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61413/NMRN Portsmouth Historic Dockyard - HMS Warrior Rewire

MEP Services Specifications

Volume 2B - Electrical Services

Revision 0

August 2022

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Volume 2B - Electrical Services

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Contents

1 Description Of The Works

1.1 Project Description

Electrical re-wire of a scheduled ancient monument on the National Register of Historic Vessels.

This Section of the Specification details the performance requirements for the electrical re-wire. It is essential that the contractor visits site during the tender period and thoroughly examine the vessel and Quayside and include for all works in the tender sum.

The Contractor shall design, supply, install, connect, test, commission and set to work a complete new electrical installation and shall strip out all equipment made redundant by the new installation. This specification describes the performance to be achieved but the Contractor shall ascertain the full scope of the works by site visits during tender stage and shall make a full assessment during the site surveys of the complete scope of work required to fully rewire the complete electrical installation throughout the complete vessel. Complete replacement of the Quayside electrical feeder pillar and the power supply to the vessel shall be included.

The schedules of outlets I Section 1.24 identify key areas but the Contractor shall ascertain and include in the tender for a complete rewire. A complete new electrical installation is required.

The Contractor shall be wholly responsible for undertaking the complete design of the electrical services as detailed within this performance specification. The Contractor shall be wholly responsible for ensuring the designs are compliant with the Employers requirements, Local Authority requirements, British Standards, Building regulations and National Museum of the Royal Navy (Operations) (NMRN) requirements.

The vessel is a unique scheduled ancient monument and the Contractor shall treat each area individually to ensure the most aesthetic solution possible. All works, routes and equipment positions shall be agreed with the Project Manager prior to commencement of works.

Systems and equipment shall be designed and selected based upon those suppliers/specialists and environmental data named/detailed herein.

The Contractor shall liaise with all specialist suppliers listed in respect to the design requirements to be incorporated.

The Contractor shall provide a full 12 Month warranty for all items supplied and installed.

The works will be carried out between 3rd January 2023 and 31st March 2023 when the vessel will be closed to visitors generally. The Contractor shall allow within the works for safe visitor access to the main deck during weekend periods and the February half term. Refer to NMRN documents for any supplementary programme requirements. Provide safe access during these times including safety lighting and fully functional fire alarms at all times.

The electrical installation shall be designed in accordance with the relevant and current statutory and local authority regulations and all British Standards, including but not limited to:

- All relevant and current British Standards, EN Standards and Codes of Practice;
- All Chartered Institution of Building Services Engineers (CIBSE) Guides, including the Commissioning Codes and Technical Memoranda;
- Building Research Establishment recommendations;
- Recommendations of the Health and Safety at Work Executive;
- Local Bye-Laws and Regulations;
- BSRIA Guides on access, maintainability and commissioning;
- Requirements of the Local Fire Officer and Loss Prevention Council;
- Building Regulations;

- Buildings Regulations Part L - Conservation of Fuel and Power;

- 18th Edition BS 7671: IEE Wiring Regulations 2018 including Amendment 1 and Amendment 2;

- All Standards listed in Part 2 of this specification.

HMS Warrior is a scheduled ancient monument and the works shall therefore be carried out in a manner sympathetic with the nature of the scheduled ancient monument. The Contractors design and installation shall be concealed throughout with any minor visible works only permitted where explicitly agreed with the project manager and absolutely minimised. No new holes shall be made within the vessel and existing penetrations only may be reused. Specific panelling will be removed by specialist shipwrights engaged by the client to facilitate concealed wiring. The Contractor shall indicate on builderswork plans where panel removal is required. The Contractor shall utilise existing horizontal and vertical voids for the installation of main containment routes. The Contractor shall be responsible for gaining access to these voids under the supervision of the project manager. The Contractor shall also note that these voids are classified confined working spaces and the Contractor shall implement all HSE safe working practices.

Refer to the pre-construction information.

The Contractor shall make full allowance for the complete scope of rewire works from site surveys during the tender period and shall fully ascertain the nature of the historic scheduled ancient monument in the preparation of the tender.

HMS Warrior is a decommissioned and floating scheduled ancient monument. The BS7671 IET Regulations shall be applied to the electrical installation and particular reference shall be made to the Section 730, which shall be fully complied with including requirements for galvanic separation.

The electrical services installation shall be recessed mounted and concealed throughout.

Where the electrical installation is specifically agreed to be surface mounted the aesthetic appearance of the installation shall be of utmost importance and all setting out shall be approved by the Project Manager prior to the start of the works.

Throughout the installation the contractor shall ensure that the routes of cables, containment and positions of all equipment are approved before the start of work.

No damage or creation of holes within the vessel will be permitted. Existing holes only shall be reused.

The Contractor shall issue a full set of builderswork drawings indicating where existing penetrations will be used and where ships panelling will need to be removed and reinstalled by others.

The contractor shall provide support for the electrical installation throughout. The contractor shall provide fixings appropriate to the nature of the structure which shall only be clamp type fixings to existing steelwork, no drilling will be permitted. Methods of fixings proposed by the contractor shall be submitted for comment prior to use with any supporting calculations for structural strength as requested. The contractor shall provide all primary and secondary supports, etc as required for the electrical installation and include for such with the tender. The complete electrical installation shall be securely fixed to the structural elements of the vessel or to unistrut supports which are fixed to structural elements of the vessel. The contractor shall retain full design responsibility for all fixings and support.

The Contractor shall provide full fire stopping where electrical elements pass through a fire rated partition and within the electrical carcase system throughout. The Contractor shall provide details of all proposed fire stopping/protection methods and internal fire stopping for trunking, conduits etc as applicable.

The Contractor shall ensure that fire stopping details around electrical services through wall and ceiling/floor penetrations are fully detailed on the builderswork drawings and included within the tender.

The Contractor shall engage a fire stopping specialist to create a 1 hour fire enclosure around main electrical switchgear and distribution boards. A fire rated enclosure at each location where switchgear and distribution boards are located shall be provided. For tender purposes this shall include fire rated enclosures: -

- Main switchroom;

- Forward distribution board position;
- Mid distribution board position;
- Aft distribution board position
- Kitchen distribution board position

These positions are nominally identified for tender purposes but final locations will be determined by the Contractor with the agreement of the project manager as part of the Contractors design.

The Contractor shall ensure that all the requirements for waterproofing of cable entries through external penetrations are indicated on their builderswork drawings.

The contractor shall fully examine the asbestos register prior to starting work and shall advise any impact on the proposed works as well as remaining vigilant during the course of the contract and stopping work if the presents of asbestos is suspected.

The Contractor shall note the requirements and application system for obtaining passes for employees to work in the Historic Dockyard. Refer to NMRN requirements for further details. Passes for operatives are likely to take 6-8 weeks to obtain and this can be longer for non UK residents.

1.2 Systems

The works shall be carried out within an existing scheduled ancient monument. All works shall be carried out in a manner sympathetic with the listed status of the building and the Contractor shall comply with all requirements/restrictions associated with the buildings listed status.

The electrical systems shall be installed in accordance with the IET Wiring Regulations (BS 7671) 18th Edition including amendment 1 and amendment 2 and all relevant British and European Standards and other standards detailed in clause 2.0.

The electrical services installation shall comprise the design, supply, delivery, installation, connection, testing, commissioning and putting into operation of all materials, plant and equipment as described in this specification and detailed on the accompanying drawings.

The Contractor shall ascertain the full scope of the electrical services installation from the complete tender documentation and site survey during the tender period.

Wherever the tender documents state that the Contractor shall provide, this shall be deemed to include design, supply, installation, test, commission and set to work.

The works shall consist of, but not be limited to, the following:

- Full design and Contractors proposal drawings and documentation;
- Full survey of the existing installation with report, photographs, condition report;
- Validation of any existing installations to be retained;
- Stripping out of redundant existing installations;
- Quayside Electrical Switchgear;
- Incoming electrical supply;
- Main Incoming Switchgear;
- Low Voltage Switchgear;
- Low Voltage Distribution;
- Metering Systems;
- Earthing Installation and Bonding Installation;
- Temporary Lighting;
- Lighting Installation;
- Public address system
- External Lighting Installation;
- Emergency Lighting Installation (UPS system);
- Electrical Power and Distribution to Mechanical Plant;
- Small Power and Ancillary Services;
- Small Power for future plug-in heaters
- Fire Alarm Detection and Alarm System;
- Public Address System;
- Data Installation;
- CCTV system;
- Cable Containment Infrastructure;
- Fire Protected Enclosures at electrical distribution positions;

- Mechanical adaptations to remove electrical ducted ventilation heater batteries. New mechanical controls and adaptations to maintain ducted ventilation system fully operational.
- Testing and Commissioning;
- Installation Drawings, Builderswork Drawings, Fabrication Drawings etc;
- As built record documentation including Operation and Maintenance Manuals including Record Drawings;
- Client Training;
- 12 months Planned Preventative Maintenance shall be priced as an option.

The Contractor shall examine all manufacturers installation instructions and all equipment shall be installed in accordance with these instructions.

The Contractor shall allow for procuring samples of all visible items for review by the Client. These shall be provided at an early stage in the Contract to allow time for any changes to be taken on board. The cost for these items shall be included within the Tender Costs.

This shall include but not be limited to the following:
- Luminaires;
- All wiring accessories in the specified finish and alternative finishes for client review;
- Fire and security devices;
- Public address devices;
- CCTV cameras;
- Etc.

1.2.1 Existing Systems

The Contractor shall carry out a full photographic survey of the complete vessel and shall provide a photographic record report indicating condition report for each area.

The Contractor shall carry out a full validation exercise of any existing equipment which shall be utilised or affect in any way the contract works.

The Contractor shall issue a full validation report.

Where systems being validated are specialist and to be extended, modified etc by Specialist Contractors then these Specialist Contractors shall carry out the validation exercise.

The validation exercise shall be carried out at the start of the contract prior to any works being commenced (including preparation of installation drawings) or materials being ordered.

Systems to be validated under this contract shall include:

- HMS Warrior power supply is derived from a dockside feeder pillar. All equipment within the feeder pillar is to be replaced The Dockside feeder pillar arrangement shall be subject to all tests to determine fault level, earth loop impedance etc which the Contractor shall utilise for calculations;
- The dockside lighting feeder pillar and dockside lighting which is to be retained in use;
- All equipment which will be stripped out but initially retained to maintain the vessel in full operation;
- Any equipment subject to reuse e.g. luminaires to be refurbished.

1.2.2 Temporary Supplies

The Contractor shall maintain temporary lighting to the vessel at all times for the duration of the works. Temporary LED bulkhead luminaires shall be provided throughout.

The Contractor shall maintain a fully functional fire alarm system with full automatic detection and remote indication at least to the standard of the existing fire alarm system for the full duration of the contract and until the new fire alarms are fully functional.

Provide all necessary temporary supplies to allow the safe admission of visitors to the main deck at weekends.

1.3 Stripping Out Of Existing Electrical Services

The Contractor shall strip out the existing electrical installation in a phased manner.

Stripping out shall be carried out with the utmost care and no damage to any part of the vessel will be permitted. Any equipment clips, fixings etc shall be removed with the utmost care and no damage or degradation will be permitted.

The stripping out shall include general electrical installations, public address, security, CCTV, data, telephones, TV and all miscellaneous systems.

The Contractor shall obtain written permission from the Project Manager prior to undertaking any stripping out works.

The stripping out of the electrical installation shall include the stripping out of all electrical equipment, accessories, conduit, trunking, cable tray, supports, cabling, fixings and wiring etc. Stripping out shall be carried out in accordance with the requirement to maintain temporary supplies as 1.2.2.

The Contractor shall carry out a full validation exercise and photographic record survey of all equipment. The Contractor shall carry out a full survey of condition and periodic test and inspection and shall issue a report which shall include full photographic evidence of the condition of all such equipment to be retained. Should damage occur to any equipment to be retained which is not identified in the validation report then the Contractor shall rectify all such equipment with no cost to the client. The report shall also identify any such equipment that does not fully comply with current regulations. All existing equipment which is specifically indicated to be retained shall be clearly labelled on site including all interconnecting cabling, ductwork etc. Equipment shall be retained in full operational use until fully replaced by the new installation as per the project phasing.

The photographic survey and report shall include a catalogue of existing ships lanterns to be retained and refurbished with photograph and condition report for each individual lantern.

The Contractor shall allow to carry out survey work on site to identify the use of all existing electrical equipment and cables prior to electrical stripping out works commencing. The survey work shall include fuse pulling and cable tracing as required and the results of these surveys shall be issued to the contract administrator prior to the commencement of work. Circuits to be identified include those feeding equipment external to the vessel. The survey information shall be issued as a full set of drawings fully describing the existing electrical installation to be stripped out and highlighting equipment to be retained. Written authorisation shall be obtained from the contract administrator prior to starting stripping out works. The identification of existing equipment and cable routes shall include data, security, CCTV, public address and all miscellaneous systems. This complete survey shall fully identify all circuits to be rewired.

Where stripping out of required systems within the contract area affect equipment and systems outside of the contract area (e.g. dockside), then systems shall be rewired and temporary supplies provided as necessary to provide a complete and satisfactory and fully functional system outside of the contract area, including the temporary condition.

Any equipment or cabling within the contract area which serves any equipment outside of the contract areas shall be identified by the Contractor as part of the survey work.

The Contractor shall ensure that all services to be stripped out are isolated and are tested to prove isolation before stripping our works commence.

The Contractor shall provide a method statement describing the stripping out work which shall be issued prior to the start of works and a risk assessment.

The Contractor shall note the requirement to retain and refurbish specific equipment e.g. historic lanterns.

The Contractor shall carry out the stripping out generally in accordance with the following.

The Contractor shall allow for suitable disposal of all equipment.

1.3.1 Existing Main Electrical Intake

Vessel main electrical supplies are derived from a dockside feeder pillar. The Contractor shall replace the feeder pillar structure and all equipment within the pillar with new and strip out the existing. The point of supply head in the feeder pillar shall be retained and validated. The Contractor shall replace the existing supply cable to the vessel with a new cable and cable support system and strip out the existing cable.

The existing main intake switchgear , busbars and switchboards and all electrical distribution equipment shall be stripped out in the vessel main intake position.

1.3.2 Existing Electrical Distribution

The electrical distribution sub main cables and distribution boards shall be generally stripped out and disposed of including all electrical equipment tray, containment, fixings, conduits, supports and all ancillary equipment. Strip out in a phased manner.

1.3.3 Existing Lighting Installation

The existing lighting installation and emergency lighting installation wiring, containment, luminaires, accessories etc shall be generally stripped out and disposed of. A number of historic lanterns are to be retained and refurbished under the contract.

Strip out in a phased manner and replace existing luminaires with temporary LED bulkhead luminaires to maintain lighting throughout the vessel during the contract period.

Lamps shall be disposed of in accordance with statutory legislation.

1.3.4 Existing Small Power And Ancillary Services Installation

The existing small power and ancillary services installation shall be stripped out including wiring accessories, wiring, containment, etc.

Strip out in a phased manner.

1.3.5 Existing Fire Alarm Installation

Prior to the commencement of works the contractor shall engage a fire alarm specialist.

The fire alarm system shall be stripped out throughout the whole vessel including all devices, panels, equipment, cabling containment, fixings and supports in a phased manner required to ensure a fully operational fire alarm system to the vessel at all times. Provide any necessary temporary detectors/sounders to maintain a fully functional fully automatic (with fire detectors located throughout) fire alarm system to the vessel at all times.

The existing fire alarm panel is connected via autodialler to site security and this link shall remain operational until the new fire alarm system is fully functional with the new fire alarm system autodialler in operation.

Provide autodialler cables.

1.3.6 Existing Security Installation

The Contractor shall engage a security specialist to disconnect, make safe all intruder alarms equipment , CCTV equipment and security links.

The Contractor shall then strip out all security equipment cables, containment, etc.

1.3.7 Data And Telephones

The Contractor shall engage a specialist Telecoms Engineering Services to disconnect/make safe all data and telephone systems prior to stripping out. The Contractor shall then strip out all data and telephone services. Maintain and protect any incoming copper and fibre optic supply cables.

1.3.8 Miscellaneous

The Contractor shall strip out all miscellaneous services agreed with the Project Manager including the talk back system. Strip out in a phased manner.

1.3.9 Tv Systems

Strip out the existing TV systems in a phased manner.

1.3.10 Public Address Systems

Engage a public address specialist. Strip out the existing public address system in a phased manner.

1.4 Maintenance Of Electrical Services To All Areas Outside Of The Contract Area

Refer to the relevant clauses in 1.4. The Contractor shall identify any equipment outside of the contract area served by the vessel or quayside feeder pillars and shall maintain these supplies in operation.

1.5 General

1.5.1 Plant Location Summary

The Contractor shall engage a fire specialist to create a 1 hour fire enclosure at each of the positions indicated below.

Fore – Exact position to be agreed by Contractor during design period.

- Lighting Distribution Board.
- Power Distribution Board

Mid – Main intake position for the vessel

- Lighting Distribution Board.
- Power Distribution Board
- Essential Lighting Distribution Board.
- Main MCCB Board
- Galvanic isolation equipment
- Lighting System Central Inverters

Kitchen

- Kitchen distribution boards

Aft – Exact position to be agreed by Contractor during design period

- Lighting Distribution Board.
- Power Distribution Board

1.5.2 Contractor Design Elements

The contractor shall be wholly responsible for the design of the complete project. This shall include but not be limited to:

- Complete electrical design in accordance with required standards.
- The Contractor shall produce cable calculations including current carrying capacity of conductors, voltage drop, earth loop impedance and fault calculations all to demonstrate full compliance with BS7671 (2018) IET Regulations for electrical installations 18th Edition including all amendments. The Sub-Contractor shall produce lighting calculations to demonstrate compliance with CIBSE Lighting Guide for Offices. The Sub-Contractor shall produce all other

calculations as required. The Contractor shall issue all calculations to be reviewed by the Employers Representative.

- The electrical installation shall achieve a design service life in accordance with CIBSE Guide M.
- Design shall comply with all standards in Part 2 of this specification.
- The Contractors design shall make due allowance for both starting currents and running currents of the designed circuits.
- All systems shall be designed with 20% spare capacity.
- Luminaires shall be LED high efficiency throughout, but must not distract from the appearance of the ship and shall be of suitable colour temperature and colour rendition. The quality of colour rendition shall be proved by site test and the Contractor shall include for the independent testing by the LIA (Lighting Industry Federation) to verify the performance of each luminaire type, including refurbished lanterns. Luminaires shall be suitable for their environment.
- Design of CCTV, public address, fire alarm system, telephone and data systems;
- Design of methods fixing and support for the electrical installation and equipment which shall comply with any requirements of the specification and shall be submitted for comment;
- Additional steelwork, brackets, hangers, anchors, clips, etc., for supporting all items forming the Installations and systems from the permitted fixings to the building structure including loads imposed on the structure. All fixings shall be clamp type to existing structural steel only;
- Weatherproofing to all services elements penetrating the external building fabric;
- Fire stopping and the provision of fire rated enclosures to main electrical distribution positions;
- Temporary works, facilities and provisions required during construction, commissioning and testing necessary to progress the Works in accordance with the construction programme and to meet the specified requirements;
- Builders works and fire stopping;

All calculations associated with the above shall be carried out by the Contractor and submitted for comment.

For all design elements the contractor shall provide evidence of “competence” to satisfy the client prior to engagement. A “design” undertaken by the contractor shall carry a requirement for a minimum of £1,000,000 (one million pounds) professional indemnity insurance. Where professional indemnity insurance is specifically detailed for contractor designed systems in the main contract preliminaries; the main contract preliminaries shall take precedence.

All systems shall include 20% spare capacity.

1.5.3 Voltage Drop

The Voltage Drop between the origin of the installation (the Clients Incoming Terminals) and a fixed appliance or load end of a final circuit must not exceed 3% of the nominal supply voltage for lighting circuits and 5% for power circuits as stated within the IEE Wiring Regulations.

1.5.4 Manufacturers Recommendations And Requirements

Equipment will carry particular requirements of the manufacturer or installer. Where this is the case, the manufacturer’s requirements shall be adhered to at all times during all delivery, assembly, storage, installation, testing and commissioning. If these conflict with the requirements of this design, the Contractor shall bring the issue to the attention of the Consultant.

The Contractor shall examine all manufacturers’ installation instructions and all equipment shall be installed in accordance with these instructions.

Where manufacturer's installation instructions require specific builderswork in connection, then the Contractor shall detail this required builderswork on the Contractor's builderswork drawings.

1.5.5 Future Capacity

All new LV switch panels and distribution boards shall be provided with a minimum 20% spare ways fitted with protective devices where scheduled or with blanks or covers.

All new cable containment (trunking, ladder or tray) shall be suitably sized to allow for 20% spare capacity for future use. The support structure shall be suitably sized to allow for this additional weight.

All new control and alarm panels shall be sized and selected to allow for 20% spare capacity for future additional devices. Where practical, facilities for additional capacity by way of a slave panel, controller or management unit shall be provided.

1.5.6 Electromagnetic Interference

All equipment shall be immune from, and shall not radiate, signals exceeding the limits of BS 800 and the appropriate parts of BS 6667 and BS EN 60801.

1.5.7 Builderswork

As detailed in Volume 1 of the specification the Contractor shall provide fully detailed builderswork drawings. All internal builderswork shall be full detailed. The Contractor shall carry out all of the below except where noted.

Builderswork details for services shall include: -

- Detailing of existing holes to be reused for services;
- Locations of timber panelling to be removed and reinstated by the clients specialist under direct client order;
- Where bolted access latches are anticipated to need removal, which will be carried out by the Contractor under the supervision of the Project Manager.
- Fire rated enclosures at electrical main distribution positions;
- Weatherproofing details for incoming services;
- Any other builderswork requirements.

1.5.8 Layout

The installations shall be designed to provide adequate means of access for operation and maintenance as required by safety legislation as well as for future extension. The Contractor shall note that access to existing horizontal and vertical voids in the vessel are limited and these areas will be deemed as confirmed working spaces. The Contractor shall implement all necessary Health and Safety provisions for working in confined spaces.

1.5.9 Samples

The Contractor shall allow for procuring samples of all visible items for review by the Client, Architect and Consultant. These shall be provided at an early stage in the Contract to allow time for any changes to be taken on board. The cost for these items shall be included within the Tender Costs.

1.6 Enhanced Capital Allowances

In December 1999, the UK Government issued a consultation document entitled 'Energy Efficiency Measures under the Climate Change Levy'. This document provided support for an Enhanced Capital Allowance (ECA) scheme that would reward business investment in low carbon technologies through tax incentives.

The tax incentive is claimed in much the same way as any other capital allowances on 'Corporation Tax Return' for companies paying UK Corporation Tax. Note that this method of financial return is

only applicable to the financier and is achieved by writing off the whole cost of the investment against the taxable profits for the period during which the investment is made.

An initial list of qualifying products (low carbon technologies) was published in April 2001. This list, known as the Energy Technology Product List was first endorsed by the Treasury and came into effect as of 7 August 2001. The list is updated regularly to include new products that meet the stipulated criteria. The following relevant products are currently included on that list.

- CHP;
- Boiler Plant and Equipment;
- Motors;
- Variable Speed Drives;
- Pipe Insulation;
- Lighting;
- Energy efficient refrigeration equipment.

Manufacturers requiring eligibility for their products are required to submit written evidence detailing conformity to relevant efficiency criteria. For example, in the case of boilers a manufacturer would need to submit an EC declaration of conformity for efficiency accompanied by written evidence of the full and part load efficiencies. Self-certification is possible but it must be verified by a Notified Body. On acceptance of the information supplied for the product to the Carbon Trust by the manufacturer, the product would be added to the list.

Provided an installed product is on the list, a financier can claim ECA's for the product and any other cost directly incurred for its installation. However, a detailed record of qualifying expenditure must be kept as evidence of the works.

It is proposed that the project shall incorporate, where economically feasible, energy efficient plant that has achieved enhanced capital allowance status.

1.7 Metering Strategy

The following is the proposed strategy for each utility, but this needs to be discussed and agreements with Client and the respective utilities. The Contractor shall include within the contract for a detailed metering system compliant with GIL 65 enabling 90% of the total annual consumption of each 'fuel' to be accounted for.

Utility/Service	Building
Electricity	Directly billed to Dockyard.
Telecoms	Directly billed by service provider to Dockyard

Note:

All services shall be sub metered with meters at main switchgear and distribution boards.

1.8 Systems

1.8.1 Electrical Generation Plant - Standby Generators

1.8.2 Electricity Generation Plant

1.8.3 LV Supply/Public Utility Supply

1.8.3.1 General

There is a TPN electrical supply to the vessel which originates from a feeder pillar on the dockside. The Contractor shall provide a new main supply cable to the vessel which shall have a cables

specification and containment system suitable for the rise and fall of the vessel and suitable for crossing the sea between vessel and dockside.

The quayside feeder pillar shall be renewed and all electrical equipment within the feeder pillar shall be replaced with new.

The Contractor shall retain the quayside lighting feeder pillar and carry out a full validation periodic test and condition report.

1.8.3.2 Main Switchgear And Distribution

The Contractor shall design, supply, install, test and commission a complete main switchgear and system of electrical main distribution.

1.8.4 General LV Power (Small Power Systems)

1.8.4.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete small power system.

The Contractor shall design, supply, install, test, commission and set to work a complete small power system for plug in electric heaters.

1.8.5 Lighting Systems

1.8.5.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete lighting and external lighting system.

This shall include the specialist refurbishment, electrical rewire and lamp replacement with LED of all historic ship's lanterns. The Contractor shall engage a specialist for this work and issue a method statement within the tender.

1.8.6 Lighting Control Systems

1.8.6.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete lighting and external lighting control system.

1.8.7 Emergency Lighting Systems

1.8.7.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete emergency lighting system.

1.8.8 Electrical Power To Mechanical Systems

1.8.8.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete system of electrical power to mechanical plant.

1.8.9 Earthing Systems

1.8.9.1 General

The Contractor shall design, supply, install, test, commission and set to work a complete system of earthing. Earthing cables to the dockside shall be replaced under this contract.

1.8.10 Not Used

1.8.11 Communication Systems

The Contractor shall design, supply, install, connect, test, commission and set to work telecommunications system.

1.8.12 Fire Detection And Alarm Systems

1.8.12.1 General

The Contractor shall design, supply, install, connect, test, commission and set to work a complete fire alarm system and life safety systems.

The fire alarm system shall be linked via Autodialler to the Dockyard Security.

1.8.13 Security Systems

The Contractor shall design, supply, install, test, commission and set to work complete closed circuit television system.

1.8.14 Not Used

1.8.15 Testing And Commissioning

1.8.15.1 General

The Contractor shall be responsible for the complete testing commissioning of all the electrical systems that form part of Sub Contract works.

1.8.16 Not Used

1.8.17 Public Address System

The Contractor shall design, supply, install, connect, test, commission and set to work a public address system.

1.9 Mechanical Ventilation

Remove electric heaters from ducted ventilation systems and refurbish and reinstate mechanical controls for the complete ventilation system.

1.10 Main LV Distribution

1.10.1 General

The Contractor shall provide a new main incoming power supply cable from the dockside feeder pillar to the vessel. The design shall allow for the external conditions and the movement of the vessel. The Contractor shall also note the requirement for vessels to come alongside the HMS Warrior. The Contractor shall connect the incoming cable to a new a main incoming switchboard within the ship.

Residual current protection shall be provided in the feeder pillar and on the vessel and shall show selectivity with RCD units provided on the vessel.

An existing feeder pillar provides the electrical supply to the ship. The feeder pillar is connected to a 400A incoming feeder pillar supply. There is also a small garage type consumer unit that feeds some local power on the jetty which is to be removed. The complete feeder pillar shall be substituted with a new equivalent feeder pillar unit suitable to house all new equipment incorporating a new IP65 distribution board with incoming and outgoing protective devices to feed a loval 32A IP65 socket and future dockside supplies. Replace incoming supply.

The 400A MCCB is to be stripped out and replaced with a new Schneider NSX 400 MCCB with earth leakage protection as Schneider NSX400 Vigi MB with the following characteristics;

- Adjustable sensitivity from 300mA to 30A
- Adjustable time delay
- Intentional delay from 0 to 310ms
- Max break time from <40 to <800ms
- Rated voltage 200...440 – 440...550

The MCCB is to be housed in an IP65 enclosure within the feeder pillar. An adjustable form of main RCD protect shall be provided to both feeder pillar and on the vessel.

The contractor shall include for any upgrade/amendments required at the feeder pillar location and removal of any redundant supplies.

1.10.1.1 Main Intake Switchboard

The Contractor shall provide a main intake switchboard.

The main intake switchboard shall be frame mounted panel board as Schneider Power Pact 4 and shall be in accordance with BS EN 60439-1 and BS EN 60529 IP31. Switchboard short circuit withstand capacity shall be 36kA for 1 second. Switchboards shall be front access. Cable exit shall generally be top entry but incomers shall be bottom entry.

The switchpanel shall be complete with a dedicated incoming section for metering of incoming services complete with CIT arrangement of an appropriate size for the services.

The number of outgoing MCCB units shall be to suit the number of distribution boards plus 20% spare capacity.

Busbars shall be 400A TPN+E HDHC copper section to BSEN 60439-1 and shall have short circuit withstand of 36kA for 3 seconds. A copper earth bar shall run the full length of the switchboards. All busbars LSOH sleeved.

Full designation labels shall be provided by the manufacturer and shall be manufactured from Traffolyte.

The switchboard shall be finished epoxy polyester powder coat RAL 9001 cream.

The switchboard shall be equipped with Schneider NS MCCB 4 pole normal supply incomer with RCD unit

The switchboard shall be complete with outgoing moulded case circuit breakers.

All outgoing switchboard ways shall be clearly labelled with circuit description, protective device fitted and outgoing cable type and size. Labelling shall be both internal and external on the front of each MCCB enclosure.

All meters for incoming and all outgoing supplies shall be MID compliant multi-function as Schneider PM5110 and provide the following information: -

- KWH;
- Voltage PP P/N;
- Current on each phase;
- Active power including min and max;
- Reactive power;
- Apparent power;
- Power factor;
- Frequency;

- Harmonies;

- Clock – real time and date;

- Outputs – pulsed/Modbus.

Digital metering shall be provided and the switchboard shall incorporate all necessary current transformers, protection fuses etc. Metering shall be compatible with and connected to the central metering system.

The switchboard shall incorporate a TPN MCCB to supply a Furse ESP415M1 surge suppression unit.

3 Spare MCCB's shall be provided for future expansion

Issue full switchboard type test certificate for approval.

A framed schematic diagram shall be provided to the LV intake and shock notice, etc.

- SWITCHBOARD MOULDED CASE CIRCUIT BREAKERS

  Moulded case circuit breakers shall be manufactured in accordance with BS 4752 Part 1 with the frame ratings and trip settings shown on the drawings.

  Moulded case circuit breakers shall be as Schneider compact NS/NSX range or equal with thermal and magnetic fault protection. MCCB's shall have a breaking capacity of 50kA service Ics.

  Circuit breakers shall have trip free toggle operating mechanisms with internal cross bar to ensure common tripping of all poles. Manual reset shall be required after fault trip regardless of motorisation control.

The moulded case wall mounted switchboard shall include supplies as follows;

- TPN – Lighting static inverter unit

- TPN – Lighting static inverter unit (Essential Supplies)

- TPN – Power DB – Forward

- TPN – Power DB – Mid

- TPN – Power DB – Aft

- TPN – Surge Suppression

- SPN - Fire Alarm Panel

- SPN – Security Panels

- TPN – Kitchen

- TPN – Kitchen

- SPN - Shop

- TPN – As required for other distribution boards

- TPN – Spare – 20% spare requirement

All breakers to be sized as part of the contractor design duties and protection setting detailed.

At the main intake position the Contractor shall provide the means of Galvanic Isolation (Isolating Transformer) in compliance with BS7671 Section 730.

1.10.1.2 System Of Electrical Distribution

The Contractor shall design, supply, install, connect, test, commission and set to work a complete low voltage distribution system including switchgear, distribution boards, cables, cable tray, supports and fixings and all ancillary equipment required to form a complete and satisfactory installation.

Sub main distribution circuit cables shall comprise cross linked polyethylene insulated, steel wire armoured cables with low smoke and zero halogen sheaths (XLPE/SWA/LSOH).

Sub main distribution circuit cables shall be installed on heavy duty marine grade stainless steel cable trays or heavy duty galvanised steel cable ladders utilising single or two bolt LSOH cleats at Manufacturers recommended fixing centres. Cables shall be installed as a single layer.

Cables shall be identified by unique cable reference numbers using cable identity markers. This cable identity shall be fixed at all terminals and at 10 metre intervals along the length of run. Markers shall be engraved traffolyte or approved alternative.

All cables shall be BASEC approved.

Cable trays shall be of the return flange type. Cable trays shall be of the heavy duty marine grade stainless steel. Cable trays and cable ladders shall be solidly fixed from the vessel structural steelwork utilising marine grade stainless steel clamp type fixings. Insulators shall be provided as necessary to meet the Galvanic isolation proposals. The Contractor shall allow for all cables, tray, trunking sets, bends, tees, offsets etc. which shall be proprietary manufactured items wherever possible and included in the tender. Site made fabrication/cuts shall not be accepted unless agreed by the Project Manager.

External switches shall be weatherproof as BG IP55 range. Switches shall be 3 pole 40 amp IP65 rated or 6 pole 63 amp IP54 rated.

Cable containment shall be routed within the horizontal and vertical voids within the vessel which the Contractor shall note are confined working spaces.

1.10.1.3 Submain Fire Rated Cables

Fire rated main supply cables for sub main services shall be armoured cables as DRAKA FIRE TUF FTP120 or equal. Cables shall be in accordance with 120 minute fire rating of BS8519: 2010.

1.10.2 Not Used

1.10.2.1 Rubber Matting

Rubber matting shall be provided to the main LV intake switchroom to run the full length of all distribution boards and switchboards. Rubber mats shall be to BS921 and shall be 900mm wide.

1.10.2.2 Metering

A system of meters shall be provided to all distribution boards throughout the ship.

Meters shall be provided to main incoming switchgear and to all distribution boards.

Provide all necessary current transformers for meters as required.

All meters shall be compliant with the MID certification scheme. (European Measuring Instruments Directive).

All meters shall display current, voltage, frequency, energy (maximum demand and energy (KWH). Meters shall be suitable for remote communication and shall be equipped with Modbus comms outputs. Meters shall be complete with provision for digital inputs and a Modbus output which shall be in accordance with the required protocol of the BMS system detailed in the mechanical specification.

1.10.2.3 Distribution Boards

The moulded case circuit breaker MCCB board shall provide supplies for lighting distribution boards, power distribution boards, fire alarms etc. The number of distribution boards shall be determined by the Contractor but shall include the following as a minimum;

Power DB – Forward

Power DB – Mid

Power DB – Aft

Lighting DB – Forward

Lighting DB – Mid

Essential Lighting DB - Mid

Lighting DB – Aft

Kitchen DB

Kitchen DB

Shop DB

All lighting DB's shall be fed from a static inverter so as to provide a 3 hours backup for all lighting.

An essential lighting distribution board shall be fed from a static inverter and this board shall feed selected luminaires (30% approx) in general circulation areas

The Contractor shall provide single & three phase distribution boards. Distribution boards shall be surface mounted metal clad pattern with integral isolating switches in accordance with BS5486 Part 12 and BSEN 60439-3. Distribution boards shall be as Schneider.

Distribution boards shall have an integral main isolator and residual current circuit breakers (RCD/RCBO's). Each sub-distribution board shall be provided with at least 25% spare capacity and outgoing ways. MCB's shall be in accordance with BSEN 60898 and BSEN60947-2.

RCBO's shall be in accordance with BSEN 61009. All circuits shall be protected by RCBO devices. All RCBO's shall have a 16KA fault rating (Icu). Distribution boards shall be as Schneider Isobar or equal.

The Contractor shall provide AFFD (Arc fault Detection Devices) to all final circuits. AFDD devices shall be in accordance with BSEN62606.

All unused ways shall be fitted with blanks.

DB's shall be fully labelled with Board Reference. Labels shall be Traffolyte.

DB Charts shall be provided, encapsulated. Warning labels shall be provided.

All distribution boards shall be fitted with key operated locks.

All distribution boards shall be equipped with surge protection devices.

1.10.2.4 Distribution Board Charts

The Contractor shall provide new typed and laminated circuit identification charts to all distribution boards. These shall be installed inside the distribution access cover. Each schedule shall indicate as a minimum;

Circuit references

Breaker size

Cable type and size

Final load details (e.g. Studio Lighting)

Incoming cable details including Ze and S.C.C.

1.10.3 Additional Dockside Services

The contractor shall provide new feeder pillar at the existing feeder pillar position. The feeder pillar will house a switch fuse unit and external distribution board to serve IP rated socket outlet on the dockside for events. All equipment within the existing feeder pillar shall be replaced as previously described.

The new feeder pillar shall be marine grade stainless steel construction with epoxy paint finish, IP rated to IP65. Vandal resistant locks and hinges.

The distribution board shall be IP 54 rated and suitable for exterior use. It shall have 6no. 32A Power MCB's & 6no. 10A Lighting MCB's

The sockets are to be as MK Ingress protected IP67 commando outlets.

1.11 Lightning Protection And Earthing

1.11.1 Not Used

1.11.2 Earth And Equipotential Bonding System

The Contractor shall design and provide a complete earthing system in full compliance with BS 7671, The 18th Edition IEE Wiring Regulations including amendments British Standards Codes of Practice and the local Electricity Boards P.M.E requirements.

Th earthing system shall connect to the dockside earthing provision. Provide galvanic isolation as required by BS7671 Section 730.

RCD protection shall be provided to the complete vessel as well as to each final circuit. Selectivity shall be achieved and the main RCD device have residual earth settings and time settings.

Earth bars shall be provided as required. The Earth bars shall be 50mm x 6mm copper and wall mounted on insulators. The bars shall have disconnector for the main connection.

Protective earthing shall be carried out utilising XL-LSOH cables on marine grade stainless steel cable ladder and cable tray.

The Contractor shall earth and bond all services in accordance with BS7671.

All connections from protective conductors to the relevant pipework etc shall be made with clamps complying with BS 951.

1.12 Small Power Installation

The Contractor shall design, supply, install, connect, test and commission and set to work a complete small power and ancillary services installation including all equipment, wiring accessories, cables, cable containment, fixings, supports, and all ancillary items required to provide a complete and satisfactory installation.

The contractor shall include within the tender a temporary 3 phase builders supply joined to the existing feeder pillar.

1.12.1 System Of Wiring

The Contractor shall provide a complete system of small power and ancillary services detailed within this specification.

The Contractor shall rewire and disconnect the central control panel in the main intake serving the ducted heating system. All ducted heating shall be rewired. A new control panel for ducted

ventilation only shall be provided and the ducted ventilation system fully refurbished tested and commissioned.

The system of wiring shall be concealed within the carcass of the vessel.

The system of wiring shall be as FP 200 Plus cables on marine grade stainless steel cable tray. Cables to be white in sheath colour with Low Smoke Zero Halogen outer sheath. Cable to meet the following standards:

BS EN 50200, PH120

BS 5839-1, 6, 8 & 9 'standard' fire resisting cable

BS 5266-1 'standard' fire resisting cable

BS 8519 Category 1 control cable

BASEC approved

All cable clips for fire cables shall be LSOH covered stainless steel.

The system of wiring shall be concealed within the carcass of the vessel. There are existing horizontal voids and vertical voids within the vessel which shall be utilised as routes for cable containment. The Contractor shall be responsible for opening up access to the voids including removal of bolted covers. Timber panelling removal where required for rewiring shall be identified by the Contractor and reviewed by the Clients specialist.

Cables routed from the service void cable tray system to final electrical outlets shall be concealed and follow routes agreed with the project manager.

1.12.2 Wiring Accessories

Socket outlets, fused connection units etc to where concealed from view shall be as MK Logic Plus white plastic finish and shall be as MK Metalclad Plus in plant rooms. Wiring accessories and shall be as Wandsworth special plate finish in all visible areas as agreed with client, e.g. antique bronze etc. Provide client with display case of samples of all available finishes for client selection included in tender sum. It is likely that different finishes will be required to different areas.

Shaver outlets shall be dual voltage to BSEN 61558.

Socket outlets shall be 13A three pin switched to BS1363.

The Contractor shall allow for new socket outlets and wiring accessories throughout and shall generally allow for new twin switched sockets with single sockets agreed as part of the design development.

The Contractor shall provide all necessary supports for the mounting of wiring accessories.

1.13 Power To External Areas

1.13.1 External - Small Power

All external power outlets shall be grey plastic UV resistant TSSO outlets with integral RCD protection and shall be from the BG IP55 Range. These shall be as indicated on the drawing.

External isolators shall be IP65 rated as manufactured by Craig and Derricott.

The Contractor shall allow to provide IP55 outlets in all internal areas of the vessel in which an IP rated design is required due to the environment.

1.14 Electrical For Mechanical Services

The Contractor shall fully co-ordinate all electrical supplies to mechanical equipment and shall allow for the installation, testing and commissioning of all elements of the electrical installation associated with the mechanical equipment and controls installation.

The Contractor shall ascertain the electrical requirements of all mechanical plant and shall ensure that the correct supplies are provided.

The Contractor shall provide all power cabling, power containment etc. to the mechanical control panel positions:

Provide a new control panel to the ducted ventilation system and remove all duct heater batteries and reinstate the system including ductwork modifications.

1.15 Outlets for Heater

Refer to Appendix A2 for the required location of IP65 16A heater sockets which shall, be wired on dedicated final circuits. Sockets shall be as MK Commando. Refer to Appendix A2 for nominal locations but include for an additional 8 No. locations for tender purposes.

1.15.1 Not Used

1.15.2 Not Used

1.15.3 Not Used

1.16 Lighting Systems

1.16.1 Lighting Installation

The Contractor shall design, supply, install, connect, test and commission and set to work the complete lighting installation including luminaires, lamps, equipment, wiring accessories, lighting controls, cables, cable containment, fixings, supports, and all ancillary items required to provide a complete and satisfactory installation.

The Contractor shall design a complete lighting and emergency lighting system throughout the vessel. Lighting shall be in accordance with CIBSE Lighting Guides and Emergency Lighting shall be in accordance with BS5266.

The lighting installation shall be fed from three dedicated distribution boards, one located forward, one middle and one aft. The three lighting distribution boards shall be fed from the main intake MCCB board via a static inverter system

An essential lighting installation shall be fed from one mid distribution board fed from a dedicated MCCB via a separate static inverter system

All luminaires shall be either centrally switched or under localised PIR/manual switch.

The contractor shall allow for 2 way switching for access and egress of ship from both brows to the control room.

Central public walkways shall be centrally switched from the main control room

The contractor shall supply, install, connect, test and commission new LED handrail lighting to ladders along all visitor routes which shall be switched centrally, the contractor shall also provide a cost only to provide LED handrail lighting to ladders which are not on the visitors routes, these shall be switched locally.

LED handrail lighting will require handrails to be removed and routed by specialist as required with protected LED lighting tape provided to the handrail as per the detail on HMS Victory which is available for inspection on site. All associated works by the Contractor. Provide sample for approval. Visit HMS Victory to ascertain the full nature of the work.

1.16.2 System Of Wiring

The system of wiring shall be as FP 200 Plus enhanced cables on marine grade stainless steel cable tray. Cables to be enclosed in galvanised steel conduit on walls. Cables to be white in sheath colour with Low Smoke Zero Halogen outer sheath. Cable to meet the following standards:

BS EN 50200, PH120

BS 5839-1, 6, 8 & 9 ‘standard’ fire resisting cable

BS 5266-1 ‘standard’ fire resisting cable

BS 8519 Category 1 control cable

BASEC approved

All cable clips for fire cables shall be LSOH covered stainless steel.

The system of wiring shall be concealed within the carcass of the vessel. There are existing horizontal voids and vertical voids within the vessel which shall be utilised as routes for cable containment. The Contractor shall be responsible for opening up access to the voids including removal of bolted covers. Timber panelling removal where required for rewiring shall be identified by the Contractor and removed and reinstated by the Clients specialist.

Cables routes from the service void cable tray system to final electrical outlets shall be concealed and follow routes agreed with the Project Manager.

1.16.3 Wiring Accessories

Lighting switches shall be as MK Logic Plus White Moulded range with white plastic finish where non visible or shall be MK Metalclad Plus type in plant areas. Wiring accessories shall be as Wandsworth special plate finish to be agreed with the Client in all visible areas e.g antique bronze etc. Provide client with display case of samples of all available plate finishes for client selection. The selection of any finish shall be included in the tender sum. It is likely that different finishes will be required to different areas.

Switches shall be compatible with the lighting control system.

Light switches shall generally be flush mounted.

Light switches shall be mounted at the heights that comply with building regulations.

The Contractor shall provide all necessary supports for the mounting of wiring accessories.

1.16.4 General

The lighting installation shall be designed in accordance with the CIBSE/SLL Code for Lighting 2012 and all relevant CIBSE Lighting Guides.

Luminaires shall be equipped with high frequency ballasts and shall be high efficiency LED light sources throughout.

The LED colour temperature shall be agreed with the Client to suit the historic nature of the vessel. The colour temperature shall be consistent throughout. The colour rendering index of the source shall be minimum 90, ROHS compliant, efficacy minimum 130 lumens per watt. LED lamp life shall be 50,000 hours tested utilising LM-80 standards to demonstrate LT70 compliance.

All luminaires shall be solidly fixed from the building structure with all necessary intermediate supports provided as required.

Where new luminaires ae required they shall be of an equivalent standard as the existing but shall be high efficiency LED and shall be IP65 rated in all relevant areas both externally and internally where the internal environment requires.

All luminaires shall be provided complete with appropriate drivers and transformers. Each luminaire shall be provide with a plug type connection for disconnection and removal.

All luminaires shall be supplied and installed by the Contractor. The Contractor shall allow for obtaining a sample of each and every light fitting for review/approval prior to installation. Samples will be needed on site shortly after (within 3 weeks) of the Contractor starting on site and in accordance with programme requirements.

Existing Historic ships lanterns shall be fully refurbished as part of the contract works. The number of lanterns and types are detailed in Appendix A3. The breakdowns of types and location are indicative but the Contractor shall make an allowance for the refurbishment of 285 historic lantern fittings.

The Contractor shall engage a specialist for the internal rewiring and relamping and refurbishment of the historic lanterns. The Contractor shall advise the proposed specialist and the proposals for refurbishment with the return of tender.

All lanterns shall have a full electrical rewire and electrical refurbishment with the provision of high efficiency LED lamp sources. All shall be fully internally rewired. New lamp holders shall be provided and these shall be small Edison screw type throughout.

All existing brass fittings shall be visually refurbished, police lanterns have glazing replaced with clear polycarbonate and shall be stripped and relaquered, bulkheads shall be repaired and relaquered, gimballs shall be repaired and relaquered and sconces repaired and relocated.

On completion of the lighting installation the Contractor shall carry out a full set of lighting level measurements throughout both internally and externally and shall issue a complete set of drawings indicating the illumination levels.

Provide one sample of each historic lantern after refurbishment for client approval.

1.16.5 Not Used

1.16.6 External Lighting

The complete external lighting installation shall be completed utilising equipment and ancillary items rated to IP65 minimum.

The Contractor shall provide IP65 luminaires to all external areas of the vessel as well as internal areas that warrant an IP rated design due to the internal environment.

The following works are required to the masts: -

- New flood lights to fore, main and mizzen tops illuminating the deck;
- New CCTV cameras to the fore and main tops;
- Speakers to the fore, main and mizzen cross trees for the bird scarer;
- New WiFi box;
- Supplies for Xmas Lights (lighting will be by others and method for plug in connection to be provide and agreed).

The Contractor shall engage with NMRN Master Rigger in terms of executing these works and high level works shall be installed by the Master Rigger from agreed interface points (IP67 Connection boxes) on the Contractors behalf.

1.17 Lighting Control Specification

Luminaires shall be manually switched or PIR controlled where indicated.

1.18 Lighting System Ups

1.18.1 Emergency Lighting

The contractor shall design, supply, install, test and commission a 3 hour emergency lighting supply to all luminaires and shall be provided by the emergency lighting static inverter unit. The central emergency lighting system shall be fully compliant with BS 5266-1 and BS EN 50171.

The system shall operate on a switch maintained basis.

Standard features shall include;

- Battery recharge of 12 hours to 80% of specified duty
- Battery de-rated for end of life, at 20°C to 1.8V/cell end of discharge voltage
- Monitoring of open battery circuit breaker

- Engineers test key switch with timer
- Inverter rated for 120% of the rated system load for the rated duration
- System configured with Active Standby capability - for energy efficient emergency lighting
- Solid state changeover device - not contactor controlled
- Remote monitoring via volt free contacts
- Full microprocessor control panel including diagnostics and mimic diagram
- User friendly interface includes: measurements, alarms, mimic indications & data logger system
- Designed for front maintenance access

All luminaires shall be fully refurbished and repaired.

The contractor shall design, supply, install, test and commission a 3 hour emergency lighting static inverter which shall include a separate batter backed supply to essential luminaires. The system shall be fully compliant with BS 5266-1 and BS EN 50171 and shall include all of the above features.

The combined static inverter system shall provide a resilient battery backed lighting system for the vessel.

The Electrical Contractor shall carry out an emergency lighting illuminance test to prove compliance with BS5266. The Electrical Contractor shall allow for this process to be repeated on two separate occasions outside of normal hours for witnessing and verification purposes.

Emergency lighting test and completion certificates in accordance with BS5266 shall be provided.

Provide an Emergency lighting test log book within the operating and maintenance manuals.

The contractor shall provide adequate ventilation to the static inverter room.

Illuminated exit signs shall be provided along visitor routes detailed in the luminaire schedule.

Provide 2 weeks' notice of all tests and invite a representative of the Services Engineer's to witness all tests.

The Contractor shall include the inverter systems for tender purposes and shall carry out a full evaluation of the available space, environmental conditions and environmental requirements of the inverters . The Contractor shall also review the option of conversion battery packs as an option and shall report to the Client.

1.19 Schedules Of Lighting And Small Power Equipment

The contractor shall conduct a full survey of all rooms on the ship to ascertain the full extent of the rewire. Areas indicated below are of the principle areas but do not encompass all areas of the vessel.

All areas to be fully rewired.

1.19.1 Cable Deck Forward

Light fittings around the perimeter to be refurbished.

Light fittings to be refurbished and to go back in original positions.

4 x uplighters to be removed permanently and 3 Amp supply to sockets to be removed permanently.

New 2 x 13A Twin Sockets to be hidden at high level in cupboard.

Lights to be switched centrally in existing control room.

13A Single Sockets to be kept hidden in shelving units and lights to be hard wired to a switched fuse spur unit. All new.

Ships police lighting in the Midships area to be controlled centrally in the existing control room.

12 Sconces, 2 Police lanterns - 14 total existing luminaires to be refurbished.

12 new single switched sockets

2 new Speakers

1.19.2 Sick Bay

Lighting to be switched centrally in control room.

Lights to be refurbished, keep original positions.

Add in new strip lighting and a new socket to aid the cleaners in agreed position.

New LED strip lights to be added in the stair handrails – Refer to handrail lighting requirements in the specification.

5 historic bulkheads to be refurbished.

New cleaners socket and LED strip to be positioned near the cupboard in agreed location.

1.19.3 Sail Store

Not on a visitors route, so lighting to be controlled via new PIR.

New 1 x 13A Twin Sockets at high level (hidden above hatch to void space).

3 x new light fittings – 2 small Pizza lights and 1 large strip light to be replaced with equivalent.

1.19.4 Void Space

Nothing to be fitted in way of lighting or power.

Lighting and power to aided by festoon lights and temporary power by socket above hatch.

1.19.5 Main Gun Deck – Mid Section

Lighting area to be switched centrally in control room. All lighting to be refurbished

Each shelf unit to have a new 13A single socket and new fused spur for light.

New PA speakers to sit above shelfing unit – on show.

Funnel space lights to be refurbished and to go back to original positions.

1.19.6 Gun Deck Galley

Lighting to be switched locally in Galley.

Refurbishment of light fittings, to go back in original positions.

All electrical kitchen equipment wiring and accessories to be replaced with new like for like

1.19.7 Galley Seating Area

Tables 10-20 shall have new LED strip lighting installed, LED strip lights to be put on top of shelving unit, All new

New PA system – to double up and serve all announcements and entertainments etc.

To be included in Audio Specialist package.

1.19.8 Browns Capstans

New 2 x 13A Twin Sockets to be at high level. Using existing holes.

1.19.9 Routine's Desk

4 2-4 New 13A Twin Switched Sockets hidden at high level.

Existing lights to be refurbished and original positions to be kept.

1.19.10 Commando's Cabin

Refurbish picture lights from commando's cabin.

Light above the table to be removed and replaced with a new battery light visually the same to keep effect.

4 original lights to be refurbished and replaced in existing locations.

1.19.11 Gallery's Store Room

Light fittings to be refurbished and put back into original positions

1.19.12 Quartermasters Mess

4 historic Sconces to be refurbished, 4 new Sockets

Current positions of lights to be maintained and switch locally in mess room.

Refurbish all current light fittings.

Fan to remain

New sockets keep current positions and number.

1.19.13 Lobby Area

Current positions of lights and switched centrally.

Refurbish current light fittings.

New sockets keep current positions and number.

4 historic Bulk heads, 2 historic Police Lanterns to be refurbished.

2 new sockets

1.19.14 Volunteers Mess

Current positions of luminaires and switched locally in mess room.

Refurbish current historic light fittings.

New sockets keep current positions and number but replace for new.

New point of use water heater 3kW with new double pole switch.

8 Sconces, 2 bulkheads, 2 police lanterns to be refurbished.

1.19.15 Cabin

1 x light to be replaced with new.

1 x new PIR.

1 x new 13A Twin socket.

1 x light to be replaced with new.

1 x new PIR.

1 x new 13A Twin socket.

1.19.16 Old Shower Room

2 x lights to be replaced with new.

1 x new PIR.

1 x new 13A Twin socket.

1 5ft Fluorescent to be replaced with new LED equivalent.

1.19.17 Locker Room

1 x light to be replaced with new.

1 x new PIR.

1 x new 13A Twin Socket.

1 Pendant, 1 fluorescent, 1 socket all to be replaced with new equivalent.

1.19.18 Sail Locker

Lights to be refurbished and switched centrally.

Sockets keep current positions and number but replace for new hidden in sail locker accessed for cleaning only.

2 Sconces to be refurbished.

1.19.19 Cable Locker Flat

Lights switched centrally.

Refurbish current light fittings.

4 x new 13A Twin sockets, 1 in each corner.

New LED strip light on top of vent for use when cleaning.

4 Bulk Heads, 1 police Lantern to be refurbished.

1.19.20 Armoury

2 x lights to be replaced with new

1 x new PIR

1 x new 13A Twin Socket

3 Fluorescents to be replaced with new LED equivalent.

1.19.21 Shell Store

Original lights to be refurbished

Switched locally.

2 sconces to be refurbished.

1.19.22 Marines Flat

Lights switched centrally.

Refurbish current historic light fittings.

4 x 13A new Twin sockets, 1 in each corner.

New LED strip light on top of vent for use when cleaning.

10 Bulk Heads, 4 Police Lanterns to be refurbished

1.19.23 Chief Engineers Store

1 x new 13A Twin socket.

1 x light to be replaced with new.

Light switched centrally.

3 Bulk Heads, 2 Police Lanterns to be refurbished.

1.19.24 Musicians Office and Marines Store

2 x lights to be replaced with new

1 x new PIR.

1 x new 13A Twin Socket.

2 Sconces to be refurbished.

1.19.25 Issuing Store and Paymasters Store

2 x light in each compartment in current positions to be replaced with new.

Switched centrally.

1 x new 13A Twin Sockets hidden in each compartment.

2 Sconces to be refurbished

1.19.26 Pantry/Captains Steward

Point of use water heaters to be replaced with new double pole switches.

2 x new 13A Twin Sockets.

1 x new PIR

New Lighting required

1 5ft fluorescent, 2 twin Sockets, all new lighting to be LED equivalent.

1.19.27 Paper Stores

1 x new 13A Twin Socket.

1 x new PIR.

New LED strip lights required.

New 13A Twin Sockets to be above hatches to aid the use festoon lighting if need to gain access.

Possible locations for the Aft fuse board location.

2 Fluorescents to be replaced with LED equivalent, 2 new sockets. Server Room Data.

1.19.28 Chest Room

1 x light to be replaced with new.

1 x new PIR.

1 x new 13A Twin Socket.

2 Sconces to be refurbished.

1.19.29 Aft Magazine and Handling Room

Current positions of lights and switched centrally.

Refurbish current light fittings.

Heaters to be removed.

New 2 x sockets hidden, 1 in each apartment.

3 Sconces, 1 Police Lantern to be refurbished, 2 Sockets new.

Adjoining Lamp Room – 2 sconces to be refurbished.

1.19.30 Bread Room

As current layout. Lighting to be refurbished

Switched centrally.

All spot lights to be removed.

Engine room controls to remain in current position.

1 new emg Bulk head, 1 new socket

1.19.31 Engine Room

Re-design whole lighting in this area.

Remove all spot lights and coloured lights.

Sockets hidden.

Switched centrally.

Keep heaters locally, change to new equivalent.

7 police Lanterns, 12 bulk Heads, 3 Sconces – 22 total – luminaires to be refurbished

2 new sockets

Engine Workshop – 8 Pendants, 2 Emg Bulk Heads, 3 Sockets – all to be replaced with new

Boiler Room – 19 Bulk Heads, 5 police Lantern to refurbish, 16 sockets to be provided as new

Coal Stores – 2 Fluorescents to be replaced with LED equivalent.

1.19.32 Stairwell

1 x cleaners socket.

Emergency light above the door to be replaced

1.19.33 Cells

Sconce light in cells switched centrally. All sconce lighting to be refurbished

1.19.34 Cable Tier And Drying Room

1 x light to be replaced

1 x PIR.

1 x 13A Twin socket.

1.19.35 Handing Rooms

Sconce lighting to be refurbished

Current positions of lights and switched centrally.

1.19.36 Shop

Lights and switched locally.

Refurbish current light fittings.

Sockets keep current positions and number but replace for new.

1.19.37 Bathroom Flat

Lights switched locally.

Refurbish current light fittings.

Sockets keep current positions and number but replace for new

New LED strip light required on top of vent for use when cleaning.

1.19.38 Working Galley

Replace like for like to bring up to required standards.

1.19.39 Seaman's Flats

Lights switched centrally.

Refurbish current light fittings.

2 x 13A Twin Sockets on top of bag lockers hidden.

New LED strip light required on top of vent for use when cleaning.

Void spaces both Port and Starboard IP65, LED vapour proof fitting to be on a PIR.

1.19.40 Issuing Room Flat

1 x light in each compartment in current positions to be replaced.

Switched centrally.

1 x 13A Twin Sockets hidden in each compartment.

1.19.41 Gunroom Pantry

Sconce lighting to be refurbished

Centrally switched.

1.19.42 Clerks Office + Assistant Surgeons

1 x light to be replaced

1 x PIR.

1 x 13A Twin Socket.

1.19.43 Gunroom

Lights switched centrally.

Refurbish current light fittings.

Heaters to be removed.

4 x 13A Twin sockets, 1 hidden in each corner in possible locker.

1.19.44 Wardroom And Cabin Area

1 x light in each compartment in current positions.

Switched centrally.

Refurbish current Light Fittings.

1 x 13A Twin Sockets hidden in each compartment.

1.19.45 Officers Cabin Area

1 x light to be replaced

1 x PIR.

1 x 13A Twin Socket.

1.19.46 Surgeon And Assistant Engineers Office

1 x light to be refurbished

Refurbish current Light Fittings.

Switched locally in cabin.

1 x 13A Twin Socket.

1.19.47 Shaft Tunnel

Current layout. Lighting to be refurbished

Switched locally.

2 x 13A Twin Sockets.

1.19.48 Auxiliary Space

Spot lights to be removed.

Keep original layout. All other lighting to be refurbished

Switched centrally.

Spot light to show high step – possible trip hazard.

1.19.49 Fwd And Aft Boiler Room

Track lighting to be removed.

Behind boiler either side 4 x IP65 vapour proof strip lights on a local switch.

4 x 13A Twin Sockets each side of which one socket to be by entrance for cleaners to use.

Hidden LED strip light to be fitted on top of boiler track to aid the cleaners exact position for this unknown as a trial is required.

Forward end strip light under the step.

1.19.50 Stairwell To Function Heads

Current layout. All lighting to be new

Switched centrally.

1.19.51 Function Heads

Re-design and re-wire deck head lights, hand dryer and macerator to meet the specified Regulations.

1.19.52 Gun Room Officers

2 x new twin socket outlet. One new luminaire.

1.19.53 Upper Deck

Replace all upper deck lighting like for like.

Replace all upper deck socket plus add 6 new IP65 socket

Add discrete provisions for concealed LED lighting.

Add LED lighting strips to all exercise canopies from upper deck to main deck.

1.19.54 Fore and Aft Brow

Handrail lighting.

1.19.55 All Main Deck Entrances/Canopies

New LED Lighting.

1.20 Life Safety Systems

1.20.1 Fire Alarm

1.20.1.1 General

The Contractor shall design, supply, install, connect, test, commission and set to work a complete fire alarm system shown on the drawings and detailed within this specification. The fire alarm system shall comprise all equipment, accessories, wiring, cable containment, fixings, supports and all other equipment necessary to form a complete and satisfactory system.

The complete fire alarm system shall be analogue addressable. The fire alarm system shall be in accordance with this performance specification.

The Contractor shall engage a fire alarm specialist to design the fire alarm system, provide all equipment and test, commission and certify the complete fire alarm system.

The fire alarm system control panel shall be capable of adjusting the device sensitivities and shall be able to programme alarm sensitivities and delay adjustments, day/night mode etc.

The Contractor shall provide a complete analogue addressable fire alarm system. The system shall be fully monitored. The fire alarm system shall be in accordance with BS 5839 Part 1: 2017 Category L1. In specific limited areas relaxations to the L1 requirements may be agreed by the Client due to the specific construction of the vessel and so the system will be classified BS5839 L5 although will be expected to meet L1 standards in all but limited agreed specific areas. All equipment shall comply with the relevant sections of BS EN 54. All equipment shall be LPCB approved.

The system voltage shall be 24V DC and shall operate as detailed within the fire cause and effect. The fire alarm system shall be complete with addressable loops. Each loop shall have a minimum of 20% spare capacity for future detection devices and 20% spare capacity for future sounder devices. Short circuit isolation devices shall be provided at each zone boundary minimum.

The Contractor shall provide loop wired addressable detector devices, addressable sounder devices, addressable beacons, addressable interface units etc, in the positions shown on the drawings. Sounder devices and beacons shall be provided as a complete integral unit with the associated detector. Detector bases shall be of the plug in type. Bases shall be common and shall have anti removal facility.

The Contractor shall provide a microprocessor based, analogue addressable fire alarm control and indicating panel in accordance with BS5839 and BS EN 54. The fire alarm panel shall be surface mounted in the ships control room with standard manufacturers finish. A keyswitch shall be provided to isolate interfaces during panel/system testing with auto return after set time period.

The Contractor shall include with the tender for a repeat fire alarm panel, position to be agreed near the entrance to the vessel.

The complete fire alarm system shall be provided with an autodialler unit which shall be connected to the Historic Dockyard Security Office.

The fire alarm panels shall be complete with 40 character text information and zonal indicator LED units. The number of fire alarm zones shall be determined by the Contractor but shall generally comprise zones for each floor level, zone for staircase, zone for each plant areas, etc.;

The control panels shall be fully fitted with the facility for providing a remote alarm to the Dockyard Security Office via an autodialler.

The fire alarm system shall be complete with integral sealed lead acid batteries as required to give a standby power supply of 72 Hours with facility to operate the system in full alarm for a further 30 minutes.

Fire alarm detection, sounder and ancillary devices shall be provided. Heat detectors shall be in accordance with BSEN 54-5, Smoke detectors shall be of the optical type and shall be in accordance with BS-EN 54-7, and sounders shall be of the electronic sounder type and shall be in accordance with BSEN 54-3. In general detection devices shall be of the combined optical smoke and heat element type.

All sounders shall be loop powered. All sounders emit the same alarm tone.

The Contractor shall provide visual zonal indication relating to the layout of all building areas at the main fire alarm panel position showing the arrangement of zones in accordance with the requirements of building control.

The system of wiring shall be PH 120 as FP 200 Plus enhanced cables on Marine grade stainless steel cable tray.

All cable clips for fire cables shall be LSOH covered stainless steel.

The Contractor shall provide addressable fire alarm interface units where shown on the drawings. Interface units shall be provided to the following systems which shall operate in conjunction with the fire alarm cause and effect: -

- Mechanical control panels;

The fire alarm system shall general operate on the double knock principle as follows: -

- First knock – Interface with above systems

- Panel indication
- Initiate sounders

– Second knock – Initiate autodialler.

The fire alarm system shall be fully tested and commissioned and full test certification shall be provided in accordance.

A set of drawings shall be provided indicating the achieved sound levels by the fire alarm system sounders in each area.

The Contractors fire alarm specialist shall develop the full and final fire cause and effect. This final cause and effect shall be issued to the design team for final sign off. The cause and effect shall be in accordance with the fire strategy report.

The Contractor shall include within the tender for the fire alarm specialist to carry out two fire alarm services visits during the defects liability period. One visit shall take place after six months and one after twelve months.

The Contractor shall provide a fire alarm system and smoke vent fire system log books along with all other record and operation and maintenance information required by the specification

1.20.1.2 Not Used

1.20.1.3 Not Used

1.20.1.4 Not Used

1.20.1.5 Fire Strategy/Cause & Effect

The Contractor shall develop a cause and effect document for the fire alarm and issue to all parties for comments.

1.20.1.6 Not Used

1.20.1.7 Installation Requirements

Refer to specification. Comply with all installation requirements of BS5839, all parts.

1.21 Security Systems

1.21.1 Security Specialist

The Contractor shall engage a Security Specialist to provide a complete CCTV system. The Security Specialist shall be NSI certified to Gold Standard.

The CCTV system shall be in compliance with the BSEN 62676 series. The new CCTV system shall maintain the CCTV coverage of the existing system as a minimum.

1.21.2 Scope Of Works

The Contractor shall design, supply, install, programme, test and commission a complete CCTV with facility for future expansion.

The CCTV system shall include the following: -

- An IP based CCTV system to cover the external and internal areas of the vessel. The number of CCTV cameras shall match the existing quantity of the vessel and the contractor shall provide a schedule of proposed provision at the tender stage;
- 2 No. CCTV monitors shall be provided in Portsmouth Dockyard Site Security Office linked by Broadband Connection;
- Two number CCTV system monitors shall be provided in the Ship Main Control Room;

- CCTV cameras shall be fixed colour and shall provide adequate coverage of the specified areas. The Security Specialist shall design the system to provide fully satisfactory coverage of the specified areas and to operate in the daytime and night-time lighting conditions present in each area;
- Control equipment and digital recording facilities shall be provided. Digital recording shall include for a frame rate of 24fps and data storage for all cameras on the system for a minimum of 30 days;
- CCTV system to be capable of future expansion;
- The system shall be satisfactory for the purposes of facial recognition.

1.21.3 Not Used

1.21.4 Not Used

1.21.5 Not Used

1.21.6 Not Used

1.21.7 The CCTV System Specification

General Requirements

The CCTV system is intended to provide assistance to the NMRN staff in the monitoring of the vessel. The cameras shall be positioned to provide surveillance of key areas internally and externally.

All cameras shall be monitored by the Site Dockyard Security office, and controlled and monitored by the ships control room office

Video Recording System

The CCTV system shall be provided on HIKVISION 32 channel IP digital recording systems of rack mountable servers for IP cameras as HDVR Digital Video Recorder ranges. The system shall be accessible via web browser with user definable permissions and privileges. Number of cameras to be accommodated will be all active cameras plus 10 number spare.

The contractor shall specify the size of hard drive capacity to enable storage for a minimum of one calendar month.

Redundant storage shall be provided. Transfer of recorded data shall be via web browser and a DVD writer included within the tender.

The recording facility shall be provided in control room office.

Specification as follows: -

Video Input and Transmission

- 2 x 32-ch IP cameras can be connected
- Connectable to the third-party network cameras

HD Video Output and Decoding

- H.265/H.265+/H.264/H.264+/MPEG4 self-adaptive;
- Up to 8-ch decoding at 1080p resolution;
- HDMI1/VGA1 and HDMI2/VGA2 simultaneous outputs provided;
- HDMI1 output at up to 4K (4096 x 2160) resolution.

Storage and Playback

- Full channel recording at up to 12 MP resolution;
- Up to 8TB capacity for each HDD supported;
- HDD hot swap with RAID0, RAID1, RAID5, RAID6 and RAID10 storage scheme configurable;
- 8-ch synchronous playback at 1080p resolution

Smart and POS Function

- Supports multiple VCA (Video content Analytics) events;
- Smart search for the selected area in the video; and smart playback to improve the playback efficiency;
- Supports VCA search for fire/ship/temperature/temperature difference detection triggered video files;
- POS information overlay on live view and playback;
- POS triggered recording and alarm.

Professional and Reliable

- ANR technology to enhance the storage reliability when the network is disconnected;
- Configurable normal or hot spare working mode to constitute an N+1 hot spare system.
-

Network & Ethernet Access

- Hik-connect for easy network management'
- 2 Gigabit Ethernet network interfaces.

Video/Audio input	IP video input	32-ch
	Incoming bandwidth	320 Mbps, or 200 Mbps (when RAID is enabled)
	Outgoing bandwidth	256 Mbps, or 200 Mbps (when RAID is enabled)
Video/Audio output	Recording resolution	12 MP/8 MP/6 MP/5 MP/4 MP/3 MP/1080p/UXGA/720p/VGA/4CIF/DCIF /2CIF/CIF/QCIF
	CVBS output (Optional)	1-ch, BNC (1.0 Vp-p, 75 Ω), resolution: PAL: 704 × 576, NTSC:
	VGA1 /HDMI1 output resolution	VGA1: 2K (2560 × 1440)/60Hz, 1920 × 1080/60Hz, 1280 × 1024/60Hz, 1280 × 720/60Hz, 1024 × 768/60Hz HDMI1: 4K (3840 × 2160)/60Hz, 4K (3840 × 2160)/30Hz, 2K (2560 × 1440)/60Hz, 1920 × 1080/60Hz, 1600 × 1200/60Hz, 1280 × 1024/60Hz, 1280 × 720/60Hz, 1024 × 768/60Hz
	VGA2 /HDMI2 output resolution	1920 × 1080/60Hz, 1280 × 1024/60Hz, 1280 × 720/60Hz, 1024
	Audio output	2-ch, RCA (Linear, 1 KΩ)
Decoding	Decoding format	H.265/H.265+/H.264/H.264+/MPEG4 self-adaptive
	Live view/Playback resolution	12 MP/8 MP/6 MP/5 MP/4 MP/3 MP/1080p/UXGA/720p/VGA/4CIF/DCIF
	Synchronous playback	16-ch
	Capability	2-ch @ 8 MP (30fps) /8-ch @ 1080p (30fps)

VCA	VCA detection	Human body detection, face detection, vehicle detection, line crossing detection, intrusion detection, region entrance detection, region exiting detection, unattended baggage detection, object removal detection, audio loss exception detection, sudden change of sound intensity detection, and defocus detection
	VCA search	Human body search, behavior analysis, face detection, fire/ship/temperature/temperature difference detection video files and pictures; people counting and heat map statistics
Network management	Network protocols	TCP/IP, DHCP, Hik Cloud P2P, DNS, DDNS, NTP, SADP, SMTP, NFS, iSCSI, UPnP™, HTTPS
Hard disk	SATA	8 SATA interfaces
	eSATA	1 eSATA interface
	Capacity	Up to 8TB capacity for each HDD
Disk array	Array type	RAID0, RAID1, RAID5, RAID6, RAID10
External interface	Two-way audio	1-ch, RCA (2.0 Vp-p, 1 k Ω)
	Network interface	2, RJ-45 10/100/1000 Mbps self-adaptive Ethernet
	Serial interface	RS-232; RS-485; Keyboard
	USB interface	Front panel: 2 × USB 2.0; Rear panel: 1 × USB 3.0
	Alarm in	16
	Alarm out	4 (8 optional)
General	Power supply	100 to 240 VAC, 50 to 60 Hz
	Max. Power	200 W
	Consumption (without hard disk)	≤ 70 W
	Working temperature	-10 to +55° C (+14 to +131° F)
	Working humidity	10 to 90 %
	Chassis	19-inch rack-mounted 2U chassis
	Dimensions (W × D × H)	445 × 470 ×90 mm (17.5"× 18.5" × 3.5")
	Weight (without hard disk)	≤ 10 kg (22 lb)

CCTV System

A schedule of the CCTV system and proposed cameras shall be provided with the return of tender. The system shall comprise cameras, switchers , CCTV monitors, digital recording and PTZ camera control.

All pictures shown on the monitors shall be as specified, or of an equivalent quality system, and digital storage media shall be included in the respective tenders together with any necessary requirements to maintain image quality

There shall be no noticeable deterioration in picture quality during the defects liability period.

The system shall be controlled in the ship control room with a keypad, joystick or mouse system at each position. The keypad, mouse or joystick system shall be able to select cameras and monitors at each position.

Each monitor output display shall have date, time and camera identification of up to twenty characters.

Cameras

All cameras shall be IP.

The Contractor shall provide details of field coverage for each camera. The contractor will be required to survey the site with the client's representatives in order to define the required field of view for each camera and to specify the lenses to meet this requirement.

The contractor shall specify IP colour/mono cameras with automatic white balance, back light compensation and motion detection.

Cameras shall be capable of operating at 12 or 24 volts.

Individual CCTV cameras shall be provided to: -

- Jetty
- Aft Gangway
- Fore Gangway
- Captains Cabin
- Half deck
- Cable deck
- Sick berth
- Fore starboard
- Aft Starboard
- Fore Port
- Aft Port
- Engineer Flat
- Cell Flat
- Ward Room
- Gun Room
- Lower Steering Flat
- Marine Flat
- Cell Flat
- Starboard Seaman
- Port Seaman Flat
- Laundry Flat
- Hoarding Room
- Engine Room
- Aft Stokehold
- Macerator Flat
- Rigging Cameras -
  - Supply and wire and final fitting by Shipwrights

This is the minimum number of cameras to be incorporated in the contractors design.

Lenses

Cameras shall employ fixed and varifocal focus lenses. Night time levels of illumination must be considered in the lens specification. Lens selection shall be by the Security Specialist.

A guide to the required field of view shall be as shown on the drawings. The Contractor shall ensure the pictures produced on the monitors show the required target area with maximum clarity - refer testing of CCTV System.

Monitors

Provide 2 No. CCTV monitors in the Ship Control Room.

The monitors shall be 19 inch flat panel LCD displays of an appropriate size according to the matrix configuration of cameras to the screen and the intended viewing distance.

The minimum resolution shall be 540 TV lines.

Monitors shall be free standing desk mounted.

Digital Recording

The digital recorder shall be able to record a minimum of 30 days recording of information in MP4 format and download copy files to DVD RAM or DVD RW (+/-). The recording system shall be capable of event, emergency, alarm and alarm search recall.

Recordings shall be in colour internally and externally colour day, monochrome night.

The unit shall be able to still frames during playback with pictures free of noise and picture movement and save still images separately as JPEG files complete with time/date camera address details.

Camera Housings

Housing shall be dome housings IP65 rated.

Commissioning

During commissioning of the CCTV system, a video test DVD shall be made of picture quality of each and every camera.

The methods and set-up for each camera test shall be detailed in writing and agreed with the Project manager.

The results of the tests as recorded on the test DVD shall be used as a bench mark at hand over and as a means of determining any deterioration over the defects liability period.

Un-interruptible Power Supply (UPS)

The Contractor shall supply a suitably sized UPS to support the PC and associated monitoring equipment.

The UPS's shall be of sufficient capacity to supply the power requirements for the security system for 1 hour (excluding equipment with battery backup).

The UPS's shall have at least a 50% continuous overload capability.

The UPS shall have the capability to accept standby power provided by others.

The UPS shall give a battery low alarm to the VDU at least 10 minutes before automatic shutdown of the UPS and not until after 15 minutes of running on healthy batteries.

The UPS shall give an alarm to the VDU when it is running on batteries.

The UPS shall give an alarm to the VDU when it is bypassed.

The Control Facilities

The Command and Control

The Command and Control facility for the Alarm reporting and CCTV system are to be an integrated system and the controls are to be sited in the control room Office. Central security will be manned by permanent staff.

Operation

The security system must be capable of operation by one Person. The each of the three console should be:

- Easy to understand and operate;

Video playback

There will be a graphics screen at each CCTV PC and monitor for Video playback. This screen will have buttons for all the main transport functions (play, stop, pause, fast forward rewind, forward search and reverse search). Users will have option to switch the video signal from the hard drive or DVD Ram directly to a monitor. Users shall be able to select which display mode to use. Duplicating recorded footage shall also be possible from this screen by using record controls that have been assigned to either a dedicated play back DVD drive in the system.

A sequence editor shall be provided to set-up camera sequences which display cameras on to monitors for preset individual dwell times per camera and view where applicable (i.e. pre-set functions of pan tilt & zoom). A number of timers shall also be available to allow sequences & events to be triggered automatically.

Support and future development of the software and CCTV equipment drivers must be available from multiple sources. Evidence of suitably qualified VARs (value added re-sellers), of the software package, along with evidence of the software development tools provided for them, are to be provided by the tenderer

CCTV Cameras

Internal Cameras

CCTV cameras shall be as HIKVISION.

All cameras shall be IP based high definition units providing a minimum specification of a Minidome Day & Night colour IP camera, with a fixed lens sized by Specialist to suit field of vision, 4MP, providing

30 ips, with a 24 infrared lens with a range of 25 approx. meters, 2.4 ONVIF compatible integral LED lighting.

The camera sensor shall provide accurate colour rendition through a wide variety of lighting conditions.

All cameras shall be suitable for operating in colour mode to a minimum illuminance of 0.05 lux, and shall then operate in b/w mode to a minimum illuminance of 0.01 lux.

Cameras shall be housed within discrete vandal proof weatherproof IP66 dome enclosures.

The contractor shall supply and install the cameras as shown on the Tender drawings. The cameras shall be high definition, state of the art colour cameras, capable of showing clear pictures at low lighting levels.

The cameras shall be installed in keeping with the building and fabric. They shall be robust and vandal resistant. Wall mounted cameras shall be mounted on brackets. Wall mounted brackets shall be powder coat finish, colour to be advised. The colour shall be confirmed by the Contractor prior to manufacture.

Camera	
Image Sensor	1/3" Progressive Scan CMOS
Min. Illumination	0.01Lux @ (F1.2,AGC ON), 0.014 Lux @ (F1.4,AGC ON), O Lux with IR
Shutter Speed	1/3 s ~ 1/10,000 s
Slow Shutter	Support
Lens	Fixed by Specialist to Suit Field of View
Angle Adjustment	Pan: 0° – 355, Tilt: 0° - 75°, Rotation: 0° - 355°
Lens Mount	Φ14
Day & Night	IR cut filter with auto switch
WDR	120db
Compression	
Video Compression	H.264/MJPEG/H.264+
H.264 Type	Main Profile
Video Bit Rate	32 Kbps – 16 Mbps
Audio (-S)	G.711/G.722.1/G.726/MP2L2, 64KBPS (G.711) / 16kbps (G.722.1)/16Kbps (G.726) / 32-128Kbps(MP2L2)
Image	
Max. Resolution	2688x1520
Frame Rate	50Hz: 20fps (2688x1520), 25fps (1920x1080), 25fps (1280x720) 60Hz: 20fps (2688 x 1520), 30fps (1920 x 1080), 30fps (1280x720)
Enhancement	BLC/3D DNR/ROI
Image Setting	Rotate Mode, Saturation, Brightness, Contrast, Sharpness adjustable by client software or web browser
Day/Night Switch	Auto/Schedule/Triggered by Alarm In
Network	
Network Storage	NAS (Support NFS, SMB/CIFS); ANR, Built-in Micro SD/SDHC/SDXC card slot, up to 128 GB
Alarm Trigger	Intrusion Detection, Line Crossing detection, Motion detection, Dynamic Analysis, Tampering alarm, Network disconnect, IP address conflict, Storage exception
Protocols	TCP/IP, UDPICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6, Bonjour
Security	One-key reset, flash-prevention, dual stream, heartbeat, mirror, password protection, privacy mask, watermark, IP address filtering, anonymous access
Standard	ONVIF 9PROFILE S, PROFILE G), PSIA, CGI, ISAPI
General	
Interface	1 RJ45 0M/100M Ethernet interface
Operating Conditions	-30°C – 60°C (-22°F – 140°F) Humidity 95% or less (non-condensing)
Power Supply	12V DC+10%, PoE (802.3af)
Power Consumption	Max. 5.5W
Ingress Protection	IP66
Impact Protection	IEC60068-275Eh, 20J; EN50102, up to IK10
IR Range	20~30 meters
Dimensions	Φ140 x 99.9 mm (Φ 5.51" x 3.94")
Weight	1000g (2.20lbs)
Order Model	

DS-2CD2742FWD-I, DS-2CD2742FWD-IS, DS-2CD2742FWD-IZ, DS-2CD2742FWD-IZS

External Cameras
All cameras shall be IP based high definition units providing a minimum specification of a 4mp Camera with a Lens of 2.8-12MM and with an inbuilt IR range of approx 30m. The camera sensor shall provide accurate colour rendition through a wide variety of lighting conditions Integral LED lighting.

All cameras shall be suitable for operating in colour mode to a minimum illuminance of 0.05 lux, and shall then operate in b/w mode to a minimum illuminance of 0.01 lux.

Cameras shall be housed within discrete vandal proof weatherproof IP66 dome enclosures.

The cameras shall be high definition, state of the art colour cameras, capable of showing clear pictures at low lighting levels.

External cameras shall be PTZ (Pan, Tilt and Zoom).

Specification as follows: -

- ANP1/1.8" Progressive Scan CMOS;
- 920 × 1080 @ 60fps;
- Ultra-low light;
- Auto-iris;
- 120dB WDR;
- IP67;
- IR and white light, optional;
- Capture rate > 99% (certain countries and regions);
- Recognition rate > 98% (certain countries and regions)R Series Ultra Low Light.

Camera	
Image Sensor	1/1.8" Progressive Scan CMOS
Min. Illumination	Color: 0.002 Lux @ (F1.2, AGC ON), 0.0027 Lux @ (F1.4, AGC ON), 0 Lux
Shutter Speed	1 s to 1/100,000 s, supports slow shutter
Lens	2.8 mm to 12 mm, F1.4, horizontal field of view: 92° to 32° 8 mm to 32 mm, F1.6,
Auto-iris	DC drive
Day & Night	IR cut filter with auto switch
Digital Noise Reduction	3D DNR
WDR	120dB
Compression Standard	
Video Compression	Main stream: H.264/MPEG4 Sub stream: H.264/MPEG4/MJPEG
H.264 Type	Baseline Profile/Main Profile/High Profile
H.264+	Support
Video Bit Rate	32 Kbps to 16 Mbps
Audio Compression (-S)	G.711/G.722.1/G.726/MP2L2
Audio Bit Rate (-S)	64Kbps (G.711) /16Kbps (G.722.1) /16Kbps (G.726) /32-160Kbps (MP2L2)
Image	
Max. Resolution	1920 × 1080
Main Stream Max. Frame	50Hz: 50fps (1920 × 1080, 1280 × 960, 1280 × 720) 60Hz: 60fps (1920 × 1080, 1280 × 960, 1280 × 720)
Sub Stream Max. Frame Rate	50Hz: 25fps (704 × 576, 640 × 480, 352 × 288) 60Hz: 30fps (704 × 480, 640 × 480, 352 × 240)

Third Stream Max. Frame Rate	50Hz: 25fps (1920 × 1080, 1280 × 960, 1280 × 720, 704 × 576, 640 × 480, 352 × 288) 60Hz: 30fps (1920 × 1080, 1280 × 960, 1280 × 720, 704 × 480, 640 × 480, 352 × 240)
Image Enhancement	BLC /3D DNR/Defog/EIS
Image Setting	Rotate mode, saturation, brightness, contrast, sharpness adjustable by client software or web browser
Region of Interest	Support 4 fixed region for each stream, and dynamic tracking
Target Cropping	Support
Day/Night Switch	Auto/Schedule/Triggered by Alarm In (-S)
Picture Overlay	LOGO picture can be overlaid on video with 128 × 128 24bit bmp format

Network	
Network Storage	Support microSD/SDHC/SDXC card (128G), local storage and NAS
Alarm Trigger	Road traffic, motion detection, video tampering alarm, network disconnected, IP address conflict, illegal login, HDD full, HDD error
Protocols	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, 802.1X, QoS, IPv6
General Function	One-key reset, anti-flicker, three streams, heartbeat, password protection, privacy mask, watermark, IP address filter, mirror
Standard	ONVIF (profile S, profile G), PSIA, CGI, ISAPI
Interface	
Communication Interface	1 RJ45 10M/100M Ethernet port
Audio (-S)	With –S model: 1 audio input(line in/mic in), 1 audio output
Alarm (-S)	With –S model: 1 input, 1 output
Video Output	1Vp-p composite output (75 Ω/BNC)
On-board storage	Built-in microSD/SDHC/SDXC slot, up to 128 G
Reset Button	Yes
Audio (-S)	
Environment Noise	Support
Audio I/O	Support
Audio Sampling Rate	16kHz/32kHz/44.1kHz/48 kHz
General	
Operating Conditions	-IZS/P, -IZ/P, -LZS/P: -30 °C to +60 °C (-22 °F to +140 °F), Humidity 95% or less (non-condensing)
Power Supply	12 VDC 3 10%, terminal block PoE
Power Consumption and Current	-(IZS)(IZ)/P: 12 VDC, max. 13.3 W, 1.2 A; PoE, max. 17.6 W, 0.3 A to 0.5 A -IZHS/P: 12 VDC, max. 14.5 W, 1.3 A; PoE, max. 19.2 W, 0.3 A to 0.5 A -LZS/P: 12 VDC, max. 18.1 W, 1.6 A; PoE, max. 24 W, 0.4 A to 0.6 A
IR	-IZ/P, -IZS/P, -IZHS/P: 850 nm IR wavelength, up to 50 meters for 2.8 to 12 mm lens, up to 100 m for 8 to 32 mm lens
White Light	-LZS/P: up to 50 meters for 2.8 to 12 mm lens, up to 100 m for 8 to 32 mm
Heater	-IZHS: support

1.22 Telecommunication Systems

The Contractor shall design, supply, install, connect, test and commission a complete Category 6 structured cabling installation for landlord data, security and telephone systems. The data specialist shall fully configure the data and telephone system to client requirements. The Contractor shall provide a data system at least equivalent to the existing with enhancements as detailed.

The Contractor shall include with the tender for a WiFi system throughout the vessel.

The Contractor shall also design, supply and install active switch equipment as CISCO 10/100/1000Mb within a data cabinet to interface all data with incoming data. Provide the number of ports required plus 50% spare capacity.

The structured cabling installation for data installation shall include patch panels, patch leads, data cabinets, copper and fibre cables, cable containment, copper and fibre cable terminations, fixings, supports and all ancillary items to provide a complete and satisfactory system.

The Contractor shall engage a telephone/data specialist to provide a complete Cat 6 structured cabling installation.

The complete data system shall be as Brand Rex or equal and shall be complete with 25 year manufacturer's warranty. The complete installation shall be in accordance with manufacturer's instructions. The complete system and all components shall be from one manufacturer.

All equipment and proposed works shall be formally approved before commencement.

STANDARDS

The complete Cat 6 system shall meet the requirements of ISO, ANSI, T1A and EIA.

All cabling must be certified to:

ANSI/T1A/EIA – 568 C

ISO 61156-5 Ed 2

The data system shall also comply with:

Draft Standard EN 50288-11-1

1.22.1 Telephone Service To Vessel

The Contractor shall provide all new telecoms and data wiring for the ship, including replacing all telecoms/data cable entering the ship from land.

Carry at all liaison with British Telecom. All works shall be subject to BT requirements and shall be approved by British Telecom.

All other telephone services will be ordered by the Client.

1.22.2 Data Racks/Cabinets

The Contractor shall provide data rack for landlord telephone and data services as per the existing set-up.

Data racks shall be complete with all patch panels and cable management.

The ground floor main comms room rack shall be floor mounted. Rack shall be steel frame with stove enamelled finish.

The racks shall be suitable for 19inch rack mounted equipment in multiples of 1inch height.

The racks shall have removable, lockable, rear and side panels. Panels shall have lockable glass front doors which shall be capable of opening through more than 90 degrees and shall be removable (quick release). Data cables shall enter from top N bottom generally. Panels shall have top and bottom vents and floor standing cabinets shall have integral fans.

Racks shall be fully equipped with heavy duty mounting profiles.

Vertical and horizontal cable management basket shall be provided at the rack position.

All data racks shall be earth bonded and fitted with appropriate earth lug.

Cabinets shall be fitted with engraved Traffolyte identification label.

As part of the Contractor's installation drawings and elevation of the rack shall be provided showing proposed rack layout.

The Contractor shall provide a dedicated power circuit to each rack with fused connection units and PDU bar with six socket outlets. The Contractor shall provide an input lead. The Contractor shall also provide a UPS supplied PDU bar with six socket outlets with output leads.

The floor standing comms rack shall be fitted with a 15 minute 5kVA UPS unit as UPS Systems Ltd or equal.

1.22.3 Patch Panels

Patch panels shall be 19inch 24 port RJ45 Cat 6 with height 1U. A 1U horizontal cable management bar shall be provided at each patch panel position.

All outlets shall be labelled to a sequence agreed.

The number of 24 part patch panels shall be to suit the number of Cat 6 cables to be terminated and connected at each rack. All Cat 6 cables shall be terminated on to a patch panel within the local data rack.

Cat 6 cables shall be terminated at patch panels in a sequence.

1.22.4 Cat 6 Cable

The Contractor shall supply, install, connect, test and commission a complete landlord data and telephone Cat 6 data cable installation. The Contractor shall provide four pair UTP Cat 6 LSF cables from data rack patch panels to each data outlet shown on the drawings. Data outlets shall generally comprise two data outlets housed in a single gang plate box.

LSOH Cat 6 cables shall be installed on marine grade stainless steel cable tray in voids.

Cat (6) cables shall be secured to cable tray with cable ties.

No cable shall exceed 90 metres in length.

All cables shall be labelled with numbering sequence to be agreed. Cables shall be labelled at both ends.

Data cables shall be separated from other cables including main cables. Cable separation shall meet all required standards including separation distances specified. Cable separation shall be 200mm from unshielded power cables.

1.22.5 Cat 6 Outlets

Cat 6 landlord telephone and data outlets shall be generally twin outlets mounted with a single gang white plastic plate. Outlets shall be shuttered white plastic 25mm x 50mm Cat 6 RJ45 modules.

All data outlet boxes shall be minimum 35mm deep.

All outlets shall be fitted with engraved labelling to suit the agreed labelling methodology.

1.22.6 Cat 6 Testing Parameters

All Cat 6 cabling shall be certified ISO, ANI/TIA/EIA complaint.

All cables shall be tested and commissioned. 100% testing. Each cable shall be fully certified.

Any Cat 6 cabling not meeting or exceeding the requirements for ISO, ANSI/TIA/EIA shall be inspected for anomalies, and re-terminated or replaced entirely if necessary to ensure compliance.

For the avoidance of doubt the following shall automatically be considered not meeting the requirements for cabling standards: -

- Any joint within a single cable run (between its 2 termination points)
- Any single cable run over 90m
- Any data cable run in parallel with high voltage cables (within 200mm)
- Any data cable that has pairs within it 'un-twisted' at the termination points more than 20mm

Cabling certifications should be sent in PDF format. This should include both the summary sheet and detail for each result.

Each Cat 6 cable shall be tested for;

- Wire map;
- Cable length;
- Attenuation;
- NEXT;
- Delay or Delay skew;
- ELFEXT;
- Return Loss;
- PSNEXT;
- PSELFEXT;
- PSELFEXT

1.22.7 Data Network For Cctv Installation

The CCTV systems shall be IP based technology.

The Contractor shall design, supply, install, connect, test and commission a complete Category 6 structured cabling installation for CCTV systems.

The Specialist shall design, supply and install active switch equipment.

The structured cabling installation for the CCTV installations shall include patch panels, patch leads, data cabinets, copper and fibre cables, cable containment, copper and fibre cable terminations, fixings, supports and all ancillary items to provide a complete and satisfactory system.

The Contractor shall engage a data specialist to provide a complete Cat 6 structured cabling installation.

The complete data system shall be as Brand Rex or equal and shall be complete with 25 year manufacturer's warranty. The complete installation shall be in accordance with manufacturer's instructions. The complete system and all components shall be from one manufacturer.

All equipment and proposed works shall be formally approved before commencement.

STANDARDS

The complete Cat 6 system shall meet the requirements of ISO, ANSI, T1A and EIA.

All cabling must be certified to:

ANSI/T1A/EIA – 568 C

ISO 61156-5 Ed 2

The data system shall also comply with:

Draft Standard EN 50288-11-1

1.22.8 Data Racks/Cabinets

All security equipment shall be located within the data racks.

1.22.9 Patch Panels

Patch panels shall be 19inch 24 port RJ45 Cat 6 with height 1U. A 1U horizontal cable management bar shall be provided at each patch panel position.

All outlets shall be labelled to a sequence agreed.

The number of 24 part patch panels shall be to suit the number of Cat 6 cables to be terminated and connected at each rack. All Cat 6 cables shall be terminated on to a patch panel within the local data rack.

Cat 6 cables shall be terminated at patch panels in a sequence.

The Contractor shall provide a Cat 6 patch cable at the data rack for every Cat 6 plus cable/outlet provided under the contract.

1.22.10 Cat 6 Cable

The Contractor shall supply, install, connect, test and commission a complete Cat 6 data cable installation. The Contractor shall provide four pair UTP Cat 6 LSOH cables from data rack patch panels/switches to items CCTV cameras as required.

LSOH Cat 6 cables shall be installed on marine grade stainless steel cable basket within voids.

Cat (6) cables shall be secured to cable tray with cable ties internally and shall be armoured externally installed in ducts but suitable for duct burial.

Cables shall be provided for CCTV equipment and as required by CCTV specialists.

No cable shall exceed 90 metres in length.

All cables shall be labelled with numbering sequence to be agreed. Cables shall be labelled at both ends.

Data cables shall be separated from other cables including main cables. Cable separation shall meet all required standards including separation distances specified. Cable separation shall be 200mm from unshielded power cables in risers.

1.22.11 Cat 6 Testing Parameters

All Cat 6 cabling shall be certified ISO, ANI/TIA/EIA complaint.

All cables shall be tested and commissioned. 100% testing. Each cable shall be fully certified.

Any Cat 6 cabling not meeting or exceeding the requirements for ISO, ANSI/TIA/EIA shall be inspected for anomalies, and re-terminated or replaced entirely if necessary to ensure compliance.

For the avoidance of doubt the following shall automatically be considered not meeting the requirements for cabling standards: -

10.3.1Any joint within a single cable run (between its 2 termination points)

10.3.2 Any single cable run over 90m

10.3.3 Any data cable run in parallel with high voltage cables (within 200mm)

10.3.4 Any data cable that has pairs within it ‘un-twisted’ at the termination points more than 20mm

Cabling certifications should be sent in PDF format. This should include both the summary sheet and detail for each result.

Each cable shall be tested for;

- Wire map;

- Cable length;
- Attenuation;
- NEXT;
- Delay or Delay skew;
- ELFEXT;
- Return Loss;
- PSNEXT;
- PSELFEXT;
- PSELFEXT

1.22.12 Network Equipment

Active network switches shall be provided by the Contractor.

1.23 Miscellaneous Systems

1.24 Public Address System

The contractor is to supply install test and commission a new PA address system that covers the entire ship.

All existing PA equipment is to be replaced with newer updated current specification equipment, the existing PA equipment is listed below.

As a minimum the PA system shall replace all existing equipment with enhancements as required.

1.24.1 Tiller Flat :

3 x 5 mts 2-way Extensions

2 x 3 mts 4-way Extension (plus 1 Orange suspect fuse holder)

2 x Short 2-way Extension

1 x 3-way Plug In Adapter

2 x White Clip Spotlights

4 x White Screw Clamp Spotlights

4 x Brass Lanterns

1 x deLonghi Heater.

1.24.2 Gun Deck :

4 x Speakers – In Place or in Tiller Flat

6 x Speakers –Under covers with cables

1.24.3 PA Room :

2 x Stand Alone Loudspeaker Systems

1 x Radio/CD Player

2 x PA Amplifiers

1 x Small Mixer Desk

Various Loudspeaker and Mic Cables

4 x Shure Mics XLR Type

1 x Shure remote Mic PG58 (marked spare)

1 x Shure remote Mic SM58 plus remote receiver

1.24.4 Routine Desk :

1 x Large Mixing Desk

1 x PA Amplifier

1.24.5 Extras –

1 x Bose Music System - SEM's Office.

1 x Remote mic receiver (for PG58 Shure mics) – Hatch at Centre Line Aft Gun deck.

1.25 Testing And Commissioning

The Contractor shall test and commission all installed electrical systems in accordance with the current IEE/IET Wiring Regulations, and National Inspection Council for Electrical Installation Contracting (NICEIC) standards.

The Contractor shall note that on completion of each phase of the works a full IST Test (Integrated Systems Test) shall be carried out. The test shall prove the interoperability of interconnected systems, shall prove the operation of systems under all power, signal failure conditions, etc. The Contractor shall issue an IST schedule of tests for approval in advance.

Contractor shall to test all electrical circuits throughout the building from the main incoming supply though to every final circuit. The Contractor shall produce the full test certification and distribution board charts in paper and electronic versions for the O&M manuals. Test certificates shall be NICEIC forms fully completed.

All disconnections or similar operations needing to satisfy the requirements for testing, and the appropriate reinstatement, shall be included. A full method statement for the complete testing and commissioning of the installation shall be prepared by the Electrical Services Contractor for approval prior to any tests being carried out. This method statement shall include all specialist cause and effect, disaster recovery and standard test procedures.

The testing and commissioning of the specialist elements of the electrical installation shall generally be carried out by the specialists engaged by the Contractor for each section of the works.

A low voltage continuity test shall be carried out to ensure a safe measure of earth bonding before any earth fault loop impedance tests are carried out. The earth fault loop impedance and prospective fault current shall be tested at each distribution point on the installation.

The Contractor shall ensure all connections and adjustments are made correctly, and that the installations and equipment are in a completely safe and satisfactory condition.

The Contractor shall operate, and rigidly adhere to, a permit to work system covering the entire electrical installations. The Electrical Services Contractor shall nominate an 'Authorised Person' to manage this system. The Authorised Person shall retain a record of all energised supplies and testing progress at all times.

All activities carried out by the Contractor in pursuance of the requirements of this section of the Specification shall be carried out by competent experienced operatives and continuously supervised, by a competent, experienced and specialist commissioning engineer.

Upon completion of the works, the Contractor shall ensure all tests are carried out and recorded and all necessary forms are submitted to the Consultant for review prior to giving a full demonstration of the installation and equipment to the Client & Consultant. At this time the previously described record drawings and manuals shall be handed over.

1.25.1 Witnessing And Demonstration

The Contractor shall allow for the Consultant to come to site to witness all electrical installations and specialist installations in line with the requirements of the specific clauses in Scope of works sections. A Client Representative may also wish to attend.

1.25.2 Demonstration And Training

The Electrical Services Contractor shall allow an appropriate amount of time for demonstration and training in the operation of the electrical systems to the Client. Include a minimum of 2 days training for each system.

1.25.3 Schedule Of Spares

The Contractor shall provide the following spares for the Client at Practical Completion:

- 5% spare of each type of lamp installed;
- 5% spare of each fuse installed;
- Spares for each key operated device provided.

All the above items shall be handed to the Employers representative at the completion of the contract and signature obtained as proof of delivery.

1.25.4 Tools

Issue list of recommended tools and provide two complete sets.

1.25.5 Control Of Electrical Supplies

The Contractor shall be completely responsible for supervising and managing the electrical supplies within the site. This shall include putting into place a strict permit to work system.

1.25.6 Building Log Book

As a separate document in addition to the O&M manuals the Contractor shall provide a building log book which shall summarise for day to day use operational procedures for all system. The log book shall include;

- Schedule of floor areas;
- System description;
- Simplified equipment locations and schematics;
- Control strategies;
- Commissioning reports;
- Schedule of meter positions and descriptions.

1.25.7 Operation And Maintenance Manuals

The Contractor shall produce Operating and Maintenance manuals and record drawings as detailed in Part 1 of this specification.

The manuals shall include the following as an absolute minimum:

- A brief description of the extent of the contract works, date of the contract and contact details for the Principle Contractor and all relevant Contractors;
- A full technical description of each of the systems installed, written to ensure that the Client's staff can fully understands the scope and facilities provided.
- Schedules (system by system) of all plant, equipment, cables, etc., stating their locations, model type, duties and performance figures. Each item of plant, equipment etc., installed shall have a unique code number cross referenced to the record and diagrammatic drawings and schedules;
- A technical description of the mode of operation of all systems;
- Starting up, operating and shutting down instructions for all equipment and systems installed;
- Control sequences for all systems installed;
- Detailed recommendations as to the preventative maintenance frequency and procedures that should be adopted by the Client to ensure the most efficient operation of the systems;
- A list of normal consumable items;
- A list of recommended spares to be kept in stock by the Client, being those items subject to wear or deterioration and which may involve the Client in extended deliveries when replacements are required at some future date. This shall include any special tools required for maintenance to be carried out;
- Plant replacement schedule;
- Procedures for fault-finding;
- Emergency procedures, including telephone numbers for emergency services;
- Full H&S, COSHH and details for all installed services including details of any residual risks;
- The name, address, and full contact details of the manufacturer of every item of plant and equipment together with catalogue list numbers;
- Manufacturers technical literature for all items of plant and equipment assembled specifically for the project, excluding irrelevant matter and including detailed drawings, schematics and operating and maintenance instructions;
- A copy of all manufacturers' guarantees or warranties;
- Commissioning test certificates;
- Copies of all equipment software discs including all set-up parameters e.g. fire alarm panels, BMS software/settings etc;
- Schedules of all fixed and variable equipment settings established during commissioning;
- Inspection Certificates shall be provided for the future retention of maintenance reports and the maintenance contract documents;
- Record Drawings;
- Legend and Symbols for drawn information

1.25.8 Defects Rectification

During the defects period faults shall be rectified within 24 hours with temporary parts provided where necessary or 12 hours for major failures affecting use to the development.

1.25.9 Not Used

1.25.10 Planned Preventative Maintenance

The Contractor shall include an option within the tender for the first twelve months planned preventative maintenance on completion of the contract works.

Planned preventative maintenance shall include all recommended maintenance by the manufacturers of equipment provided under the contract.

Planned preventative maintenance for all specialist installations shall be carried out by the system specialists detailed within this specification.

The Contractor shall provide within the tender a planned preventative maintenance proposal and schedule.

Planned preventative maintenance shall include the replacement of all day to day items which fail during the twelve month planned preventative maintenance period including luminaire lamps etc.

2 Standards

2.1 Electrical Systems

- Local Electricity Supply and Wiring Regulations.
- BS1363:1995 13A plugs, socket-outlets, adaptors and connection units specification for rewireable and non-rewireable 13A fused plugs (including and 9541, 14539 Oct 03).
- BS 7430: Code of Practice for Earthing.
- BS 7671: IEE Wiring Regulations, 18th Edition.
- BS EN 60076 Power Transformers.
- BS EN 60076-11 Dry-type power transformers.
- BS 8450:2006 – Code of Practice for installation of electrical and electronic equipment in ships – All sections
- IEC 60270 High Voltage test techniques.
- IEC 60529 Degree of protection provided by enclosures.
- IEC 60551 Determination of Transformer & Reactor sound levels.

2.1.1 Switchgear

BS Ref.	Title
BS EN 60269	Low voltage fuses – General requirements
BS EN 60076	Power transformers – General
BS EN 60076-3	Power transformers. Insulation levels, dielectric tests and external clearances in air
BS EN 60076-5	Power transformers. Specification for ability to withstand short circuit
BS 921	Specification for rubber mats for electrical purposes
BS EN 62271-100	High voltage switchgear and control gear. High voltage alternating-current circuit-breakers
BS 5992	Electrical relays.
BS 6231	Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and control gear wiring
BS EN 60038	CENELEC standard voltages
BS EN 60073	Basic and safety principles for man-machine interface, making and identification – coding principles for indication devices and actuators
BS EN 60076 -1	Power transformers. General
BS EN 60076 -5	Power transformers. Ability to withstand short circuit
BS EN 60255	Measuring relays and protection equipment
BS EN 62271-103	High-voltage switchgear and control gear. Switches for rated voltages above 1 kV up to and including 52 kV
BS EN 62271-104	High-voltage switchgear and control gear. Alternating current switches for rated voltages of 52 kv and above

BS EN 60282	High-voltage fuses
BS EN 60282 - 1	High-voltage fuses. Current-limiting fuses
BS EN 62271-200	High-voltage switchgear and control gear. AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
BS EN 62271-105	High-voltage switchgear and control gear. Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV
BS EN 61439	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
BS EN 60529	Specification for degrees of protection provided by enclosures.
BS EN 62271	High-voltage switchgear and control gear. Common specifications
BS EN 60947	Low-voltage switchgear and control gear.

2.1.2 Main LV Distribution

BS Ref.	Title
BS EN 60076	Power Transformers
BS EN 50541-1	Three phase dry-type distribution transformers 50 Hz, from 100 kVA to 3150 kVA, with highest voltage for equipment not exceeding 36 kV. General requirements
BS EN 60529	Degrees of protection provided by enclosures (IP code)

2.1.3 Small Power Systems

BS Ref.	Title
BS 159	High voltage bus-bars and bus-bar connections
BS 799-5	Oil burning equipment. Carbon steel oil storage tanks. Specification
BS EN 12285	Workshop fabricated steel tanks
BS EN 60085	Electrical insulation. Thermal evaluation and designation
BS 2869	Specification for fuel oils for agriculture, domestic and industrial engines and boilers.
BS 4552	Fuel filters, strainers and sediments for compression-ignition engines.
BS 4999	General requirements for rotating electrical machines
BS 5000	Specification for rotating electrical machines of particular types or for particular applications
BS EN 62271-200	High-voltage switchgear and control gear. AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
BS EN ISO 12100	Safety of machinery. General principles for design. Risk assessment and risk reduction
BS 5514	Reciprocating internal combustion engines: performance. Specification for standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

BS ISO 6826	Reciprocating internal combustion engines. Fire protection
BS 6580	Corrosion inhibiting engines coolants (antifreeze).
BS 6472	Guide to evaluation of human exposure to vibration in buildings.
BS EN 61869-2	Instrument transformers. Additional requirements for current transformers
BS ISO 8528	Reciprocating internal combustion engine driven alternating current generating sets
BS EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 60034-22	Rotating electrical machines – AC Generators for reciprocating internal combustion engine driven generating sets.
BS EN 61439	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
BS EN 60529	Specification for degrees of protection provided by enclosures
	Electricity Association Engineering Recommendations G5/3 and G59/1.
	Electricity (Factories Act) Special Regulations (1908) & (1994).
	The Electricity Supply Regulations (1988).
	The Health and Safety at Work etc. Act (1974).
	The Electricity at Work Regulations (1989).

2.1.4 Earthing And Lightning Protection

BS Ref.	Title
BS EN 60269	Low voltage fuses
BS EN 60269-4	Low voltage fuses. Supplementary requirements for fuse-links for the protection of semiconductor devices
BS 89	Direct acting indicating analogue electrical measuring instruments and their accessories. Specification for special requirements for ammeters and voltmeters
BS EN 50272-1	Safety requirements for secondary batteries and battery installations. General safety information
BS 6493	Semiconductor devices. Discrete devices. General
BS EN 62040	Uninterruptible power systems (UPS).
BS EN 60073	Basic and safety principles for man-machine interface, making and identification – coding principles for indication devices and actuators
BS EN 60146	Semiconductor converters – general requirements and line commutated converters
BS EN 60529	Specification for degrees of protection provided by enclosures
BS EN 60898-2	Circuit breakers for over current protection for household and similar installations
BS EN 60947-5-6	Low voltage switchgear and control gear

2.1.4.1 Lighting Systems

2.1.4.2 Interior Lighting

- BS 4533 (BS EN 60598) – Luminaires.
- BS 5489 Road Lighting Part 9 Lighting for urban centres and public amenity areas.
- BS7671 The IEE Wiring Regulations, 17th Edition.
- BS EN 61547 – Specification for general lighting purposes : EMC immunity requirements.
- CIBSE Code for Lighting.
- CIBSE lighting design guides (LG series).
- ILE recommendations for the reduction of light pollution.

2.1.4.3 Exterior Lighting

- BS 4533 (BS EN 60598) – Luminaires.
- BS 5489 Road Lighting Part 9 Lighting for urban centres and public amenity areas.
- BS7671:– The IEE Wiring Regulations, 17th Edition.
- BS EN 61547 – Specification for general lighting purposes: EMC immunity requirements.
- CIBSE Code for Lighting.
- CIBSE lighting design guides (LG series).
- ILE recommendations for the reduction of light pollution.

2.1.4.4 Emergency Lighting System

- BS 5266-1 Emergency lighting. Code of practice for the emergency escape lighting of premises.
- BS EN 1838 Lighting applications – emergency lighting.
- BS EN 50172 Emergency escape lighting systems.
- EN 60 598-2-22 Luminaires for Emergency Lighting.
- IEC 598-2-22 Luminaires for Emergency Lighting.
- CIBSE TM 14: Emergency Lighting.

2.1.5 Life Safety Systems

BS Ref.	Title
BS EN 60898	Specification for circuit breakers for overcurrent protection for household and similar installations.
BS EN 60947	Low Voltage switchgear and control gear

2.1.5.1 Fire Detection And Alarm System

- BS 5839 Part 1 Fire detection and alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance.
- BS 9999 Code of practice for fire safety in the design, management and use of buildings.
- NFPA 72 2002 National Fire Alarm Code where required for sprinkler system.

2.1.6 Security Systems

BS Ref.	Title
BS EN 60898	Specification for circuit breakers for overcurrent protection for household and similar installations.
BS EN 60947	Low Voltage switchgear and control gear
BS EN 62271-1	High-voltage switchgear and control gear. Common specifications
BS EN 62271-106	High-voltage switchgear and control gear. Alternating current contactors, contactor-based controllers and motor-starters
BS EN 62271-103	High-voltage switchgear and control gear. Switches for rated voltages above 1 kV up to and including 52 kV
BS EN 62271-102	High-voltage switchgear and control gear. Alternating current disconnectors and earthing switches
IEC 60255	Measurement relay and protection equipment

2.1.7 Communication Systems

BS Ref.	Title
BS EN 60269	Low voltage fuses
BS EN 60947	Low Voltage switchgear and control gear

2.1.7.1 Power Cabling And Containment Systems

The following containment systems are provided for:

Service	Containment	Cabling
External Power Cabling	HDPE Ducting	XLPE/SWA/PVC
Internal HV Cabling	HD Cable Ladder Rack	Belted & Screened XLPE/SWA/LSF Red Sheath
LV Power Cabling	HD Cable Ladder Rack	XLPE/SWA/LSF
Fire Survival Power Cables	HD Cable Ladder Rack	FR 120min FP 600
Generator Alternator Tails	HD Cable Ladder in Trench	EPR oil resistance single core flexible double insulated
Equipment Room Floor Void Power	MD Cable Tray/Cable Basket	XLPE/SWA/LSF
Small, Power in Access Floor Areas	MD Cable Tray/Cable Basket	XLPE/SWA/LSF & Power Track
General Small Power	Cable Trunking/Galvanised Conduit	LSF Single Cores
Lighting	Cable Trunking/Galvanised Conduit	LSF Single Cores
Emergency Lighting	MD Cable Tray/Cable Basket	FP 200 with gland terminations
Emergency Lighting Cast In	Cast in Conduit (oversized)	FP 200 with pot end terminations

2.1.7.2 Structured Cabling Containment And Cabling Systems

The following containment systems are provided:

Service	Containment	Cabling
External Utility Cabling	Steel Ducting	By Utility
Utility Distribution	MD Cable Tray/Cable Basket with inlay	Single Mode Fibre
Building Fibre Optic Network	MD Cable Tray/Cable Basket with inlay	Multi core Multimode 50/125 Fibre Optic
Building UTP Primary Cabling	MD Cable Tray/Cable Basket with inlay	Cat 6A UTP LSF
UTP in Access Floor Areas	MD Cable Tray/Cable Basket with inlay	Cat 6A UTP LSF
UTP in General Areas	MD Cable Tray/Cable Basket with inlay	Cat 6A UTP LSF
To Flush Wall Outlets	Galvanised Conduit	Cat 6A UTP LSF
External Data	HDPE/PVC Cable Duct	External Grade Cat 6A UTP
PMMS Primary Network	MD Cable Tray/Cable Basket with inlay	Multimode CWZ 120min survival 50/125 Fibre Optic

2.1.8 Distribution Boards

BS Ref.	Title
BS EN 60269	Low voltage fuses

BS EN 61439	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies
BS 7671	Requirements for Electrical installations
BS EN 60947	Low Voltage switchgear and control gear

2.1.9 Cartridge Fuses

BS Ref.	Title
BS 646	Specification. Cartridges fuse links (rated up to 5 Amperes) for AC and DC service.
BS 1362	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs).
BS 2950	Specifications. Cartridge fuse links for telecommunications and light electrical apparatus.

2.1.10 Miniature Circuit Breakers (MCB)

BS Ref.	Title
BS EN 60898	Specification for circuit breakers for over current protection for household and similar installations.

2.1.11 Cable Trunking

BS Ref.	Title
BS 4607	Non-metallic conduit and fittings for electrical installations.
BS 7671	Requirements for Electrical Installations
BS EN 50085	Cable trunking

2.1.12 Conduit Systems

BS Ref.	Title
BS EN 61386	Conduit systems for cable management. General requirements
BS EN 856	Rubber hoses and hose assemblies. Rubber-covered spiral wire reinforced hydraulic type. Specification
BS 4607	Non-metallic conduit and fittings for electrical installations.
BS EN 61439	Low-voltage switchgear and control gear assemblies. Power switchgear and control gear assemblies

2.1.13 Wiring In Conduit And Trunking

BS Ref.	Title
BS 7211	Thermosetting insulated non-armoured cables for voltages up to and including 450-750V for electric power, lighting and internal wiring and having low emission of smile and corrosive gases when affected by fired.
BS 7629	Specification for 300/500V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire.

BS 7671	Requirement for electrical installations.

2.1.14 Cable Baskets

BS Ref.	Title
BS EN 61537	Cable Basket systems and cable ladder systems for cable management
BS EN 10346	Hot dip pre-galvanised coatings on fabricated iron and steel articles.

2.1.15 Cable Ladder

BS Ref.	Title
BE EN 61537	Cable Basket Tray systems and cable ladder systems for cable management
BS EN 10346	Hot-Dip Pre-Galvanised

2.1.16 Power Supply Cables

2.1.16.1 Medium Voltage Cabling

BS Ref.	Title
BS EN 10257-1	Zinc or zinc alloy coated non-alloy steel wire for armouring either power cables or telecommunication cables. Land cables
BS 3988	Specification for wrought aluminium for electrical purposes, solid conductors or insulated cables.
BS 5467	Specification for cables with thermosetting for insulation for electricity supply for rated voltage up to and including 600/1000 Volts and up to and including 1900/3300 Volts.
BS 6121	Mechanical cable glands.
BS EN 60228	Conductors of insulated cables
BS 6724	Thermosetting insulated, armoured cables for voltages of 600/1000V and 1900/3300V, having low emission of smoke and corrosive gases when affected by fire.
BS 7671	Requirements for Electrical Installations
BS 7769	Electric cables. Calculation of the current rating.

2.1.17 Mineral Insulated Copper Sheathed (MICS) Cables

BS Ref.	Title
BS EN 61386-1	Conduit systems for cable management. General requirements
BS EN 60702	Mineral insulated cables and their terminations with rated voltages not exceeding 750V.
BS 6207	Mineral insulated cables with a rated voltage not exceeding 750V cables.

2.1.18 Lighting Installation

BS Ref.	Title
EN 55015	Specification for limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
EN 60061	Specification for lamp caps and holders together with gauges for the control of interchange ability and safety
EN 60064	Performance requirements for tungsten filament lamps for domestic and similar general lighting purposes
EN 60081	Performance specification for double capped fluorescent lamps
EN 60155	Glow starters for fluorescent lamps.
EN 60598	Luminaries. Specification for general requirements and tests
EN 60669-1	Switches for household and similar fixed electrical installations
EN 60921	Specifications for ballasts for tubular fluorescent lamps. Performance requirements
EN 60923	Specification for performance requirements for ballast for discharge lamps
BS EN 61347	Lamp control gear general and safety requirements.
BS EN 60929	Specification for performance requirements for DC supplied electronic balance for tubular fluorescent lamps
EN 60927	Specification for performance requirements for starting devices
EN 61048	General and safety requirements for capacitors for use in tubular
EN 61049	Performance requirements for capacitors for use in tubular fluorescent and other discharge lamp circuits
EN 61184	Specification for bayonet lamp holders
BS EN 13032	Light and lighting measurement and presentation of photometric data of lamps and luminaires.

2.1.19 Emergency Lighting

BS Ref.	Title
EN 1838	Lighting application – emergency lighting
EN 60598-2-22	Luminaires. General requirements and tests
BS 5266	Emergency Lighting

2.1.20 General Power Outlets

BS Ref.	Title
BS 546	Specification. Two pole and earthing-pin plugs, socket outlets and socket outlet adapters.
BS 5733	Specification for general requirements for electrical accessories.
BS 1363	13 Amp plugs, socket outlets and adapters.
IEC 60269	Low voltage fuses
EN 60309	Plugs, socket outlets and couplers for industrial purposes

2.1.21 Wiring Accessories

BS Ref.	Title
BS 1363	Specification for 13 amp plugs, sockets-outlets and adaptors.
BS 4177	Specification for cooker control units 1992
BS 4662	Boxes for flush mounting of electrical accessories. Requirements and test methods and dimensions.
BS 5733	Specification for general requirements for electrical accessories

2.1.22 Fire Alarm Systems

BS Ref.	Title
BS EN 14604	Smoke alarm devices
BS 5839	Fire detection and alarm systems for Building
BS 5839 Part 1	Code of Practice for system design, installation, commissioning and maintenance
BS EN 54-11	Fire detection and fire alarm systems. Manual call points
BS 5839 Part 3	Specification for automatic release mechanisms for certain fire protection equipment
BS EN 54-4	Fire detection and fire alarm systems. Power supply equipment
BS 5839 Part 6	Code of practice for the design, installation and maintenance of the fire detection and fire alarm systems in dwellings
BS 6387	Specification for performance requirements for cables required to maintain circuit integrity under fire conditions 1994
BS EN 54	Fire detection and fire alarm systems

BS EN 54-2	Fire detection and fire alarm systems – control and indicating equipment
BS EN 50130-4	Alarm systems – electromagnetic compatibility – products family standard. Immunity requirements for components of fire, intruder and social alarm systems
BS EN 50134	Alarm systems – social alarm systems
BS EN 60079	Electrical apparatus for explosive gas atmosphere

2.1.23 Radio And Television Systems

BS Ref.	Title
BS 6259	Code of practice for design, planning and installation, testing and maintenance of sound systems.
BS 6513	Wideband cabled distribution systems
BS 7587	Specifications for interconnection of radio and TV receivers to feeder systems outlet
BS EN 60728-11	Cable networks for television signals, sound signals and interactive services. Safety
BS EN 61030	Specification for domestic digital bus (D2B) for audio, video and audio visual systems
BS EN 61938	Audio, visual and audio visual systems. Interconnections and matching values. Preferred matching values of analogue signals
HTM 2015	Bed head services. Validation and verification. Operational management

2.1.24 Security Systems

BS Ref.	Title
BS 4737	Intruder alarm systems
BS 4737 Sec 4	Intruder alarm systems – Codes of practice. Code of practice for exterior alarm systems.
BE EN 50131	Alarm systems. Intrusion systems
BS EN 50132	Alarm systems. CCTV surveillance systems for use in security applications
BS EN 50133	Alarm systems. Access control systems for the use in security applications
BS EN 50134	Alarm systems. Social alarm systems
BS EN 50136	Alarm systems. Alarm transmission systems and equipment
PD CLC/TR 50456	Guidelines for achieving compliance with EC directives for Alarm Systems

2.1.25 Electromagnetic Compatibility (EMC)

BS Ref.	Title
BS EN 61000-6	Electromagnetic compatibility (EMC). Generic standards
BS EN 61000-6-1	Electromagnetic compatibility – Generic immunity standard (2007)
BS EN 61000	Electromagnetic compatibility (EMC) Limits
BS 7671	Regulations for Electrical Installations

2.1.26 Earthing

BS Ref.	Title
BS 951	Specification for clamps for earthing and bonding purposes
BS EN 62305	Code of Practice for Protection of Structure Against lightening
BS 6701	Telecommunications equipment and telecommunications cabling, specifications for installation, operation and maintenance 2004
BS 7430	Code of Practice for Earthing
BS 7671	Requirements for Electrical Installations
BS EN 13601	Copper and copper alloys – Copper rod, bar and wire for general electrical purposes
BS EN 60079	Electrical apparatus for explosive gas atmospheres
BS EN 50310	Application of equipotential bonding and earthing in buildings with information technology equipment
HSG 41	Petrol filing stations: construction and operation

2.1.27 Lightning Protection

BS Ref.	Title
BS EN 1011-4	Welding. Recommendations for welding of metallic materials. Part 4 – Arc welding of aluminium and aluminium alloys.
BS EN 62305	Code of Practice for Protection of Structure against lightening
BS 7430	Code of Practice for Earthing
95/201482 DC	Assessment of the risk of damage due to lightening
BS EN 50164	Lightening Protection Components – Requirements for Connection Components
BSRIA TN 1/94	Lightning Protection of Buildings and their Contents
BRE Digest 428	Protecting Buildings Against Lighting
MES C53	Model Engineering Specification – Lighting Protection System

2.1.28 Inspection And Testing

BS Ref.	Title

BS 5839 Part 1	Fire detection and alarm systems for buildings. – Code of practice for system design, installation and servicing
BS EN 62305	Code of practice for protection of structure against lightening
BS 7430	Code of practice for earthing
BS 7671	Requirements for electrical installations
BS 7698	Reciprocating internal combustion engine driven alternating current generating sets

3 Public Utility Supply / Hv Supply / Transformers

4 Low Voltage Distribution System

4.1 Low Voltage Switchboards

4.1.1 General

The LV switchboards to be manufactured in accordance with this Specification and by a specialist manufacturer.

Switchboards shall be suitable for indoor use, in the form of freestanding floor mounted, front and rear access cubicle or front only access, to suit the location as indicated on the Consultants Drawings and shall be extendible.

The LV switchboards shall be partially type tested assembly (PTTA) constructed as a factory built switchboard to BE EN 60439-1 (IEC60439) including amendment 1,2 & 3 (Low Voltage Switchgear and Control gear Assemblies) to Form 4b minimum and constructed by primary switchgear manufacturers or approved authorised assemblers. The switchboards shall have full ASTA certification for the busbar assembly, all interconnecting copper work and enclosing metalwork. Evidence of certification shall be submitted to the Employer's Representative.

The main LV Switchboards shall be sectionalised via an ACB bus-coupler to facilitate two sections, rated to withstand a short circuit of 50kA for 1 second.

Switchboards shall contain incoming and outgoing ACB's / MCCB's / Fuseswitches, digital meters, VT's & CT's, & all Instruments and relays, as detailed, to enable the distribution of power to areas as shown on the power distribution drawings.

Means of isolation on the front of the switchboards shall be provided. The door should have an interlock, and the door shall be lockable.

The switchboards shall have the capability for non-intrusive thermal imaging.

The switchboards shall be constructed with a minimum ingress protection rating defined as follows:

- Switchgear in enclosed locked switchroom IP31
- Switchgear in distribution cupboards IP31
- Switchgear in enclosed but shared plant rooms IP43
- Switchgear in outdoor or non-enclosed plant rooms IP65

Additional protection for other areas shall suit the installation requirements.

Each main incoming section of the switchboard and, where indicated, selected outgoers, shall include a multi-function, digital display instrument.

The CTs shall be mounted to suit the available space and bus bar arrangements.

Where Utility metering equipment is required at the LV switchboards, the requirements for the provision for cable termination and housing of meters shall be checked with the supply authority.

The switchboard shall have full size neutrals (i.e. 100%) and ACBs fully rated neutrals.

All outgoing circuit terminations shall be suitable for crimp lug connections sized and spaced to suit the cables.

Only one conductor is to terminate at each terminal.

Where equipment is provided with turret type terminals crimp spade lugs shall be provided.

Where fine stranded cables are terminated in feed through terminals bootlace ferrules shall be provided.

Auxiliary circuit connections shall be using adequately rated melamine terminals with clamp type connections.

All switchboards shall include removable gland plates with pre-cut holes to enable ease of entry and connection.

Gland plates to be suitable for glanding multicore armoured cables.

Circuits for fire and life safety shall include covers finished in red.

Spare space up to 10% for future additional outgoing ways shall be provided.

The switchboard shall be designed with due regard to the installation location and access restrictions. With the switchboards installed adequate space shall be available for cabling, making off, testing and inspecting. Particular attention is drawn to the need for access to all fixings, particularly on busbars, switches and connections for routine inspection and tightening.

Detailed drawings of all switchboards shall be submitted for approval prior to commencement of manufacture.

4.1.2 Not Used

4.1.3 Moulded Cases Circuit Breakers (MCCB)

MCCB's shall be plug-in type, 3-pole device in compliance with BS EN 60947-2 and have a breaking capacity not less than 25kA.

All MCCB devices to incorporate adjustable overload protection. Devices above 160A to include in addition adjustable short-circuit protection and time delay (electronic device).

Where MCCB's are installed to protect mechanical plant and lifts, an electronic motor trip protection unit to be installed.

4.1.4 Protective Relays

Protective relays shall be installed for each incoming ACB and these shall be suitable for operation from current transformers having 5A rated secondary's.

Overcurrent protection shall be afforded by 3 pole extremely-inverse definite minimum time (IDMT) relays, for use with current transformers having a minimum specification of 10VA 10P20.

REF protection shall be by means of high stability circulating current relays and current transformers shall be Class X type with characteristics suitable for the burden and fault currents involved.

4.1.5 Fused Switchgear And Air-Break Switches

All fused switchgear and air-break switches whether mounted in switchboards or separately shall conform to the requirements of the Standards.

All contacts shall be fully shrouded and shall have a breaking capacity on independent manual operation as required by the Standards.

All switches shall be suitable for inductive full load switching.

The fuse links shall be high rupturing capacity, cartridge type, conforming to the Standards.

The switches fused or unfused shall be heavy duty type, totally enclosed in a sheet steel case and be of the 500 volt range, three pole and unswitched neutral. Glazed porcelain or non-hygroscopic flame retarding bases and carriers shall be fitted together with a hand operating mechanism.

Airbreak switches shall be fuse switch units having solid copper links of adequate current rating fitted in lieu of fuse links and suitable for breaking the installed load.

The "ON" and "OFF" positions of all air break switches shall be clearly indicated by a mechanical flag or similar device.

Switch and airbreak switch operating handles shall either be removable from or retractable into the unit when the switch is in either the "ON" or "OFF" position.

Padlocking facilities shall be provided for all switches.

Where door mounted operating mechanisms are provided additional padlock facilities shall be provided within the compartment on the operating system.

The switches shall have a quick make and break independent manual switch action with spring assisted mechanism ensuring positive ON/OFF movement and identification.

In T.P. & N. fuse switch units bolted neutral links shall be fitted. For single pole and neutral fuse switches and airbreak switches, the neutral conductor shall be taken through a bolted link. Breaking the neutral conductor, either with linked or non-linked switches shall not be permitted, and the practice of providing a double pole linked switch with a solid link in one pole for use as a single pole and neutral fuse switch shall not be accepted.

Where the neutral connection does not form part of the switch, a separate connection is acceptable providing the connection can be associated with the circuit phase conductors.

Fuse switches and airbreak switches separately mounted shall have a minimum degree of protection to the Standards as follows:

- Indoor locations IP42
- In external areas IP65

All individual units shall be clearly labelled, labels to be "Traffolyte" or similar material, suitably engraved. Colours, size of engraving etc., to be generally as provided for switchgear. All labels shall be securely fixed. The use of self-tapping screws or adhesive is not acceptable.

4.1.6 Measuring Instruments

All ammeters and voltmeters for use in conjunction with switchgear shall comply with the Standards for industrial accuracy.

Where analogue meters are required, meters shall be of the 100 mm dial square 240º scale flush pattern.

All voltmeters shall be provided with flush mounted instrument switches arranged to read any phase to neutral or line voltage. Voltmeters to be scaled 0-500 volts.

All ammeters shall be provided with similar instrument switches connected to read phase currents, and out of balance current and scaled according to location.

All instrument switches shall include an off position.

Current transformers shall be of ring pattern in accordance with the Standards. Busbars shall include removable, accessible links where current transformers are to be fitted. Adequate supports shall be provided for centralising the current transformers. Labels stating "Instrument CTs behind cover" shall be provided where necessary.

Where indicated on the Consultants Drawings kilowatt hour meters shall be provided suitable for 3 phase 4 wire unbalance loads. Single phase energy meters up to 100A may be suitable for direct reading. Single phase supplies in excess of 100A and all three phase supplies shall be suitable for CT summation metering.

Time switches shall have 72 hour battery back-up or 36 hour spring reserve. Time switch controlled external lighting shall have solar dials suitable for the installation latitude.

4.1.7 Contactors

Contractors shall be of the block, air break type to category AC-3, suitably rated for uninterrupted duty and shall comply with BS EN 60947. Replaceable operating coils shall be individually protected by a suitably rated fuse and suitable for 230V operation. Contacts shall be replaceable and pre-conditioned to avoid the requirement of bedding in whilst on site.

A minimum of one normally open and one normally closed auxiliary contact shall be provided on all contactors for status indication.

Automatic changeover contactors shall be of the 4 pole type comprising a pair of electrically and mechanically interlocked heavy duty contactors, no volt detection relay and control circuit protection fuses. All components shall be contained within a heavy duty enclosure having a minimum degree of protection to IP42 and rated for category AC-3 operation.

4.1.8 H.R.C. Fuses

Unless otherwise stated H.R.C. (BS 88) fuses of the maximum rating of all equipment shall be included.

Each H.R.C. fuse for switch and distribution gear shall be certified for Category of Duty required by the relevant Standards.

All H.R.C. fuses for plugs and fuse spur units shall comply with the requirements of the Standards.

All H.R.C. fuses shall be supplied by the same manufacturer and be of the same class or type to ensure adequate discrimination and grading throughout the distribution system.

4.1.9 Not Used

4.1.10 Not Used

4.1.11 Not Used

4.1.12 Not Used

4.1.13 Not Used

4.1.14 Metering Equipment

Digital multi-meters and CTs shall measure and display instantaneous readings of voltage, current, frequency, power factor, power kW, kVA, kWh and harmonic content and shall be provided where indicated on the High/Low Voltage Power Distribution Schematic. All meters shall be procured from the same manufacture.

All digital multi-meters on incoming circuits on switchboards shall measure and display individual harmonics up to the 31st. Meters on the outgoing circuit side shall measure the THD (power & current) only.

The digital multi-meter shall be arranged to monitor/measure line to neutral voltages, neutral to earth voltage and 4 currents, including neutral (measured, not calculated). Connections for meters shall be provided to allow removal of the meter without isolation of the switchboard. Provision shall be included to short the CT terminals prior to removal.

Digital multi-meters within the switchboard shall be supplemented with power from the 24V DC battery tripping unit when mains power is not available. Each meter to be provided with a serial connection (Modbus compatible) and be wired between meters to a set of terminals within a segregate compartment where they can then be connected to the BMS.

A Dranetz test socket and associated CT's/VT's shall be provided in addition to the incoming meters for the connection of a portable Dranetz meter.

Provision for MCCB integrated digital multi-metering shall be provided. Each meter to be provided with serial connection and connected back to the BMS.

4.1.15 Transient Overvoltage Protection

Transient overvoltage protection shall be provided within the LV switchboards. Each protector to be capable of surviving the worst case transients expected at the point of installation and sustain protection for subsequent transient events.

Each protector to control transients to level below the susceptibility and vulnerability of the equipment fed from the switchboard. The protector shall not impair or interfere with the protected systems normal operation. MOV; 100kA minimum. Devices shall be provided with a visual indication indicating device state i.e. protection available/reduced/not available.

4.1.16 Identification Labels

Identification labels shall be provided on all switchboards, to include:

- Manufacturers name and address.
- Manufacturers identification number.
- Rated capacity, Voltage, Current, Frequency.
- Degree of protection.
- Short circuit rating.
- Year of manufacture.

Switchboards shall include full descriptive circuit identification labels for all outgoers and include the device rating and protection type. Labels shall be typically in the following form with 10mm characters for line 1:

RE/DB/00/01

RISER RE/01 DB

(NON-ESS LTG & SP)

200A TPN MCCB

Labels in general shall be of "Traffolyte" or similar plastic material finished matt and suitably engraved black on white. The exact details of lettering etc., shall be agreed before fixing. All labels shall be securely fixed. The use of self-tapping screws or adhesive is not acceptable.

Labels shall be located in a readable location not affected by future extensions.

4.2 Distribution Boards

4.2.1 General Performance

All MCB distribution boards shall comply with the relevant parts of BS EN60439 and phase identification to BS7671 Amendment No 2.

All MCB distribution boards shall be fabricated from rust protected sheet steel and be coated with epoxy powder paint the finished colour to be moonstone beige.

Minimum degree of protection shall be:

- In enclosed locked switchroom IP31
- In distribution cupboards IP31
- In enclosed but shared plant rooms IP43
- In outdoor or non-enclosed plant rooms IP65

All MCB distribution boards shall include a fully shrouded main busbar assembly, which shall include integral provision for the electrical disconnection and isolation of an unused outgoing ways and the live side terminals of outgoing occupied MCB ways. Where boots or similar devices are supplied to cover live parts of spare ways the board shall be deemed not to comply with this requirement.

All MCB distribution board neutral bars shall be supplied complete with insulating cover requiring the use of a tool to facilitate its removal on B type boards.

All 3 phase MCB distribution boards shall accept 3 or 4 pole incoming devices to enable switching of incoming neutral.

All MCB distribution boards outgoing ways shall be capable of conversion, through the use of a kit, to facilitate neutral switching through the use of 2 or 4 pole devices.

All MCB distribution boards shall accept 1, 2, 3 and 4 pole (3 or 4 pole on B type boards) MCB's as outgoing units, be capable of accepting the following outgoers.

a) RCBO's (Combined MCB/RCD's) of single phase type having the following characteristics:

- Manufactured and tested to BS EN 61009.
- A minimum breaking capacity of 10kA to BS EN 60898.
- A or AC classification.
- 10, 30 or 100mA sensitivities.
- Permanent non-adjustable and non-removable earth fault protection.
- A width of no more than one outgoing way where the neutral is unswitched.
- Automatic protection against reverse polarity.
- Automatic disconnection in the event of a lost neutral.
- Be able to accept auxiliary contacts, under voltage release or shunt trip.

b) Three phase RCBO's (combined MCB/RCD's) of type providing protection, disconnection and isolation of all live conductors including the neutral:

- Manufactured and tested to BS EN 61009.
- A breaking capacity of 10kA to BS EN 60898 (15kA to BS EN60947-2).

c) MCB's or RCBO's combined with a full range of electrical auxiliary devices:

- Shunt trips.
- Under-voltage releases.
- Auxiliary switches.
- Alarm switches.
- Emergency stop release.

d) Any combination of a, b and c above.

All distribution boards and equipment enclosures are to include hinged access to the MCB's and supplementary equipment complete with 'tool' operation for normal access and provision to fit padlocks to the access covers. The padlocking arrangement shall be neat.

All distribution boards shall include full circuit isolation facilities suitable for breaking the full rated circuit capacity.

All distribution boards shall include full shrouding to all live parts and be provided with sealing covers for all unused ways.

All distribution boards shall be provided with phase identification and numbering using indelible printed numbering.

Distribution board neutral and earth bars shall include one identified way for each single-phase way provided. All connections within distribution boards shall include cable idents for all conductors.

The arrangement of neutral and earth bars shall allow connection of circuit conductors on the same side of the board as the associated phase MCB way.

Each distribution board and equipment enclosure shall be provided with encapsulated circuit charts and circuit distribution schematics. These shall be fitted to the enclosure or in adjacent frames to allow easy removal for updating.

Each distribution board serving lighting circuits shall additionally include a phase failure relay arranged with VFC contacts to interface with the emergency lighting system. It is acceptable for the PFR to be connected to 3 phases of circuits serving lighting to additionally provide partial local circuit failure. (Note the lighting control system shall also provide local circuit failure for the emergency lighting system as a separate system).

At handover, provide 10 sets of MCB locking assemblies and compatible padlocks.

4.2.2 General Installation Requirements

All MCB distribution boards shall make ample provision for cabling. In particular cable space must be available to the rear of the pan assembly, furthermore the pan assembly shall be removable to further ease cabling and to avoid the ingress of foreign bodies during the preparation of cable entry points.

All MCB distribution boards shall facilitate the protection, disconnection and isolation of all incoming and outgoing live conductors including the neutral, such that routine tests can be performed with the minimum of effort.

Type ‘B’ MCB distribution boards may be required to be associated into neat and tidy groups as specified in the schedules. Units shall therefore be of modular dimensions, and it should be possible to mechanically join boards both vertically and horizontally with the use of a manufacturer supplied kit.

Single phase ‘A’ type MCB distribution boards shall be also available in modular dimensions for similar association.

To allow for all installation requirements to be met from the same manufacturer’s equipment the manufacturer shall provide a complete service as follows:

Provide a complete range of ‘A’ type and ‘B’ type distribution boards and accessories.

Provide a complete range of ‘A’ type and ‘B’ type multi-service units enabling the inclusion of both MCB’s and control devices such as Contractors, push buttons, signal lamps, etc., in the same enclosure.

Provide a complete range 10kA to BS EN 60898 (15kA to BS EN 60947-2) MCB’s with current rating up to 63A.

Provide an MCB flush mounting accessory or other arrangement.

All MCB’s shall be panel mounted with or without DIN-rail by preference, this requirement shall be met as standard however an accessory is an acceptable solution.

Be capable of providing “specials” by manufacturing prefabricated assemblies in their own workshop.

4.2.3 Particular Specification Type ’A’ MCB Distribution Boards.

Main busbars shall have a current carrying capacity of up to 125A.

Outgoing busbar stabs shall have a current carrying capacity of 100A.

It shall be possible to convert, through the use of a distributed neutral kit, any outgoing way to a neutral terminal, such that it may be disconnected, isolated and protected, along with the associated phase conductors, with the use of 2 pole MCB'S or RCBO'S.

Outgoing neutral and earth connections shall be capable of clamping as a minimum, the range of standard cable sizes from 1-25mm^2, without the necessity of using a crimp or similar wiring aid.

The neutral bar shall as a minimum have as many ways as outgoing SP ways, the earth bar shall have as many ways as outgoing ways with terminals available for the purpose of supplementary bonding.

An ample quantity of knockouts shall be provided in the rear, top, bottom and on both sides of the enclosure in the range 20 - 32mm, the rear knockouts shall be necessarily larger to allow all cables to enter from the rear.

4.2.4 Particular Specification Type 'B' Distribution Boards

There should only be one range with Main busbars shall having a current carrying capacity of up to 250A.

Fully Type Tested conditional short circuit rating of 25kA to BS EN 61439 PART 1 AND 2 with MCCB incomer.

Outgoing busbar stabs shall have a current carrying capacity of 100A.

It shall be possible to convert any outgoing way, through the use of a distributed neutral kit, to a neutral terminal, such that it may be disconnected, isolated and protected, along with the associated phase conductors, with the use of a 2 or 4 pole MCB's or RCBO's.

Outgoing neutral and earth connections shall be capable of clamping as a minimum, the range of standard cable sizes from 1-25mm^2, without the necessity of using a crimp or similar wiring aid.

The neutral bar shall as a minimum have as many ways as outgoing sp ways, the earth bar shall have as many ways as outgoing ways with terminals available for the purposes of supplementary bonding.

Gland plates shall be removable top and bottom and shall have no knockouts for maximum glanding flexibility.

Where a large number of outgoing ways over and above 24TP&N are required, it shall be possible to bolt two db's one above the other or side by side. The manufacturer shall supply terminal blocks to allow cables to be taken from an outgoing way.

4.2.5 Miniature Circuit Breakers (MCB)

MCB's to comply with BS EN 60947-2.

Where not indicated, MCB's shall be type C for general circuits and type C for circuits with electronic control gear. All MCB's shall be rated at 15kA.

MCBs shall have locking capabilities in the way of a padlock.

4.2.6 Residual Current – Operated Circuit Breakers (RCBO)

RCBO's to comply with BS EN 61009.

All RCBO's shall be rated at 15kA and shall be 30mA sensitivity where not otherwise indicated.

RCBO's shall have locking capabilities in the way of a padlock.

4.2.7 Residual Current Circuit Breakers (RCCB)

RCCB's to comply with BS EN 61008.

RCCB's shall be 30mA sensitivity where not otherwise indicated.

4.2.8 Switch Disconnectors

Provide switch disconnectors in compliance with BS EN 60947-3 provided as indicated on the drawings.

Each switch disconnector to be fully rated to switch motor circuits and other highly inductive loads (AC23).

Switch disconnectors to have a minimum making and breaking capacity of 1.35kA and 50kA respectively.

Switch disconnector fuses to be supplied complete with BS88 HRC fuse links.

4.3 Surge Protection

In addition to primary surge protection for the main switchboards, additional surge protection (Direct connected Furse ESP 415 M1 protector) shall be fitted in the following locations:

- Main switchboards with local fuse or breaker protection.

- Distribution Boards feeding external services: units may be connected direct to the load side of main switches but maintain full shrouding for supplies up to 100A. Units are to be housed in an enclosure complete with viewing window or to be integrated in the board itself.

Individual external power and communication circuits are to include local integrated surge protection to suit the device connected. These are to include, but not be limited to:

- CCTV camera connection box: space is to be left within the CCTV camera junction boxes for the video cable connection and associated surge protector to be provided by the security specialist.

- Incoming Telecom Services: all lines that enter or leave the building (i.e. main telecom incomers, etc.) shall be protected via suitable plug-in protectors. These shall be fitted for a series connection into each disconnection module requiring protection at the PBX distribution frame.

- Equipment such as RF receivers with aerials or satellite links shall be protected with suitable RF protectors installed in series with the coaxial cables where these enter the building. The final selection of the surge protector shall be coordinated with the satellite/aerial final distribution equipment characteristics (impedance, RF max power and voltage, etc.).

- All supplies to external equipment at roof level (i.e. extract fans, external lighting, motorised cleaning equipment, etc.) shall be provided with suitable surge protectors installed in-line with the power supply on the isolators / fuse connection units integrated within the final connection enclosure or within a separate enclosure, or at the outgoing way of the relevant distribution board.

4.4 Works Test

4.4.1 Not Used

4.4.2 Site Testing

The Contractor shall be responsible for the complete testing of the systems within the building to the standards laid out in this specification.

Prior notice of all site tests shall be given to the Employer's Representative giving him the opportunity to attend.

The Contractor shall provide all instruments necessary for carrying out the specified testing.

Tests shall be carried out as the work proceeds but a final test on the whole installation shall be carried out on completion. Where tests are failed, works shall be rectified and tests repeated until a pass is achieved.

During the progress of the works, the Contractor shall carry out tests on conduit runs to ensure low resistance and shall submit test sheets immediately any section of the conduit is completed and Testing.

The testing schedule shall include but not be limited to the following:

4.4.2.1.1 Switchboards:

- Insulation resistance at 1000V to all cables and switchgear
- Busbar contact resistance (Ducter) test compared to works readings.
- Earth loop impedance.
- Interlock proving.
- Meter and instrument operation.
- 'Ducter' tests are to be carried out with a test current of 10A for the lowest ohm scale.

All test instruments used shall be covered by a current test certificate not more than 12 months old.

4.4.2.1.2 General Electrical Installations:

- Continuity of final ring circuit conductors.
- Continuity of protective conductors including main and supplementary equipotential bonding.
- Earth electrode resistance.
- Insulation resistance.
- Insulation of site built assemblies.
- Protection by electrical separation.
- Protection by barriers or enclosures provided during erection.
- Circuit impedance.
- Polarity.
- Earth fault loop impedance/fault level.
- Prospective fault levels.
- Operation of residual current devices.

Tests shall be carried out in the above sequence. Standard methods of testing shall be used as defined in the IEE Wiring Regulations for Electrical Installations.

On completion of tests the suitability of equipment installed shall be re-verified to ensure safety of operation. This particularly applies to disconnection times for fuses and circuit breakers.

When the testing is satisfactorily complete, the Contractor shall set to work and demonstrate the correct operation of the installations in accordance with the design intent.

Low Voltage Switchgear

The Contractor shall check the insulation resistance between phases, between each phase and earth and between the instrument wiring and earth.

The Contractor's attention is drawn to the need to short circuit all instrument and current transformer connections by bonding at the terminals, to open circuit all instruments and voltage coils by removing the potential fuses and disconnection of the current transformer earth connections.

The results of all these tests shall be recorded.

The Contractor shall ensure that on completion of the tests all bonding is removed and that the current transformer earth connections and potential fuses are replaced.

4.4.3 Pre-Commissioning

On completion of the works and before systems are energised the Contractor shall visually inspect the installation to ensure that electrical equipment is in compliance with the Specification, correctly selected and erected and not visibly damaged so as to impair safety.

The Contractor shall ensure that all equipment included under this sub contract is thoroughly cleaned and checked for serviceability immediately before setting to work.

All automatic controls and safety devices shall be inspected and checked for serviceability before the working power is applied to the system.

4.4.4 Commissioning And Testing Records

The commissioning schedule shall include but not be limited to the following.

- The Contractor shall be responsible for the manufacturers attending site to carry out all specialist commissioning of plant items and systems.

- Setting, calibration and testing of all indication and alarm systems and safety devices.

- Operation of all automatic and manual plant switching including interlocks and automatic changeovers.

Check instruments and gauges for scale range and accuracy of readings and set points.

Upon completion of commissioning and testing the Contractor shall assemble his commissioning and testing records into a bound manual. The manual shall be made available when the commissioned and tested installation are ready for demonstration to the Employer or Employer's Representative. The records shall be supplied in copies of the O&M manuals, the requirements for which are specified elsewhere.

4.4.5 System Performance Proving

The Contractor shall be required to demonstrate to the Construction Stage Supervisor and the Consulting Engineer the following aspects of the LV Systems Operation and Performance and shall include a full demonstration of the LV protection system with simulation of failures to show the operation of the protective systems.

Demonstrations shall include functionality tests and random checks to prove repeatability of commissioning results including switching, control and operation.

The Contractor shall be responsible for producing a comprehensive list of and programme for these demonstrations for approval of the Employer's Representative.

The approved list shall be included in the O&M manuals as a basis for annual proving of full functionality.

4.4.6 Witnessing And Inspection By Statutory Bodies And Utilities

The Contractor shall allow for the witnessing of testing as required, any separate testing that may be required by Statutory Authorities and full completed system inspection on the services installation.

The Contractor shall obtain in writing from the relevant authorities, written confirmation of their acceptance of the installations.

4.4.7 Regular Testing And Maintenance

The complete electrical distribution system shall need to be regularly tested and maintained in accordance with BS 7671, Requirements for Electrical Installations (IEE Wiring Regulations). The Contractor to ensure that the requirements for regular testing and maintenance are clearly stated in

the Operation & Maintenance Manuals. A pro-forma for regular testing and maintenance shall be provided in the O & M manuals by the Contractor along with a log book.

For details of plant removal, refer to the plant replacement strategy.

Designers risk assessments have been carried out for the design; these risk assessments are not contained within this specification, but shall have been issued during tender with the tender documents.

5 Earthing System

5.1 General

The Contractor shall install, test and commission an earthing system in accordance with BS7671. An independent and approved specialist Contractor is to test and confirm the site ground conditions to suit the rod type earthing network prior to commencing the works.

Safety Earthing shall be achieved by reducing the potential between conductive parts both extraneous and exposed to zero. Exposed conductive parts shall have sufficiently low impedance to operate the nearest upstream protective device in the prescribed time limitations as stated in BS 7671, whilst limiting the energy to the capacity of the connected equipment and cabling.

The Contractor shall ensure that any part of the earth fault current path provided by the Electricity Supply Company or others is suitable for the operation of the earth fault protection to be installed.

The Contractor shall obtain the agreement and permission of undertakings providing services that are to be bonded to the earthing system.

The Earthing system shall consist of earth connections to the reinforced bars of the building structure, earth rods, earth bars, earth connections to bonding conductors and earth connections to third parties systems. The bonding system shall ensure a complete equipotential bonding zone exists throughout the building.

Sacrificial vertical shuttering shall be used as a primary Earthing conductor surrounded by filled earth up to ground level.

As a minimum the following third parties systems shall be included.

- Structural Steelwork.
- Hot and Cold Water Systems.
- Fuel Systems.
- Flue systems.
- District Cooling Water Systems.
- Split DX Cooling Systems.
- Gas Systems.
- Sprinkler Systems
- Food and Beverage Systems.
- Telecommunication Systems
- Lift Installations.
- All electrical metallic cable containment provided by other Contractors.

5.2 Technical Requirements

5.2.1 Earth Pits

Earth pits where required shall include stainless steel rods driven into the ground to achieve a minimum of 1ohms or better. The Contractor shall include for driving a minimum of 20m depth of rods for each pit, take measurements and agree to stop or proceed. All rods shall be driven using the appropriate earth rod hammer with protected covers.

Additionally, for external earth pits, the ground is to be core drilled 100mmØ for 10m and backfilled with resistive clay (‘Bentonite’) or similar approved locally.

Internal earth pits (where allowed by the structural engineer) shall be of the moulded type complete with puddle flange for setting within the floor slab. Pits shall include sealing rings to prevent ground water ingress. The pits shall include duct extensions extending below any backfill or blinding.

The Contractor shall provide rates for driving additional rods, providing additional pits, buried interlinks and re-testing.

5.2.2 External Earth Bars

A main earth bar shall be installed within each LV switchroom and shall include a removable link between main earth connections and bonding connections for testing. A minimum of 18 connection points per earth bar shall be provided for general earthing suitable for M10 connections. A 12 point clean earth bar shall also be provided within the main LV switchrooms.

External earth bars shall be fabricated from 50x6mm hard drawn copper bars mounted on insulated mounts of either porcelain or plastic construction the bars shall include for all connections identified on the earthing schematics and shall allow for 25% spare connections. Each earth bar shall include for a test link to allow the testing of the system both upstream and downstream of the bar. The bars shall be labelled with their reference no and the legend **Electrical Earth Connection Do Not Disconnect**. The earth bars shall be mounted 600mm AFFL and shall have a clear working area of 750mm in front of them.

Each earth bar shall be mounted on insulated supports located at 300mm centres for 25mm bar and 450mm centres for 50mm bar, giving 30mm clearance at rear of bar.

Clearance holes for M10 shall be drilled, one for each cable plus 30% spare holes (two minimum) at 50mm minimum centres through bar for connection of cable lugs. Ensure clearance holes are minimum necessary size to maintain adequate lug/bar contact.

5.2.3 Earth Terminal Connections

Main earth conductors and main equipotential bonding conductors shall be connected to main earth terminals. Terminate conductors with compression type lugs suitable for bolting direct to the bar.

Extend separate protective and bonding conductors to the switchboards, incoming services and other extraneous conductive parts.

5.2.4 Earthing Of Low Voltage Distribution Network

Sub-distribution supplies shall be arranged as described Low Voltage Distribution System section of this specification. All power and circuit cables are to include additional CPCs sized to match the respective phase conductor up to 70mm^2 maximum. In addition to main switchboard internal earth bars, external earth bars shall be provided to allow easy termination of the circuit additional CPC.

Power circuits shall be wired in accordance with section 607 of BS 7671.

Power outlets shall be provided with two earth terminals for high integrity earthing.

5.2.5 Interlinking Network

A system of interlinking networks shall be provided to interlink all main earth bars within main switchrooms and large plant room earth bars.

The network is to consist on a 70mm^2 insulated cable network, attached to the cable distribution containment and forming a continuous uninterrupted network. All connections to the network are to use exothermic welded connections with tee connections to each main earth bar.

5.2.6 Identification

Use numbered and/or lettered plastic cable sleeves to indicate circuit numbers of conductors.

Ensure conductors are connected to earth bar in same sequence as phase and neutral conductors.

Identify at switchboard and building earth bars each protective, bonding and earthing conductor.

Provide labels on bars adjacent to each conductor.

All earth pits shall include number identification tags located in agreed locations labelled “EARTH PIT REF……” face engraved on a stainless steel disk.

5.3 Testing And Commissioning

Refer to Low Voltage Distribution System “Testing and Commissioning” section and to the specific requirements of BS 7430.

6 Lightning Protection System

7 Small Power Distribution System

7.1 Layout Of Accessories

The positioning, setting out and coordination of all electrical accessories shall be identified in detail by the architect's detailed drawings. Electrical drawings only identify the number and type of accessories.

Where a discrepancy exists between the numbers of socket outlets shown on the architectural drawings then the electrical drawings are to take preference.

Where architectural information does not exist then the Contractor shall identify the position of the accessories himself on his working drawings for approval by the CA.

7.2 Samples

The Contractor shall provide samples of all electrical accessories for approval prior to the commencement on site for approval by NMRN. Each sample shall be identified with its type manufacturer and intended locations.

7.3 Technical Requirements

7.3.1 General

The small power installation shall be carried out utilising a single manufacturer for all accessories and a common faceplate design and finish for accessories within the same types of areas.

Electrical small power distribution to equipment shall include supplies to:

- Fixed equipment via a local form of isolation which has the capability of being disconnected from the supply via the nearest upstream protective device within 5 seconds under fault conditions whilst limiting the energy let through to below that of the equipment and cables connected to it.

- Portable equipment via general purpose socket outlets which have the capability of being disconnected from the supply via the nearest upstream protective device within 0.4 seconds under fault conditions whilst limiting the energy let through to below that of the equipment and cables connected to it.

All circuits feeding general purpose outlets and other outlets and fused connection units feeding fixed appliances in "wet" areas (i.e. toilets, bathrooms, etc.) shall be protected by RCD's / RCBO's.

All metal components shall be bonded to the accessory CPC and the wiring/enclosure box shall be fully earthed to the incoming conduits. Interconnecting CPC shall be provided between the enclosure and the accessory metal grid and front plate.

All electrical accessories shall be protected against damage. When the accessories are fitted they shall be fitted with protective covers, when using architectural flat plate accessories do not install the front plates until all wet Sub-s are completed.

All accessories shall be aligned horizontally and vertically. When groups of accessories are mounted in close proximity to each other the Sub-Contactor shall provide a sketch of each of the groups identifying the use of each accessory. for approval by the NMRN.

When installing accessories all measurements shall be taken to the centre line of the accessory from either finished floor or top of worktop. Where accessories are sited in tiled walls the setting out shall be centred on the joints of the tiles. The conduit installation shall have a 300mm length of flexible conduit feeding each accessory to allow the exact setting out of the accessories.

7.3.2 Outlets And Fused Connection Units

Small power outlets and fused connection units shall be in compliance with the relevant parts of BS 1363.

Each outlet shall be provided with two earth terminals in accordance with section 607 of BS 7671.

The terminal capacity for live, neutral & earth shall be 3 x 2.5mm sq., 3 x 4mm sq. and 2 x 6mm sq. respectively.

The outlets shall have a 3 pin operated safety shutter and be rated at 250V A.C.

All sockets outlets and fused connection units, with exception of the ones serving security and life safety loads, and shall come complete with a double pole switch to isolate the load from the mains. The neutral shall make contact before the live contact and shall break after the live contact with a 3mm contact gap in the open position.

Fused Connection Units serving Main and Repeater Fire Alarm panels shall include an isolating facility via a key operated switch.

Where switched, FCUs shall have double pole switching; the neutral shall make contact before the live contact and shall break after the live contact with a 3mm contact gap in the open position.

Where FCUs are identified as feeding specific pieces of equipment, the faceplates shall be engraved with legends identifying the equipment connected e.g. Hand Dryer. Mounting heights shall be as agreed with NMRN; where heights are not identified the mounting heights are given in the mounting height schedule.

When FCUs are mounted in ceiling voids, they shall be mounted within 1m of the equipment they are feeding and in accessible position such that they can be operated in a safe manner and have their fuse replaced.

Fused Connection Units (FCUs) shall include flex outlet facility and neon indication.

Flex outlets they shall not be closer than 100mm above horizontal surfaces and 300mm below ceilings. If exposed, the final connection cords shall be of a colour that is acceptable to the architect and be cut to the appropriate length. Coiled cords in ceiling voids shall not be allowed and any excessive cable trimmed back. Flexes shall be clipped direct to support structure where possible using ceiling and plant secondary support structure.

All accessories shall have finishes as indicated in the technical schedules included as part of the Tender Documents.

The outlets shall have 20 year guarantee.

7.3.3 Switches

When a lighting control system is specified, all lighting switches and other lighting control accessories shall be checked with the lighting control manufacturer to ensure full compatibility with the lighting control system. The Contractor shall ensure that all switches match in type and finish the specification of other electrical accessories at all opportunities. Accessories supplied by the lighting control manufacturer shall not be used unless it is specifically identified in the Technical Schedules or unless discussed and agreed with the Architect.

Timed switching shall generally be carried out by a centralised lighting control system where this is not specified then separate time switches shall be employed with the following characteristics:

- Standard: in compliance with BS EN 60730-2-7.

- Type: quartz stabilised solid state with 50hour Ni-Cad battery support.

- Timer Accuracy: 1min/annum.

- Special Programme functions:

    - Solar dial for site latitude.
    - Weekend special programme.
    - Automatic Summer/winter time switchover.
    - Day omit.

- Manual override.

– Programme Repeat Cycle: 5 + 2 days.

– Common Fault Alarm: Volt-free changeover contact.

7.3.4 Isolating Switches

Isolating switches for the isolation of large items greater than 3kW/13A and which are required to be sited in areas where they are required to match the look and format of general electrical accessories (e.g. kitchens) shall comply with BS EN 60947-1 and shall generally have a utilisation category of AC21 for non-motor applications and AC23 when supplying motors and other highly inductive loads.

Cooker Control Units shall be in compliance with BS 4177 and shall come minimum IP rating of IP31. They shall include double pole switching facility and shall have a rating of 45A unless otherwise stated in the drawings or Schedules.

7.3.5 Luminaire Connectors

All recessed luminaires shall be connected by means of removable connector or tap off unit mounted in the ceiling void within 1.0m of the luminaire and accessible through either:

– The luminaire aperture after removal of the luminaire.

– Removal of a local ceiling tile.

– Opening a specifically constructed access panel in the ceiling.

Where separate control gear or emergency lighting battery packs are required they shall be removable through the means of access once disconnected.

Where luminaires are mounted onto trunking then the luminaire connector shall be mounted directly onto the trunking adjacent to the luminaire.

The luminaire connectors shall have the appropriate number of pins to allow any lighting control signals to also be disconnected at the same time as the power to the luminaire. Separate lighting control connectors shall only be used with prior agreement with the Consulting Engineer. Emergency luminaire connectors shall also include a pin to isolate the unswitched live feed to the luminaire or separate battery box.

7.4 Testing And Commissioning

The Contractor shall demonstrate that circuit breakers operate within the tolerances specified.

Refer also to Low Voltage Distribution System “Testing and Commissioning” section.

9 Cables

9.1 General

All cables shall have high conductivity copper conductors and manufactured by BASEC member companies.

All cables shall be delivered to site with the makers identification labels attached and these shall be handed over on request.

The Contractor shall be responsible for the off-loading and handling of the cable on site, and shall ensure that the cables are delivered to site on drums and properly protected against mechanical damage. Where lengths are cut from cables the open cable ends shall be sealed.

Each drum when delivered shall be accompanied by a certificate giving manufacturer's name, works order number and results of tests carried out in accordance with the appropriate certification.

Cables shall not be installed unless the stored cable and ambient temperature has been above 0°C for at least 24 hours.

Sheaths of cables shall be identified by a colour code as detailed below. The colour markers may be neatly painted bands or be self-coloured plastic with a minimum width of 25mm at intervals not exceeding 10 metres and each side of wall or floor slab. For vertical risers this shall be increased to at least one band per floor level.

Where multi-compartment trunking is used each service shall be identified by a colour code.

SERVICE	COLOUR	COLOUR NO. (B.S. 5252)
Small Power	Orange	06 E 55
Power (Electrics to Mechanical Services)	Orange	06 E 55
Controls/BMS	Light Buff	08 D 41
Emergency/Essential Supplies including UPS	Pink	02 D 41

9.2 LV Armoured Power Supply Cables

Armoured cables designated XLPE SWA LS0H shall have cross linked polythene insulation, steel wire armour and low smoke zero halogen sheath.

All cables shall be 600/1000V grade and comply to BS 6724.

Single core cables shall have a non-magnetic armour of hard drawn aluminium wires.

Terminations shall be in accordance with the cable manufacturers' recommendations using compressing type cable glands and hydraulic compression cable lugs.

Each termination gland shall include 'banjo' type earth lugs for direct CPC connections.

Separate CPC conductors shall be provided in parallel to the armouring for all internal circuits.

The use of additional cores within the cable as a CPC in lieu of a separate cable is permitted providing all tails are over-sheathed with the correct colour coded sleeve.

Cables shall be fixed with cable cleats where installed on ladder rack or fixed direct.

Small section (4mm^2 and below) armoured internal final circuit cables may be tie wrapped to cable tray or cable basket.

Where joints are necessary in armoured cables, these shall be carried out in accordance with the manufacturers recommendations using Raychem jointing and heat shrink materials to achieve a neat slim joint.

All cable joints shall be made by qualified jointers and precautions shall be taken to exclude moisture and foreign matter. The cables shall be tested before and after the jointing process.

Cable glands shall be of the compression type designed for the cable to which it is fitted. Special attention must be given to ensure complete continuity of the steel wire armouring of cables used as the earth conductor.

The end of the tails shall be provided with heavy duty, solderless cable lugs of high conductivity copper, electro-tinned and applied to the conductor by means of a hydraulic crimping tool for connection to switchgear terminals.

Bends in XLPE cables shall be in accordance with manufacturer's recommendations.

Cables entering cable end boxes in switchboards, etc., shall be run straight for a distance of not less than 300 mm from the armour clamp.

All armoured cables shall be insulation tested at 1000V.

All cables shall include circuit reference identification at each termination or joint.

9.2.1 Support And Fixing For Cables

Cables generally shall run in service ducts and/or false ceilings as indicated on the Tender Drawings.

Where cables are run fixed to the structure or in vertical ducts provide and fix claw type cable cleats. Cleats shall consist of two similar halves, pressure die cast aluminium alloys, with single or double bolt fixing according to cable size.

Cable supports shall be spaced and arranged to give adequate support and fixing for the various cable sizes. In general, the Contractor shall work to the cable manufacturer's recommendations, particularly as regards vertical runs.

Large multiple cable runs of three or more shall be supported by perforated cable tray, or cable racking.

The Contractor shall include for all work associated with fixing cable supports to the structure such as cast in fixings, etc.

9.2.2 Identification Of Cables

Cables shall be provided with identification labels at all positions where cables change direction and each side of wall or floor slab and where cables are in multiple runs, labels shall be at 10 metres intervals and at each termination.

Labels shall be manufactured from traffolyte engraved to show the size of the cable and the equipment being fed. In cases where the cable is feeding a single phase load the phase shall also be shown on the label.

9.3 Cables Buried Direct In Ground

Cables buried direct in ground shall be installed in trenches at a depth not less than 750mm on a 150mm bed of builders' sand.

Back-filling shall consist of 150mm builders' sand over the cables with polythene "Danger Electricity" marker tape extending the full length of the cable.

Where installed below hard standing or roads, cables shall be installed in smooth walled plastic ducts coloured black and selected from the 'Rigiduct' range. Ducts shall be installed in trenches at a depth not less than 750mm on a 150mm bed of builders' sand. Back-filling shall consist of 150mm builders' sand over the duct with polythene "Danger Electricity" marker tape extending the full length of the duct.

The routes of all buried cables and ducts shall be clearly indicated on record drawings with clear dimension particularly for changes in direction.

At each main duct entry point and changes of direction, markers shall be fixed to paving slabs to indicate the presence of buried cables. The labels shall be brass, and face engraved.

9.4 Fire Survival Cabling Systems

The following circuits and systems shall include cabling compliant with BS, BASEC and LPCB requirements for Fire Survival use category to suit the applicable system installation standard with the following survival times:

- Fire and Voice alarm systems (detection circuits) 60min
- Fire and Voice alarm networking systems 120min
- Fire Communication system 60min
- Disabled Refuge Communication system 60min
- Emergency lighting system 120min
- Smoke vent dampers and control devices 120min
- Fire Fighting supplies to Smoke Fans & Sprinkler Pumps etc. 120min
- Fire Fighting lift supplies and associated circuits 120min

Cables are to comply to the appropriate standards including:

- BS 60702 for mineral insulated cables.
- BS 7629-1 for soft skinned screened multicore cables.
- BS 7846 & BS 8491 for armoured multicore cables.
- BS 6387; BS 8519; BS 8434 Pt 1 & 2 and BS EN 50200 for survival testing.
- IEC 331 for single core cables in steel conduit.

Cabling for fire and voice alarm systems shall be include a red LSOH outer sheath.

Cabling for emergency lighting systems shall include a white LSOH outer sheath

Power cabling for life safety circuits are to include red banding, nom 100mm long on either side of each wall penetration and at minimum 10m intervals between.

Where cables are concealed or chased within the building fabric, metal cover casings shall be provided for additional mechanical protection.

Emergency lighting circuits shall use single core IEC 331 cables (AEI Firetec or similar) installed in a separate trunking and conduit system to the fitment connection point.

Where cables are concealed or chased within the building fabric, metal cover casings shall be provided for additional protection.

Cables shall be installed on cable tray for primary routes and clipped direct in voids etc.

Fixing centres for soft skinned cabling shall be as described for MICC cables.

9.5 MICC Cables

MICC cable shall be used where indicated in the Specification.

Cables shall be installed to the manufacturers' recommendations with all necessary glands and accessories.

All M.I.C.C. cables and cable accessories, glands, etc., shall be LSOH sheathed coloured as follows:

- Fire & life safety Red
- General power circuits Orange

Matching colour gland sheaths shall be provided.

Light duty grade cable is acceptable for fire alarm, emergency lighting and general small power circuits. Heavy duty cable shall be used for all fixed power supply circuits.

All terminations and seals shall be made in accordance with approved methods, care being taken to exclude moisture and foreign matter from the terminations and seals. The seals shall be tested immediately on completion and repeated when the whole installation has been completed.

All terminations shall be provided with a tight fitting LSOH covering sleeve.

Cable terminations at distribution boards and switchgear shall be made by means of cold screw-on pot type seals, and in conjunction with ring type universal glands. Brass locknuts with serrated washers shall be used where cables terminate at equipment not provided with a screwed entry.

Cable seals sealing compound and sleeves for general use shall be suitable for operating temperatures up to 105°C. For terminations at heaters whose terminal chambers shall exceed 105°C, seals sealing compound and sleeve shall be 185°C grade.

Seals shall be secured at plant and accessories by standard compression glands retained in screwed or clearance entry holes. These holes shall be suitably sized to avoid the need for increasing or reducing sockets and nipples. Nuts, sockets and nipples shall be of brass. Gland plates for single core cables shall be non-magnetic.

Manipulating and straightening of the cables shall be carried out with bending levers and roller straighteners manufactured by the cable makers. The use of a wood block and hammer shall only be permitted for final "dressing".

Where M.I.C.C. cables are installed during building construction they shall be LSOH sheathed and where liable to mechanical damage, they shall be provided with adequate temporary protection in the form of sheet steel troughs or by other approved methods.

Where M.I.C.C. cables are fixed directly to the structure the Contractor shall provide non-ferrous spacer clips for multiple runs and single fixing non-ferrous clips for single runs. Brass round head screws of minimum size No. 8 shall be used having a minimum length of 25mm employing suitable manufactured plugs as necessary. Clips securing single cable shall be of one fixing screw pattern. Two screw patterns shall be used for multiple cable runs. Spacing of cable fixings shall be to manufacturer's recommendations.

Multiple cable runs (exceeding four cables) shall be supported with non-ferrous spacer clips secured to perforated cable tray.

No through joints in any M.I.C.C. cables shall be used unless approved by the Consulting Engineer. Where so approved the joints shall be of the brass sleeve type internally threaded at each end to receive a ring type universal gland, fitted to each of the cable ends. An ebonite spreader shall be used within the sleeve to hold the cores in position. Solder type connectors shall be used on all cables up to and including 25mm^2. Above this size mechanical type connectors shall be used.

Where M.I.C.C. cables are run to motors, etc., on island bases, they shall be drawn into protective conduits buried in the floor, or run overhead on cable tray dependent on supply position.

All cables shall be kept entirely separate from pipework associated with other services and in general direct contact shall not be permitted between the cables and such pipes except where earthing is required by the Regulations.

All labour employed in the installation of M.I.C.C. cables shall be properly trained in the methods recommended by the cable manufacturers and be fully competent to carry out the work.

Where fixed to the structure, M.I.C.C. cables shall be fixed at 150mm centres. Cables shall be fixed in all areas including voids and ducts.

All cable tails shall include phase identification sleeves.

Fixed power supply cables shall include circuit identification labels at each termination.

9.6 Heat Resistant Cable

Where heat resistant cables (85°C) are specified for boiler houses, similar plant rooms or heat generating plant they shall be EPR insulated, braided and compounded.

150°C rubber insulated, heat resistant flexible cord with treated glass filament braid shall be in accordance with the relevant Standards.

Where flexible cables are installed within ceiling voids they shall be silicone rubber insulated, terylene braided type.

9.7 Multi Core Halogen Free Multicore Cables

Multicore cables for final power and lighting distribution shall be in accordance with BS 7211 (code ref. 3182B, 3183B, 3184B) and constructed with Low Smoke Halogen Free materials to IEC 61034, BS EN 50268, IEC 60754-2, BS EN 50267-2, BS EN 60332-1-1 and BS EN 60332-1-2, BS EN 60332 Part 1 and 2 (Plain copper conductor, LS0H insulation, LS0H flexible sheath).

The earth core shall have the same cross sectional areas as the live and neutral cores.

All cables to be provided from BASEC member companies.

Connections to extra low voltage lamps shall use 2.5mm^2 2-core cable neatly tie wrapped to light duty cable tray fixed to the ceiling support system. Cable tray shall be provided for final unsupported connections so as not exceed 1.5m. Separate cables shall be provided from the transformer to each fitment.

Final connections to 230V luminaires shall be in 0.75mm^2 cable (24/0.2).

Cables are to be neatly clipped and routed using cable basket or similar containment. Fixing clips are to be used for cables fixed direct using nylon cable clips.

Both cable ends are to include circuit identifications.

Nylon cable glands are to be used complete with nitrite rubber bushes sized to suit the cable diameter.

Where core colours do not match circuit needs, full over-sleeving shall be provided correctly colour coded at each termination. Where a core is used for clean earth, this is to be over-sleeved green/yellow and include cable markers designated ‘CE’.

Cable stripping is to be carried out with the recommended tools.

9.8 Single Core Cables In Conduit & Trunking

Single core cables for distribution in conduit and trunking for final power and lighting distribution shall be in accordance with BS 7211 (code ref. 6491B) and constructed with Low Smoke Halogen Free materials to BS EN 60332-1, BS EN 60332-3 Part 21,22,23,24 and 25, BS EN 50363-5 Type El 5 (Plain copper conductor, LS0H insulation).

The maximum number of cables drawn into conduits, trunking and ducts shall be in accordance with the regulations.

Separate CPC’s shall be provided for each circuit, sized to match the circuit conductor cross sectional areas (CSA) unless otherwise stated, up to a maximum of 70mm^2.

Cables of 2.5mm^2 CSA and above shall be stranded.

9.9 Control Cables

Control cables shall be installed at a minimum distance of 100mm from power cables unless otherwise agreed in writing with the Consulting Engineer.

9.9.1 Digital Signals

Control cables for digital signals shall be rated for 300/500 volt, the conductors shall be fine stranded copper LSOH insulated. Core identification shall be with imprinted figures. The minimum core cross section shall be 1mm^2. The overall sheath shall be of LSOH resistant to petrol, oil, grease and most chemicals. The permissible operating temperature at conductor shall be 70°C.

9.9.2 Analogue Signals

Control cables for analogue signals shall be screened twisted pair cables rated for 250 volt for one pair and 5060 volt (AC/DC) for 2-24 pairs. The conductors shall be fine stranded and LSOH insulated. The screen shall be a branding of tinned copper wires. The overall LSOH sheath shall be resistant to petrol, oil, grease and most chemicals. The permissible operating temperature at conductor shall be 70°C. The minimal core cross section shall be 0.75mm^2.

9.9.3 Power

Power cables for motor actuators, etc., shall be LSOH sheathed wiring cables consisting of solid or stranded copper conductors with LSOH sheathing. The permissible operating temperature at conductor shall be 70°C. Rated voltage shall be 300/500 volt. Conductor size 2.5 mm^2 and above shall be stranded. The minimum size of conductor shall be 1.5 mm^2.

9.9.4 Data Transmission

Specialist cabling for data transmission shall be of a type recommended by the system Supplier suitable for the system selected and for use in the environment in which it is installed.

9.10 Cable Protection

Sleeves comprising plastic conduit shall be installed for all cables passing through brick, concrete or similar structures to permit future withdrawal without disturbing the structure.

All exposed or concealed cables rising from the ground or floor shall be protected up to a height of not less than 2 meters. The protection shall be by means of steel tube or metal channel of minimum thickness 2mm. Bare metal sheaths of cables so protected must be covered to prevent corrosion.

9.11 Cable Core Identification

Indelibly printed cable markers shall be fitted over all ends of outgoing cables in sub-main and final distribution boards to mark clearly the corresponding circuit numbers and (in D.P. and T.P. boards) phase colours both on live and neutrals.

Cable cores for extra low voltage or similar applications not subject to the IEE Wiring Regulations shall be distinctively coloured and/or marked. The colours used shall be different from any of those specified for other purposes in the IEE Wiring Regulations for Electrical Installations.

In addition to phase identification, the cores of cables connecting control gear, thermostats, valves, etc., with marked terminals shall be fitted with identification sleeves bearing the same marking as the terminals of the apparatus to which they are connected.

Cable markers shall be of the threaded type cable markers forming a tight fit to the cable cores.

11 General Requirements

11.1 Painting

11.1.1 General

The Contractor shall allow for cleaning, preparing and priming all ferrous pipes, supports, brackets and items of equipment whatsoever supplied under this Sub-Contract. Such priming shall comprise two coats of non-toxic zinc chromate paint of dissimilar colour for bare ferrous and non-ferrous metals and calcium plumbate priming paint to BS 3698 for galvanised steel or composite wood/metal components. Paint finishes shall in all cases be applied as the works proceed.

The Contractor shall also be responsible for making good any priming coats applied off site which are damaged in transit to the site, in off-loading or in placing into position. Similarly the Contractor shall make good any deterioration in applied priming coats to the satisfaction of the Consulting Engineers.

The Contractor shall be responsible for the adequate protection of items supplied with works finishes and for making good any damage to such finishes to the satisfaction of the Consulting Engineers up to the time of handover.

Where complete painting systems are applied by the Contractor he shall obtain paint for priming, undercoating and finishing coats from the same manufacturer and shall ensure that they are suitable for the application concerned and that they are compatible.

Where the Contractor is required to apply priming coats only with subsequent coats being applied by the Main Contractor, he shall liaise direct with the Main Contractor to ensure that the various paints comprising the complete painting system are obtained from a single manufacturer, are suitable for the application concerned and that they are compatible.

All surfaces shall be cleaned with all mill and weld scale and excess jointing compound etc. removed and finally degreased before painting. The preparation of surfaces prior to the application of priming coats shall be strictly in accordance with the paint manufacturer's recommendations.

In positions inaccessible to manual cleaning and where scraping is insufficient, an approved chemical rust remover shall be used and applied in accordance with the manufacturer's recommendations. All surfaces treated with rust remover and surrounding areas which may have become contaminated shall be thoroughly washed with fresh water prior to priming.

Exposed conduit threads and surfaces from which paint has been removed shall be thoroughly cleaned and repainted with a galvanite paint.

Surface exposed to salt spray, salt laden atmosphere or atmosphere polluted with chemicals shall be thoroughly washed with fresh water prior to priming.

Priming coats shall be applied as soon as practicable after preparation and cleaning of surfaces and in any event the same day.

Where more than one priming coat is specified each coat shall be of a different colour to that previously applied.

All paint shall be suitable for various items to which they are applied.

The storage, preparation, thinning and application of paint shall be strictly in accordance with the manufacturer's recommendations.

All painting carried out on site shall be by brushing unless otherwise agreed in writing with the Architect and Main Contractor.

The number of paint coats applied shall be sufficient to provide complete and even coverage and shall not in any event be less than the coats specified herein.

In addition to the requirements set out above the Contractor shall allow for painting in accordance with the following Sub-Clauses:

11.1.1.1 Oil Fill, Foam Inlet, Sprinkler Inlets, Sprinkler Stop Valve Boxes:

2 coats non-toxic zinc phosphate

2 undercoats

1 coat hard gloss oil paint DEF 1156 to colour approved by the Architect

11.1.1.2 Oil Storage And Daily Service Tanks

External surfaces shall be painted in accordance with the provisions of BS 799 and CP 3002. Any associated internal and external access ladders shall be painted to the same specification as the external surfaces.

Internal surfaces shall be protected after the construction to prevent rusting prior to filling the tanks with oil.

11.1.1.3 Galvanized Water Storage Cisterns

Internal surfaces of galvanized water storage cisterns and tanks including internal access ladders where provided:

2 coats non-tainting black bituminous paint to B.S. Type 1

11.1.1.4 Mild Steel Tanks - Internal Surfaces

Internal surfaces of mild steel sectional water storage tanks and vessels including internal access ladders where provided:

Touch up factory applied primer

2 coats non-tainting black bituminous paint to B.S. Type 1

11.1.1.5 Mild Steel Tanks - External Surfaces

External surfaces of mild steel sectional water storage tanks and vessels including external access ladders where provided:

Touch up factory applied primer

2 coats black bituminous paint to B.S. Type 1

11.1.1.6 Galvanized Ductwork - Cut Edges

All cut edges on galvanized sheet steel ductwork:

For internal application

1 coat etching primer

1 coat non-toxic zinc phosphate

For external applications

1 coat etching primer

2 coats non-toxic zinc phosphate

11.1.1.7 Galvanized Ductwork - Behind Grilles

Internal surfaces of galvanized sheet metal ductwork visible behind grilles and diffusers:

1 coat etching primer

2 coats matt black

11.1.1.8 Buried Ferrous Pipework

All ferrous pipework buried:

2 coats non-toxic zinc phosphate

2 coats black bituminous paint to B.S. 3416 Type 1

11.1.1.9 Ferrous Pipework, Supports, Brackets Exposed To Atmosphere Including Secondary Support Systems

All ferrous pipework and supports, brackets, etc. where exposed to atmosphere.

Where insulated - 2 coats non-toxic zinc phosphate

Where uninsulated - primer as above plus 2 coats black bituminous paint to B.S. 3416 Type 1.

11.1.1.10 Ferrous Pipework Supports, Brackets Internal

Where insulated - 2 coats non-toxic zinc chromate

Where uninsulated - Primer as above

Finishing coat by others

11.1.1.11 Copper Pipework, Supports And Brackets Exposed

Where uninsulated - Priming and Finishing coats by others

11.1.1.12 Galvanized Pipework, Supports And Brackets

All cut edges and threads on pipework, supports and brackets:

For internal applications:

1 coat etching primer

1 coat non-toxic zinc phosphate

For external applications:

1 coat etching primer

2 coats non-toxic zinc phosphate

11.1.1.13 Galvanized Cable Trays, Trunking And Conduits

All cut surfaces and threads on galvanized cable trays, trunking and conduits:

For internal applications:

1 coat etching primer

1 coat non-toxic zinc phosphate

For external applications:

1 coat etching primer

2 coats non-toxic zinc phosphate

11.1.1.14 Access Ladders, Platforms, Steps And Hand Railing

All external access ladders, platforms, steps and hand railing shall be provided with a hot dip galvanized finish to BS EN ISO 1461 in accordance with this section of the Specification.

Any subsequent damage to finishes on site:

1 coat etching primer

2 coats non-toxic zinc phosphate

11.1.1.15 Plant And Equipment Drainage Pipework

All uninsulated plant and equipment drainage pipework exposed to atmosphere, within the building and in plant rooms:

2coats of suitable primer

2coats of black bituminous paint to BS 3416 Type 1

11.1.1.16 Exposed Conduits

Surfaces and threads from which paint has been removed shall be thoroughly cleaned and repainted with 2 coats galvanite paint.

11.1.1.17 Galvanised Components

Galvanised components shall be painted with 2 No. substantial coats of cold galvanising paint to repair damage due to installation, cutting, drilling, welding etc.

11.1.1.18 Works Finished Items

Items of plant and equipment shall be supplied with works applied finishes as stated elsewhere in this Specification.

The Contractor shall be responsible for adequate protection of items supplied, works finishes and for making good or replacing any damaged, finished to the satisfaction of the Architect or his representative up to the time of handover.

11.2 System Installation Diagrams

Schematic diagrams of all installed systems shall be provided with all items of plant, equipment and ancillaries scheduled and identified by their unique reference characters.

Schematic diagrams shall be provided in an appropriate perplex glazed mounting frame suitable for wall mounting.

Schematic diagrams shall be installed in each plant room and equipment room for the plant contained therein.

11.3 Notices

All Notices referred to in this clause shall be in both English and the local language.

Notices shall be provided and fixed on the doors to and adjacent to transformers, HV and LV Switchgear and Motor Control Panels. Notices shall comprise a metal based wall chart explaining resuscitation methods and precautions following electric shock.

A white traffolyte label not less than 100mm long and 50mm high shall be attached to the main switchboard. It shall be engraved in red letters not smaller than those shown in the IEE wiring regulations and shall read:

IMPORTANT

THIS INSTALLATION MUST BE PERIODICALLY INSPECTED AND TESTED AND A REPORT ON ITS CONDITION OBTAINED AS PRESCRIBED IN THE REGULATIONS FOR THE ELECTRICAL EQUIPMENT OF BUILDINGS ISSUED BY THE INSTITUTION OF ELECTRICAL ENGINEERS.

Date of Completion.....

At each main switchboard, provide the following notices and instructions encapsulated or rigid vinyl and fixed to suitable notice boards:

- Electric shock treatment
- Distribution schematic diagram

Locations for the above notices to include:

- HV and LV Switch Rooms
- Substations
- Standby Generator Room
- Motor Control Panels

To all electrical equipment access covers and doors, provide BS EN ISO 7010 warning notices for the voltage present.

To all electrical rotating plant and equipment, provide BS EN ISO 7010 mandatory caution notices to isolate for safe working and automatic starting.

11.4 Rubber Mats

Provide rubber mats in front of the following electrical equipment:

- HV switchgear.
- LV switchgear.
- Transformers.
- Diesel generators.
- Motor control panels.

Rubber mats to be 900mm wide, 9mm thick, comply with BS 921 and laid in one length to suit all equipment including provisions for extension.

11.5 Eye Wash Facilities

Eye wash facilities shall comprise wall mounted eyewash kits complete with instructions and two 500ml eye wash solutions complete with wall mounted notices.

Kits shall be provided in the following locations:

- Adjacent to the HV Switchgear Room.

- Water Services Plant Room.

11.6 Fixings

11.6.1 General

The Contractor shall submit builders work drawings showing his proposals for fixing to structural and non-structural elements.

Such proposals shall be in accordance with the requirements of this Specification and the arrangements shown on the Tender Drawings.

11.6.2 Shot Fired Fixings

Shot fired fixings will not be permitted.

11.6.3 Cast In Inserts

The Contractor is advised that the Main Contractor will provide inserts cast into soffits of the structural slabs as indicated on the Tender Drawings.

The Contractor shall use the cast in inserts with compatible fixings for the purpose of supporting the installations comprising the Sub-Contract Work.

All angle, channel or other members required to span the inserts to achieve the specified supporting requirements shall be provided and fixed by the Contractor.

The cast in inserts shall not be used for anchor point fixings.

In no circumstances shall the load on any individual insert exceed the maximum load stated on the Tender Drawings.

11.6.4 Anchor Point Fixings

Anchor point fixings shall be made with expanding bolts, built in rag bolts or built in steel sections.

11.6.5 Built In Components

All items required to be built into the structure shall be clearly detailed on the Contractors builders work drawings. Such items shall include anchor point fixings, plant and equipment holding down bolts, fire dampers, puddle pipes, sleeves and the like.

All items and components to be built in shall be provided by the Contractor and made available to the Main Contractor for building in to suit the construction programme.

11.6.6 Drilling For Fixings

The Contractor shall drill structural and non-structural elements for screw and expanding bolt fixings subject to the Main Contractors approval. Such drilling shall be limited to holes up to 6mm diameter.

Where holes are required in excess of 6mm diameter the Contractor shall obtain the Main Contractors express approval for each location prior to drilling.

All necessary plugs, screws and bolts shall be provided by the Contractor.

11.6.7 Fixing To Structural Steelwork

Fixings to exposed structural steelwork shall only be permitted with the prior approval of the Structural Engineer.

Where such approval is given fixings shall be of an approved clamp on type.

Welding to or drilling of structural steelwork shall not be permitted.

11.6.8 Fixings In Shafts

Pipework, trunking, ductwork and cables in vertical shafts **must only** be fixed to and supported from the structure at each floor level where dry lined partitions are used.

Attention is drawn to the dry lining (plasterboard construction) of walls to shafts in which services are to be installed. These walls are not to be perforated by any services fixings/supports.

Should cast-in type fixings be proposed, allowance must be made for the design, supply and fixing of the inserts. The Contractor must allow for carrying out this work in sequence with other Contractors, as directed by the Main Contractor.

11.7 Permanent Access Provisions

All items of plant, equipment and components incorporated into the final installations shall be freely accessible to permit safe operation, inspection, maintenance and where appropriate replacement.

Access arrangements and provisions shall include necessary requirements to assist the Building User in meeting his obligations under the Health and Safety at Work Regulations.

Access provisions shall comply with the requirements of relevant Statutory Regulations and British Standards including:

- BS 2853: The design and testing of steel overhead runway beams.
- BS 5395 3: Code of Practice for the design of industrial stairs, permanent ladders and walkways.
- BS 6037: Code of Practice for permanently installed suspended access equipment.
- BS EN ISO 141222-1: Code of Practice for Means of Access to Machinery – Choice of fixed means of access between two levels.
- BS EN ISO 141222-2: Code of Practice for Means of Access to Machinery – Working Platforms and Walkways.
- BS EN ISO 141222-3: Code of Practice for Means of Access to Machinery – Stairways, Step ladders and Guard Rails.

Where indicated on the Tender Drawings or described in this Specification as forming part of the Contract Works the Contractor shall supply and install:

a) Fixed mild steel access ladders of welded and/or bolted construction. Ladders shall be inclined between 5º and 15º to the vertical and incorporate 20mm diameter rungs uniformly spaced at centres between 230mm and 255mm. Rungs shall be welded to stringers with no reduction at ends. Where serving a platform or landing the top rung shall be at the same level as the platform/landing.

   Ladders shall be provided with circular safety hoops. The lowest hoop shall be fixed 2400mm above floor level and the highest hoop 1100mm above the platform/landing served.

   No individual ladder length shall exceed 9.0m. For heights in excess of 9.0m rest platforms shall be provided at approximately equal spacing and ladders shall be staggered to enforce rests at each platform. Rest platforms shall not be less than 1.0m square and shall be provided with toe plates and safety handrails.

   Fixed mild steel access ladders and platforms shall be hot dipped galvanized after manufacture.

b) Fixed mild steel platforms of welded and/or bolted construction.

   Unless otherwise agreed with the Architect or his representative platform flooring shall be of open type with individual panels limited to 1600mm x 1000mm. Each panel edge shall be arranged to rest on load bearing members and retained in position by a minimum of four fixings. All panels shall be removable such that on removal the remaining panels are firmly retained in position.

100mm high toe plates shall be provided around the perimeter of each platform and around each permanent floor cut-out.

Tubular steel safety handrails shall be provided around the perimeter of each platform to a height of 1100mm. Where served by an access ladder the hand railing shall incorporate a spring loaded self-closing gate at the platform entry point. Gates are not required on rest platforms.

Platform components shall be hot dipped galvanized after manufacture.

c) Lifting equipment and tackle for removing plant items or components including fixed eyebolts, runway beams and associated block and tackle/beam trolley.

11.8 Secondary Supplementary Support Steelwork

The Contractor shall provide all necessary secondary supplementary support steelwork for the support of the mechanical and electrical building services, access platforms, steps, hand railing and lifting beams within the scope of the Sub-Contract Works as specified herein and indicated on the Tender Drawings unless specifically stated otherwise.

Uniformly distributed loads, point loadings and operational loads shall be catered for in the secondary supplementary steelwork designs. The Contractor shall ensure that any design imposed load criteria on the structure, as stated elsewhere in the Tender Documentation, is not exceeded.

Secondary supplementary support steelwork shall comply with BS 3974 and BS EN 1993.

Unless specifically stated to the contrary the steelwork shall not be fire protected.

In order to minimise the risk of injury to personnel.

- Brackets and support shall be designed so as to maintain clear widths and headroom in access ways.

- End caps shall be fitted to Unistrut members.

Particular requirements for areas with secondary supplementary support steelwork are as follows:

11.8.1 Roof Plant Areas

- Support steelwork and platforms, steps and handrails for freestanding smoke extract fans and associated ductwork.

- Support of low level secondary services including access step-overs, etc.

- Steelwork bases for plant and equipment in roof plantrooms.

11.8.2 Services Risers

- To suit support requirements for mechanical and electrical services and construction of the risers.

- Access platforms/chequer plate flooring.

- Access ships ladders.

11.8.3 Substations

- Platforms for cooling systems.

11.9 Roof-Mounted Building Services Supports

Access platform and step-overs shall be supported on freestanding galvanized steel frame assemblies with polypropylene bases as manufactured by Roof-Pro or equal and approved.

Support frames shall not penetrate the roof waterproofing membrane and shall be designed to facilitate easy access for the purpose of repair or renewal of the roof waterproofing membrane by

others. Support frames should elevate building services and associated equipment above the roof waterproofing membrane to a typical minimum height of 450mm unless otherwise agreed with the Architect and Consulting Engineer.

All support frames shall be constructed incorporating only hot dipped (HDG) or hot dipped spun galvanized components (including all nuts, bolts, cross steels, threaded studs etc.). Support legs shall be both fully height adjustable (threaded) and detachable (bolted on). Where the roof pitch is equal to or greater than 1:80, as pivoting base shall be employed.

Isolation of the polypropylene bases from the roof membrane shall be achieved by the use of 6mm rubber protection mats or as recommended by the manufacturer of the Specialist Roof Support System.

Point-load and pressure calculations shall be carried-out by the manufacturer of the Specialist Roof Support System and shall be submitted to the Main Contractor, Architect, Structural Engineer and Consulting Engineer for review.

Calculations shall take into account:

- Limiting point loadings on the roof finishes.
- Limiting structural loading.
- Clearance for future maintenance of roof finishes.
- Stability under high winds.
- No damage to the roofs waterproofing system.

Submissions shall include a method statement covering:

- Maintenance of plant and equipment.
- Maintenance/ renewal of the roof waterproofing membrane and insulation finishes.

The method statement shall be included within the operation and maintenance procedures.

11.10 Plant Bases

Plant bases, plinths and stands shall be used to ensure that all plant and equipment, including control panels, are raised a minimum of 150mm above the surrounding floor level whilst remaining level and true.

11.11 Bunds

The Contractor shall install bunds in the floor void in each Landlord's Comms Rooms to contain spillage or leakage from wet services.

Wet services including refrigerant pipework, cold water feeds and condense lines shall be run in neat lines parallel to the raised floor grid adjacent to the air conditioning units they serve. The bunds shall be formed from minimum 100mm high mild steel angle bedded on a durable sealant or mastic and shall be installed on both sides of the services being contained. Mechanical fixings shall be used to ensure the bund can withstand reasonable loads.

The bund shall be tested to ensure it is watertight to a head of 75mm. The Contractor shall allow for draining of the bund after testing and for drying of the area before the piped services are installed. The test shall be witnessed by the Consulting Engineer.

Water leak detection tape shall not be installed until after the bunds are tested.

11.12 Civil Works In Conjunction With External Services

11.12.1 General

Civil works in conjunction with the incoming potable water main shall be carried out by the Main Contractor, generally as described herein and shown on the Tender Drawings.

The Contractor shall provide Installation Drawings for the external services coordinated with the works of all other Contractors and shall liaise fully with the Main Contractor.

11.12.2 Ducts, Sleeves And Fittings

Ducts, sleeves and fittings shall be provided by the Main Contractor, generally as in accordance with the Installation Drawings to be prepared by the Contractor.

All materials shall contain pigments and U.V. stabilisers to provide colour stability and weathering properties. All pigments shall be of high purity and resist leaching in contact with acidic soils. Materials shall offer a high resistance to chemicals and shall not embrittle at low temperatures.

A variety of colours shall be available to suit local authority and NJUG requirements. The appropriate service application shall be printed on ducts with a smooth outer surface.

A comprehensive range of accessories shall be available including junctions, long radius bends, bell mouths, adaptors, seals, puddle flanges and cap ends.

Puddle sleeves shall be provided where ducts pass through external walls below ground level and floor slabs in contact with the ground in accordance with the requirements of the 'Pipework, Fittings Valves and Cocks' Section of this Specification.

Underground ducts shall be:

11.12.2.1 Twin Wall Ducting

Twin wall ducting manufactured from high density polyethylene (HDPE) with a corrugated outer pipe and smooth inner bore. Ducts shall be available in a range of sizes.

Ducts shall comply with ESI 12-24, meet the stiffness and impact requirements of BS EN 61386-24 and be certified by the British Board of Agreement.

11.12.2.2 Pvc-U Ducting

Single wall ducting manufactured from PVC-U with a smooth inner bore. Ducts shall be available in a range of sizes.

Ducts shall be manufactured in accordance with British or other approved standards for the application BS 3506, BS 4660 and BS EN 1401-1.

11.12.2.3 Polyethylene Ducting

Single wall ducting manufactured from either MDPE or HDPE with a smooth inner bore. Ducts shall be available in a range of sizes in straight lengths and coils. Jointing shall comprise sleeve couplings or butt fusion welding.

Ducts shall comply with the requirements of ESI 12-24.

Heavy duty polyethylene ducting shall be manufactured from either MDPE or HDPE to SDR 11 and 17 dimensions.

11.12.3 Duct Colour Coding

Duct colours shall be provided in accordance with Local Authority and NJUG requirements. Unless stated otherwise colour coding shall be as follows:

SERVICE	COLOUR CODING
Electricity	Black
Gas	Yellow
Security	Green
Telecommunications	Grey

The appropriate service application shall be provided on ducts with a smooth outer surface.

11.12.4 Laying And Jointing Of Ducts And Fittings

All ducts and fittings shall be checked for soundness and freedom from defects and damage, prior to installing, and joint spaces shall be cleared of dirt.

Pipe ducts shall be installed in compliance with the duct manufacturer's requirements.

Pipe ducts shall be cut with a fine-toothed saw and the cut end shall be chamfered with a file, deburred and cleaned all in accordance with the duct manufacturer's supplier's instructions.

Jointing compounds, rings, seals and lubricants shall be of the type recommended by the duct manufacturer/supplier.

Ducts shall be laid horizontal and straight to line on a prepared bed with all necessary fittings. Flexible joints shall be made in strict accordance with the manufacturer's/suppliers instructions.

11.12.5 Duct Identification/Detection Tapes

Combined cable identification and detection tapes appropriate to the service application shall be laid along the route of all service ducts external to the building footprint.

11.12.6 Draw Wires

Draw wires shall be provided in all ducts and sleeves.

11.12.7 Sealing Open Ends Of Sleeves

Open ends of all sleeves and terminations for later insertion of pipes shall be temporarily sealed and plugged or capped during progress of the Works to prevent entry of foreign matter. Purpose made plastic, shaped hardwood, or metal plugs or drain plugs shall be used. Screwed-up paper or cloth pushed into open ends will not be acceptable and shall not be used.

11.12.8 Excavations For Pipes, Ducts, Sleeves And Chambers

Excavations shall be undertaken by the Main Contractor immediately before laying beds or pipes, and not, therefore, be commenced on any section of work until a full supply of pipes and fittings is available for the section.

Excavations shall be made true and even, the trench bottoms being trimmed to correct level and well rammed. Mud, rock projections, boulders and hard spots shall be removed and replaced with approved fill material, well consolidated.

External mechanical and electrical services shall generally be installed in common trenches. For individual services the minimum width of trench shall be 300mm greater than external diameter of the service pipe, duct or cable.

The setting and construction of the trench timbering shall be carried out by skilled timbermen and the whole of the work shall be adequately supervised.

As backfilling proceeds all timber that can be safely removed shall be taken out as the work progresses.

Any trenches excavated in error to a greater depth than required shall be in-filled back to the required level.

The trench bottom shall be kept free of water.

Trenching requirements shall be confirmed by the Contractor in accordance with the recommendations of the Supplier of the service pipe, duct or cable for the application and ground conditions obtaining.

11.12.9 Bedding To Pipes, Ducts, Sleeves And Fittings

Bedding requirements shall be confirmed by the Contractor in accordance with the recommendations of the Supplier of the service pipe, duct or cable for the application and ground conditions obtaining.

11.12.10 Surround To Pipes, Ducts, Sleeves And Fittings

Surround requirements shall be confirmed by the Contractor in accordance with the recommendations of the Supplier of the service pipe, duct or cable for the application and ground conditions obtaining.

11.12.11 Backfilling To Pipes, Ducts And Sleeves

Backfilling shall not commence until the pipes and sleeves have been inspected and completion of the surrounds.

Selected fill shall be laid in 100mm layers and hand compacted to a level 300mm minimum above top of pipe followed by main backfill material placed and compacted in 300mm layers - any trench sheeting being withdrawn as the work proceeds. Mechanical compactors shall not be used until there is at least 300mm hand compacted cover over the pipes.

Selected fill shall consist of uniform readily compactable excavated material from which stones over 25 mm size, large lumps of clay, tree roots, vegetable matter and frozen soil have been removed.

Backfill requirements shall be confirmed by the Contractor in accordance with the recommendations of the Supplier of the service pipe, duct or cable for the application and ground conditions obtaining.

Temporary bridges shall be provided over trenches by the BWIC and fire stopping Contractor to carry construction traffic, and prevent damage to pipework after backfilling.

11.12.12 Valve And Meter Chambers

11.12.12.1 General

Chambers shall be constructed by the Main Contractor generally as described herein, as indicated on the Tender Drawings and in accordance with Installation Drawings to be provided by the Contractor.

Bases to chambers shall be cast in concrete of 25 N/mm^2 mix, the size of the base shall be equal to the external dimensions of the chamber.

Brick chambers shall be built with Class ‘B’ engineering bricks to BS EN 772 Part 3 and 7 and BS EN 771-1 in English bond 225 mm thick, unless shown otherwise on the Tender Drawings, set in cement mortar 1:3 with flush pointed internal joints. Brickwork shall be cut around pipes, formed into relieving arches and corbelled over to receive concrete cover slabs as necessary. Lintels shall be provided as required.

Cover and surface box frames shall be solidly bed in 1:3 cement: sand mortar over the whole area, entirely over the opening, level with surrounding finishes and square with joints in surrounding finishes. All covers and frames shall be heavy duty type suitable for heavy goods vehicle and fire appliance traffic. Covers shall be suitable for brick insets where located in paved areas.

The Contractor shall ascertain the requirements of relevant local authorities and utilities for the incorporation of such requirements in the Installation Drawings.

11.12.12.2 Isolating Valve Chambers

Surface boxes shall conform to BS 5834 Part 2.

11.12.13 Cable Access Chambers

Cable access chambers shall be constructed by the Main Contractor generally in accordance with the requirements for 'Valve and Meter Chambers' within this Section of the Specification or as indicated on the Tender Drawings and in accordance with Installation Drawings to be provided by the Contractor.

Alternatively, proprietary sectional chambers, manufactured from UV resistant HDPE may be used subject to the chambers being approved as required by the appropriate local authorities. Chambers, covers and frames shall be suitable for heavy goods vehicle and fire appliance traffic. Covers shall be suitable for brick insets where located in paved areas. Chambers shall be colour coded to NJUG recommendations and in accordance with 'Duct Colour Coding' requirements within this Section of the Specification. Installation details shall be based on the Manufacturers/Suppliers recommendations for the application.

11.12.14 Depth Of Ducts & Sleeves

Mechanical and Electrical Services ducts and sleeves shall be installed by the Main Contractor generally with the following cover depths or to the specific requirements of individual utilities.

SERVICE	MINIMUM COVER OVER DUCT OR SLEEVE
High Voltage Cables	600 mm
Low Voltage Cables	450 mm
Telecommunications	350 mm
Cable TV	250 mm
Security	250 mm
Gas	375 mm (i) 600 - 700 mm (ii)
Mains Water	900 mm

Notes:

(i) Pipework not exceeding 50 mm diameter shall be laid with not less than 375 mm cover.

(ii) Pipework exceeding ø 50 mm diameter shall be laid with not less than 600 mm of cover under paved footpaths and not less than 750 mm cover under roadways and grass verges.

11.12.15 Inspection And Completion

All sleeves shall be offered by the Main Contractor for inspection by the Contractor prior to surrounding and backfilling.

Inspections shall include but not be limited to checks that all sections of the installation are free from obstruction and debris and complete with draw wires prior to offering the installation for inspection.

The Main Contractor, shall give the Consulting Engineer and Contractor adequate notice in accordance with the requirements of the Sub-Contract, of their intention to offer the installation or any part(s) thereof for inspection.

On completion of the inspection all open ends and terminations shall be sealed.

12 Setting To Work, Testing And Commissioning

12.1 General

The Contractor shall be responsible for the management, co-ordination and witnessing of off-site and on-site setting to work, testing and commissioning activities including setting to work and the balancing of mechanical air and water systems installed within the Sub-Contract Works.

The Contractor shall make due allowance in the Tender for fully co-operating and co-ordinating with all other Contractors in all setting to work, testing and commissioning activities.

The Contractor shall be required, upon completion of the demonstration and acceptance activities together with the witnessing and inspections by Statutory and Utility bodies, to prepare and submit a report to certify that the inspection and commissioning activities required to establish that services installation complies with the Specification have been completed.

This Setting to Work, Testing and Commissioning Specification shall be read in conjunction with the Setting to Work, testing and Commissioning sections of Volume 2B Electrical Specification and general requirements shall be deemed to apply to the whole MEP Works.

12.2 Scope

The Scope of the Contractor in setting to work, testing and commissioning or witnessing of testing and commissioning of the systems shall be as outlined below and described in the tables of commissioning and testing responsibilities.

In addition to any specific requirements for commissioning and testing called for elsewhere in this Specification and associated responsibilities, the Contractor shall be responsible for:

a) Off-site/Works testing.
b) On-site construction tests.
c) System cleaning and flushing.
d) Pre-commissioning checks.
e) Setting to work.
f) Testing and commissioning of the BMS/automatic control system and sub-systems.
g) Testing and commissioning of the fire protection systems in the Sub-Contract Works.
h) Testing and commissioning of the Electrical systems in the Sub-Contract Works.
i) Testing and commissioning MEP plant.
j) Fine tuning of the installations where necessary to achieve the specified operation and performance.
k) Demonstration of operation of the Sub-Contract Works including full functionality tests to show the achievement of the specified operation.

The Contractor shall also be responsible for:

a) Operation of the MEP installations to facilitate setting to work, testing, commissioning and witnessing activities within the scope of other Sub-Contracts.
b) Ensuring all required tests at the manufacturer's works on plant and equipment and components are properly carried out and certified.
c) Returning to site during the first year's operation to carry out and record further performance tests as necessary to demonstrate satisfactory operation under both winter and summer full load conditions. In connection with this, the Contractor shall allow in his Tender for updating and re-issuing the record documentation to incorporate the results of future tests.

12.3 Electrical Services Testing And Commissioning

12.3.1 Site Construction Tests

12.3.1.1 General

In addition to the works tests of items of plant and equipment, the Electrical Services Contractor shall note that the Commissioning Contractor, Client Project Management Assistant and Consulting Engineer may require to be present at site testing.

Prior notice of each construction test shall be given to the Commissioning Contractor, Client Project Management Assistant and Consulting Engineer to afford them the opportunity to be represented at the test.

To facilitate progress, these tests shall be made in sections as the work proceeds, but a final test of each installation shall be carried out on completion.

If satisfactory results are not obtained at any stage of the test, the test shall be stopped and the fault rectified as necessary by the Contractor. Following rectification the test shall be repeated.

Unless otherwise specified herein site construction tests shall include:

12.3.1.2 Low Voltage Switchgear And Distribution

12.3.1.2.1 Low Voltage Switchgear

The Electrical Services Contractor shall check the insulation resistance between phases, between each phase and earth and between the instrument wiring and earth.

The Electrical Services Contractor's attention is drawn to the need to short circuit all instrument and current transformer connections by bonding at the terminals, to open circuit all instruments and voltage coils by removing the potential fuses and disconnection of the current transformer earth connections.

The results of all these tests shall be recorded.

The Electrical Services Contractor shall ensure that on completion of the tests all bonding is removed and that the current transformer earth connections and potential fuses are replaced.

12.3.1.2.2 Low Voltage Distribution

The Electrical Services Contractor shall be responsible for the complete testing of the systems within the building to the standards laid out in this specification. All results shall be submitted to the 2040 Commissioning Services Contractor.

Prior notice of all site tests shall be given to the Client Project Management Assistant and Consulting Engineer giving him the opportunity to attend.

The Electrical Services Contractor shall provide all instruments necessary for carrying out the specified testing.

Tests shall be carried out as the work proceeds but a final test on the whole installation shall be carried out on completion. Where tests are failed, works shall be rectified and tests repeated until a pass is achieved.

During the progress of the works, the Electrical Services Contractor shall carry out tests on conduit runs to ensure low resistance and shall submit test sheets immediately any section of the conduit is completed and tested.

The testing schedule shall include but not be limited to the following:

a) Continuity of final ring circuit conductors
b) Continuity of protective conductors including main and supplementary equipotential bonding
c) Earth electrode resistance
d) Insulation resistance
e) Insulation of site built assemblies
f) Protection by electrical separation
g) Protection by barriers or enclosures provided during erection
h) Circuit impedance
i) Polarity
j) Earth fault loop impedance/fault level
k) Prospective fault levels
l) Operation of residual current devices

Tests shall be carried out in the above sequence. Standard methods of testing shall be used as defined in the IEE Wiring Regulations for Electrical Installations.

On completion of tests the suitability of equipment installed shall be re-verified to ensure safety of operation. This particularly applies to disconnection times for fuses and circuit breakers.

When the testing is satisfactorily complete, the Electrical Services Contractor shall set to work and demonstrate the correct operation of the installations in accordance with the design intent.

12.3.2 Pre-Commissioning Checks

12.3.2.1 General

On completion of the works and before systems are energised, the Electrical Services Contractor shall visually inspect the installation to ensure that electrical equipment is in compliance with the Specification, correctly selected and erected and not visibly damaged so as to impair safety.

The Electrical Services Contractor shall ensure that all equipment included under this contract is thoroughly cleaned and checked for serviceability immediately before setting to work.

All automatic controls and safety devices shall be inspected and checked for serviceability before the working power is applied to the system.

12.3.2.2 Low Voltage Switchgear And Distribution

On completion of the works and before systems are energised the Electrical Services Contractor shall visually inspect the installation to ensure that electrical equipment is in compliance with the Specification, correctly selected and erected and not visibly damaged so as to impair safety.

The Electrical Services Contractor shall ensure that all equipment included under this contract is thoroughly cleaned and checked for serviceability immediately before setting to work.

On completion of the works and before systems are energised, the Electrical Services Contractor shall visually inspect the installation to ensure that electrical equipment is in compliance with the Specification, correctly selected and erected and not visibly damaged so as to impair safety.

The Electrical Services Contractor shall ensure that all equipment included under this contract is thoroughly cleaned and checked for serviceability immediately before setting to work.

All automatic controls and safety devices shall be inspected and checked for serviceability before the working power is applied to the system.

12.3.3 Testing And Commissioning

Tests shall be carried out as required by the Specification for earth electrode resistance, insulation resistance, polarity, continuity, together with the ability to withdraw cables from any conduit and re-draw in cables.

The Contractor shall provide all instruments necessary for carrying out such tests.

During the progress of the works the Contractor shall carry out such tests on the conduit runs, to ensure low resistance and shall submit test sheets, in triplicate, to the Client Project Management Assistant with a copy to the Consulting Engineer immediately any section of the conduit work is completed and prior to any conduit being covered by plaster, concrete, etc.

The Contractor shall keep a strict diary of progress of the works and record of all instructions given both verbally and in writing, together with the date and name of the person giving such instructions. The diary shall be at the disposal of the Client Project Management Assistant and Consulting Engineer as and when directed.

In addition, the Contractor shall submit to the Client Project Management Assistant and Consulting Engineer a full report at the end of each month, giving the exact position to date of the various installations.

12.3.3.1 Lighting Systems

12.3.3.1.1 First Stage On Site Commissioning

The first stage commissioning shall include the implementation of all the preliminary aiming angles and filtration demonstrated to the Commissioning Management Contractor.

12.3.3.1.2 Second Stage On Site Commissioning

The second stage commissioning will consist of the final measurement of illumination levels and assessment of the lit effect by the Lighting Consultant and Consulting Engineer, This commissioning will only take place during the hours of darkness a minimum of 1 hour after sunset. The commissioning and measurement procedure shall follow the general guidelines laid out in the CIBSE guide to lighting Commissioning. The Electrical Contractor shall allow for full attendance during this commissioning period with appropriate access equipment to get to all lamps. This commissioning will not take place until after the final builder's clean has taken place. The lighting commissioning maybe linked with the lighting control system commissioning.

12.3.3.2 Lighting Control System

12.3.3.2.1 First Stage On Site Commissioning

The first stage commissioning shall include the implementation of all the preliminary lighting scenes and control regimes demonstrated to the commissioning specialist. This will include the demonstration of local control and central control at the head end. The preliminary lighting scenes shall be issued for implementation after the successful signing off of the pre-commissioning demonstration.

12.3.3.2.2 Second Stage On Site Commissioning

The second stage commissioning will consist of the final adjustment of illumination levels, fade times, focusing and aiming of luminaires to form a complete and final installation. This commissioning will only take place during the hours of darkness a minimum of 1 hour after sunset. The Contractor shall

allow for full attendance during this commissioning period with appropriate access equipment to get to all lamps. This commissioning will not take place until after the final builder's clean has taken place.

12.3.3.3 Emergency Lighting And Emergency Lighting Monitoring System

12.3.3.3.1 First Stage On Site Commissioning

The first stage commissioning shall include the implementation of the entire preliminary control/test regimes. These shall be demonstrated to the commissioning specialist. This will include the demonstration of local control and central control at the head end. The preliminary control/test regimes shall be issued for implementation after the successful signing off of the pre-commissioning demonstration.

12.3.3.3.2 Second Stage On Site Commissioning

The second stage commissioning will consist of the final checking of emergency illumination levels, to form a complete and final installation compliant with the standards. This commissioning will only take place during the hours of darkness a minimum of 1 hour after sunset. The Electrical Contractor shall allow for full attendance during this commissioning period with appropriate access equipment to get to all lamps. This commissioning will not take place until after the final builder's clean has taken place. Only when this commissioning has been signed off shall the statutory authorities be invited for their inspection.

12.3.3.4 Fire Alarm System

The Fire Alarm System shall be commissioned to achieve the performance described in the Specification including all cause and effects, panel indications and correct graphics.

12.3.4 Overall Performance Testing

Following completion of the commissioning of individual systems/elements the Contractor with other Contractors as appropriate and under the direction of the Commissioning Contractor and Client Project Management Assistant shall carry out performance tests with all installations operating simultaneously to verify achievement of the specified requirements.

Should the results of tests show that any item fails to achieve its specified duty or operating efficiency for reason of the Electrical Services Contractor default, the Electrical Services Contractor shall modify or replace such items at his own cost and additionally be responsible for any consequential Bid. Any item so replaced and/or modified shall be re-commissioned and tested.

a) Performances tests shall as a minimum requirement, include:
b) Environmental tests to demonstrate the ability of the plant and equipment to maintain the specified requirements.
c) Operation of the plant and equipment, to enable actual noise levels and the effectiveness of anti-vibration provisions to be assessed and checked against specification.
d) Installation performance including single, standby, multi duty plant and systems, and of plants specified for future use.
e) Full functionality tests demonstrating the correct operation and performance of all mechanical and electrical systems in all modes of operation including interaction and interfaces with other building elements and systems and all safety features and interlocks.

Prior to undertaking performance testing of the installation the Electrical Services Contractor shall agree with the Commissioning Contractor, Commissioning Manager and the Architect or his representative his proposals for providing necessary artificial loads or test arrangements required to allow the installation to be operated through their full range of operating conditions and duties.

12.3.4.1 Low Voltage Switchgear And Distribution

The Electrical Services Contractor shall be required to demonstrate to the Commissioning Contractor and the Consulting Engineer the following aspects of the LV Systems Operation and Performance and shall include a full demonstration of the LV protection system with simulation of failures to show the operation of the protective systems.

Demonstrations shall include functionality tests and random checks to prove repeatability of commissioning results including switching, control and operation.

The Electrical Services Contractor shall be responsible for producing a comprehensive list of and programme for these demonstrations for approval of the Client Project Management Assistant.

The approved list shall be included in the O&M manuals as a basis for annual proving of full functionality.

12.3.4.2 Emergency Lighting And Emergency Lighting Monitoring System

The Electrical Services Contractor shall be required to demonstrate to the Commissioning Contractor and the Consulting Engineer the following aspects of the Emergency Lighting Systems Operation and Performance and shall include a full demonstration of the ELMS system with simulation of failures to show the operation of the protective systems.

Demonstrations shall include functionality tests and random checks to prove repeatability of commissioning results including switching, control and operation.

This demonstration will only take place during the hours of darkness a minimum of 1 hour after sunset. The Contractor shall allow for full attendance during this commissioning period with appropriate access equipment to get to all lamps.

The Electrical Services Contractor shall be responsible for producing a comprehensive list of and programme for these demonstrations for approval of the Client's Representative.

The approved list shall be included in the O&M manuals as a basis for annual proving of full functionality.

12.3.4.3 Fire Alarm System

The Electrical Services Contractor shall be required to demonstrate to the Commissioning Contractor and the Consulting Engineer the following aspects of the Fire Alarm Systems Operation and Performance and shall include a full demonstration of the graphical front end system with simulation of failures to show the operation of the protective systems.

Demonstrations shall include functionality tests and random checks to prove repeatability of commissioning results including switching, control and operation.

This demonstration will only take place after normal working hours. The Contractor shall allow for full attendance during this witnessing period with appropriate access equipment to get to all devices.

The Electrical Services Contractor shall be responsible for producing a comprehensive list of and programme for these demonstrations for approval of the Client's Representative.

The approved list shall be included in the O&M manuals as a basis for annual proving of full functionality.

12.3.5 Final Acceptance

A 'Hand Over' certificate shall be completed to record final acceptance by the Client, Client Project Management Assistant or his representative. The certificate shall be signed by the Client, Client Project Management Assistant or his representative.

12.3.6 System Documentation

The final system Operating and Maintenance Manual shall be handed over to the Client or his representative prior to the date of Practical Completion of the Works.

The Electrical Services Contractor shall ensure that all relevant information has been incorporated within the Operating and Maintenance Manual including all test sheets. The manual shall also include copies of all wiring schedules, software analogue/digital data points, panel drawings, description of operation and verification sheets.

On satisfactory completion of the Testing and Commissioning procedures the Electrical Services Contractor shall issue a Completion Certificate as prescribed in the IEE Wiring Regulations.

In addition to the Completion Certificate the Electrical Services the Contractor shall provide Inspection and Test Certificates for the complete Electrical Installation.

12.4 Testing And Commissioning Records

Upon completion of commissioning and testing individual Contractor's shall assemble and submit detailed test records to the Contractor who shall produce a composite commissioning and testing manual for the project. The Contractor shall ensure that as a minimum the following are provided.

a) Comprehensive index of contents.
b) Commissioning and testing results and records on a system by system basis properly cross referenced to design values and data.
c) Generators, Transformers, Switchboards, and other relevant plant performance characteristics.
d) Copies of Works test certificates.
e) Copies of the Contractor's own commissioning and testing certificates.
f) Copies of letters confirming acceptance of the completed installations by the relevant Statutory Authorities and Utilities.

The Contractor shall initially provide a draft copy of the composite Commissioning and Testing Manual to the Main Contractor, Consulting Engineer and Construction Stage Supervisor. This shall be issued at the time of requesting attendance at site to witness the Contractor's demonstrations of the completed commissioned and tested installations.

At the time of submission, the Contractor shall confirm:

a) All test records are accurate.
b) The completed installations operate in accordance with the specified requirements.

Manuals shall be submitted in accordance with the requirements of the 'Particular Conditions' Section of this.

Where subsequent performance tests are required to demonstrate performance under winter/summer operating conditions the Contractor shall allow for updating and re-issuing copies of his commissioning and testing records manual to record such further tests.

12.5 Final Demonstrations And Acceptance

The individual Contractor's shall operate the commissioned and tested installations to demonstrate the operation to the Main Contractor, Construction Stage Supervisor, Consulting Engineer, Acoustic Consultant and Employer. The extent of such demonstrations shall include all switching, control, indication and safety devices in all modes of operation as necessary to satisfy the Consulting Engineer that the installations have been properly commissioned, in accordance with the specified requirements and achieve the design intent.

The Contractor shall further repeat commissioning tests and performance tests as directed by the Consulting Engineer to demonstrate the accuracy of the Contractor's records.

Upon satisfactory completion of the demonstrations, the Construction Stage Supervisor and Consulting Engineer shall certify acceptance of the commissioning and testing.

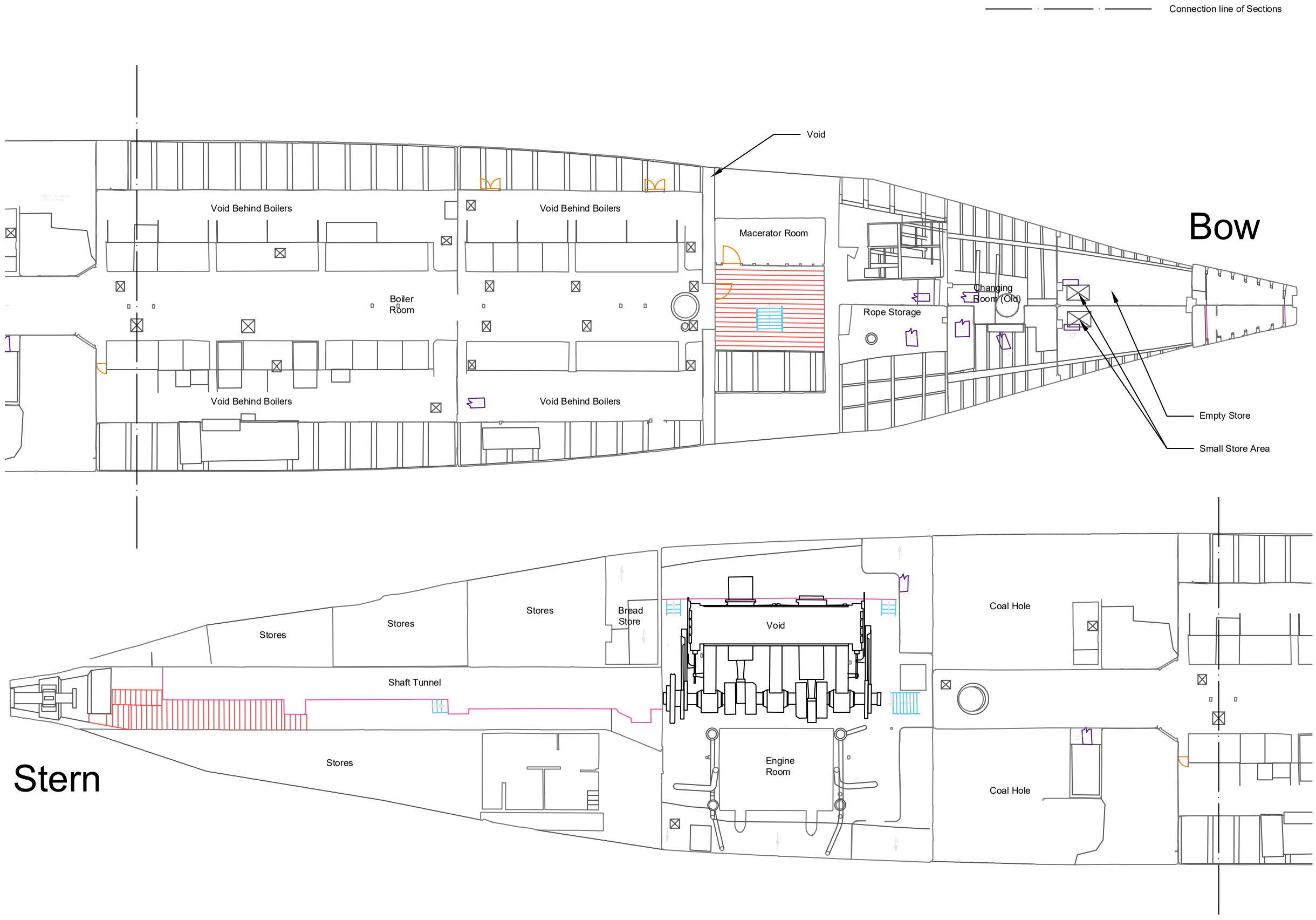
The Contractor shall return to site during the first year of occupation of the building to make and record further tests to establish satisfactory operation under both summer and winter operating conditions. The Contractor shall invite the Main Contractor and the Architect or his Representative to witness such tests. The objective of the tests shall be to check the satisfactory performance of the installations which could not be carried out without the availability of building design loads. Tests shall include the performance of the HVAC systems, etc., and may include continued achievement of noise levels and effectiveness of anti-vibration provisions.

12.6 Not Used

12.7 Inspection By Employer's Insurance Company

The Contractor shall include for attendance of and fully co-operate with the Insurance Company appointed by the Employer during inspection of any plant or parts of the Sub-Contract Works.

13 Appendix A1 – Indicative Vessel Layouts



General Notes

This drawing has been created based on survey data captured by Downland Partnership during November and December 2017

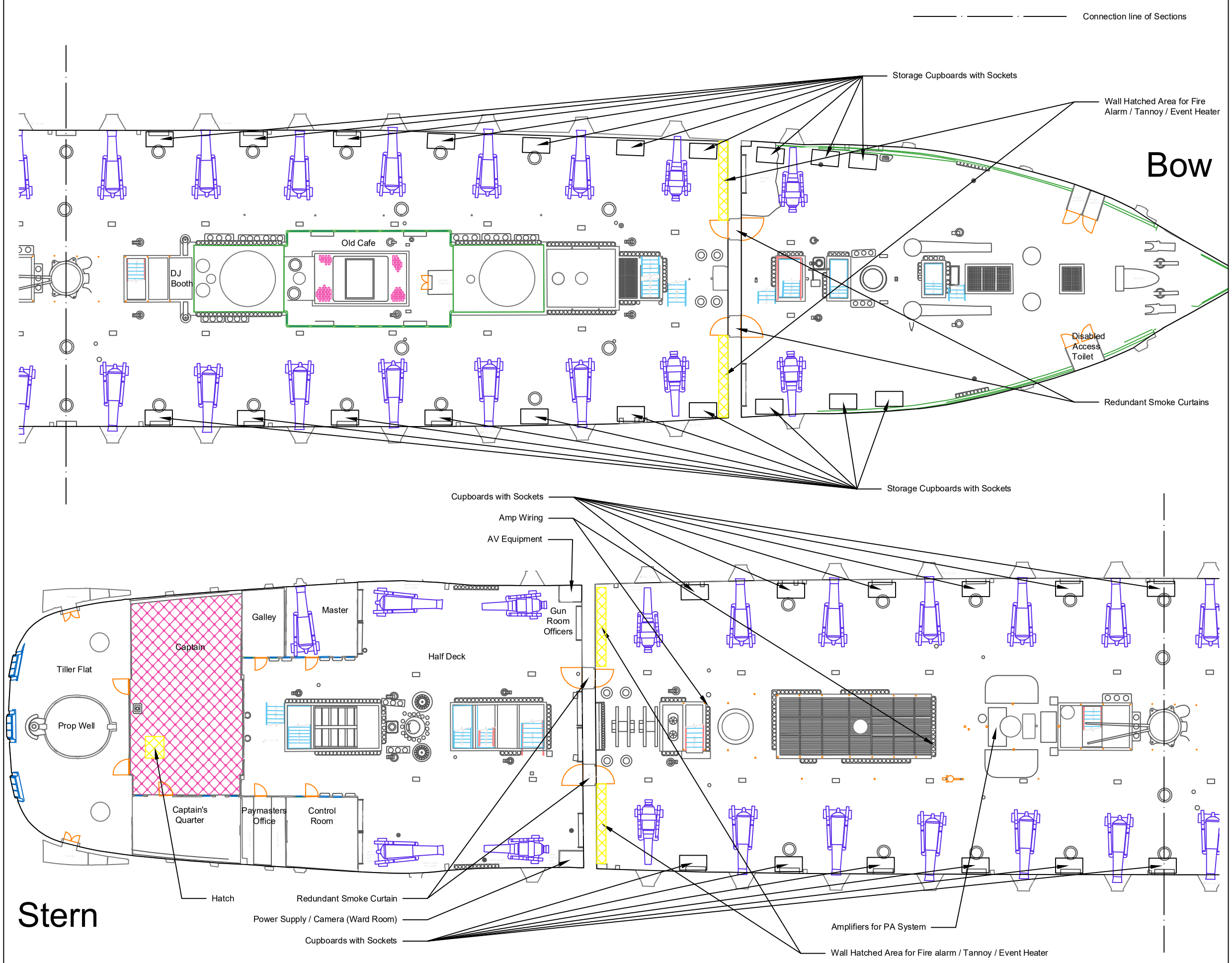
This drawing is for detailing room and void areas only

Revision Notes

TennysonSuite
HEALTH, SAFETY & TRAINING CONSULTANTS

Unit Y
Rich Industrial Estate
Avis Way
Newhaven
East Sussex
BN9 0DU
Telephone:01273 646737

HMS Warrior	Engine Room Plan
23/08/2022	
Scale: Not to Scale	
Drawn by: MH	Checked by: DD



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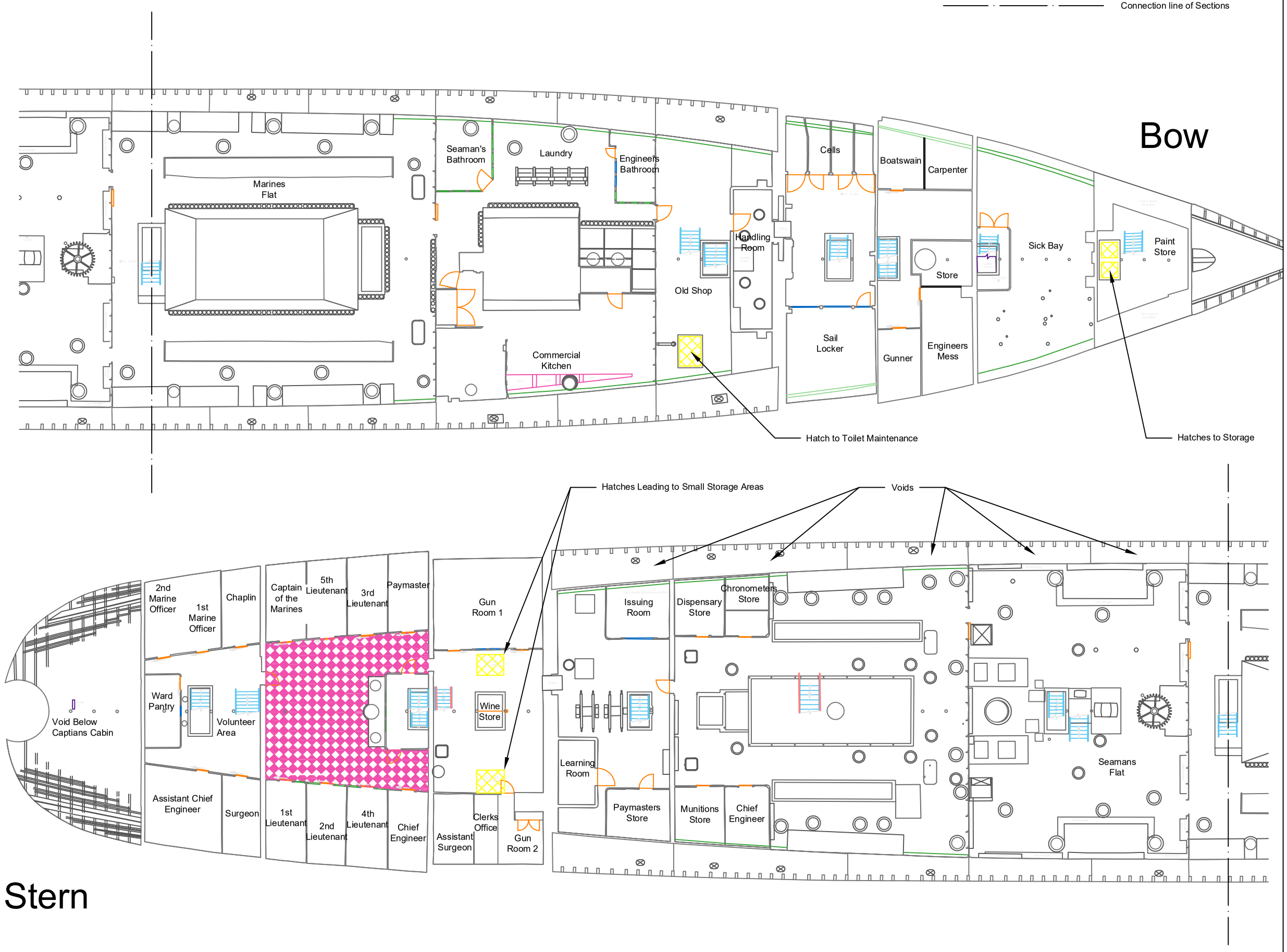
Telephone:01273 646737

HMS Warrior	Gun Deck Plan
23/08/2022	
Scale: Not to Scale	
Drawn by: MH	Checked by: DD



General Notes

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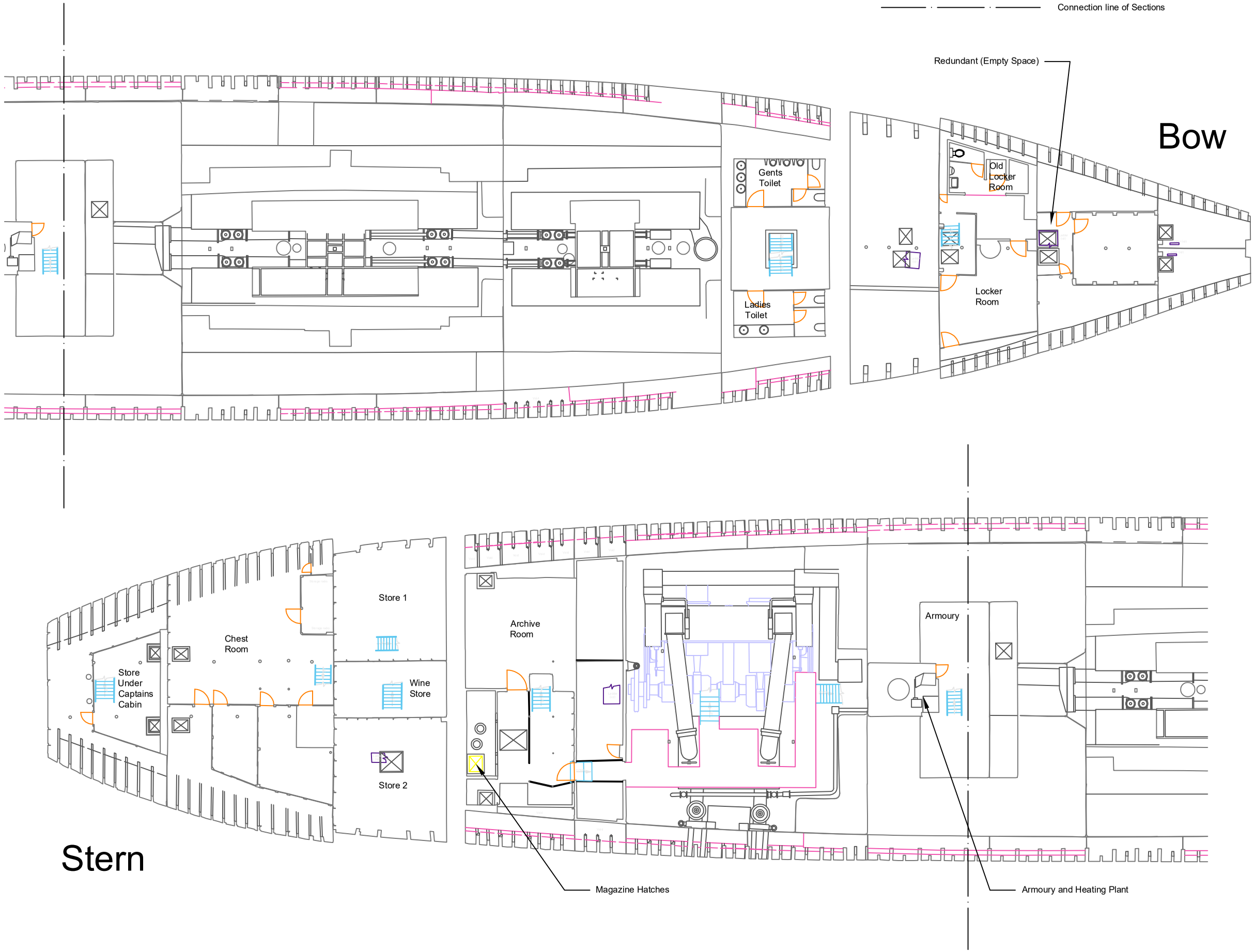
BN9 0DU
Telephone:01273 646737

HMS Warrior	Lower Deck Plan
23/08/2022	
Scale: Not to Scale	
Drawn by: MH	Checked by: DD



General Notes

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This drawing is for detailing room and void areas only

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HMS Warrior	Lower Deck 2 (Orlop) Plan
23/08/2022	
Scale: Not to Scale	
Drawn by: MH	Checked by: DD

Gun Deck

HMS Warrior	
Room Name	Location
Disabled Toilet	Gun Deck Bow
Old Cafe	Gun Deck Bow
DJ Booth	Gun Deck Bow
Gun Room (Officers)	Gun Deck Stern
Half Deck	Gun Deck Stern
Master	Gun Deck Stern
Galley	Gun Deck Stern
Control Room	Gun Deck Stern
Paymasters Office	Gun Deck Stern
Captian	Gun Deck Stern
Captains Quarter	Gun Deck Stern
Tiller Flat	Gun Deck Stern
Prop Well	Gun Deck Stern

Lower Deck

HMS Warrior	
Room Name	Location
Paint Store	Lower Deck Bow
Sick Bay	Lower Deck Bow
Store	Lower Deck Bow
Carpenter	Lower Deck Bow
Boatswain	Lower Deck Bow
Engineers Mess	Lower Deck Bow
Gunner	Lower Deck Bow
Cells	Lower Deck Bow
Sail Locker	Lower Deck Bow
Handling Room	Lower Deck Bow
Old Shop	Lower Deck Bow
Engineers Bathroom	Lower Deck Bow
Laundry	Lower Deck Bow
Commercial Kitchen	Lower Deck Bow
Seaman's Bathroom	Lower Deck Bow
Marines Flat	Lower Deck Bow

HMS Warrior	
Room Name	Location
Seamans Flat	Lower Deck Stern
Clock Store	Lower Deck Stern
Dispensary Store	Lower Deck Stern
Chief Engineer	Lower Deck Stern
Munitions Store	Lower Deck Stern
Issuing Room	Lower Deck Stern
Paymasters Store	Lower Deck Stern
Learning Room	Lower Deck Stern
Gun Room 1	Lower Deck Stern
Wine Store	Lower Deck Stern
Gun Room 2	Lower Deck Stern
Clerks Office	Lower Deck Stern
Assistant Surgeon	Lower Deck Stern
Paymaster	Lower Deck Stern
Chief Engineer	Lower Deck Stern

HMS Warrior	
Room Name	Location
Captain of the Marines	Lower Deck Stern
1st Lieutenant	Lower Deck Stern
2nd Lieutenant	Lower Deck Stern
3rd Lieutenant	Lower Deck Stern
4th Lieutenant	Lower Deck Stern
5th Lieutenant	Lower Deck Stern
Chaplin	Lower Deck Stern
1st Marine Officer	Lower Deck Stern
2nd Marine Officer	Lower Deck Stern
Volunteer Area	Lower Deck Stern
Ward Pantry	Lower Deck Stern
Surgeon	Lower Deck Stern
Assistant Chief Engineer	Lower Deck Stern
Void Below Captains Cabin	Lower Deck Stern

Lower Deck 2 Orlop

HMS Warrior	
Room Name	Location
Locker Room	Lower Deck 2 Orlop Bow
Old Locker Room	Lower Deck 2 Orlop Bow
Gents Toilets	Lower Deck 2 Orlop Bow
Ladies Toilets	Lower Deck 2 Orlop Bow
Armoury	Lower Deck 2 Orlop Stern
Archive Room	Lower Deck 2 Orlop Stern
Store 1	Lower Deck 2 Orlop Stern
Wine Store	Lower Deck 2 Orlop Stern
Store 2	Lower Deck 2 Orlop Stern
Chest Room	Lower Deck 2 Orlop Stern
Store Under Captains Cabin	Lower Deck 2 Orlop Stern

Engine Room

HMS Warrior	
Room Name	Location
Changing Room (Old)	Engine Room Bow
Rope Storage	Engine Room Bow
Macerator Room	Engine Room Bow
Boiler Room	Engine Room Bow
Void Behind Boilers	Engine Room Bow
Coal Hole	Engine Room Stern
Heating Plant	Engine Room Stern
Engine Room	Engine Room Stern
Void	Engine Room Stern
Bread Store	Engine Room Stern
Stores	Engine Room Stern
Shaft Tunnel	Engine Room Stern

General Notes

Revision Notes

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East Sussex
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Telephone:01273 646737

HMS Warrior

23/08/2022

Scale
Not to Scale

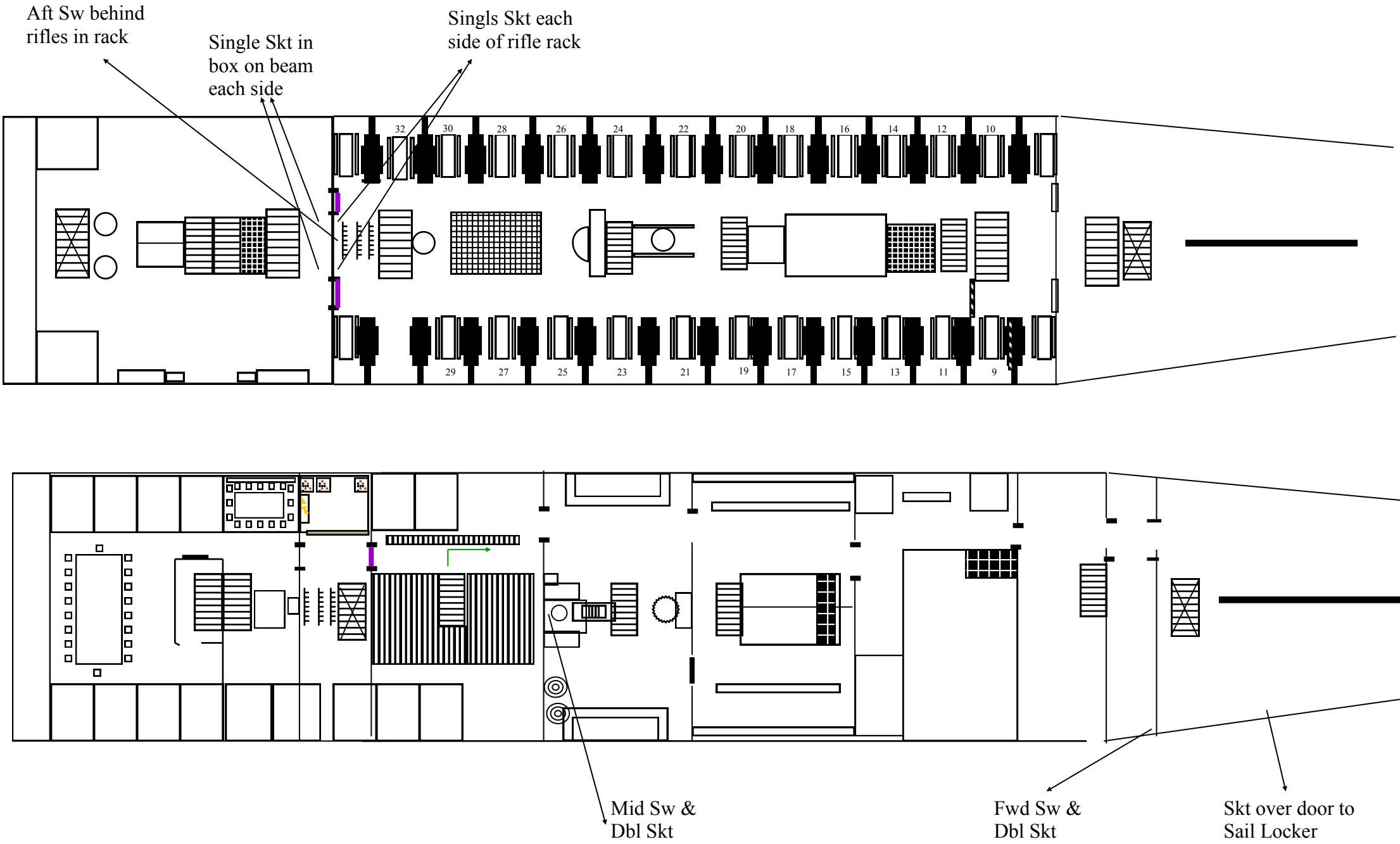
Drawn by
MH

Checked by
DD

Room Names and Locations

14 Appendix A2 – Heater Switch and Socket Positions

440 Volt Blue Heater Switch and Socket Positions



15 Appendix A3 – Survey of Lights to be Refurbished

Survey of
Requirements for Refurbished lights

An on board survey was carried out by the Electrical Team to show the type and Quantity of lights that are required to be refurbished as part of the HMS Warrior Re-wire ITT Tender.

Type of Fitting	Quantity
Large Lantern	71
Small Lantern	79
Sconce Lighting	100
Gimble wall lights	11
Large Gimble Table lights	6

A total of 285 lights are required to be refurbished.
Please see Photos attached to see the different styles.

All lights are to be refurbished - By this meaning upgrading and future proofing the fitting to be LED, incorporating the compatibility to be able to have a UPS back up and Cleaned / Polished to a as new condition.

Large Lantern

Small Lantern


Sconce Light


Brass Gimble wall lights

Large Gimble table lamps

Emergency Exit signage As Orlight ORLEXTCW Surface mounted Emergency Exit Sign

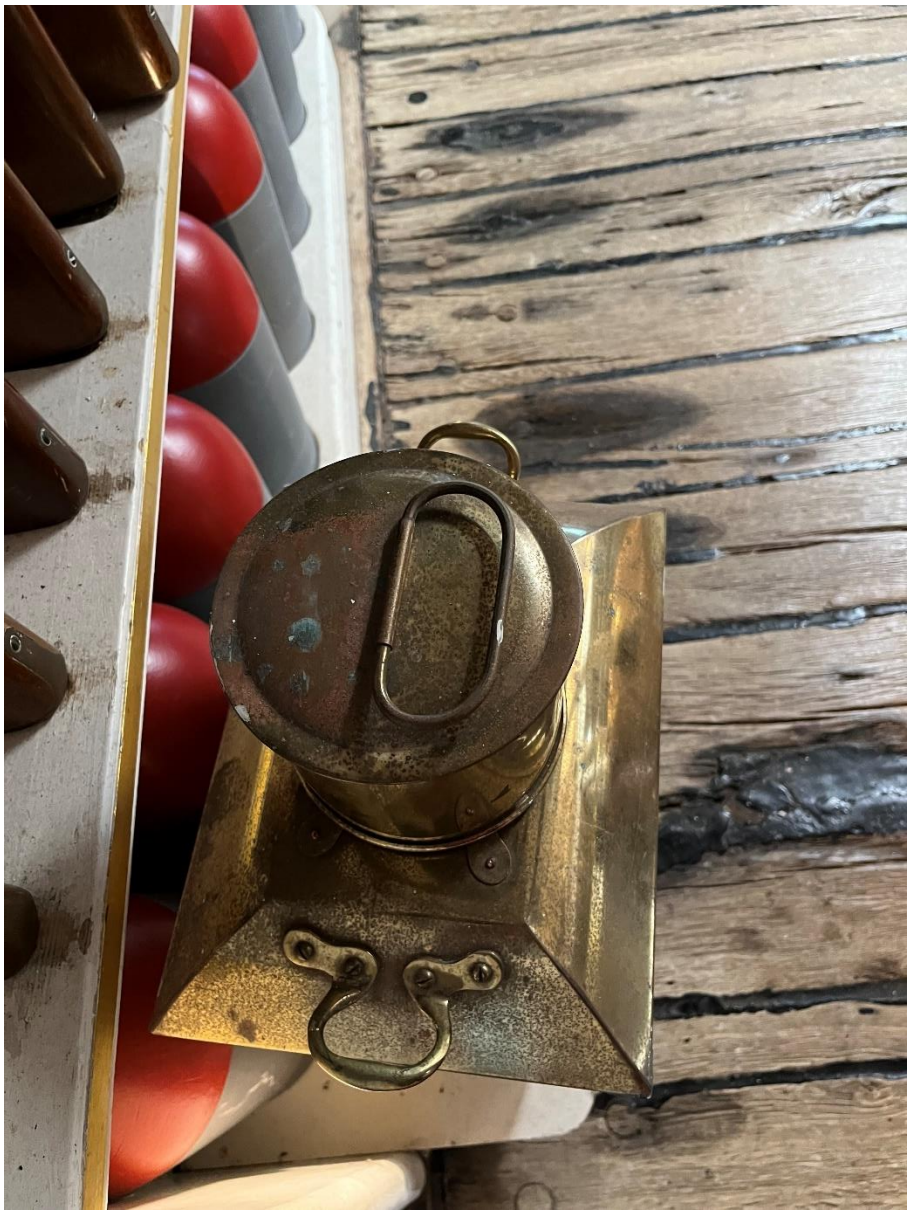
Fitting	Upper Deck	Main Deck	Lower Deck	Orlop/Hold/Storage	TOTAL	
Police Lantern		14	23	32	69	
Bulkhead Lantern		17	46	12	75	
Sconce Light		45	35	10	90	
Gimbal Light (small)		7	5		11	
Gimbal Light (large)		1	2		6	
TOTAL	0	84	111	54	251	

Brass Bulkhead

Brass Police Lantern

Large Gimball Light

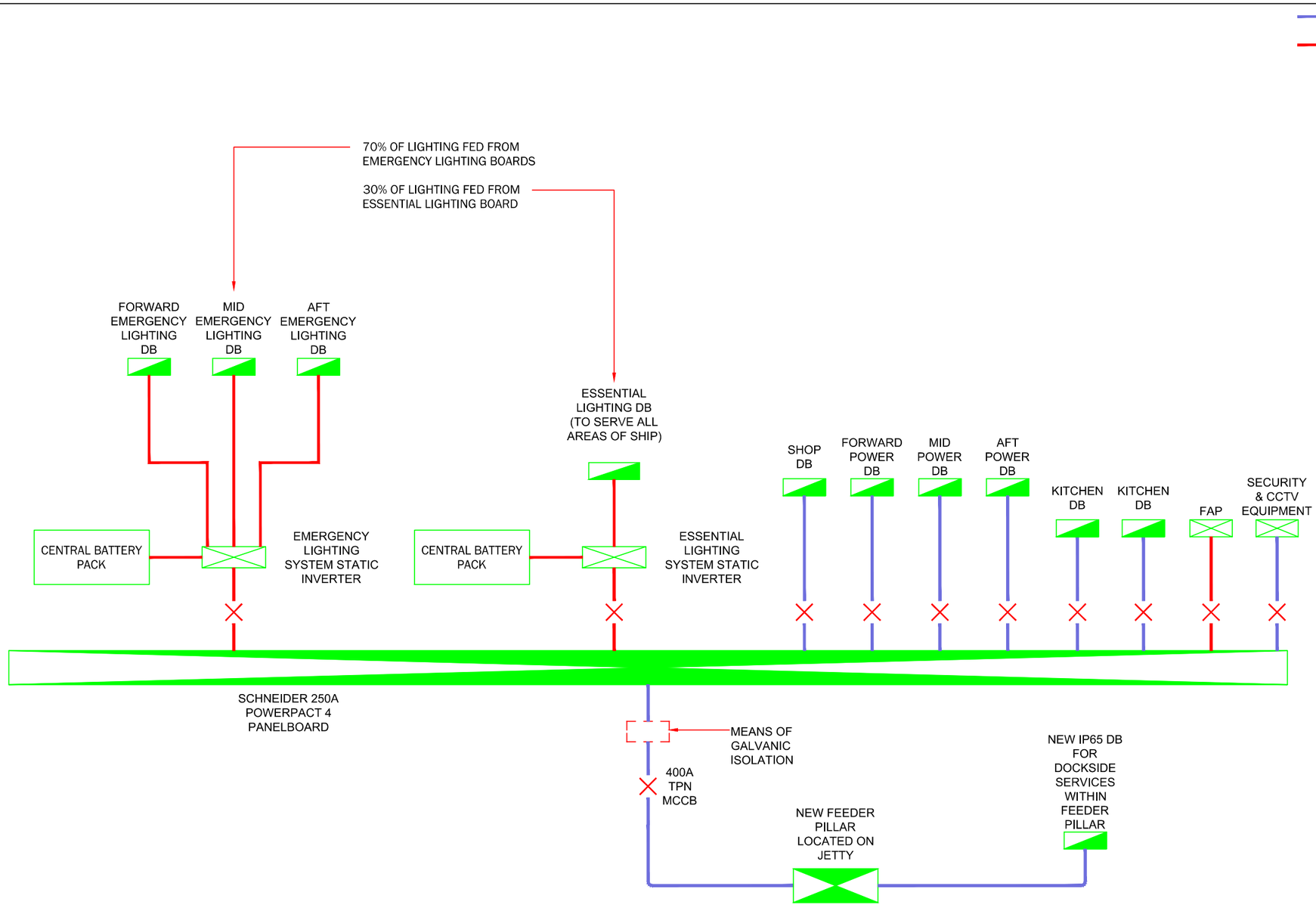
Police Lantern



Sconce Light

Small Gimbal Light

16 Appendix A4 – Indicative High Level Schematic



IMPORTANT:

This drawing shall not be scaled.

Unless stated otherwise, all dimensions are in millimetres.

Where applicable, all dimensions shall be checked by the contractor onsite, prior to commencement of any works.

This drawing shall be read in conjunction with all other drawings and the services specification document(s).

All materials and workmanship shall conform with the relevant British & European Standards, Specifications and Codes of Practice.

Indicated, referenced or derived dimensions are not to be considered as final and no reliance should be made regarding final coordination, setting-out or installation.

Service penetrations where indicated are indicative only and subject to final location by the services contractor in agreement with the structural engineer and architects.

The accuracy of the size and location of the services' penetration requests can only be relied upon to the same level that the design resolution (MEP, Architectural and Structural) was at the time that the requests were produced.

This drawing should not be used for installation or construction purposes.

NOTES:

Rev	Date	Description	Drn	Chkd
P3	XXXXX	Updates with additional DBs	SM	GW
P2	Nov '18	As Clouded	SM	GW
P1	Oct '18	Preliminary Issue	SM	GW

chapmanbdsp
www.chapmanbdsp.com info@chapmanbdsp.com

Client: NMRN

Project: HMS Warrior Re-wire

Status: Preliminary Issue

Drawing Title: Schematic Overview

Drawn	Engineer	Checked	Date origin
CAD	ENG	APP	XXX '18

Scale @ A3	File/BIM ref
1:50	61413-CBD-00-ZZ-DR-E-2001.dwg

Sheet number	Revision
61413-CBD-00-ZZ-DR-E-2001	P01

17 Appendix A5 – Electrical Tender Summary

Breakdown of Tender Sum

1.	Contractor Design and Contractor Proposal Drawings	£
2.	Preliminaries	£
3.	Surveys and Validations	£
4.	Stripping Out	£
5.	Quayside Feeder Pillar Switchgear	£
6.	Main Incoming Switchgear	£
7.	Electrical Main Distribution	£
8.	Earthing	£
9.	Luminaires	£
10.	Electrical Rewire Lighting and Power	£
11.	Fire alarm installation first fix	£
12.	Fire alarm installation second fix	£
13.	Public address system installation first fix	£
14.	Public address system installation second fix	£
15.	CCTV system installation first fix	£
16.	CCTV system installation second fix	£
17.	LED handrail lighting - Visitors Routes	£
18.	LED handrail lighting - Off Visitors Routes	£
19.	Installation, builders work, fabrication Drawings	£
20.	Modifications to Ducted Ventilation	£
21.	Comms/data installation	£
22.	Dockside Services	£
23.	Testing and Commissioning	£
24.	Client Training	£
25.	Anything not included above	£
	TOTAL TENDER SUM	£
12 months Planned Preventative Maintenance shall be priced as an option.		£

The Contractor shall issue a complete set of drawings rates within the tender.

SIGNED:	
COMPANY:	
ADDRESS:	
DATE:	