MECHANICAL & ELECTRICAL ENGINEERING SERVICES SPECIFICATION

for the

REPLACEMENT OF LEV SYSTEMS IN WORKSHOP W1/36 & W1/40

at

NATIONAL OCEANOGRAPHY CENTRE, SOUTHAMPTON

CLIENT
National Oceanography Centre, Southampton - Estates
University of Southampton Waterfront Campus
European Way
Southampton
SO14 3ZH

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NBS Create Specification

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00-05-10 Project Definition

101 Project description

- **Project reference**: J2170905
- **Project title**: NOCS - Workshop LEV
- **Project description**: Replacement of LEV system in workshop

102 Project overview

- **General**: The replacement of 3no LEV fume extract systems including;

  - Removal of existing systems in their entirety
  - Installation of 2no LEV fume systems to workshops to serve welding procedure each consisting of; extensions arms, new ductwork, termination duct 3,000 above roof, etc
  - Installation of 1no LEV fume system to workshop to serve welding and grinding process consisting of; extension arm and filter/fan unit served by compressed air system
  - Testing and commissioning of systems
  - Testing of retained electrical supplies
  - Provision of new electrical arrangement
  - Provision of Automatic controls installation
  - Operating and Maintenance Manual
  - Building work in connection with the installation

150 Asbestos survey report

- **Details**: Client shall supply Asbestos Register

00-05-15 Works Terminology

110 Terminology

- **Meaning**: Terms, derived terms and synonyms used are as defined in this section or in the appropriate referenced document.

210 Description terminology

- **Attendance**: Includes
  The use of the Main Contractor's temporary roads, pavings and paths, standing scaffolding, standing power operated hoisting plant,
  The provision of temporary lighting of an equivalent brightness to the finished lighting brightness,
  The provision of water,
  The clearing away of rubbish and paying all charges in connection with its disposal, the provision of secure hard standing space for the sub-contractor's own offices, plant and material storage,
  The use of standing mess rooms, sanitary accommodation and welfare facilities and
  The provision of all Health and Safety facilities and all Fire Safety precautions, services, equipment, signage, facilities, Marshalls and the like necessary to comply with the relevant parts of the Joint Fire Code.
  Additional requirements should be described as 'Special attendance'.
- **Building Manual**: A document containing information of use to subsequent building owners, occupiers and users about the requirements and procedures for effective operation, maintenance, decommissioning and demolition of the building.
- **Construction Work**: Permanent work together with temporary work.
- **Contractor**: The party who undertakes to perform the services, supply goods or carry out work defined in a contract. Includes Main Contractor, Prime Contractor, Supplier, Service provider, Builder, Subcontractor, etc. as the context dictates, which may be defined terms in certain standard contract forms.
- **Contractor's choice**: Selection delegated to the Contractor, but liability to remain with the specifier.
- **Contractor's design**: Design to be carried out or completed by the Contractor, supported by appropriate contractual arrangements, to correspond with specified requirements.
- **Cost**: The amount paid or given by one party to another in exchange for goods, work or services.
- **Designer**: A person carrying out design on a project.
- **Deviation**: Difference between a specified dimension or position and the actual dimension or position.
- **Employer**: The party to the Contract for whom the goods, work or services are provided. Includes Client (in consultancy contracts and CDM Regulations), the Employer, Building owner or Purchaser (in construction contracts), the Developer (in development agreements and funding agreements), or the 'Main' contractor in contractor/ subcontractor agreements - which may be defined terms in certain standard contract forms
- **Estimate**: An approximate evaluation of either time or cost of part or the whole of a project.
- **Execute**: To complete a task fully and put into effect. To fix, apply, install or lay products securely, accurately, plumb and in alignment.
- **Existing**: Items retained in place to receive new work.
- **Fastener**: Device for mechanically attaching something to something else.

- **Manufacturer and Product reference**: Manufacturer - the body under whose name the particular product, component or system is marketed.
  Product reference - the proprietary brand name and/ or reference by which the particular product, component or system is identified.
  References are as specified in the manufacturer's technical literature current on the date specified.
- **Manufacturer's standard**: Where used in conjunction with a specified proprietary product, accessories to be those recommended by the product manufacturer.
- **Permanent Work**: Work to be constructed and completed in accordance with the Contract.
- **Price**: An indication of the amount required to be paid by one party to another in exchange for goods, work or services.
- **Product**: Material, both manufactured and naturally occurring, goods and accessories for permanent incorporation into the Works.
- **Requirements**: A description in outline or detailed form of the development, or a part of it, which one party requires another to design and/or build.
- **Schedule of rates**: The subdivision of product and execution prices by a pre-determined unit basis.
- **Schedule of Work**: The subdivision of work items by a pre-determined classification. Can form the basis of a pricing document where Bills of Quantities are not used.
- **Schematic**: A drawing of a system showing components, products, systems and their interconnections.
- **Site equipment**: The Contractor's apparatus, appliances, machinery, vehicles or things of whatsoever nature required in or about the construction for the execution and completion of the Works and the remedying of defects.
  Includes Appliances, vehicles, consumables, tools, temporary work, scaffolding, cabins and other site facilities.
  Excludes: Temporary work, Employer's products and equipment or anything intended to form or forming part of the permanent Works.
- **Specification**: Written description of requirements.
- **System**: Products, components, equipment, accessories, controls, supports and ancillary items, including installation, necessary for that section of the work to function.
- **Temporary work**: Incidental work to undertaken during construction but not intended to form part of the completed work.

310 Activity terminology

- **Advise**: See 'Communicate'.
- **Agree**: See 'Communicate'.
- **Approve**: Record conformance of work to specified criteria by giving formal or official sanction.
- **Communicate**: Includes advise, inform, agree, confirm, notify, seek or obtain information, consent or instructions, or make arrangements.
- **Confirm**: See 'Communicate'.
- **Ease**: Adjust moving parts of designated products, systems or work to achieve free movement and good fit in open and closed positions.
- **Fix**: Receive, unload, handle, store, protect, place and fasten in position; dispose of waste and surplus packaging; to include labour, materials and site equipment for that purpose.
- **Give notice**: Communicate in writing to the person administering the Contract at the address listed therein.
- **Inform**: See 'Communicate'.

- **Keep for recycling**: As 'keep for use' but relates to a naturally occurring material rather than a manufactured product.
- **Keep for reuse**: Do not damage designated products, systems or work. Clean off bedding and jointing materials. Stack neatly, adequately protect and store until required by the Employer or Purchaser, or for use in the Works as instructed.
- **Make good**: Execute local remedial work to designated work. Make secure, sound and neat.
- **Match existing**: Provide products and work of the same appearance and features as the original, excluding ageing and weathering. Make joints between existing and new work as inconspicuous as possible.
- **Notify**: See 'Communicate'.
- **Quote**: Use 'Estimate'.
- **Recycle**: Collect, sort, process and convert discarded or recovered components into raw materials for use in the creation of new products.
- **Refix**: Fix previously removed products.
- **Remove**: Disconnect, dismantle as necessary and take out the designated products or work, together with associated accessories, fixings, supports, linings and bedding materials. Dispose of unwanted materials.
  Removal of a system includes this work.
- **Remediate**: Action or measures taken to lessen, clean-up, remove or mitigate the existence of hazardous materials existing on a property; in accordance with standards, specifications or requirements as may be required by statutes, rules, regulations or specification.
- **Repair**: Execute remedial work to designated products. Make secure, sound and neat. Excludes redecoration and replacement.
- **Replace**: Supply and fix new products matching those removed. Execute work to match the original new state of that removed.
- **Reuse**: Recover components to be fixed or used in the project or other buildings without the requirement for recycling.
- **Submit**: Deliver an item in a specified format to a specified person within a specified timeframe.
- **Submit proposals**: Submit information in response to specified requirements.
- **Supply and fix**: Supply of products, components or systems to be fixed, together with their fixing.

00-05-20 Project Participants

Management and delivery roles

120 Client

- **Name**: National Oceanography Centre
- **Address**: European Way
  Southampton
  SO14 3ZH
- **Contact**: REDACTED
- **Telephone**: REDACTED
- **Email address**: REDACTED

130 Contract Administrator

- **Name**: TNG Consulting Engineer Ltd
- **Address**: 31 Carlton Crescent
  Southampton
  SO15 2EW
- **Contact**: REDACTED
- **Telephone**: REDACTED
- **Email address**: REDACTED

135 Employer

- **Name**: National Oceanography Centre
- **Address**: European Way
  Southampton
  SO14 3ZH
- **Contact**: REDACTED
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- **Email address**: REDACTED

205 Principal Designer

- **Name**: TNG Consulting Engineers Ltd
- **Address**: 31 Carlton Crescent
  Southampton
  SO15 2EW
- **Contact**: REDACTED
- **Telephone**: REDACTED
- **Email address**: REDACTED

210 Principal Contractor

- **Name**: Shall be the appointed Tenderer

270 Electrical services engineer

- **Name**: TNG Consulting Engineering Ltd
- **Address**: 31 Carlton Crescent
  Southampton
  SO15 2EW
- **Contact**: REDACTED
- **Telephone**: REDACTED
- **Email address**: REDACTED

280 Mechanical services engineer

- **Name**: TNG Consulting Engineering Ltd

00-05-70 Project Location

110 Project location

- **Details**: NOCS - Existing workshops W1/36 and W1/40

211 Pricing

- **Pricing**: Price and extend each item individually and summarise in accordance with the Tender Summary Sheet included within the specification. Do not group items together.
  A Schedule of Quantities and inclusive rates showing how the Tender is made are to be submitted with AW5.2 Pricing Schedule. The prices contained in this estimate may be used as a basis for pricing any additional or omitted works.
  Unless otherwise stated, Tenders shall include in respect of each items specified:
  - Project administration;
  - Costs for all elements of design work required by this specification;
  - Labour and all costs in connection therewith;
  - Material, goods and all costs in connection therewith (eg conveyance, delivery, unloading, storing, returning packings, handling, hoisting, lowering);
  - Fitting and fixing materials and goods in position;
  - Establishment charges, overhead charges and profit.

  All specialist quotations shall be broken down showing each element itemised. The Employer does not undertake to accept the lowest or any Tender and no payment shall be made for the costs associated with the preparation of the Tenders.
  Unless otherwise stated, tenders shall include in respect of each of the items specified
  - Design and project administration.
  - Labour and all costs in connection therewith.
  - Materials, goods and all costs in connection therewith (e.g. conveyance; delivery; unloading; storing; handling; hoisting; lowering).
  - Fitting and fixing materials and goods in position.
  - Connections to existing services.
  - Establishment charges, overhead charges and profit.
  - Any costs which he will incur during the commissioning of the installation for supervision of the plant and specialist suppliers
  - Extension of the manufacturer's warranties as necessary and insurances, etc.
- **Specialist Sub-Contractors and Named Manufacturers**: If the Contractor proposes to sub-contract any work out to a third party, these details shall be included in the schedule provided in the Tender return document. Subcontracting of works will only be accepted if the schedule is duly completed and returned with the Tender documentation. The Contractor shall be responsible for ensuring all Sub-Contractors, Suppliers and Manufacturers, embodied within the Contract deliver, install and complete all works in compliance with the agreed programme.
- **Alternatives**: The Contractor shall submit his Tender based on the scheme detailed in this Specification and on the accompanying drawings and the Manufacturers listed. The Contractor shall be responsible for checking all details, quantities and specifications provided on Manufacturer's quotations are correct against the Tender documents prior to Tender submission. No post Tender claim for monies resulting from failure to undertake this checking will be acknowledged.
  The Contractor is free to propose equal equipment by an alternative Manufacturer and state his proposal and any variation in his Tender price on the Schedule of Alternatives. This variation in price shall incorporate all cost variations to the proposed installation as a result of his proposal. No post-Tender claim for additional money resulting from a change of Manufacturer proposed by the Contractor will be considered. Notwithstanding this, it shall be clearly understood that where a particular Manufacturer is specified, alternatives of equal standard, quality and operation may be considered but the Tender prices shall be deemed to include only for the Manufacturer's items

detailed in the Specification. If any alternatives are approved, they will be authorised by a Variation Order issued by the Architect.

221 Site visit

- **Nature of the site**: Ascertain before Tendering, including access thereto and local conditions and restrictions likely to affect the execution of the Work.
- **Arrangements for visit**: During the Tender period, the proposed site will be available for on-site viewing by appointment with the Employer's Agent. The Contractor shall be deemed to have visited site, to have acquainted himself as to the nature and extent of the works, to inspect local conditions, means of access and other matters that may affect the Tender price and to have examined the Specification, Drawings and Conditions of Contract.

10-45-20/110 Deconstruction system

System outline

10-45-20/110 Deconstruction system

- **Description**: The following removal works shall be carried out:

  - 3no LEV systems to be removed including fans, ductwork, supports etc [FEU1/W1/36, FEU2/W1/36 and VEU1/W1/40]
  - Redundant automatic controls, power wiring, equipment, fittings, containment etc.

  The following equipment and installations shall be retained and protected during the works:

  - Existing electrical supply cabling and conduit from main control panel to redundant switched disconnection unit

  All existing redundant mechanical and electrical services shall be removed from the site and agreed before the installation works take place.
  Asbestos register shall be issued by NOCS to the Contractor before the works commence.

  All redundant mechanical and electrical services systems shall be removed in their entirety in a safe and controlled manner. All equipment shall be electrically isolated, drained down, purged, etc. by the Contractor before the removal works take place.

  The Contractor shall visit site to ascertain the extent of the works necessary to carry out the entire removal of all redundant mechanical services and associated systems. These works shall be allowed for in the tender costs.

- **Contract survey**:
  - **Scope of contract survey**: Existing.
  - **Type of survey**: Existing.
  - **Survey limitations**: None.
  - **Timing**: Before commencing onsite.

Execution

10-45-20/635 Disconnection of services type A

- **Disconnection of supplies and removal of fittings and equipment**: Arrange with the client. Remove fittings and equipment where agreed.
- **Decommissioning action plan**: Submit proposals.
- **Timing**: Prior to installation works.

Ω End of system

55-60-10/110 Compressed air supply system

System outline

55-60-10/110 Compressed air supply system

- **Description**: The existing compressed air system serving a local reel system in workshop W1/40 shall be modified and extended to serve the new LEV system [filter/fan unit] as detailed on the Tender drawings.
- **Source supply**: Existing.
- **Pipelines**: 90-10-65/310 Copper pipelines.
- **Pipeline ancillaries**: 90-10-90/330 Ball valves and 90-30-10/375 Hoses, spiral.
- **Pressure reducing stations**: 90-30-10/390 Pressure reducing stations.
- **In line filters**: 90-30-10/380 In line filters.
- **Couplings**: 90-30-10/345 Couplings.
- **Supports**: 90-90-60/390 Services supports.
- **System completion**: 55-60-10/820 Testing and commissioning.

Products

90-10-65/310 Copper pipelines

- **General requirements**: 90-10-65/315 Copper pipeline fittings and 90-10-65/320 Copper pipeline jointing materials.
- **Standard**: To BS EN 1057.
- **Grade**: R220;
  R250;
  and R290.
- **Finish**: Plain.
- **Execution**: 90-10-65/630 Installing copper pipelines and 90-10-65/635 Brazed joints in copper and copper alloy pipes.

90-10-65/315 Copper pipeline fittings

- **Capillary**: To BS EN 1254-1.
- **Flanges**: To BS EN 1092-3.

90-10-65/320 Copper pipeline jointing materials

- **Standards**:
  - **Solder for capillary fittings**: To BS EN ISo 9453.
  - **Lead free solder for capillary fittings**: To BS EN ISO 9453.
  - **Brazing filling**: To BS EN ISO 17672.
  - **Flange jointing rings**: To BS EN 1514-4.

90-10-90/305 Connections for accessories

- **Capillary**: To BS EN 1254-1.
- **Compression for copper tubes**: To BS EN 1254-2.
- **Compression for plastics pipes**: To BS EN 1254-3.
- **Flanged for cast iron**: To BS EN 1092-2.
- **Flanged for copper alloy**: To BS EN 1092-3.

- **Threaded**:
  - **Where pressure-tight joints are made on the threads**: To BS 21 or BS EN 10226-1.
  - **Where pressure-tight joints are not made on the threads**: To BS EN ISO 228-1.

90-10-90/330 Ball valves

- **General requirements**: 90-10-90/305 Connections for accessories.
- **Material**: Brass copper alloy.
- **Manufacturer**:
  - **Product Reference**: Refer to STR
- **Connections**: Threaded.
- **Finish**: Natural.

90-30-10/345 Couplings

- **Standard**: To BS EN 983.
- **Type**: Claw.
- **Manufacturer**:
  - **Product Reference**: Refer to detailed specification BO6.
- **Size**: Refer to detailed specification BO6.
- **Connections**: Refer to detailed specification BO6.

90-30-10/375 Hoses, spiral

- **Manufacturer**:
  - **Product Reference**: Refer to detailed specification BO6.
- **Material for spiral hoses**: Refer to detailed specification BO6.
- **Size**: Refer to detailed specification BO6.
- **Hose length**: Refer to detailed specification BO6.

90-30-10/380 In line filters

- **Type**: Coalescing.
- **Manufacturer**:
  - **Product Reference**: Refer to detailed specification BO6.
- **Flow rate**: Refer to detailed specification BO6.
- **Particle removal**: Refer to detailed specification BO6.
- **Number of elements**: Refer to detailed specification BO6.
- **Pipeline sizes**: Refer to detailed specification BO6.
- **Connections**: Refer to detailed specification BO6.

90-30-10/390 Pressure reducing stations

- **Type**: Duplex.
- **Manufacturer**:
  - **Product Reference**: Refer to detailed specification BO6.
- **Accessories**: Pressure relief valves, pressure gauges and quarter turn ball valves.

90-90-60/390 Services supports

- **Support type**: Beam clips;
  Cantilever hanger;
  Proprietary support channels and fixings;
  and All ductwork shall be supported by steel drop rods. Wire suspensions shall not be used..

- **Positioning**: All ductwork shall be independently supported within 500mm both sides of any partition.

Execution

90-10-65/630 Installing copper pipelines

- **General requirements**: 90-10-65/690 Spacing of pipelines;
  90-10-65/625 Installing slide guides;
  90-10-65/615 Installing pipeline fittings;
  90-10-65/610 Pipelines installation generally;
  90-10-65/710 General inspection and testing;
  and 90-10-65/620 Installing anchors generally.
- **Standard**: In accordance with CDA publications 88 Copper tube in buildings and 149 Large diameter copper tubes.
- **Jointing method**:
  - **Permanently concealed joints**: Brazed.
  - **Accessible joints**: Brazed.

90-10-65/635 Brazed joints in copper and copper alloy pipes

- **Preparation, marking and sealing**: In accordance with BS EN 14324.

90-10-65/690 Spacing of pipelines

- **Minimum clearance between insulated pipelines and**:
  - **Wall finish**: 25 mm.
  - **Ceiling finish or soffit**: 100 mm.
  - **Floor**: 150 mm.
  - **Electrical services**: 150 mm.
  - **Adjacent services**: 100 mm.
  - **Uninsulated pipeline**: 75 mm.
  - **Another insulated pipeline**: 25 mm.
- **Minimum clearance between uninsulated pipelines and**:
  - **Wall finish**: 25 mm.
  - **Ceiling finish or soffit**: 100 mm.
  - **Floor**: 150 mm.
  - **Electrical services**: 150 mm.
  - **Adjacent services**: 150 mm.
  - **Another uninsulated pipeline**: 25 mm.

90-10-65/710 General inspection and testing

- **Inspection of joints**:
  - **Joints**: Cut out, cut open and inspect.
- **Safety precautions**: In accordance with HSE GS 4.

System completion

55-60-10/820 Testing and commissioning

- **Requirements**: New system modification tested to 1.5 times operating pressure

Ω End of system

65-40-45/130 Local exhaust ventilation system

System outline

65-40-45/130 Local exhaust ventilation system

- **Description**: The LEV system works shall incorporate the following:

  - Removal works
  - 2no LEV systems to serve room W1/36
  - 1no LEV system to serve room W1/40
  - Distribution ductwork
  - 2no ductwork termination points above roof
  - Testing and commissioning

  The two LEV systems serving room W1/36 are provided to serve welding works and consists of replacement systems as indicated on the Tender drawings.

  The main system [FEU/2/W1/36] in room W1/36 consists of 4,200 extension extract arm with 4,200 self-supporting flexible extract arm, extract fan and ductwork rising to discharge above roof. The fan unit shall be mounted on a stanchion/post fixed to the floor and wall, the final height shall be agreed onsite.

  The bench system [FEU/1/W1/36] in room W1/36 consists of 3,000 self-supporting flexible extract arm, extract fan and ductwork rising to discharge above roof. The fan unit shall be fixed to the wall.

  The discharge ducts for each of the units shall terminate 3,000 above the finished roof level with a high velocity jet cowl with drain. The discharge arrangement shall be carried out by a specialist as defined on the equipment schedule.

  The LEV system [FEU/3/W40 previously VEU1/W1/40] serving room W1/40 is provided to serve welding and grinding works and consists of a replacement system as indicated on the Tender drawings. The system consists of filter unit with fan and 5,000 self-supporting flexible extract arm. The unit is recirculation air only with integral controls.

  For the controls installation refer to the automatic controls section.

  LEV OPTION

  The Tenderer shall provided extra over cost for upgrading the bench system [FEU/1/W36] to match the arrangement of the main system [FEU/2/W36] i.e. fan, extension arm and flexible arm and mounting arrangement. The cost shall be submitted on Tender Summary Sheet

  ASSOCIATED BUILDERS WORK AND ATTENDANCE

  General Description:
  The Contractor shall include within the Tender price for all builders work, making good, redecoration and cleaning associated with the installation works.

The following outlines the main builders work items. The Contractor should note that the following is not an exhaustive schedule. The Contractor must visit site to ascertain the full extent of builders work.

It is anticipated that the Contractor shall need to employ a building contractor to carry out certain aspects of the builders work.

Site Setup:
The Contractor shall have access to onsite facilities provided by the client for the purposes of their site personnel, including sub-contractor staff including: welfare and toilets facilities.

The site set-up shall include but not be limited to the details as indicated in the specification any additional Contractor requirements shall be agreed at the Pre-Contract meeting.

The site compound shall generally include:

- Temporary skip

General builders work

- Roof works: provision of scaffolding, roof edge protection, temporary protection over roof lights, platform access to work area etc.
- Roof works: replacement of weathering aprons for new ductwork and support system passing through roof
- Roof works; temporary weatherproofing of holes left by removed ducts
- Internal work: access platform/tower to allow high level services installation works [circa. 11,000 from ffl to roof]
- Bracketry/support for M&E equipment
- Making good of redundant holes
- Clear and clean site on completion of the works
- The client shall move equipment etc to allow works to take place

- **System performance**: 65-40-45/240 Local exhaust ventilation (LEV) design parameters.
- **System manufacturer**: As defined on equipment schedules
- **Fans**: 90-45-30/320 Centrifugal fans.
- **Air ductwork and accessories**:
  - **Ductwork**: 90-45-25/315 Circular sheet metal ductwork and fittings.
- **External exhaust air terminals**: 90-45-40/430 Discharge stack terminating with high velocity jet cowl
- **Identification of ductwork and equipment**: 90-90-55/420 Identifying ductwork.
- **Fan control**: On/ off switch.
- **Execution**: 65-40-45/620 Installing local exhaust ventilation.

- **System completion**: 65-40-45/810 Testing;
  65-40-45/820 Commissioning;
  65-40-45/840 Demonstrations;
  65-40-45/850 Documentation;
  65-40-45/860 Spares and consumables;
  and 65-40-45/870 Maintenance.

Products

90-45-25/315 Circular sheet metal ductwork and fittings

- **Standards**: To HVCA DW/144;
  BS EN 1506;
  and BS EN 12237.
- **Classification**: To DW/144: Class A Low Pressure.
- **Air leakage testing**: Required where system flow rate >0.2m3/s and Maximum permissible air leakage rates shall be as DW144 Table 2 - Low Pressure Class A or Medium Pressure Class B as dictated by specified AHU or fan external static pressure, with tests carried out in accordance with DW143.
- **Material**: Mild steel.
- **Construction**: Straight seamed.
- **Flexible joint connections**: Fit on fan inlets and outlets and at building expansion joints.
- **Hangers and supports**:
  - **Strength requirements**: To BS EN 12236.
  - **Notes**: All ductwork shall be independently supported within 500mm either side of any partition and All ductwork shall be supported via drop rods. The use of gripper wire shall not be acceptable.
- **Access openings**: Function: As HVCS TR19 Table 2;
  Inspection;
  Cleaning;
  and Maintenance.
- **Sizes**: As DW 144 Appendix D;
  Unless otherwise detailed medium radius bends shall be used as standard. Where square bends are used turning vanes shall be provided;
  and Self piercing drill screws shall not be used on ducting, only blind rivets shall be accepted.

90-45-30/320 Centrifugal fans

- **Performance**: To BS 848-1.
- **Duty**:
  - **Air volume**: As fan schedule.
  - **Resistance**: As fan schedule.
  - **External static resistance**: As fan schedule.
- **Mechanical safety**: To BS 848-5.
- **Electrical safety**: To BS EN 60335-2-80.
- **Dimensions**: To BS 848-4
- **Operating conditions**:
  - **Environment**: Refer to STR.
  - **Air density**: 1.20 kg/m3.

- **Operation**: Refer to STR.
- **Motor and drive**: Match Fan - Motor efficiency: To efficiency classes as defined in IEC 60034-30, for ratings as follows:
- **Motor Ratings**: Up to 7.5kW: IE2 and 7.5kW or larger: IE3.
- **Casing**: Refer to STR.
- **Mounting**: Refer to STR.
- **Material**: Refer to STR.
- **Anti-vibration mountings**: Refer to STR.
- **Flexible duct connections**: Refer to STR.
- **Accessories**: Air flow sensors;
  Back draft shutters;
  Bird guard;
  Flow measurement points;
  Insect guard;
  Motorized shutters;
  Speed controller;
  Hinged access panel;;
  and Removable access panel.

90-45-40/430 Discharge stack

- **Manufacturer**: As detailed on equipment schedule
- **Height**: 3,000 above roof
- **Execution**: 90-45-40/620 Installing discharge stack.

Execution

65-40-45/620 Installing local exhaust ventilation

- **Standard**: In accordance with HSG 258.

90-45-40/620 Installing discharge stack

- **Position**: Locate stack 3,000 above the roof
- **Rain caps**: High velocity jet cowl

System completion

65-40-45/810 Testing

- **Standard**: In accordance with HSG 258, chapter 8.
- **Test results**:
  - **Submit**: On completion.
  - **Number of copies**: Hard copy and electronic

65-40-45/820 Commissioning

- **Standard**: In accordance with HSG 258, chapter 8.

65-40-45/840 Demonstrations

- **Instruction**: Instruct and demonstrate the purpose, function and operation of the installations.

65-40-45/850 Documentation

- **Operating and maintenance instructions**:
  - **Scope**: Submit for the system as a whole giving optimum settings for controls.
  - **Product information**: Include product description, date of purchase, performance characteristics, application (suitability for use), method of operation and control, and cleaning and maintenance requirements.
  - **Format**: Paper copy and Electronic
  - **Number of copies**: Two.
- **Record drawings**:
  - **Content**: Location and arrangement of plant;
    Location, size and route of ductwork;
    and Location of outlets.
  - **Format**: A1 paper print and Electronic.
  - **Number of copies**: Two
- **Submittal date**: At handover.

65-40-45/870 Maintenance

- **Servicing and maintenance**: Undertake until 12 months after completion.

Ω End of system

70-70-40/110 Inspection and testing of new low voltage electrical installations or changes to an existing installation

System outline

70-70-40/110 Inspection and testing of new low voltage electrical installations or changes to an existing installation

- **Description**: The existing supply cabling shall be tested and retained and connected to the new fans. The completed installation shall be tested to satisfy the requirement the of latest version BS7671
- **General requirements**:
  - **Electrical test engineer**: Electrical installation contractor.
  - **Approval**: National Inspection Council for Electrical Installation Contracting (NICEIC).
  - **Evidence of approval**: Submit.
  - **Test equipment calibration**: UKAS approved.
- **Execution**: 70-70-40/610 Test equipment calibration and 70-70-40/620 Inspection and testing electrical installations generally.
- **System completion**: 70-70-40/860 Electrical installation certificates.

Execution

70-70-40/610 Test equipment calibration

- **Test equipment calibration**: UKAS approved.

70-70-40/620 Inspection and testing electrical installations generally

- **Standards**: In accordance with BS 7671 and IET Guidance Note 3.
- **Installed equipment standards**: Verify and confirm compliance with the relevant equipment standards.
  Verify and confirm that all parts of the fixed installation are selected and erected correctly.
  Verify and confirm that the fixed installation is free from visible damage or otherwise defective.
- **Continuity of protective conductors**:
  - **Equipment**: Continuity tester with short circuit current of at least 200 mA, and a no load d.c. or a.c. voltage between 4 V and 24 V.
- **Insulation resistance (minimum)**:
  - **Other circuits less than or equal to 500 V (excluding SELV and PELV)**: 2 megohm when tested at 500 V d.c.
- **External earth fault loop impedance (Ze)**: Direct measurement.
- **Connection of test equipment to existing switchgear**: Submit proposals.
- **Earth fault loop impedance (Zs)**: Direct measurement.
- **Measurement locations**: Origin, switchgear, fixed equipment and outlets, circuit extremities.
- **Prospective fault current**:
  - **Method**: Direct measurement.
  - **Location**: Origin, and at points where protective devices are required to operate under fault conditions.
- **Phase sequence**: Verify.
- **Cable containment**: Measure electrical continuity and insulating properties of containment. Submit results.

System completion

70-70-40/860 Electrical installation certificates

- **Standard**: In accordance with BS 7671 appendix 6 and To National Inspection Council for Electrical Installation Contracting (NICEIC) standard.
- **Format**: Electronic, type written results.
- **Test equipment identity**: Record on test certificates.
- **Certificates of calibration**: Submit for each test instrument.
- **Schedule of test results**: Submit three copies.

Ω End of system

70-70-45/110 Low voltage distribution system

System outline

70-70-45/110 Low voltage distribution system

- **Description**: The electrical installation associated with the LEV systems shall incorporate the following:

  - Removal of redundant equipment
  - Testing retained power supplies
  - Installation of 3no new switch disconnectors
  - Final testing of new installation

  The existing power supplies shall be retained with the local switch disconnectors being replaced.

- **Connection to low voltage supply**: Existing.
- **Distribution circuit cabling**:
  - **Types**: Existing.
- **Containment**: Reuse existing
- **Containment accessories**: Existing.
- **Rewireable installation**: Required.
- **Electrical identification**: To satify NOC's requirements

Ω End of system

75-75-50/160 Mechanical extract systems control

System outline

75-75-50/160 Mechanical extract systems control

- **Description**: The automatic controls installation is a CDP element of works and shall be carried by the clients
Specialist:

  Matrix Control Solutions Ltd
  Suite 19/19, 2nd Floor
  Rushmoor Business Centre
  Kingsmead
  Farnborough GU14 7SR
  Tel: 01252 362640

  The works shall incorporate the following:

  - Removal of existing redundant systems
  - Provision of new installation serving each system
  - Electrical power wiring modification
  - Controls wiring to field equipment etc.
  - Modifications and provision of graphics to headend
  - Testing and commissioning

  The controls and monitoring of the two LEV systems in W1/36 [FEU1/W1/36 and FEU2/W1/36] shall consist of the following:

  - Replacement of local on/off switch with controls linked back to main control panel
  - Fault monitoring: run status monitored on contactor within MCP
  - Power supply interlinks with other systems as required by NOCS

  The controls and monitoring of the LEV system in W1/40 [FEU3/W1/40] shall consist of the following:

  - The unit is complete with integral controls and panel
  - Fault monitoring of flow/pressure
  - Run status monitored on MCP
  - Power supply interlinks with other systems as required by NOCS
  - Provide new labelling on main panel [old reference VEU1/W1/40]

  The Controls Specialist shall carryout all electrical works as detailed under clauses 70-70-40 and 70-70-45.

  Provide and fix labelling adjacent each unit; rectangular white laminated plastic engraved with black lettering

- **System performance**: 75-75-50/201 Design type A and 75-75-50/201 Design type B.
- **Objectives**: Contractor's design.
- **Extract fan control strategies**: 75-75-50/272 Constant volume extract fan control strategy.
- **Equipment**: 90-65-50/340 Control panels.
- **Equipment interconnectivity**: Wired.
- **Cables**: As Specialist's recommendations.
- **Containment**: 90-55-10/380 Rigid conduit.
- **Containment accessories**: 90-55-10/460 Conduit fittings.
- **Rewireable installations**: Required.
- **Control equipment power supply**: Mains supply.
- **System completion**: 75-75-50/830 Commissioning of automatic control systems.

System performance

75-75-50/201 Design type A

- **Design**: The automatic controls system is a CDP element of works
- **Submit including the following information**: Description of operation, point schedules, panel/wiring diagrams and fascia drawings, method statements for testing and commissioning, method statements for witness testing and graphics.

75-75-50/272 Constant volume extract fan control strategy

- **Equipment to be controlled**: Constant volume extract fan interlocked with associated supply fan and hand/off/auto switch hardwired to motor.
- **Fan control**:
  - **Fan operation**: Proved when extract air pressure switch or air velocity switch is made. If condition is not met within failure time, generate a fan failure alarm and disable the fan.
  - **Failure time**: Contractor's choice.
- **Shut down**: Disable fan.

Products

90-55-10/360 Flexible conduit

- **Manufacturer**: Kopex.
- **Standard**: To BS EN 61386-23.
- **Material**: Composite and Metallic.
- **Mechanical properties**:
  - **Resistance to compression**: Heavy.
  - **Resistance to impact**: Heavy.
  - **Resistance to bending**: Flexible.
  - **Tensile strength**: Medium.
  - **Suspended load capacity**: Medium.
- **Temperature range**:
  - **Lower temperature (maximum)**: -5°C.
  - **Upper temperature (minimum)**: 130°C.
- **Electrical properties**: With electrical continuity properties; insulated CPC installed internally and bonded to each end of conduit.
- **Ingress protection (minimum)**: To BS EN 60529, IP67.

- **Resistance to corrosion**: To BS EN 61386-1, Class 4.
- **Resistance against flame propagation**: Flame-retardent BLUE 'Limited Fire Hazard' covering.
- **Sizes (OD)**: 20 mm;
  25 mm;
  32 mm;
  40 mm;
  and 50 mm.
- **Special features**: Connectors selected from Manufacturer's range to suit application and environment.
- **Execution**: 90-55-10/715 Installing pliable and flexible conduit.

90-55-10/380 Rigid conduit

- **Manufacturer**: Contractor's choice.
- **Standard**: To BS EN 61386-21.
- **Material**: Steel.
- **Mechanical properties**:
  - **Resistance to compression**: Heavy.
  - **Resistance to impact**: Heavy.
  - **Resistance to bending**: Rigid.
  - **Tensile strength**: Heavy.
  - **Suspended load capacity**: Heavy.
- **Temperature range**:
  - **Lower temperature (maximum)**: -5°C.
  - **Upper temperature (minimum)**: 105°C.
- **Electrical properties**: With electrical continuity properties.
- **Ingress protection (minimum)**: To BS EN 60529, IP x4.
- **Resistance to corrosion**: To BS EN 61386-1, Class 2.
- **Resistance against flame propagation**: Required.
- **Sizes (OD)**: 20 mm;
  25 mm;
  and 32 mm.
- **Execution**: 90-55-10/720 Installing rigid metallic conduit;
  90-55-10/735 Installing conduit connections to equipment;
  and 90-55-10/765 Conduit, trunking and ducting zones.

90-55-10/460 Conduit fittings

- **Manufacturer**: Match conduit.
- **Standards**: To BS EN 61386-1 and to BS EN 61386-21, BS EN 61386-22, or BS EN 61386-23 as appropriate; or to BS 4607-1.
- **Material**:
  - **Type**: Malleable iron and Steel.
  - **Finish**: Match conduit.
- **Conduit boxes**: Fit covers of same material and finish as boxes. Include brass earthing terminals in PVC-U boxes.
- **Plugs**:
  - **For metallic boxes**: Slotted brass.
  - **For non-metallic boxes**: Hexagon screwed PVC-U.

- **Locknuts**:
  - **For metallic boxes**: Hexagonal steel.
  - **For non-metallic boxes**: Knurled circular PVC-U.
- **Execution**: 90-55-10/700 Installing conduit, trunking and ducting type B.

90-65-50/340 Control panels

- **Manufacturer**: Submit proposals.
- **Enclosure**:
  - **Ingress protection (minimum)**: To BS EN 60529, IP44.
  - **Mechanical protection (minimum)**: To BS EN 62262, IK05.
  - **Material**: Submit proposals.
  - **Doors and panels**:

    Form: Right angle return construction with rounded edges and corners, concealed hinges and internal gaskets.

    Swing: Submit proposals.

    Hardware: Corrosion-resistant lever type handles with latching mechanism.

    Locks: Cylinder, with standardized key type.
- **Isolator**:
  - **Type**: Switch-disconnector to BS EN 60947-3.
- **Internal separation**:
  - **Form**: Submit proposals.
- **Gland plate gaskets**: Match the assembly's degree of ingress protection.
- **Internal cable zones**: Sufficient to allow cabling to be neatly routed and terminated.
- **Interconnecting cable**: Single core PVC insulated cables to BS 6231.
- **Terminals**:
  - **Mounting**: Suitable for mounting to 35 mm DIN rail.
  - **Identification**:

    Neutral and earth bar terminals: Label with the outgoing circuit reference.

    Cable terminations: Label with circuit reference, with push-on plastics markers.
- **Trunking**:
  - **Standard**: To BS EN 50085-2-3.
  - **Material**: PVC-U.
- **Execution**: 90-65-50/630 Installing control panels.

Execution

90-55-10/700 Installing conduit, trunking and ducting type B

Shared by: 90-55-10/460 Conduit fittings; 90-55-10/715 Installing pliable and flexible conduit; and 90-55-10/765 Conduit, trunking and ducting zones.

- **Standards**: In accordance with BS 7671 and IET Guidance Note 1.
- **Preparation**: Cut square. Remove burrs and sharp edges to make smooth.
- **Protection of metallic conduit, trunking and ducting**:
  - **Joints and ends**: Remove grease, oil, dirt and rust before applying protective paint. Paint immediately following installation.
  - **Protective paint**:

    Generally: Compatible with conduit, trunking and ducting finish.

    Type: Galvanizing zinc rich paint, two coats.

- **Cross-sectional area**: Maintain throughout the conduit, trunking and ducting length.
- **Arrangement**: Position vertically and horizontally in line with equipment served, and parallel with building lines.
- **Spare containment**: To be defined.
- **Draw wires**: Install nylon tapes galvanized soft iron wires within spare conduit, trunking and ducting.
- **Distance from other services running parallel (minimum)**:
  - **Generally**: 150 mm.
  - **Above radiators**: 600 mm.
  - **Steam services**: 600 mm.
- **Drainage of conduit, trunking and ducting**: Locate drainage outlets at lowest points in conduit, trunking and ducting installed externally, and where condensation may occur.
- **Fire barriers**: Provide to maintain integrity of fire compartments.
- **Rewireable installations**: Enable rewiring from accessible boxes or accessories only.
- **Support**: Independently fix and support conduit, trunking and ducting from building structure.
- **Cleaning**: Clean insides of conduit, trunking and ducting before installing cables.
- **Cabling**: Install when conduit, trunking and ducting enclosure is complete.
- **Submittals**: Submit manufacturer's technical information. Submit drawings showing the proposed routes of conduit, trunking and ducting and the location of service outlets.

90-55-10/700 Installing conduit, trunking and ducting type C

- **Standards**: In accordance with BS 7671 and IET Guidance Note 1.
- **Preparation**: Cut square. Remove burrs and sharp edges to make smooth.
- **Protection of metallic conduit, trunking and ducting**:
  - **Joints and ends**: Remove grease, oil, dirt and rust before applying protective paint. Paint immediately following installation.
  - **Protective paint**:
    Generally: Compatible with conduit, trunking and ducting finish.
    Type: Galvanizing zinc rich paint, two coats.
- **Cross-sectional area**: Maintain throughout the conduit, trunking and ducting length.
- **Arrangement**: Position vertically and horizontally in line with equipment served, and parallel with building lines.
- **Spare containment**: To be defined.
- **Draw wires**: Install nylon tapes galvanized soft iron wires within spare conduit, trunking and ducting.
- **Distance from other services running parallel (minimum)**:
  - **Generally**: 150 mm.
  - **Above radiators**: 600 mm.
  - **Steam services**: 600 mm.
- **Drainage of conduit, trunking and ducting**: Locate drainage outlets at lowest points in conduit, trunking and ducting installed externally, and where condensation may occur.
- **Fire barriers**: Provide to maintain integrity of fire compartments.
- **Rewireable installations**: Enable rewiring from accessible boxes or accessories only.
- **Support**: Independently fix and support conduit, trunking and ducting from building structure.
- **Cleaning**: Clean insides of conduit, trunking and ducting before installing cables.
- **Cabling**: Install when conduit, trunking and ducting enclosure is complete.

- **Submittals**: Submit manufacturer's technical information. Submit drawings showing the proposed routes of conduit, trunking and ducting and the location of service outlets.

90-55-10/700 Installing conduit, trunking and ducting type D

- **Standards**: In accordance with BS 7671 and IET Guidance Note 1.
- **Preparation**: Cut square. Remove burrs and sharp edges to make smooth.
- **Protection of metallic conduit, trunking and ducting**:
  - **Joints and ends**: Remove grease, oil, dirt and rust before applying protective paint. Paint immediately following installation.
  - **Protective paint**:

    Generally: Compatible with conduit, trunking and ducting finish.

    Type: Galvanizing zinc rich paint, two coats.
- **Cross-sectional area**: Maintain throughout the conduit, trunking and ducting length.
- **Arrangement**: Position vertically and horizontally in line with equipment served, and parallel with building lines.
- **Spare containment**: To be defined.
- **Draw wires**: Install nylon tapes galvanized soft iron wires within spare conduit, trunking and ducting.
- **Distance from other services running parallel (minimum)**:
  - **Generally**: 150 mm.
  - **Above radiators**: 600 mm.
  - **Steam services**: 600 mm.
- **Drainage of conduit, trunking and ducting**: Locate drainage outlets at lowest points in conduit, trunking and ducting installed externally, and where condensation may occur.
- **Fire barriers**: Provide to maintain integrity of fire compartments.
- **Rewireable installations**: Enable rewiring from accessible boxes or accessories only.
- **Support**: Independently fix and support conduit, trunking and ducting from building structure.
- **Cleaning**: Clean insides of conduit, trunking and ducting before installing cables.
- **Cabling**: Install when conduit, trunking and ducting enclosure is complete.
- **Submittals**: Submit manufacturer's technical information. Submit drawings showing the proposed routes of conduit, trunking and ducting and the location of service outlets.

90-55-10/710 Installing conduit generally type B

- **Fixing**: Fix securely. Fix boxes independently of conduit.
- **Changes of direction**: Conduit boxes or bends site formed by machine. Do not use elbows, tees or inspection bends.
- **Joints**:
  - **Generally**: Manufacturer's jointing fittings.
  - **Number of joints**: Minimize.
  - **Lengths of conduit**: Maximize.
  - **Open ends**: Plug.
  - **At movement joints in structure**: Manufactured expansion coupling. Install adaptable boxes on both sides of joint at a maximum distance of 300 mm.
- **Connections to boxes, trunking, equipment and accessories**: Screwed couplings with rubber bushes at open ends.
- **Conduit boxes**:
  - **Generally**: Install flush with finished surfaces. Provide extension rings if required.

  - **Fixing screws**: Countersunk, or round-headed screws.
  - **Number of fixings (minimum)**: Two.
  - **Lids**: Fasten with brass slot pan head screws.
- **Rear outlet boxes**: Locate where surface conduits pass through walls to external equipment.
- **Draw-in boxes**:
  - **Spacing (maximum)**: 10 m.
  - **Number of bends between draw-in boxes (maximum)**: Two.
  - **Floors**: Do not install draw-in boxes in floors.
- **Conduit in walls**: Avoid concealed horizontal runs.
- **Suspended ceiling installations**: Fasten outlet boxes to structure above ceiling.

90-55-10/710 Installing conduit generally type C

- **Fixing**: Fix securely. Fix boxes independently of conduit.
- **Changes of direction**: Conduit boxes or bends site formed by machine. Do not use elbows, tees or inspection bends.
- **Joints**:
  - **Generally**: Manufacturer's jointing fittings.
  - **Number of joints**: Minimize.
  - **Lengths of conduit**: Maximize.
  - **Open ends**: Plug.
  - **At movement joints in structure**: Manufactured expansion coupling. Install adaptable boxes on both sides of joint at a maximum distance of 300 mm.
- **Connections to boxes, trunking, equipment and accessories**: Screwed couplings with rubber bushes at open ends.
- **Conduit boxes**:
  - **Generally**: Install flush with finished surfaces. Provide extension rings if required.
  - **Fixing screws**: Countersunk, or round-headed screws.
  - **Number of fixings (minimum)**: Two.
  - **Lids**: Fasten with brass slot pan head screws.
- **Rear outlet boxes**: Locate where surface conduits pass through walls to external equipment.
- **Draw-in boxes**:
  - **Spacing (maximum)**: 10 m.
  - **Number of bends between draw-in boxes (maximum)**: Two.
  - **Floors**: Do not install draw-in boxes in floors.
- **Conduit in walls**: Avoid concealed horizontal runs.
- **Suspended ceiling installations**: Fasten outlet boxes to structure above ceiling.

90-55-10/710 Installing conduit generally type D

- **Fixing**: Fix securely. Fix boxes independently of conduit.
- **Changes of direction**: Conduit boxes or bends site formed by machine. Do not use elbows, tees or inspection bends.
- **Joints**:
  - **Generally**: Manufacturer's jointing fittings.
  - **Number of joints**: Minimize.
  - **Lengths of conduit**: Maximize.
  - **Open ends**: Plug.

  - **At movement joints in structure**: Manufactured expansion coupling. Install adaptable boxes on both sides of joint at a maximum distance of 300 mm.
- **Connections to boxes, trunking, equipment and accessories**: Screwed couplings with rubber bushes at open ends.
- **Conduit boxes**:
  - **Generally**: Install flush with finished surfaces. Provide extension rings if required.
  - **Fixing screws**: Countersunk, or round-headed screws.
  - **Number of fixings (minimum)**: Two.
  - **Lids**: Fasten with brass slot pan head screws.
- **Rear outlet boxes**: Locate where surface conduits pass through walls to external equipment.
- **Draw-in boxes**:
  - **Spacing (maximum)**: 10 m.
  - **Number of bends between draw-in boxes (maximum)**: Two.
  - **Floors**: Do not install draw-in boxes in floors.
- **Conduit in walls**: Avoid concealed horizontal runs.
- **Suspended ceiling installations**: Fasten outlet boxes to structure above ceiling.

90-55-10/710 Installing conduit generally type E

- **Fixing**: Fix securely. Fix boxes independently of conduit.
- **Changes of direction**: Conduit boxes or bends site formed by machine. Do not use elbows, tees or inspection bends.
- **Joints**:
  - **Generally**: Manufacturer's jointing fittings.
  - **Number of joints**: Minimize.
  - **Lengths of conduit**: Maximize.
  - **Open ends**: Plug.
  - **At movement joints in structure**: Manufactured expansion coupling. Install adaptable boxes on both sides of joint at a maximum distance of 300 mm.
- **Connections to boxes, trunking, equipment and accessories**: Screwed couplings with rubber bushes at open ends.
- **Conduit boxes**:
  - **Generally**: Install flush with finished surfaces. Provide extension rings if required.
  - **Fixing screws**: Countersunk, or round-headed screws.
  - **Number of fixings (minimum)**: Two.
  - **Lids**: Fasten with brass slot pan head screws.
- **Rear outlet boxes**: Locate where surface conduits pass through walls to external equipment.
- **Draw-in boxes**:
  - **Spacing (maximum)**: 10 m.
  - **Number of bends between draw-in boxes (maximum)**: Two.
  - **Floors**: Do not install draw-in boxes in floors.
- **Conduit in walls**: Avoid concealed horizontal runs.
- **Suspended ceiling installations**: Fasten outlet boxes to structure above ceiling.

90-55-10/715 Installing pliable and flexible conduit

- **General requirements**: 90-55-10/700 Installing conduit, trunking and ducting type B.
- **Fixings**: Steel p-clip with PVC insert.

- **Joints**: Threaded.
- **Connections to trunking**: Female adaptors and externally screwed brass bushes.
- **Connections to equipment**: Flange mount.

90-55-10/720 Installing rigid metallic conduit

- **General requirements**: 90-55-10/710 Installing conduit generally type D; 90-55-10/700 Installing conduit, trunking and ducting type D; and 90-55-10/710 Installing conduit generally type E.
- **Fixings**: Distance saddle and Spacer bar saddle.
- **Joints**: Screwed.
- **Threaded conduits**: Tightly screw to ensure electrical continuity, with no thread showing.
- **Conduit connections to boxes and items of equipment, other than those with threaded entries**: Earthing coupling with male brass bush and protective conductor.

90-55-10/735 Installing conduit connections to equipment

- **General requirements**: 90-55-10/710 Installing conduit generally type B; 90-55-10/700 Installing conduit, trunking and ducting type C; and 90-55-10/710 Installing conduit generally type C.
- **Surface mounted equipment**:
  - **Concealed conduit**: Conceal the final connection.
  - **Exposed conduit**: Contain the final connection from the conduit box within flexible metal conduit.
- **Equipment subject to vibration**: Flexible metal conduit of adequate length to facilitate removal of equipment for maintenance. Final termination in swivel connectors.
- **Connections to external equipment**: 90-55-10/360 Flexible conduit.

90-55-10/765 Conduit, trunking and ducting zones

- **General requirements**: 90-55-10/700 Installing conduit, trunking and ducting type B.
- **Ceiling voids**: Provide clear distance of 150 mm (minimum) between underside of any conduit, trunking or trunking and the topside of ceiling.

90-65-50/630 Installing control panels

- **Clearance (minimum)**: Submit proposals.
- **Fixing equipment**: Fix independently of wiring installation with zinc electroplated fasteners.
- **Orientation**: Accurate and square to vertical and horizontal axes. Align adjacent items of switchgear on the same horizontal axis.
- **Identification**:
  - **Neutral and earth bar terminals**: Label with the outgoing circuit reference.
  - **Cable terminations**: Label with circuit reference, with push-on plastics markers.

System completion

75-75-50/830 Commissioning of automatic control systems

- **Pre-commissioning**: In accordance with Commissioning Code C.
- **Commissioning**: In accordance with Commissioning Code C.
- **Notice (minimum)**: 48 h.

Ω End of system

APPENDIX A

SCHEDULE OF DRAWINGS

APPENDIX A

SCHEDULE OF DRAWINGS

MECHANICAL & ELECTRICAL ENGINEERING SERVICES

Drawing No	Drawing Title
J2170905 M6(GF)601	Existing & Proposed LEV System Layout
J2170905 E3(L1)301	Existing & Proposed Electrical Services Serving LEV Systems

APPENDIX B

SCHEDULES OF TECHNICAL REQUIREMENTS

B1	**LEV System**
B2	**Discharge Duct Above Roof**

APPENDIX B

SCHEDULE OF TECHNICAL REQUIREMENTS

B1 LEV SYSTEM

Supplier: Nederman Ltd
91 Seedlee Road
Walton Summit Centre
Bamber Bridge
Preston
PR5 8AE

Telephone: 01772 334721
Website: www.nederman.co.uk

Location	W1/36
Position	Over bench
Serving	Welding
Reference	FEU1/W1/36
Fan Type	N24 0.9kW, 3Ph, 400V (14510422)
Arm	3m Original Extraction Arm (10554335)
Accessories	Extension Arm Wall Bracket (10550635) Manual Fan Starter FMS 1.6 – 2.5 (14502237) Air Flow Indicator (Manufacturer to Select)

Location	W1/36
Position	Workshop
Serving	Welding
Reference	FEU2/W1/36
Fan Type	N29 1.59kW, 3Ph, 400V (14522529)
Arm	Extension Air 4.2m (10506635) Duct kit fume, Ext. Arm 4.2m (10374376) 4m Horizontal Original Ext. Arm (10554535)
Accessories	Post/Stanchion for Mounting Ext. Arm (67000006) Manual Fan Starter FMS 2.5 – 4 (14502337) Air Flow Indicator (Manufacturer to Select

Location	W1/40
Position	Workshop
Serving	Welding and Grinding Dust
Reference	FEU3/W1/40
Fan Type	N29 2.2kW, 3Ph, 400V, Filter Wall Box Automation (12684863)
Arm	5m NEX MD Extraction Arm (10564332) Wall Bracket 4 – 5M NEX (10372722)
Accessories	Air Flow Indicator (Manufacturer to Select

APPENDIX B

SCHEDULE OF TECHNICAL REQUIREMENTS

B1 LEV SYSTEM – contd

Notes:-

1. The manufacturer shall commission the system in accordance with current 'HG258 Controlling Airborne Contaminants at Work', providing certification and commissioning report.
2. Final mounting heights of equipment shall be agreed on site, including final post/stanchion height.
3. Airflow indicator/tester is battery operated.
4. Final selection of equipment shall be verified by the manufacturers to comply with HG258 and the working drawings.

APPENDIX B

SCHEDULE OF TECHNICAL REQUIREMENTS

B2 DISCHARGE DUCT ABOVE ROOF

Supplier: A1 Flue System
Maun Way
Boughton Industrial Estate
New Ollerton
Nottingham
NG22 9ZD

Telephone: 01623 860578
Website: www.A1flues.co.uk

Quantity	2
Manufacturers System	Delta Vent
Serving	Fume Extract
Dia (mm)	150
Duct Height Above Roof	3000 self-supporting
Duct Internal	To suit support requirements
Accessories	- Support system - High velocity jet cowl with drain

APPENDIX C

HANDOVER DOCUMENTATION AND PROCEDURES

C1	Introduction
C2	Scope and Definitions
C3	General Requirements
C4	Content, Structure and Layout
C5	Drawing Records Generally
C6	Mechanical Records
C7	Electrical Records
C8	Communication Systems Records

C1 INTRODUCTION

The Client shall maintain, as part of its Health & Safety File and Operation & Maintenance Manuals, an up-to-date series of Record Drawings showing building outlines, partitions and Engineering Services, which may take the form of schematics.

All such information is the property of the Client and as such will not be conveyed to any third party without the express written consent of a duly authorised officer of the Client.

The primary legislation in the UK associated with the operation and maintenance of Building Services is the Health and Safety at Work Act 1974.

Under Sections 3 and 6 of this Act, as amended by the Consumer Protection Act 1987, Designers, Manufacturers and Importers or Suppliers of plant and systems have a duty to provide adequate operating information for the User to ensure that the plant or system will be safe and without risk to health when in use. This should include details of any maintenance required for continued safe operation.

Sections 2 and 6 of the Health and Safety at Work Act imply that building owners must possess adequate operating information for the operation and maintenance of Building Services. The primary items of legislation that apply are:

- Construction (Design and Management) Regulations 2015 (CDM)
- Control of Substances Hazardous to Health Regulations 2002 (COSHH)
- Electricity at Work Regulations 1989
- Environmental Protection Act 1990
- Factories Act 1961
- Regulatory Reform (Fire Safety) Order 2005
- Management of Health and Safety at Work Regulations 1999
- Offices, Shops and Railways Premises Act 1963
- Pressure Systems and Transportable Gas Containers Regulations 1989
- Provision and Use of Works Equipment Regulations 1998
- Workplace Health, Safety and Welfare Regulations 1992
- Disability Discrimination Act 2005
- The Notification of Cooling Towers and Evaporative Condenser Regulations 1992
- The Control of Noise at Work Regulations 2005

It is the Client's intention that, through implementation of its' procedure, all CAD/CAFM drawings supplied to the Client will be compatible with existing drawings.

Where the project affects existing buildings for which records exist, the As-Fitted drawings shall use the existing Record Drawings as their basis; and these shall be requested from the Project Manager before commencing work.

C2 SCOPE AND DEFINITIONS

This Specification details the type and content of technical documentation required to provide for the safe and efficient operation and maintenance of Engineering Services, including As-Fitted and other drawings. The Engineering Services covered by this Specification shall include (as appropriate):

- Mechanical
- Electrical
- Public Health
- Fire Protection
- Security
- Control
- Communication Systems

C2 SCOPE AND DEFINITIONS - contd

For the purpose of this Specification, maintenance terms defined in BS 3811: 1993 have been used as far as practicable. The British Standard Glossary of Refrigeration, Heating, Ventilation and Air Conditioning Terms (BS 5643: 1984) shall be used as guidance for defining terms in the technical documentation.

The following definitions of terms will apply:

Equipment: Any engineering plant, machine or component

System: A basic concept of equipment or appliances, connected, associated, or independent so as to form a complex unity

Installation: A specific system placed in position and set up for use

Supplier of Technical Manuals (called the **Supplier**): The organisation made responsible for providing the correct documentation (even though the organisation employs an Author to supply this, or to carry out associated work)

Author: The person or organisation that writes, collates and presents the information and produces the final Operating and Maintenance Manual (this could be the Supplier but may be either an independent organisation offering this service or in-house staff of the Installation Contractor or Consulting Engineer)

Client: The purchaser of the installation or installations, or an assignee

Enquiry Specification: The Specification for the technical documentation which is prepared by the Client's professional Advisor and against which selected Authors are invited to Tender

Contract Specification: The Specification as modified by a post-Tender discussion to form the basis of a Contract to cover the technical documentation. It may form part of the Specification for an Engineering Installation.

C3 GENERAL REQUIREMENTS

C3.1 Preparation of the Manual

To ensure that the Operating and Maintenance Manual is available when required, unless otherwise agreed, the information shall be issued in accordance with the programme detailed in Section C3.8.

Responsibility for production of the As-Fitted documentation shall be the responsibility of the primary Mechanical and Electrical Sub-Contractor, who shall nominate an individual within his Company or other organisation to prepare the documentation. The individual or firm appointed to prepare the Operating and Maintenance Manual (subsequently called the Author) shall write, assemble and complete the Manual in accordance with the requirements of this Specification.

In the event of the project being a refurbishment or extension, unless otherwise specified, the Manuals shall either form an Addendum to the existing Manuals or (if the project is relatively minor in nature), additional technical information required as a result of the project works shall be incorporated in the existing Manuals.

Where sufficient generic information exists in retained documentation associated with the building in which the project was carried out, then this shall not be repeated in the addendum. Where existing information for the whole building is no longer appropriate or relevant, this shall be removed from the original manual and replaced with revised information.

C3.1 **Preparation of the Manual** - contd

Prior to commencement of production of the Manual, the Author shall confirm with the Client's Advisor whether the Manuals are to be:

- Entirely new and standalone
- Written as an Addendum to the existing Manuals
- Integrated with the existing Manuals

C3.2 **Writing Style and Use of English**

All documentation shall be in plain English. The text of descriptive sections shall be concise and complete. The overall aim of the document shall be to provide clarity in conjunction with brevity on a need-to-know basis. All new terms shall be defined when first introduced. Where appropriate, terminology shall accord with BS 3811: 1993 and BS 543: 1984.

Abbreviations shall only be used once their meaning has been made unambiguous. Imperatives shall be used for instructions regarding the operation, maintenance and disassembly of Engineering Services.

C3.3 **Graphics and Illustrations**

All graphical material shall be legible and fully annotated to suit the purpose for which they have been included in the O&M Manuals. Illustrations, drawing and diagrams that are incorporated in the Manual shall be easily understood in conjunction with the supporting text.

Where possible, original artwork shall be used rather than second generation scans. If original artwork cannot be obtained and images are not clear, diagrams and illustrations shall be redrawn if requested by the Client.

Where diagrams are provided in electronic format, the resolution and file format of the imagery shall be agreed prior to Manual production (eg JPEG, TIFF or EPS). Whichever format is used, the name and version of the original software that created them shall be supplied and the O&M Manuals shall include a suitable viewer.

Electronic copies of the As-Built drawings shall be provided in electronic format (CD, DVD or other prevailing technology) and saved in the drawing software package and version as detailed in the Particular Specification.

C3.4 **Content, Layout, Indexing and Cross-Referencing**

The Manual shall follow the guidance and proformas set out in Part 2 of the BSRIA Guide BG1/2007 Handover, O&M Guides, and Project Feedback. The order of engineering systems will be determined by the Author and submitted for approval to the Client's Representative.

Manuals shall comprise loose-leaf A4 pages on at least 100 gsm paper in four-ring binders constructed from PVC-covered heavyweight card. Dividers between sections and parts shall use stepped, overlapping, printed card.

All Manuals shall be laid out in accordance with Appendix B and have an alphabetical index or indexes. The index(es) should follow the text and comply with BS ISO 999: 1996 Information and Documentation - Guidelines for the Content, Organisation and Presentation of Indexes.

The indexing and cross-referencing included in other parts of the Manual shall be arranged to provide easy access to any required information. Where project Manuals are spread over multiple binders, binders shall be individually numbered; and each binder shall clearly state what is contained in each of the other binders associated with the project.

C3.4 **Content, Layout, Indexing and Cross-Referencing** - contd

The Author shall be responsible for the correction of any errors or omissions in the documentation provided to the Client.

C3.5 **Collection of Information**

Three principle sources of information will be used by the Author:

- The Scheme Designer
- The Installation Contractor/Sub-Contractors
- Equipment Manufacturers and Suppliers

If the project involves refurbishment of or extension to an existing building and the Manuals are to form an Addendum to or be integrated into existing Manuals, then these shall also be obtained from the Client for reference/updating.

The Author will be responsible for ensuring that close liaison is maintained with each of these sources and that they are aware of the information required by the Author. Such liaison will be arranged to give all parties adequate time to collate the necessary information.

The Installation Contractors will provide copies of all orders for plant, equipment and sub-let packages of work to the Author. The Author will ensure that the performance and technical data included within the Manual is for the actual equipment installed by means of a Site Inspection.

The Author shall use all the information provided and such other information believed to be necessary to produce a uniform suite of Operating & Maintenance Manual, modifying information where appropriate to provide a single, uniform presentation for the project as a whole.

C3.6 **Reader Ability**

Upon appointment, the Author shall identify (from the Client's professional Advisor) the intended maintenance strategy for the installation and the level of technical competence and comprehension of the personnel employed. The Author shall prepare the Manual to suit this level of reader and the Manual shall state the reader's assumed level of technical comprehension and competence.

Unless otherwise specified, the personnel expected to use the Manual will be General Technical Staff with broad-based maintenance skills. The Author will provide a ½ day's training in the use of the Manual for searching for specific items, so that the Building Operators will be able to use them after the building is handed over.

C3.7 **Checking and Approval**

The Author shall supply the Client's professional Advisor with a single copy of the first draft of the Manual immediately prior to the commissioning of the installation. The first draft shall contain all the information identified in this Specification, except that unavailable at the time (such as Commissioning Test Results).

The professional Advisor will check the draft and return it to the Author within a period of 2 weeks from the date of despatch by the Author, together with all comments necessary to obtain a final approved document; or, in the case of a Manual with extensive issues to resolve, a schedule of items to address.

The Client purchasing this Operating and Maintenance Manual shall have sole copyright to the document and shall be able to reproduce any part for its own use.

C3.8 **Issue of Draft and Final Information** - contd

The following is a generic programme for the latest that the sections of the documentation (as detailed in Section 7.4 of this document) shall be issued for comment/approval, which shall be adhered to unless otherwise agreed:

- Sections 1-6 1 week prior to Handover
- Sections 7 & 8 1 week prior to Handover
- Section 9 1 week prior to Handover - hand drawn if late changes have occurred
- Section 10 As commissioning and witnessing is carried out - at latest by Handover

All final information shall be collated and updated within 2 weeks of Handover; with final electronic format information issued within 3 weeks of Handover.

In order to ensure that the Client have sufficient drawn information at time of Handover, it is imperative that a set of marked up drawings indicating installation progress and design changes is kept on site and updated as the installation progresses. These drawings will be tabled by the Main Contractor for review at monthly Project Progress Meetings.

C4 THE CONTENT, STRUCTURE AND LAYOUT OF O&M MANUALS

The O&M Manuals for Building Services installations will need to contain information in accordance with the categories scheduled in BS 4884, ie:

1. General Description
2. Contact Details/Contractual and Legal Guides
3. Operating Procedure/Detail Description
4. Maintenance Procedure and Spares
5. Fault Finding Procedures/Remedial Action
6. Health and Safety/Emergency Procedures
7. Equipment/Plant Schedule
8. Manufacturers' Literature
9. As-Built Drawings/Details/Schematics
10. Commissioning Data
11. Disposal Instructions and Modification Information

The following sections describe what is required under each heading.

C4.1 General Description

This section should be kept as brief as possible and provide a general overview of the original design intent (available in outline from the Design Brief and in detail from the Specification). It should include a summary for each engineering system installed, giving:

- The parameters and conditions within which it has been designed to operate a system
- The type of each service (gas, electricity and water) required to operate a system
- The intended method of control

C4.2 Contact Details, Contractual and Legal Guides

The contractual and legal records of an installation should include:

- The name and address of the installation
- Details of Local and Public Authority consents
- Details of the Design Teams, Consultants, Installation Contractors and Sub-Contractors
- Dates for the start of the installation, Handover and expiry of the Defects Liability Period
- Information on all guarantees affecting components, systems and plant items, together with expiry dates and names, addresses and telephone numbers of relevant contacts.

C4.2 **Contact Details, Contractual and Legal Guides** - contd

For each item of plant and equipment installed within the building and contained in the list of services covered by the O&M Manual, copies of the following documents should also be provided, where applicable:

- Test Certificates
- Manufacturers' Guarantees and Warranties
- Insurance Inspection Reports
- Safety and Fire Certificates

A clear statement should be made in this section concerning hazards and safety precautions, of which the Operators and Maintainers need to be aware. This should include:

- Any known feature or operational characteristic of the equipment or systems installed which may produce a hazard
- Any known hazards against which protection can be provided
- Any mandatory requirements relating to safety
- Any other safety precautions which should be observed
- Any other relevant warning

C4.3 **Operating Procedure/Detail Description**

This section should provide a detailed description of each engineering system installed. It should include:

- The system type (such as a cold water supply)
- System location and what it serves
- What the system depends upon in order to function
- Design data, basic design parameters, basic assumptions made during design
- Reasons for selecting particular plant
- Expected service life
- Planned operational efficiency

Instructions must be given for the safe and efficient operation of each engineering system, under normal and emergency conditions. These will be in addition to Manufacturers' literature for plant items and should include:

- A recommended strategy for operation and control
- An outline of the general operating mode
- Control data (location, effect, object, sequence, limits of capability, modes, set points)
- Standard operating and emergency operating procedures, and sequences for start-up, running and shutdown, under normal and emergency conditions
- Interlocks between plant items
- Operating procedures for standby plant
- Precautions necessary to overcome known hazards
- The means by which any potentially hazardous plant can be made safe
- Target figures for both energy consumption and energy costs
- Forms for recording plant running hours, energy consumption and energy costs

C4.4 Maintenance Procedures and Spares

i) Instructions

The Manufacturer's recommendations and instructions for maintenance must be detailed for each item of plant and equipment installed. Clear distinction should be made between planned tasks (preventative maintenance) and work done on a corrective basis. Instructions should be given on each of the following:

- The isolation and return to service of plant and equipment
- Adjustments, calibration and testing
- Dismantling and reassembly
- The exchange of components and assemblies
- Dealing with hazards that may arise during maintenance
- The nature of deterioration and checks for defects
- Special tools, test equipment and ancillary services

ii) Schedules

Maintenance Schedules should be provided for all preventative maintenance tasks. These should be based on both Manufacturers' recommendations and other authoritative sources (such as Statutory or Mandatory requirements). The Schedules should include:

- Inspections
- Examinations
- Tests
- Adjustments
- Calibration
- Lubrication
- Periodic overhaul

The frequency of each task may be expressed as specific time intervals, running hours or completed operations as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the working life of the installation.

The source of the schedules should be stated, and necessary periodic inspections and tests for instance, insurance or Supply Authority purposes should also be noted.

iii) Lubrication

A schedule of all plant requiring lubrication should be provided, together with Manufacturers' recommendations on the type of lubricants and the method and frequency of application. Where a type of lubricant is identified by product name, a generic reference (such as a British Standard) should also be given. Information must also be provided on special requirements for the handling and storage of lubricants.

iv) Parts Identification and Recommended Spares

This should comprise a parts identification list detailing and identifying replaceable assemblies, sub-assemblies and components. It should include Suppliers' recommendations for both spares and running spares (parts required for replacement due to wear or deterioration). Items normally held in stock by a Supplier, or for which a refurbishment service is available, should be identified separately.

C4.4 **Maintenance Procedures and Spares** - contd

v) **Spares Policy**

This section should offer a guide to the setting up of a spares facility including recommended stock levels. It should be prepared after consultation with the Occupier regarding the consequences of failure, risk to core business, and the period of acceptable downtime. It should also take into account Suppliers' recommendations as given above. Again, those items normally held in stock by a Supplier (or for which a refurbishment service is available) should be clearly identified.

C4.5 **Fault Finding**

Procedures for the logical diagnosis and correction of faults should be provided.

C4.6 **Emergency Health & Safety and Procedures**

This should include name, address, telephone and fax number, and E-mail addresses of the appropriate contacts in the event of fire, theft or burglary, and gas, electricity or water failures, and leaks. It should also list firms or staff to contact in the event of the failure or breakdown of plant, such as lifts, boilers or pumps. Where applicable, the location of fire-fighting equipment, hydrants and rising mains should be described. Special attention should also be given to hazards particular to the building. Depending on Client Policy, a note of security installations may also be included.

C4.7 **Equipment/Plant Schedule**

The Type, Model Number and Serial Number of all component items within the system should be listed, together with the names of their respective Manufacturers or Suppliers.

C4.8 **Manufacturers' Literature**

Details of all Manufacturers and Suppliers of equipment listed in the Manual should be provided, including name, address, telephone and fax number, E-mail contact and website. Any additional information likely to help the building operator make contact with, or obtain advice from; a Manufacturer or Supplier should also be included.

Where appropriate, details of local stockists of spare parts, replaceable assemblies or complete units should also be provided. Details should be arranged in alphabetical order of Manufacturer or Supplier name to provide a logical information retrieval procedure.

A complete set of all Manufacturers' literature should be provided for the plant and equipment installed, and assembled for each Building Services system. This literature should provide the following information:

- Description of the product as purchased
- The cost and date of purchase
- Performance behavioural characteristics of the equipment in use
- Applications (suitability for use)
- Operation and Maintenance details
- Labour, plant, materials and spatial resources required
- Methods of operation and control
- Cleaning and maintenance requirements
- Protective measures
- Labour safety and welfare associated with the equipment
- Public safety considerations

Where the data is not adequately provided in Manufacturers' literature, the author of the O&M Manual should attempt to gather the information. If the information proves unavailable, or if a Supplier is unwilling or unhelpful, this should be treated as a breach of contract.

C4.9 **Plans and Drawings**

Where the project affects existing buildings for which records exist, the As-Fitted drawings shall use the existing Record Drawings as their basis; and these shall be requested from the Project Manager before commencing work.

The drawing files will be issued to the Project Team by the Project Manager in the Client standard format/media to be returned in the same format/media once updated. All work undertaken must be clearly shown to enable accurate updating of records in accordance with the requirements of the following sections.

The Client cannot warrant or guarantee the accuracy of drawing files. Checking information and correcting critical dimension and information is the Project Team's responsibility and part of their appointment terms and conditions. Where errors are found to exist between the information received and the building layout and/or services installed, these are to be notified to the Project Manager at the earliest opportunity and instruction as to how to proceed sought.

The Health and Safety File/Operation and Maintenance Manual should contain a complete list of all As-Built drawings. All As-Fitted or As-Built drawings will be supplied in both hard copy form and AutoCAD format (.dwg files) on CD ROM; PKZip or Winzip formats should not be used. The As-Fitted drawings supplied in AutoCAD format shall be true representation of the hard copy drawings supplied.

Where the As-Built CAD drawings are not available at the Handover meeting, or if the project has a phased Handover, at (each) Handover, 2 No sets of hard copies shall be passed hand marked up to clearly show all the changes between the latest set of CAD drawings and the installation.

The Contractor shall ensure that all software used is fully converted to be compatible with the Client's software currently in use.

C4.10 **Commissioning Data**

The results of all commissioning work and associated tests should be given; this should include:

- Measured data
- Measurement points
- Test equipment used
- Details of Calibration Certificates
- A statement of whether design requirements were achieved

The Commissioning Certificates shall include plant data such as Model, Type and Serial Number. To enable crosschecking against As-Installed Data Sheets, this information shall also be provided in Excel format such that it can be easily transferred into an Asset Database.

C4.11 **Disposal Instructions and Modifications Information**

Where relevant, information should be provided on the following details:

- Any known dangers likely to arise during the disposal of specific items of plant or equipment, together with the necessary precautions and safety measures
- Methods for safely disposing of or destroying the equipment or parts thereof, including packing, insulation and fluids
- Sources from which further advice can be obtained
- Recycling information for the specific item of plant

Modifications are authorised changes which affect safety, reliability, operation or maintenance of a system or any of its components.

C4 THE CONTENT, STRUCTURE AND LAYOUT OF O&M MANUALS - contd

C4.11 Disposal Instructions and Modifications Information - contd

Information on permitted plant, or system modifications allowed for by Manufacturers or System Designers, should be included for each system. Space must be provided in the Manual for the recording of all modifications and changes as they occur (this would initially comprise a series of appropriately headed blank pages). Furthermore, it is essential that a procedure is devised and incorporated to ensure that all modifications are noted in every copy of the Manual, wherever they are located.

C5 DRAWING RECORDS GENERALLY

C5.1 Drawing Content

i) Mechanical layout drawings should show:

- The size and route of ductwork and pipework
- The arrangement of plant in Plantrooms, including the identity, size and rating of plant
- The identification and location of services concealed within the building structure or buried underground, including the depth and point of entry to the building of services
- The location and identification of pipework regulating, isolating and control valves
- The location and identification of regulating and fire/smoke dampers, and access points
- The location of silencers, grilles, diffusers and terminal units
- Details of vibration dampers

ii) Mechanical schematic drawings should detail:

- All ducting, piping and plumbing systems, including flow rates, temperatures and pressures
- The arrangement of control systems including sensors, field controllers, outstations and control panels

iii) Wiring and Controls Drawings should be provided for all equipment which should indicate:

- The origin, route and destination of each cable
- The conductor size and number of cores, insulation type & rating, cable BS or industry code
- Cable identification method and colour
- Joints and draw boxes
- Power supply cables and their fuse reference
- Location and type of sensors

iv) Electrical layout drawings should show:

- HV/LV switchboards & equipment
- Primary cable/trunking distribution routes
- Distribution switchgear & Distribution boards
- Trunking tray and ladders in Switchrooms and Plantrooms
- Single and three-phase wiring and cable routes, including sub-circuits
- Isolators, starters, socket outlets, control equipment and other associated equipment
- Lighting configuration, including distribution boards, switch locations and circuit ID.
- Emergency lighting luminaires and supply circuits
- Lightning conductors, air terminals, earth electrodes, test clamps, earth tapes & terminals
- Cables providing specialist earth circuits
- Telephone (voice) and IT (data) cabling
- The identification and location of cabling concealed within the building structure or buried underground, including the depth and point of entry to building of cabling
- Cable origin, path, destination, loading, conductor metal and size, insulation type and colour (if required for identification), number of cores in cable, number of cables in trunking
- Whether cables, conduit and trunking are concealed in wall chases, screed, cast in-situ or run on the surface
- The location, route and depth of underground cables

C5.1 **Drawing Content** - contd

v) Electrical schematic drawings should detail:

- Electrical systems, including cable size, type and number of cores
- Fire alarm systems
- Emergency lighting
- Other ancillary systems, such as security and public address systems

vi) Production Drawings of factory-built equipment - should form part of the Record Drawings.

C5.2 **Drawing Set Up**

The drawings are to be in AutoCAD format and must be virus checked. Raster images, hard copy, scanned images are not acceptable. Each drawing shall be created as a separate CAD file and carry a filename that is both unique and identifies the drawing.

All drawings are to be contained within their own drawing border suitably completed. Where Client drawing borders are used, all attributed data to be completed in order for drawing details to be imported into Automanager Workflow.

A basic layer standard has been established requiring a 'named layer', which consists of a general prefix and a name indicating the element so that layers can be readily recognised and filtered as scheduled below. Text layers should also be created where text is discipline specific; all associated text to be included on the associated layer. Only those layers actively used on a drawing are to existing in the AutoCAD file, switched on, thawed and unlocked, with the drawings purged of all unused or empty layers. Should additional layer names be created, they should be consistent throughout the project.

C5.3 **Line Definition, Text and Scale Standards**

Drawings that are required to be plotted in colour should be created with a specific plot style. This should be consistent across the project and should be supplied when drawings are distributed.

Line types should be standard AutoCAD line types; and Ltscale needs to be kept to a standard setting to maintain uniformity of appearance between drawings.

The AutoCAD font ROMANS.shx should be used in all drawings. Alternative standard AutoCAD fonts may be used to emphasise particular aspects on the drawing. Dimensions and general notes should be 2.0 mm or 2.5 mm, sub-headings should be 3.5 mm high and main headings should be 5.0 mm high.

All scale drawings must be created at 1:1 (full size) and even where paper space is being used, the model should still be at 1:1. Where scale drawings are created, text heights and other variables such as Ltscale and Dimscale need to be altered to suit as follows:

Drawing Scale	Lt Scale	Dim Scale	General Text and Dimensions		Sub-Headings 3.5 mm Text	Main Headings 5.0 mm Text
			2.0 mm	2.5 mm		
1:1	10	1	2	2.5	3.5	5
1:20	200	20	40	50	70	100
1:25	250	25	50	62.5	87.5	125
1:50	500	50	100	125	175	250
1:100	1000	100	200	250	350	500
1:200	2000	200	400	500	700	1000

C5.4 **Layering Convention**

The standard layer convention does not determine the allocation of screen colours or line types to any particular layer, but these should be determined in accordance with the line definition described herein.

Prefix Layer Usage

B Building; Walls, Doors, Windows, etc
E Electrical Services
F Furniture and Fittings
G General; Title Blocks, Grids, etc
M Mechanical Services; HVAC, etc
S Substructure; Piles, Foundations, etc
X External Services; Road, Survey Data, etc

An index should be provided of all As-Fitted drawings supplied during the installation process, identified by number and title. The index should also include a Schedule of Drawings issued by Manufacturers and Suppliers during the course of the installation work, such as control panel wiring diagrams. Refer to the following sections for the specific requirements of the drawings.

List of Layer Definitions (Abridged)

Layer Name	**Layer Usage**		
0	AutoCAD Block Insertion	F_KITCHEN	Kitchen, Bar and Vending Fittings
		F_SANITARY	Sanitary Fittings
B_SHELL	Building Shell (M&E Services)		
		G_DWGSHT	Drawing Sheet
E_ALARM	Nurse Call	G_DIMENSION	Dimensions
E_COMM	Comms and Telecomms	G_GRID	Grids
E_EARTH	Earthing	G_TEXT	Text
E_EHV	Extra high Voltage >3000v	G_UPDATE	Drawing Update (temp layer green)
E_HV	High Voltage 650 – 3000v	M_AIR CON	Air Conditioning
E_LV	Low Voltage 250v max	M_GASES_MED	Medical Gases
E_ELV	ELV 50 – 250v max	M_GASES_NAT	Natural gases
E_MV	MV 250 – 650v max	M_GENERAL	Heating
E_FIRE_LEGEND	Fire Legend	M_PLUMB	Plumbed Services
E_FIRE_ALARM	Fire Alarm System	M_STEAM	Steam Main
E_FIRE_APPLIANCE	Fire Appliances	M_CWM	Cold Water Main
E_FIRE_ESCAPE	Fire Escape Routes	M_GEOTH	Geothermal
E_FIRE_STRUCTURAL	Fire Doors etc	M_VENTILATION	Ventilation
E_FIRE_ZONE_LEGEND	Fire Zone Legend	M_DRAINAGE	Drainage
E_FIRE_ZONE1 etc	Fire Zones		
E_GENERAL	General - Electrical	X_DRAIN	Land Drainage
E_LIGHT	Lighting	X_DUCT	Duct ways, Subways
E_POWER	Electrical Power Supply	X_GENERAL	General – External Works
E_SECURITY	Security Systems	X_SERVICE	Engineering Services
E_TRANSPORT	Lifts, Escalators etc	X_SURVEY	Survey Information
E_TRUNKING	Trunking		

C6 MECHANICAL RECORDS

C6.1 Documentation

Documentation should record the following as installed:

a) The location, including level if buried, of all public service connections (eg fuel, gas and cold water supplies) together with the points of origin and termination, size and materials of pipes, line pressure and other relevant information.

b) The layout, location and extent of all piped services showing pipe sizes, together with all valves for regulation, isolation and other purposes as well as the results of all balancing, testing and commissioning data.

c) The location, identity, size and details of all apparatus and control equipment served by, or associated with, each of the various services together with copies of any Test Certificates for such apparatus where appropriate. The information with respect to size and details may be present in schedule form.

d) The layout, location and extent of all air ducts showing dampers and other equipment, acoustic silencers, grilles, diffusers or other terminal components. Each duct and each terminal component should be marked with its size, the air quantity flowing and other relevant balancing data.

e) The location and identity of each room or space housing plant, machinery or apparatus.

C6.2 Drawings

Drawings should record the following as installed:

a) Detailed general arrangements of Boiler Houses, machinery spaces, air handling plants, Tank Rooms and other plant or apparatus, including the location, identity, size and rating of each apparatus. The information with respect to the size and rating can be presented in schedule form.

b) Isometric or diagrammatic views of Boiler Houses, Plantrooms, Tank Rooms and similar machinery, including valve identification charts. It is useful to frame and mount a copy of such drawings on the wall of the appropriate room.

c) Comprehensive diagrams that show power wiring and control wiring, including size, type of conductor or piping used and identifying the terminal points of each.

C7 ELECTRICAL RECORDS

C7.1 Documentation

Documentation should record the following, including locations, as installed:

a) Main and sub-main cables showing origin, route, termination, size and type of each cable; cables providing supplies to specialist equipment, eg computers, should be identified separately.

b) Lighting conduits and final sub-circuit cables showing origin, route, termination and size of each, together with the number and size of cables within each conduit. The drawings should indicate, for each conduit or cable, whether it is run on the surface or concealed, eg in a wall chase, in a Floor screed, cast in situ, above a false ceiling, etc. These drawings should also indicate the locations of lighting fittings, distribution boards, switches, draw-in boxes and point boxes, and should indicate circuitry.

C7 ELECTRICAL RECORDS - contd

C7.1 Documentation - contd

c) Location and purpose of each emergency lighting fitting, including an indication of the circuit to which it is connected.

d) Single and three-phase power conduits and final sub-circuit cables showing locations of power distribution boards, motors, isolators, starters, remote control units, socket outlets and other associated equipment.

e) Other miscellaneous equipment, conditions and cables.

f) Lightning conductor air terminals, conductors, earth electrodes and test clamps.

g) Location of earth tapes, earth electrodes and test points other than those in f); cables providing each circuits for specialist equipment, eg computers, should be identified separately.

Documentation should also include, when applicable:

h) Distribution diagrams or schedules to show size, type and length (to within 1 m) of each main and sub-main cable, together with the measured earth continuity resistance of each.

i) Schedule of lighting fittings installed, stating location, Manufacturer, type or catalogue number, together with the Manufacturer's reference, voltage and wattage of the lamp installed.

j) Schedule of escape and emergency lighting fittings installed, stating location, Manufacturer, type or catalogue number, together with the Manufacturer's reference, voltage and wattage of the lamp installed. For battery systems, the position of the battery, its' ampere hour rating and battery system rated endurance in hours should be stated.

k) Records of smoke detectors, sprinklers, fire precautions generally, as well as security precautions (see BS 8220: Part 1).

l) Incoming supply details; the type of system, voltage, phases, frequency, rated current and short circuit level, with the details of supply protection and time of operation as appropriate.

m) Main switchgear details; for purpose-made equipment this should include a set of Manufacturer's drawings and Site Layout.

n) Transformer, capacitor and power plant details; the leading details should be given, eg for transformers, the V.A rating, voltages and type of cooling.

o) Completion Certificate, according to IEE Wiring Regulations.

C8 COMMUNICATION SYSTEMS RECORDS

C8.1 Application

The detailed recommendations given in this sub-Clause apply primarily to telecommunication, intercommunication and paging systems but much of it is also applicable to more sophisticated information systems.

C8.2 **Drawings**

Drawings should be in accordance with the provisions of C5 as appropriate, and should show the following as installed:

a) Telephone extension wiring, exchange lines and all other similar communications cable for direct speech intercommunication systems, and the following for digital data communications:

i) Details of cable routes, sizes and types of conduits and ducts; number of cable pairs fitted for immediate use, and also spare ways; joint boxes, sub-distribution frames and extension instruments or other terminal apparatus (circuit reference numbers should be shown)

ii) In the case of digital communication cabling, detail of the type of cable in use (eg twisted pair, fibre optic, etc), and the type of wall mounting outlet (ie simple type or loop-around)

iii) Floor plans of Equipment Rooms showing location and type of equipment; main distribution frame; batteries and charging equipment; operators' consoles and all associated cabling, trunking and ducts (any special provision such as anti-static or computer Flooring should be noted and Floor plans should also include details of any switching or processing equipment associated with direct speech telecommunication or digital data communication systems)

iv) Radio paging and loop systems, including routes and details and the location and details of equipment

C8.3 **Schedule of Telephone Extensions**

A schedule of telephone extensions should be maintained and should include:

a) Total number of extensions

b) Extension plan facilities

c) Auxiliary equipment and exchange lines

d) Equivalent information as in a-c) above for direct speech intercommunication and digital data communications systems

e) Comprehensive interconnection information for the main distribution frame

f) Master telephone extension directory, including the facilities available to each extension

g) Special information such as extension hunting groups

C8.4 **Schedule of Radio Paging Systems**

A schedule should be maintained for radio paging systems, to include details of:

a) Paging codes against Holders' names and extension numbers
b) Frequency and effective radiated power of transmitter(s)
c) Transmitting frequency of call-back type pagers
d) Special features such as emergency calling groups

APPENDIX D

PRE-CONSTRUCTION M&E ENGINEERING INFORMATION FORM

Client	**National Oceanography Centre, Southampton**	
Project	**Workshop LEV Replacement Project**	
Job No	Completed By	Date
J2170905	**Simon Clark**	**03/11/2017**

Pre-Construction Information Form - Sheet 2 of 60

Item		Comments	
1.0	**DESCRIPTION OF PROJECT**		
1.1	**Name**	Workshop LEV Replacement Project	
1.2	**Location**	Workshops W1/36 and W1/40	
1.3	**Background**	Terminations ductwork above roof non-compliant with regulations	
1.4	**Description of the Works**	Replacement of 3No fume extract systems	
1.5	**Programme**		
1.5.1	Key Dates:	Start on Site: Duration: Completion:	11th December 2017 2 weeks 22nd December 2017
1.5.2	Minimum Time (to be allowed between appointment of Principal Contractor and commencement of work on site):	Date for Letting of Contract: Start on Site: Lead-in Period:	Client to confirm As above 2 weeks
1.6	**Project Directory**		
1.6.1	Client:	National Oceanography Centre, Southampton	
1.6.2	Project Manager:	Priyanka Guharoy Healy	
1.6.3	Lead Designer:	TNG Consulting Engineers Limited	
1.6.4	Structural Engineer:	N/A	
1.6.5	M&E Services Consultant:	TNG Consulting Engineers Limited	
1.6.6	Specialist:	N/A	
1.6.7	H&S Project Co-ordinator:	McPhersons	
1.6.8	Contract Administrator:	TNG Consulting Engineers Limited	
1.6.9	Quantity Surveyor:	N/A	
1.6.10	Principal Contractor:	Tenderer	
1.7	**Is the site a Workplace?**	Yes	

Pre-Construction Information Form - Sheet 2 of 60

Item		Comments	
1.0	**DESCRIPTION OF PROJECT** - contd		
1.8	**Existing Records and Plans**		
1.8.1	Existing H&S File:	N/A	
1.8.2	Existing O&M Manuals:	N/A	
1.8.3	Existing Structural Drawing:	N/A	
1.8.4	Existing Main Services Drawings:	N/A	
1.8.5	Previous Site Investigation Reports:	N/A	
1.8.6	Asbestos Management Plan:	Refer to Clients documentation	
2.0	**THE SITE ENVIRONMENT AND ON-SITE RISKS**		**RAMS Required?**
2.1	**Site Definition and Access Arrangements**	Refer to Clients site rules	
2.2	**Restrictions on Deliveries**	Refer to Clients site rules	
2.3	**Adjacent Users/Uses**	Refer to Clients site rules	
2.4	**Storage of Waste and Hazardous Materials**	Refer to Clients site rules	
2.5	**Location of Existing Primary Services (Buried/Overhead, etc)**	N/A	
2.6	**Ground Conditions**	N/A	
2.7	**Existing Structural Particulars**	N/A	
2.8	**Existing Defects**		**RAMS Required?**
2.8.1	Fire Damage, Ground Shrinkage, Movement or Poor Maintenance:	N/A	
2.8.2	Plant and Equipment:	N/A	
2.9	**Health & Safety Information Contained in Earlier Design or As-Built Drawings**	N/A	
2.10	**Asbestos**	Refer to Clients register	
2.11	**Contaminated Land**	N/A	
2.12	**Existing Structures Containing Hazardous Materials**	N/A	
2.13	**Health Risks Arising From Clients Activities**	Refer to Clients documentation	

Pre-Construction Information Form - Sheet 3 of 60			
Item		**Comments**	
3.0	**CLIENT'S PROCEDURES AND MANAGEMENT REQUIREMENTS**		**RAMS Required?**
3.1	**Planning and Managing the Construction Work**	Refer to Clients site rules	
3.2	**Communication**	Refer to Clients site rules	
3.3	**Security of the Site**	Refer to Clients site rules	
3.4	**Welfare Facilities**	Refer to Clients site rules	
3.5	**Site Hoardings and Screens**	Refer to Clients site rules	
3.6	**Waste Management**	Refer to Clients site rules	
3.7	**Site Transport Arrangements or Vehicle Movement Restrictions**	Refer to Clients site rules	
3.8	**Arisings**	Refer to Clients site rules	
3.9	**Client Permit-to-Work Systems**	Refer to Clients site rules	
3.10	**Noise**	Refer to Clients site rules	
3.11	**Dust**	Refer to Clients site rules	
3.12	**Pollution**	Refer to Clients site rules	
3.13	**Fire Precautions**	Refer to Clients site rules	
3.14	**Emergency Procedures and Means of Escape**	Refer to Clients site rules	
3.15	**'No go' Areas or Other Authorisation Requirements**	Refer to Clients site rules	
3.16	**Areas the Client has Designated as 'Confined Spaces'**	N/A	
3.17	**Smoking and Parking Restrictions**	N/A	
4.0	**SIGNIFICANT DESIGN AND CONSTRUCTION HAZARDS**		**RAMS Required?**
4.1	**Significant Assumptions and Suggested Work Methods, Sequences or Other Control Measures**	Working at height above 9 metre. Working at roof level.	Yes
4.2	**Temporary Works**	N/A	
4.3	**Arrangements for Co-ordination of Ongoing Design Work**	N/A	
4.4	**Information on Significant Risks Identified During Construction**	Yes	Yes
4.5	**Material Requiring Particular Precautions**	N/A	

Information Form - Sheet 4 of 60		
Item		**Comments**
5.0	**THE HEALTH AND SAFETY FILE**	
5.1	**Testing and Commissioning, Record Drawings, O&M Manuals**	Required
5.2	**Completion and Presentation of the Documentation for and Final Arrangement and Presentation of the H&S File**	Required
5.3	**Contents of the H&S File**	**Contents shall include:** ▪ **A brief description of the work carried out;** ▪ **Any hazards that have not been eliminated through the design and construction processes, and how they have been addressed (eg surveys or other information concerning asbestos or contaminated land);** ▪ **Key structural principles (eg bracing, sources of substantial stored energy - including pre or post-tensioned members) and safe working loads for floors and roofs;** ▪ **Hazardous materials used (eg lead paints and special coatings);** ▪ **Information regarding the removal or dismantling of installed plant and equipment (eg any special arrangements for lifting such equipment);** ▪ **Health and safety information about equipment provided for cleaning or maintaining the structure;** ▪ **The nature, location and markings of significant services, including underground cables, gas supply equipment, fire-fighting services, etc;** ▪ **Information and as-built drawings of the building, its plant and equipment (eg the means of safe access to and from service voids and fire doors)**
ADDITIONAL NOTES		