the specification as well as associated drawings and schedules.

The fire alarm systems shall be provided as shown on the drawings and as specified elsewhere and shall conform to the requirements of BS 5839 and BS EN 54 (all current parts as applicable)

The design is provided at scheme level and detail design along with supply, installation and commissioning shall be carried out by the contractor via the Trust's preferred fire alarm manufacturer / installer. This will allow the design to be optimised to the Trust's requirements.

Fire detection and alarm systems are divided into three categories, as described in BS 5839 – Part 1. These categories are: -

Category L : Automatically activated systems that are designed to protect life.

L1 - Systems installed throughout the protected building.
L2 - Systems installed only in defined parts of the protected building.
L3 - Systems installed only for the protection of escape routes.
L4 - Systems installed in circulation areas used for as escape routes.
L5 - Systems installed to satisfy specific fire safety objectives.

Category M : Manually operated systems (no sub-categories)

Category P : Automatically activated systems designed to protect property

P1 - Systems installed throughout the protected building.
P2 - Systems installed only in defined parts of the protected building.

A similar categorization system for dwellings is described in BS 5839 – Part 6.

The category designation for the fire detection and alarm system to be installed will be as stated in the particular requirements of this specification.

7301002 System types

The table below gives an overview of system types

Type	Description
Manual system	A system which relies on persons detecting a fire and using the fire alarm system to raise awareness to all in the building.
Conventional monitored	A system where detectors, manual call points and sounders are wired as radial circuits with an end of line device. The fire alarm system monitors output states "normal" or "fire" as well as "fault".
Analogue or digital addressable	A multi-state system in which signals from devices are individually identified at the control and indicating panel(s). The system is wired as a loop or series of loops, dependent on the complexity of the installation.
Radio based system	A system where some or all of the interconnections between components are made by radio links.
Aspirating System	A system which monitors the particulates within the air and raises an alarm if the level of smoke particulates goes above a pre-determined level.

The system type (or types depending on the complexity of the design) for the fire detection and alarm system to be installed will be stated in the particular requirements of this specification.

7301003 Manual call points

Manual call points shall comply with BS EN 54-11 for “Type A” operation i.e. Direct Operation.

Manual call points shall be coloured “Red” with a frangible element covering the push button. Manual call points shall be clearly labeled with the text “FIRE”.

Manual call points shall be mounted no higher than 1200mm AFFL and in compliance with the Disability Discrimination Act. The contractor shall obtain final written approval from the Building Control Officer (BCO) prior to installation.

Manual call points shall be flush or surface mounted to suit adjacent accessories.

7301004 Heat detectors

Heat detectors shall comply with BS EN 54-5.

Heat detectors may be point type or line type detectors as indicated on the drawings

7301005 Point type smoke detectors

Point type smoke detectors shall comply with BS EN 54-7.
Smoke detectors shall be either ionisation chamber type or optical beam type as indicated on the drawings. Optical beam types, being the most resilient to false alarm, shall be the preferred type unless a particular risk dictates the need for ionisation detectors.

7301006 Beam type smoke detectors

Beam type smoke detectors shall comply with BS EN 54-12
Smoke detectors shall be infra-red type using either a separate transmitter and receiver or a combined transmitter/receiver unit with optical reflector. Regardless of which type is used, the detectors shall be capable of operating distances up to 100 metres and shall incorporate the facility to accept building movement which misaligns the receiver/transmitter or receiver/transmitter and reflector by up to 100mm in any direction.

7301007 Multi sensor detectors

Multi-sensor detectors shall comply with BS EN 54-5, 54-7 and 54-17.

The detector shall comprise a combination of the following sensors: -

1. Optical Smoke.
2. Heat (fixed temperature).
3. Carbon Monoxide

Each sensor element shall be capable of being programmed with different enabled / disabled time periods enabling a reduction in false alarms.

7301008 Flame detectors

Flame detectors shall comply with BS EN 54-10.

Detectors shall be either individual infra-red (IR) or ultraviolet (UV) types and if the risk dictates the need, combined UV/IR detectors as indicated on the drawings.

7301009 Aspirating systems

Aspirating systems shall comply with BS EN 54-20.
Where specified, aspirating systems shall be used either in place of/or in addition to conventional or addressable fire alarm systems.

7301010 Video smoke detection

Video smoke detection is an emerging technology which utilises the CCTV system within a building to detect the presence of smoke. Where specified, the system(s) shall be used as part of a fire engineered (performance based) design and shall be in accordance with the fire engineer's strategy. The system shall be designed, supplied, installed and commissioned by the contractor.

7301011 Sounders

Fire alarm sounders shall comply with BS EN 54-3.
The minimum sound pressure levels (dBA) shall be in accordance with BS 5839-1 and shall not fall below the figures given below

Location	Min dB(A)	Max dB(A)
General Areas	65	120
Stairways	65	120
Areas of limited extent	62	120
Bedhead	75	120
Hospital Accommodation	45	55

An area of limited extent shall be any localised area within a larger space which shows a drop off in sound pressure level from 65dB(A).

7301012 Visual alarms

All visual alarms will be provided in accordance with BS5839-1 and BS EN 54-23 and shall be either xenon beacons or twin large area LED type. The visual alarms shall be supplemented with a low sound level buzzer or external sounder, if specified in the particular requirements of this specification.
As a minimum, visual alarms shall be installed within the following areas as required by Part M of the Approved Building Regulations: -

1. Toilets (Staff / Public).
2. Changing Rooms.
3. Shower Rooms.
4. Plantrooms / Boiler Rooms.

Any additional area identified by risk assessment which may not be suitably covered by sounders alone.

Where the background sound levels are particularly high and visual alarms cannot be relied upon, consideration shall be given to removing the source of noise on fire alarm. (eg remove power to audio equipment in a nightclub on fire alarm activation)

7301013 Portable alarms

Portable alarms shall be provided in accordance with BS5839-1. The portable alarm device shall be a radio pager complete with integrated vibrating function, tactile messaging and LCD text messaging.

7301014 Control and indicating equipment

Control and indicating equipment shall comply with BS 5839-1 and BS EN 54-2.

Fault Monitoring
The control and indicating equipment shall monitor the following faults as a minimum: -

1. Short circuit in any circuit serving manual call points or detectors.
2. Open circuit in any circuit serving manual call points or detectors.
3. Removal of any manual call point or detector that is designed to be detachable.
4. Short circuit of any circuits serving fire alarm devices.
5. Open circuit of any circuits serving fire alarm devices.
6. Short circuit / open circuit of any wiring between power supplies and fire alarm devices.
7. Any earth fault condition.
8. Any operation of circuit protective device serving any fire alarm device.

A fault indication should be given, within the times stated below.

Fault	Duration
Failure of the main power supply	Within 30 minutes
Failure of the standby power supply	Within 15 minutes
Failure of battery charger	Within 30 minutes
Failure of batteries	Within 30 minutes

A zone diagram shall be fitted adjacent to each control panel in accordance with BS 5839 Part 1. The diagram should be framed and constructed to a standard suitable for its environment.

7301015 Power Supplies

Power supply units shall comply with BS EN 54-4

The power supplies shall normally be 24 volts DC derived from the mains via bridge rectifier / transformer equipment, but in the event of a mains failure the system shall operate from a battery system for a minimum of 24 hours, after which there should be sufficient capacity to operate the sounders for 30 minutes.

7301016 Remote Signalling

Remote signalling to alarm monitoring centres, such as RedCare shall be provided in accordance with BS 5979 if stated as a particular requirement elsewhere in this specification.

7301017 Fire alarm interfaces

The fire alarm system shall be interfaced to the following equipment to ensure the operation as described: -

1. Lift Control Panel – The lift car parks at Ground floor level (or as indicated in the fire strategy) and locks “out of service” during fire evacuation.
2. Mechanical Control Panel – Ventilation plant shuts down during fire evacuation (or enters a pred-etermined mode as dictated by the fire strategy).
3. Access Control Doors – Access control doors on escape routes at automatically unlocked (unless pre-determined requirements indicate an alternative course of action).
4. Door Détentes – Fire doors automatically close during fire evacuation.
5. PA equipment including voice alarm control panels

7301018 Wiring

The fire alarm system will be wired using either MICS or “enhanced” grade fire resistant “soft skin”cable in accordance with BS 5839-1. Where there are particular requirements to use a specific cable type, this is identified in the particular requirements of this specification or on drawings.

Mixture of cable types will not be permitted. Cables shall only be supplied from one manufacturer for the entire system to avoid known impedance problems caused by mixing different manufacturers cables.

Where used, the enhanced fire resistant cable will meet the PH120 classification when tested in accordance with EN 50200.

Cable used for power supplies to fire alarm panels, repeater panels or auxiliary power supplies shall have a minimum PH120 rating and be in accordance with BS 8519 Category 3.

The minimum cross sectional area of the fire alarm cables shall not be less than 1.5mm2.

The fire alarm cable shall have a LSZH outer sheath, preferably coloured red. Other colours may only be used if specified in the particular requirements of this specification or identified on associated drawings.

7301019 Installation and test

The fire alarm system shall be installed and tested in accordance with the requirements stated in BS5839-1.

Plastic cable ties shall not be used unless the cable is laid on the upper side of either cable basket or cable tray such that the cables weight is fully supported by the basket or tray and the cable ties are only used to secure the cable in place.

7301020 Commissioning and handover

The fire alarm system shall be commissioned in accordance with the requirements stated in BS5839-1. The commissioning engineer shall measure and record sound level readings.

7301021 Documentation

In accordance with BS5839-1 the fire alarm installer shall provide the following documentation on completion of system commissioning: -

1. Certificates for Design, Installation and Commissioning.
2. Operation and Maintenance Manual.
3. “As fitted” drawings.
4. Log Book.
5. Record of agreed variations from the original design specification.
6. BS7671 – Electrical Installation test certificates.

7301022 Logbook

The fire alarm installer shall provide at handover a fire alarm system log book in accordance with Annex F of BS5839-1.