

**LIST OF DRAWINGS**

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N303	Layout Plan IS 4 – Sheet 3 of 4
N304	Layout Plan IS 4 – Sheet 4 of 4
N408	Plan and Longitudinal Section – Rising Main and Gravity Sewer from Tivoli Industrial Estate Pumping Station.
N411	Plan and Longitudinal Section – Rising Main from Bellevue Villas Pump Station to Header Manhole near Woodhill Villas
N604	Tivoli Industrial Estate Pumping Station Site Layout & Details
N605	Bellevue Villas Pumping Station Site Layout & Details
N606	General Arrangement Tivoli Pumping Station
N607	Site Layout & Details of Tivoli Pumping Station
E001	Tivoli Pumping Station General & Emergency Lighting
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E003	Tivoli Industrial Estate Pumping Station General & Emergency Lighting
A5087 N226	Tivoli Crossing Plan and Longitudinal Sections

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**GENERAL ELECTRICAL SPECIFICATION****1.0 SPECIFIC REQUIREMENTS****1.1 Nominal Voltage**

400 V - 3 phase - 50Hz

**1.2 Control Voltage**

110V - 1 phase - 50 Hz.

**1.3 Zone 1 Equipment**

All electrical equipment in the Wet Well area to be suitable for use in a Zone 1 Hazardous Area.

**1.4 Cable Glands**

All electrical equipment in the Wet Well area to be terminated with an EIWF gland and shroud.

**1.5 Power Cables**

All power cables to be 600V Grade PVC/SWA/PVC to BS 6346 or armoured/screened flexible type for submersible pump motors.

**1.6 Power Cables - Motors**

Minimum size power cable for motor to be 2.5mm<sup>2</sup>

**1.7 Cable Tray**

All cable trays in the Wet Well area to be PVC type c/w lidding.

**1.8 Final Drops**

All drops to electrical equipment from cable trays to be in stainless steel dairy tubing.

**1.9 Power Factor Correction**

The Contractor is to provide power factor correction capacitors to maintain 0.95 lagging.

**1.10 Information for Approval**

The Contractor is required to submit the following for approval before construction:

- A Electrical layout drawings.
- B Power loadings
- C MCC layouts
- D MCC control schematics
- E Cable schedules

## 2.0 **GENERAL REQUIREMENTS**

### 2.1 **Manufacturer and Type**

Where “manufacturer” is used in the specification of materials it shall mean the firm under whose name the particular product is marketed. Where “type” is used it shall mean the proprietary brand name, reference or other quality by which the product is identified.

### 2.2 **Proprietary Names, Rates**

Where the phrase “or other approved” is used the rates or prices shall be held to be based on the particular commodity specified.

### 2.3 **Proprietary Names**

The phrase “or other approved” shall be deemed included whenever materials are specified by proprietary name.

### 2.4 **Supplied Goods**

Where materials and components are to be supplied by Nominated Suppliers under Prime Cost or Provisional Sums, whether specified to be fixed only or otherwise used or incorporated in the Works, they shall include taking delivery, unloading, handling on site, providing adequate storage and being responsible for safekeeping, assembly, hoisting, placing in position and fixing, providing all necessary materials for fixing, returning packing materials, carriage paid to the Nominated Supplier in good condition and obtaining credits for them.

### 2.5 **Builder’s Work**

The Contractor shall allow in his tender for the correct setting out and marking of all such builder’s work and for superintending and directing tradesmen detailed to execute such work.

### 2.6 **Leave Installation in Complete Working Order**

All tenders submitted shall be complete and shall include for all work, incidental or otherwise, to leave the complete installation in satisfactory working order. All cable runs and equipment locations shall be agreed with the Engineer before builder’s work is commenced.

## 2.7 Compliance with Specification

The electrical installation shall comply with Specifications and drawings provided at the beginning of the Contract, and with further drawings or details that may be supplied at a later date.

## 2.8 Site Visits

The Contractor is advised to visit the site and ascertain the facilities of access thereto and the general convenience of working. He must take these matters into account when tendering and no charge will be allowed in consequence of the Contractor's failure to do this.

## 2.9 Safety and Health Requirements

### 2.9.1 Safety, Health and Welfare Legislation

The Contractor's attention is directed to Clause 6.3 of the Instructions to Tenderers relating to Health and Safety requirements. The provisions of the following legislation, and all amendments thereto, shall be fully complied with:-

- (i) The Factories Act (1955)
- (ii) The Safety, Health and Welfare at Work Act, 1989
- (iii) The Safety, Health and Welfare (General Application) Regulations S.I. 44 of 1993.
- (iv) The Safety, health and Welfare (Construction) Regulations S.I. 138 of 1995.

### 2.9.2 Emergency Telephone Numbers

The Contractor shall maintain a list of emergency telephone numbers on permanent display in the site offices during the currency of the Contract. Access to a telephone shall be maintained at all times while construction activities are being performed.

### 2.9.3 Protective Clothing

The Contractor shall supply his operatives with approved protective clothing, helmets, boots, etc in accordance with the requirements of the relevant safety legislation. The Contractor shall ensure that his operatives wear these protective items at all times.

In addition to the above, when working in public property, high visibility vests must be worn at all times.

## 2.10 Site Meetings

Site Meetings will generally be held twice a month and the Contractor shall arrange to attend these meetings and to have all Sub-Contractors employed by him present at these meetings. When requested by the Engineer, manufacturers or suppliers of products shall also attend.

Minutes of these meetings will be recorded by the Engineer and forwarded to all present. A further copy shall be forwarded to the Employer, who may, or may not, attend these meetings.

### 2.11 Commissioning

The Contractor shall have sole responsibility for the complete and satisfactory commissioning of all equipment and systems supplied and/or installed under this Contract and he should allow for this in his tender. No system or plant shall be deemed to be commissioned until such time as the Contractor demonstrates to the satisfaction of the Engineer that the system or plant is operating as specified.

### 2.12 Site Supervision

The Contractor shall maintain a competent person-in-charge (site agent, foreman or working charge-hand) on the site during working hours throughout the duration of the Contract.

The Engineer shall be informed in writing of the name and seniority of the person in charge who shall not be replaced without their prior approval. The person-in-charge shall be authorised to act on the Contractor's behalf and to receive instructions from the Engineer.

### 2.13 Standards

The provisions of the latest revised editions and amendments of the following Irish and British Standards and Codes of Practice shall be held to be incorporated in this specification unless otherwise stated in this specification or on the drawings (ref. also to clause 3.17).

IS 273	Cables with PVC or XLPE insulation 600/1000V with or without SWA.
IS - 3217	Code of Practice for Emergency Lighting by NSAI.
IS - 3218	Code of Practice for Fire Detection and Alarm Systems for buildings by NSAI.
BS 31	Specification Steel Conduit and fittings for electrical wiring.
BS 731	Flexible steel conduit for cable protection.
BS 1432	Specification for copper for electrical purposes: high conductivity copper rectangular conductors with drawn or rolled edges.
BS 1433	Specification for copper for electrical purposes - rod and bar.

BS 2874	Specification for copper and copper alloy rods and sections.
BS 4568	Specifications for steel conduit.
BS 4678	Cable Trunking.
BS 5308	Specification for instrumentation cable.
BS 6004	Specification for PVC insulated cables.
BS 6121	Mechanical Cable Glands
BS 6346	Specification for PVC Insulated Cables for electricity supply.
BS 6360	Specification for conductors in insulated cables and cords.
BS 6651	Code of Practice for Protection of Structures against Lightning.
BS 6746	Specification for PVC insulation and sheath of electric cables
BS 7655	Specification for insulating and sheathing materials for cables.
IEC 439	Specification for Low Voltage Switchgear and Control Gear.
IEC 529	Classification of Enclosures.
IEC 947	Specification for Low Voltage Switchgear and Control Gear.

#### 2.14 Construction of Enclosures

All electrical equipment shall be robust construction. Enclosures shall be weatherproof except for equipment installed indoors. Unless otherwise specified in the Contract Documents, the enclosures shall be dust and damp proof to IP 54 to IEC 529.

**2.15**      **Guarantee**

All items of plant equipment, apparatus or materials supplied under this contract, whether of the Contractor's own make or supplied by another Contractor, shall be guaranteed against faulty workmanship or materials for a period of 12 months from the date of the Engineer's certificate of virtual completion. Any such faulty equipment shall be removed and replaced at the Contractor's expense.

**2.16**      **Progress Meetings**

During installation, periodical progress meetings shall be held on site, and the Contractor shall, when requested, send an official representative to these meetings. This representative should be prepared to answer questions relating to the programme of the electrical work. Detailed progress reports shall be submitted to the Engineer when requested, showing the amount of work already completed, work in progress and still to complete and work force available.

**2.17**      **Training**

The Contractor shall hand over to the staff appointed by the Client, three sets of Maintenance and Operating Instructions for all items of plant supplied by him under this Contract and shall ensure that these instructions are fully understood by the staff as soon as the items are installed.

**2.18**      **As Installed Drawings**

The Contractor shall include for supplying to the Client three sets of paper prints of all "as installed" drawings. In addition, the Contractor shall supply for use by the Client, a set of the "as-installed" drawings on computer disk prepared using the appropriate release of AUTOCAD.

**2.19**      **Regulations**

The Electrical Services Installation shall be carried out with this Specification and shall comply with the following regulations and requirements in so far as they are applicable.

1. National Rules for Electrical Installations, Second Edition 1991 of the Electro Technical Council of Ireland.
2. "Requirements for earthing in Electrical Installations" of the Electricity Supply Board.
3. The Factory (Electrical) Regulations 1972.
4. The Regulations of Local Authorities.



## 2.20 Identification Of Cables

All distribution, power, control and miscellaneous circuit cables shall be identified by cable reference numbers. Normally, these reference numbers will be shown on the Purchaser's cable schedules and/or drawings. Each cable shall be fitted with indestructible marking collars bearing the appropriate cable number. The marking collars shall be fitted at each termination and, where applicable, in each draw pit and at each point of entry and exit from a main or sub-main trench.

## 2.21 Identification of Conductors

All cable cores except those of special cables (i.e. cables with numbered cores) shall be numbered as per the cable termination schedules to identify them. The cores of cables connected to equipment having marked terminals shall be identified with interlocking ferrules bearing markings corresponding to those given in the cable termination schedules. Core numbers shall read outwards from terminals.

## 2.22 Labelling

All switchgear, distribution boards, outgoing cables etc. shall be clearly labelled to denote the service or equipment they control by means of approved plastic band with 5 mm high engraved lettering. Fuse or MCB sizes and circuit numbers must be clearly indicated adjacent to each device to facilitate identification and replacement. Where more than one phase conductor is connected to switchgear or distribution boards, clear indication of danger and of the voltage between phases which exists at such points, must be given. All labelling or types of labelling must be approved by the Engineer before installation.

## 2.23 Testing

When the installation is completed, it shall be tested in the presence of the Engineers or their representatives, in accordance with the relevant section of the ETCI Regulations. Tests shall be carried out for insulation resistance to earth and between adjacent conductors, for polarity of all switches, for continuity of live and protective conductors, particularly ring final circuits for earth loop impedance and for mechanical operation. Tests shall also be carried out for polarity of socket outlets, distribution boards etc.

The Engineers, may, if they require to do so, test the installation in sections. Two weeks written notice must be given to the Engineers by the Contractor of his intention to test the installation.

## 2.24 Supply of Materials

All materials, required to execute the contract shall be supplied by the Contractor unless otherwise specified.

**2.25 Immediate Ordering**

To avoid any undue delay in the completion of the work, the Electrical Contractor shall immediately place on order all materials to execute the contract, as soon as final instructions are given. Every effort shall be made to obtain all components as quickly as possible.

**2.26 Delay in Delivery of Equipment**

The Contractor shall advise at all stages of the work, delay in delivery of equipment which may affect completion dates.

**2.27 Supply of Equipment**

The Contractor shall supply and erect all equipment necessary to carry out the Electrical Installation, including all necessary tools, leads, ladders, scaffolding etc.

**2.28 Temporaries, Compliance with National Regulations**

During the term of the contract the Contractor shall make use of the electrical systems on site and attach thereto all electrical equipment owned by the Electrical Contractor in such a manner that at all times, the requirements of the local and national regulations are fully observed.

**2.29 Damage and Loss**

The Contractor shall be responsible for the damage or loss of electrical materials or equipment until the installation is handed over.

**2.30 Removal of Rubbish**

From time to time during the progress of works, the Contractor shall remove all rubbish, surplus materials, empty cartons, cases, cable drums etc., from all parts of the site where he is not immediately engaged on installation work.

**2.31 Completion of Contract**

Upon completion, the whole of the Electrical Installation shall be left clean and tidy, all rubbish and dust shall be removed from switchgear and switchgear enclosures.

**3.0 EQUIVALENCE OF STANDARDS**

3.1 It should be noted that nothing stated in this Specification, is to be construed as discriminating against products and materials manufactured in any of the Member States of the European Community.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard Specification of a Member State of the

European Community are called for, this requirement shall be read as including items to a relevant National Standard of any Member State of the European Union, which provides an equivalent guarantee of safety and suitability. Any reference to a National Standard shall be deemed to include amendments and addenda, if any, current at the Designated Date.

Where items certified by the National Standards Authority of Ireland as complying with an Irish Standard are called for, the provisions of Circular Letter BM 2/87, as amended by Circular Letter BC 14/92, shall apply, i.e. the requirement shall be read as either certified by the National Standards Authority of Ireland as complying with the Irish Standard, or shall be certified as complying with a relevant National Standard of another Member State of the European Community, which provides an equivalent guarantee of safety and suitability. Certification to be by the National Standards Authority of Ireland.

#### **4.0 CABLE TRUNKING INSTALLATION**

##### **4.1 General Specification**

###### **4.1.1 Trunking**

All trunking shall be the product of approved manufacturers.

###### **4.1.2 BS**

All cable trunking shall be to BS 4678.

###### **4.1.3 Sheet Steel**

Cable trunking shall be manufactured from sheet mild steel formed and treated with electrically deposited zinc.

###### **4.1.4 Galvanised**

Cable trunking to be hot dip galvanised.

###### **4.1.5 Ends and Cuts**

All ends and cuts shall be painted with two coats of galvanised paint.

###### **4.1.6 Bridge Pieces**

Steel trunking smaller than 100 mm x 100 mm, with plain edges shall be fitted with bridge pieces at not greater than 0.9 m intervals to give side rigidity.

###### **4.1.7 Up to 50 mm x 50 mm Base**

Steel trunking gauges shall not be less than 20 SWG for sizes up to 50 mm x 50 mm.

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**4.1.8 Up to 75 mm Base**

Steel trunking gauge shall be not less than 18 SWG for sizes up to 75 mm base.

**4.1.9 Up to 152 mm Base**

Steel trunking gauge shall be not less than 16 SWG for sizes up to 152 mm base.

**4.1.10 Covers**

All covers to steel trunking shall have trimmed edges and shall be fixed to trunking with patent spring clips or by screw fixings.

**4.1.11 Bends, etc.**

Standard manufacturer's steel couplings, bends, etc., and other fittings shall be used on steel trunking.

**4.1.12 Joints**

All joints between trunking sections shall be mechanically sound and shall be such to ensure that cables being drawn in shall not suffer any damage or abrasion.

**4.1.13 Earth Link**

A copper earth link shall be provided between each length of sheet steel trunking and fittings to give an efficient earth throughout the system.

**4.1.14 Trunking Installation**

All trunking shall be erected and fixed into position before installation of cables.

**4.1.15 Earthing Wire**

All trunking shall have a bare copper earthing wire run inside it which shall be bonded to it at intervals in addition to the earthing strap already called for.

**4.1.16 Conduit Connections**

All conduit connections to cable trunking shall be made off by means of flanged coupling, copper compression washer and smooth bore long reach hex. head male brass bush.

**4.1.17 Vertical Ducts**

Cable trunking in vertical ducts shall be installed with the cover facing outwards.

**4.1.18 Ceiling Spaces**

All trunking installed in ceiling spaces shall have the cover facing downwards.

**4.1.19 End-Caps**

'End Caps' shall be fitted to all trunking terminations.

**4.1.20 Wall Supports**

Cable trunking shall be supported by brackets which shall be wall mounted.

**4.1.21 Overhead Supports**

Cable trunking shall be supported from overhead by threaded bar fixed to the top of the trunking.

**4.1.22 Hanger Brackets**

Cable trunking shall be supported from overhead by threaded bar fixed to hanger brackets.

**4.1.23 Standard Fixing**

Standard Fixing of trunking to wall or ceiling structures shall be by means of 'bridge' type brackets formed from mild steel bar 25 mm x 6 mm, erected at not more than 1m centres.

**4.1.24 Brackets**

The brackets shall be formed to provide a nominal clear space of 50 mm between trunking and wall or ceiling structure; drilled clear for fixing bolts of size M8 with flat face equal in width to the trunking it is to support, and painted with two coats of aluminium or proprietary rust inhibitive paint prior to fixing.

**4.1.25 Ohmic Resistance**

The electrical resistance of any trunking system or combined trunking conduit system, or plant or apparatus attached thereto, and taken at any point of the installation and measured between such point and the "Earth Electrode" shall not exceed one half ohm.

**4.2 Compartmented Cable Trunking****4.2.1 Segregated Compartments**

Compartmented Cable Trunking shall be manufactured as standard trunking with the addition of one steel fillet or two steel fillets spot welded and so fixed as to provide two or three completely segregated compartments within the cable trunking, as particularly specified.

#### 4.2.2 **Fittings**

Where such compartmented cable trunking is particularly specified the fittings for such trunking shall also be filleted and in tee or intersection fittings steel 'crossover' pieces shall be fitted to maintain the segregation of the compartments.

### 5.0 **CONDUIT INSTALLATION**

#### 5.1 **General Specification**

##### 5.1.1 **BS**

Steel conduit shall in all cases be heavy gauge, welded steel tube, galvanised finish and shall be in accordance with BS 31 1940 as amended to requirements of metric equivalent BS 4568.

##### 5.1.2 **Electrically and Mechanically Continuous**

Conduits shall be a continuous and effective mechanical means of protection for cables and shall be electrically continuous throughout the complete conduit system.

##### 5.1.3 **Outlets**

No conduit shall be run in such a way as to form a "U" without outlet or in any other way that would provide a trap for condensed moisture. Suitable drainage outlets shall be provided where condensation is likely to occur.

##### 5.1.4 **Routing of Conduit**

The routes of all conduits, (if not indicated on the drawings), and positions of all "outlet points" and "draw in" positions shall be accurately marked out on site for the approval of the Engineer before work commences.

##### 5.1.5 **Conduit Boxes**

Conduit systems shall include sufficient conduit boxes to ensure an easy "draw-in" or "out" of the cables. Inspection boxes of adequate size shall be provided at any point where a cable connection is made. Boxes shall be of malleable cast iron or pressed steel and shall comply with BS 31 1940 Class B.

##### 5.1.6 **Sets**

The radius of "sets" (bends) in conduit shall not be less than six times the external diam. of the conduit and not more than one such set shall be installed in any one conduit "run" without a conduit box to ensure an easy draw-in of cables.

**5.1.7 Set Formation**

All "sets" shall be made cold and any "set" that distorts the conduit shall be rejected by the Engineer.

**5.1.8 Damage**

The Contractor shall take all precautionary measures as may be necessary to safeguard installed conduits, boxes etc., from damage or disturbance during the progress of the works.

**5.1.9 Foreign Bodies**

Special precautions shall be taken to prevent the ingress of moisture, silt, brick chippings, concrete, etc. into the conduits and boxes immediately these are installed and during the progress of the works.

**5.1.10 Burrs**

The inside of conduits where cut and threaded shall be reamed, to remove all burrs before the next length of conduit or conduit box is attached.

**5.1.11 Threads**

Conduit shall be threaded by means of efficient and sharp dies, in no circumstances will torn or loose threads be accepted.

**5.1.12 Thread Lengths**

Where practical all threads shall be half the length of the appropriate standard coupling, or flanged coupling; the full length of the conduit box conduit entry and half the length of a standard coupling at a "running coupling" position.

**5.1.13 Tightening Fittings**

All conduit joints at couplings, boxes, etc., shall be screwed up tight by means of a mechanical tool (e.g. pipe wrench or Stilson tool).

**5.1.14 Size**

No conduit diameter less than 20mm may be installed.

**5.1.15 Telephone Conduit**

For telephone systems, 25 mm steel conduit shall be used throughout.

**5.1.16 Conduit Boxes**

The conduit shall be fixed to boxes by means of couplings and male bushes.



**5.1.17**      **Drainage**

Steel conduits buried in floor screed shall have minimum cover of 35 mm of concrete and shall be provided with drainage points to discharge any water which may accumulate. Drainage points shall consist of plugged tees turned down with 6 mm holes drilled in the plugs for release of water.

**5.1.18**      **Ventilation**

All conduits shall have ventilation outlets at their highest and lowest points to allow free circulation of air.

**5.1.19**      **Fixing Methods**

Surface conduits shall be fixed with approved saddles while crampets may be used for conduits recessed in wall chases, etc. Recessed conduits shall have a minimum cover of 10 mm of plaster.

**5.1.20**      **Checking**

Prior to introducing wiring to any conduit system, the system shall be checked and tested to ensure maximum mechanical and electrical continuity throughout.

**5.1.21**      **Flexible Metallic Conduit**

Where conduit is used for wiring to any electrical equipment which may be subject to vibration, flexible galvanised steel conduit must be installed, with suitable adapters and fittings for connection to conduit boxes.

**5.1.22**      **Flexible Metallic Conduit BS**

All flexible metallic conduit shall be in accordance with BS 731.

**5.1.23**      **Flexible Conduit Earth Bond**

Flexible conduits shall be provided with external earth bands.

**5.1.24**      **Space Factor**

The number of cables drawn into, or laid in, an enclosure of a wiring system shall be such as to comply with regulation 521.6.4 and Annex 52A of the National Rules for Electrical Installations Second Edition 1991. A space factor of 45% shall not be exceeded.

**5.1.25**      **Draw-In Boxes Spacing**

Where conduit is to be installed from point to point in a straight run with no bends, draw-in boxes shall be provided every 10 metres of conduit run.

**5.1.26      Damage**

Where the galvanised coating is damaged during installation it shall be immediately coated with galvanised paint.

**5.1.27      Other Services Clearance**

All conduits shall be installed so as to clear all gas, hot water, steam pipes and refrigeration plant pipes by a minimum of 300 mm to the satisfaction of the Engineer.

**5.1.28      Bonding**

Where the conduit is in contact with any other metal work of any description, an efficient and permanent metallic connection shall be made between the conduit and the metal work.

**5.1.29      Hermetic Seal**

Where conduits are required to pass into or out of ducts, or from the inside to the outside of buildings, or in any other position where a considerable variation in temperature exists between different sections of the building free circulation of air must be prevented between the conduit systems of each section by inserting a conduit box in an approved position, the box to be fitted with plastic compound (after the cables have been drawn in) to hermetically seal off the conduit system at that point.

**5.1.30      Finished Plastered ceilings**

Conduit boxes are to be positioned flush with the finished plastered ceilings.

**5.1.31      Suspended Ceilings**

Conduit boxes are to be positioned on the surface on the underside of slab in the case of suspended ceilings.

**5.1.32      Wall Finishes**

The Electrical Contractor must acquaint himself with the wall finishes of the various rooms, etc.

**5.1.33      Separate Earth**

An earth cable shall be installed in all conduits and looped into earth terminals of outlets where required. It shall in turn be connected to the earth terminal of the relevant distribution board. This earth cable shall be of 2.5 mm<sup>2</sup> PVC covered stranded copper type.

## 5.2 Surface Conduit Systems (Internal)

### 5.2.1 Architectural Feature Aligning

Conduits fixed on the surface of walls, ceilings, etc. shall be run truly vertical, horizontal or parallel with the Architectural features of the building.

### 5.2.2 Fixing

Conduits shall be securely fixed by means of spacer bars and saddles with brass R.H. wood screws of 32 mm length and PVC Rawlplugs, or brass R.H. machine bolts, nuts and washers as the location and structure requires.

### 5.2.3 Boxes, Switch Boxes, etc.

Conduit boxes, switch boxes, and socket outlet boxes shall be drilled and countersunk (so that screw heads do not project into the boxes and securely fixed by means of brass countersunk wood screws of 32 mm length and PVC rawlplugs, or brass countersunk machine bolts, nuts and washers as the location and structure requires.

### 5.2.4 Exclusion of 'Hilti' Method

The "Hilti" method of fixing saddles or conduit boxes, etc., shall not be accepted by the Engineer.

### 5.2.5 Fixing to Steel Girders

Where conduits, boxes or other fittings are to be fixed to steel girders or steel beams, pipe hooks of an approved pattern shall be employed.

### 5.2.6 Drilling of Steel Girders

Holes shall not be drilled in steel girders or steel beams without written sanction by the Engineer.

### 5.2.7 Fixing Spacings

Fixings shall be spaced at 1 metre for 20mm diameter, and 25 mm diameter conduits and at 1.2 metres for 32 mm diameter conduits and above. In addition, fixings shall be provided at each side of a "set" or conduit box.

## 5.3 Water Tightness

Conduit systems which are to be "cast" in concrete floors, walls or roof structures shall be made watertight throughout.

### 5.3.1 Surface Cover

Such conduits shall have a minimum covering of at least 25 mm of concrete from any "face" of floor, wall, roof or ceiling structure.

### 5.3.2 Finishing Flush With Floor

Where conduit systems are to be "cast" in floors, walls or roof structures the conduits shall be fixed and "set" so that boxes will finish flush with the finished face of the structure.

### 5.3.3 Temporary Lids

To restrict the movement of boxes during "pouring" and prevent the ingress of concrete, temporary lids shall be fixed to the boxes and the lids drilled and fitted with a machined bolt of sufficient length either to protrude through the shuttering and be secured by means of washer and nut, or to protrude through the "pour" so as to locate such boxes.

### 5.3.4 Chases

Conduit systems are to be fixed to plaster finished concrete, brick or stone walls and are to be concealed. Such conduits shall be secured in "chases" of sufficient depth so that the conduit finishes flush with the "base" wall and the Architects specified thickness of plaster will be maintained throughout.

## 5.4 Surface Conduit Systems (External)

### 5.4.1 Water Tightness

Conduit systems shall be made effectively watertight throughout.

### 5.4.2 Fittings

All conduit boxes, adaptable boxes, fittings etc., shall be of the watertight pattern with machined faces to boxes and lids, tapped conduit thread entries and external fixing lugs.

### 5.4.3 Boxes

Boxes shall be further rendered watertight by means of PVC., or Neoprene gaskets or watertight jointing compound insertion, as instructed on site by the Engineers.

### 5.4.4 Internal Drilling

Boxes or fittings shall not be internally drilled for fixings.

**6.0**            **WIRING****6.1**            **P.V.C. Cable In Conduit And Trunking****6.1.1**        **BS**

Conductors shall be tinned high conductivity annealed copper with Type T1 of BS 6746 PVC insulation and shall comply with BS 6004 and BS 6360.

**6.1.2**        **Colour Coding**

All phase cables shall be coloured brown, red and yellow according to the phase to which they are connected, and all neutral cables shall be coloured blue.

**6.1.3**        **Conductors**

Conductors shall be stranded and shall not be smaller than 1.5 mm<sup>2</sup> unless otherwise specified.

**6.1.4**        **Installation of Cables**

Cables shall not be drawn into conduits or trunking until all such conduits or trunking lengths are firmly fixed and screwed in place.

**6.1.5**        **Loop-in System**

Wiring in general, shall be arranged on the loop-in system with conductors looped from outlet to outlet.

**6.1.6**        **Joints**

No joints in cabling will be allowed between outlets under any circumstances.

**6.1.7**        **Neutral Links**

Neutral cables shall be provided with links only at fusing positions.

**6.1.8**        **Fuses**

Fuses may only be installed in phase cables.

**6.1.9**        **Connections**

All connections at outlets, etc. shall be of the screwed type and no twisted or soldered connections shall be permitted.

**6.1.10**      **Temperature Limitations**

PVC insulated and sheathed cables shall not be installed in locations where the ambient temperature is likely to exceed 45°C.

### 6.1.11 Segregation of Low Voltage and Extra Low Voltage

Low voltage circuits shall be segregated from extra low voltage circuits. Where this requirement is impracticable, safety extra-low voltage circuit conductors shall be insulated in accordance with the requirements of the Regulations for the highest voltage present. (The Regulations referred to are the National Rules for Electrical Installations ET 101/1991 of the Electro Technical Council of Ireland).

### 6.1.12 Segregation of Large and Small Cables

Insulated sheathed single (or multi) core cables of 16 mm sq. size or larger, shall not be laid in the same trunking compartment with smaller size cables.

### 6.1.13 MICS and PVC

M.I.C.S. cables shall not be installed in cable trunkings with PVC cables.

### 6.1.14 Binding Circuits

Each circuit shall be bound separately at 2 metre intervals along the complete length of the trunking system, with waxed binding twine or PVC. PVC adhesive backed tape, and a plastic identification "tag" shall be attached indicating to which switchboard, distribution board, link box, plant or apparatus such circuit is connected. Such identification tag shall be visible upon removal of one (1 No.) length of trunking lid.

### 6.1.15 Transition of Different Cables Type

Where it is particularly specified that final circuit connections shall be a different type cable to the standard type cable throughout the installation, for example:

- a. P.V.C. to M.I.C.S. or vice versa.
- b. P.V.C. to Heat Resistant.
- c. P.V.C. to Flexible Cord.

Such transition (c) shall take place via plug and socket or (a), (b) or (c) within a conduit box or adaptable box. Such transition shall not take place within a cable trunking.

### 6.1.16 Porcelain Shrouded Connectors

The joint between the cores in the conduit box or adaptable box shall be made with approved loose type glazed porcelain shrouded pinching screw connectors of a rating not less than the cables which are being jointed.

**6.1.17 Cables in Excess of 10 mm<sup>2</sup>**

Where a transition joint is required on cables in excess of 10 sq.mm. compression type spade lugs shall be affixed to the cables and made off on to rigidly fixed porcelain (or other approved insulating material) based terminals or busbar assembly.

**6.2 PVC - SWA PVC Cables****6.2.1 BS**

PVC insulated, PVC sheathed steel wire armoured and PVC sheathed over all shall comply in all respects with IS 273/BS6346 and shall be 600/1000 volt grade.

**6.2.2 Manufacturer's Fittings**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories shall be used.

**6.2.3 Copper Conductor**

The conductor shall be of standard annealed high conductivity copper complying with the latest relevant BS shaped and respiralled for minimum overall size.

**6.2.4 Manufacturer**

Cables shall be similar to those as manufactured by "Pirelli General Cable Works Ltd.", "BICC Ltd." or approved manufacture.

**6.3 XLPE - SWA PVC Cables****6.3.1 BS**

XLPE insulated, PVC sheathed steel wire armoured and PVC sheathed over all shall comply in all respects with BS 5467 and shall be 600/1,000 volt grade.

**6.3.2 Manufacturer's Fittings**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories shall be used.

**6.3.3 Copper Conductor**

The conductor shall be of standard annealed high conductivity copper complying with the latest relevant BS shaped and respiralled for minimum overall size.

**6.3.4 Manufacturer**

Cables shall be similar to those as manufactured by "Pirelli General Cable Works Ltd.", "BICC Ltd." or approved manufacture.

**6.4 Screened Cables****6.4.1 Type**

Screened cables for instruments, etc. shall be of the PVC insulated individual screening per pair of wires and overall screened and PVC sheathed type. They shall comply with BS 5308.

**6.4.2 Installation**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories, shall be used.

**6.4.3 Conductor**

The Conductor shall be of stranded annealed high conductivity copper of cross sectional area specified in the cable schedule.

**6.4.5 Manufacture**

Cables shall be as manufactured by Pirelli General Cable Works Ltd., Belden or equal to prior approval.

**6.4.6 Underground Locations**

Where screened cables are installed in underground ducts or other underground locations, they shall be further protected by a single layer of helically wound galvanised wires and final extruded sheath of PVC.

**6.4.7 Intrinsically Safe Circuits**

The outer sheath of cables of intrinsically safe circuits shall be colour coded blue for ease of identification.

**6.5 M.I.C.S. Cables****6.5.1 BS**

Mineral insulated, copper sheathed cables shall comply with BS 6207.

**6.5.2 Insulation and Size**

They shall be 600 volt grade with solid conductors which shall not be less than 1.5 sq. mm cross sectional area.



### 6.5.3 **Manufacturer's Fittings**

All cables, glands, etc. shall be installed in accordance with manufacturer's recommendations and manufacturer's standard fittings and accessories shall be used throughout.

### 6.5.4 **Stripping Insulation**

Where connections are made to M.I.C.S. cables, the copper sheath shall be stripped back to the required position and all mineral insulation removed from the exposed cores.

### 6.5.5 **Insulation Sleeving**

Small lengths of appropriately coloured Neoprene or similar insulating sleeving shall be placed over the cores before making connections to ensure that no short circuiting occurs.

### 6.5.6 **Cable Sealing**

Cables must be properly sealed in all cases so that no moisture may get to the mineral insulation and cause a breakdown in the cables.

### 6.5.7 **Galvanised Boxes**

Standard B.E.S.A. galvanised boxes shall be used at all outlets, fitted with standard manufacturer's sealing glands.

### 6.5.8 **Loop-In system**

Wiring shall be arranged on the loop-in system with cables looping from outlet to outlet and no joints will be allowed in the cables under any circumstances.

### 6.5.9 **Connections**

All connections which shall be made at outlets only, shall be of the screwed type and no twisted or soldered connections shall be permitted.

### 6.5.10 **Surface Mounted**

All M.I.C.S. cables shall be run on the surface.

### 6.5.11 **Electrical Continuity**

Cables shall be electrically continuous across all joints.

### 6.5.12 **Fixing**

Fixing shall be by means of approved copper saddles.

**6.5.13 External Use**

Where M.I.C.S. cable is used outdoors, it shall have an overall P.V.C. sheathing:-

**6.5.14 Spacing of Clips****Max. spacing of clips for mineral insulated cables**

<u>Overall Diam. of Cable</u>	<u>Horizontal</u>	<u>Vertical</u>
Not exceeding 9 mm	600 mm	800 mm
Not exceeding 15 mm	900 mm	1200 mm
Not exceeding 20 mm	1500 mm	2000 mm
20 - 40 mm	-	-

**6.5.15 High Temperatures**

M.I.C.S. cables shall not be installed in locations where the ambient temperature is likely to exceed 1000°C unless sanctioned by the Engineer.

**6.5.16 Terminations**

M.I.C.S. cables at terminations shall be protected and sealed with ring type glands incorporating screw-on type seals, anchoring beads, neoprene sleeving and "cold" plastic compound, (tropical compound where the ambient temperature exceeds 55°C). The whole assembled in a manner in compliance with the recommendations of the manufacturer of the cable.

**6.6 Underground Cables****6.6.1 LT and Signal Cables**

Underground LT and signal cables shall be run in 100mm PVC pipes laid a minimum of 600mm below grade.

**6.6.2 Armoured**

LT and signal cables underground shall be of a type incorporating an armour or metal sheath, or both.

**6.6.3 Type of Cable**

Underground L.T. cables shall be PVC/SWA/PVC or XLPE/SWA/PVC and shall comply in all respects with BS 6346 or BS 5467 respectively and shall be 600/1,000 volt grade.

**6.6.4 Excavation**

The Civil Contractor will supply all labour for trench excavation and reinstatement.

**6.6.5 Wavin Pipes**

The Civil Contractor will supply and lay all Wavin pipes.

**6.6.6 Signal Cables**

All signal cables installed underground shall run their entire length in separate 100mm PVC ducts run with a minimum of 600mm separation from LT ducts.

**6.6.7 Joints**

Joints in cables installed underground shall not be accepted by the Engineer.

**6.7 Flexible Cords****6.7.1 250 Volt Grade**

Flexible cords shall be 250 volt grade minimum three core.

**6.7.2 Conductors**

The conductors shall be stranded, high conductivity flexible copper, insulated and sheathed with vulcanised rubber on PVC and braided overall with a glazed cotton sheath.

**6.7.3 Heat Resisting Flexible Cord**

Heat resisting flexible cords shall have stranded nickel plated annealed copper conductors insulated with yarn or woven tape braided with glass fibre and the whole impregnated with varnish.

**6.8 Telephone Cables****6.8.1 Telephone Cables**

Telephone cables shall be single core or multicore as particularly specified with high conductivity copper conductors of size not less than 0.5 mm sq., P.V.C. insulated and extrusion sheathed overall; and impedance rating not less than 50 ohms.

**6.8.2 Underground Located**

When telephone cables are installed in underground or external surface locations, they shall be further protected by a single layer of helically wound galvanised wires and final extruded sheath of P.V.C.

## 7.0 LIGHTING FITTINGS

### 7.1 Type and Installation

All light fittings shall be of a type and pattern specified and shall be installed as shown on drawings.

### 7.2 Cleaning

The Electrical Contractor shall be responsible to see that all fittings are properly cleaned at time of installation.

### 7.3 Damage

Any fittings showing damage, marks or scratches shall be replaced by the Electrical Contractor.

### 7.4 Final Circuit

Internal lighting circuits shall be run in 1.5 sq. mm cable radial circuits, with not more than 2 kw of incandescent lighting load or 1.7 kW of fluorescent lighting, discharge lighting.

### 7.5 Lighting Fixture List

A legend for the various light fittings used in the installation shall be contained on the drawings.

### 7.6 Fluorescent Fittings

Low wattage and fluorescent fittings shall be connected to fixed wiring by PVC single or multicore (including earth) conductors.

### 7.7 Chain Suspended Terminations

Chain suspended fittings shall be fed by a PVC multicore cable with an earth conductor and terminated at the fitting by a nylon stuffing gland.

### 7.8 PVC Flex

The Contractor shall allow a length of 1 m, 3 core heat resistant cable for final terminations to fluorescent luminaries.

### 7.9 Fluorescent Tubes

Fluorescent tubes shall be Philip Colour 840 or equal to approval.

**7.10 PVC Insulated Cables**

PVC insulated cable shall not be connected direct to lamp holders or used for internal wiring of lighting fittings where they may be affected by the heat of the lamps.

**7.11 Energy Saving Fittings**

All fittings shall be energy saving fittings.

**7.12 Hazardous Area Light Fittings & Accessories**

All light fittings used in Hazardous Areas shall be suitably rated. A legend for the hazardous area fittings is contained on the drawings.

7.13 All cables, cable glands and accessories shall be suitably rated for use in a Zone 1 Hazardous Areas.

**7.14 Lighting Switches 20A**

Lighting switches shall be of 20 Amp rating ~~SP~~ as shown on drawing.

**7.15 Lighting Switches Height above FFL**

Switches shall in all cases be mounted at 1350 mm above finished floor level to under-side of the switch boxes.

**7.16 Multi-Gang Switch Boxes**

Where the number of switches are grouped in one location multi-gang switch boxes shall be used. Where more than one phase is incorporated in a switchbox the box shall be divided so that not more than one phase is in any one compartment and the front plate shall be engraved "Danger 400 Volts" in red lettering.

**7.17 Lighting Switches Ex Rated**

Lighting switches in hazardous areas shall be rated 16 Amps, protected to EExde IIC T6. They shall be of CEAG manufacture or equal to approval.

**8.0 EMERGENCY LIGHTING FITTINGS****8.1 Type and Installation**

All emergency light fittings shall be of a type and pattern specified and shall be installed as shown on drawings.

**8.2**      **Cleaning**

The Electrical Contractor shall be responsible to see that all fittings are properly cleaned at time of installation.

**8.3**      **Damage**

Any fittings showing damage, marks or scratches shall be replaced by the Electrical Contractor.

**8.4**      **Final Circuit**

Internal lighting circuits shall be run in 1.5 sq. mm cable radial circuits, with not more than 2 kW of incandescent lighting load or 1.7 kw of fluorescent lighting, discharge lighting.

**8.9**      **Lighting Fixture List**

A legend for the various light fittings used in the installation shall be contained on a separate drawing.

**8.10**     **Fluorescent Fittings**

Low wattage and fluorescent fittings shall be connected to fixed wiring by PVC single or multicore (including earth) conductors.

**8.11**     **PVC Chain Suspended Terminations**

Chain suspended fittings shall be fed by a multicore cable with an earth conductor and terminated at the fitting by a nylon stuffing gland.

**8.12**     **PVC Flex**

The Contractor shall allow a length of 1m, 3 core heat resistant cable for final terminations to fluorescent luminaries.

**8.13**     **PVC Insulated Cables**

PVC insulated cable shall not be connected direct to lamp holders or used for internal wiring of lighting fittings where they may be affected by the heat of the lamps.

**8.14**     **Fixing**

Emergency luminaries and exit signs shall be surface mounted on the wall or ceiling as indicated on the drawings.

**8.15      Hazardous Area**

Emergency lighting fittings used in the hazardous areas as identified in the Zone section drawings shall be suitably rated for Zone 1 or Zone 2 as specified on the drawing.

**9.0      SOCKET OUTLETS****9.1      Socket Outlet Legend**

A legend for the various socket outlets used in the installation is contained on the drawings. Alternatives shall be to the Engineer's prior approval.

**9.2      Industrial Plugs and Sockets**

Industrial plugs and sockets shall be to BS 4343 or DIN 49462/63, CEE 17.

**9.3      Industrial Sockets Mounting Height**

Industrial sockets shall be wall mounted at 1200mm above finished floor level unless otherwise noted on the drawings.

**9.4      16A Socket Circuits**

16A rated sockets may be wired in unlimited numbers on radial circuits where diversity permits.

**9.5      Sockets Other Than 16A**

All sockets except 16A must be wired on a separate circuit.

**10.0      CABLE TRAY INSTALLATION****10.1      PVC Cable Tray****10.1.1      Installation**

The Electrical Contractor shall include for the complete PVC cable tray installation, as indicated on the drawings and as specified herein, and shall include for all supports.

**10.1.2      PVC Cable Trays**

Cable trays shall be rigid PVC and have wide flanged edges and shall be fitted with lidding throughout.

**10.1.3 Manufacturer**

Cable trays shall be of Planet Wattohm manufacture or of Unex manufacture supplied respectively by Ellickson Engineering Ltd., Waterford and EWL Electric, or equal to approval.

**10.1.4 Fittings**

Joints, bends, tees, turn ups, turn downs, reducers and the like shall be factory made unless otherwise approved.

**10.1.5 Size and Supports**

Cable trays shall be of sufficient size to accommodate all the cables in each individual cable run and shall be firmly supported and fixed so that the total weight of the cable and trays shall be carried without undue sagging. Reference shall be made to manufacturer's recommendations regarding spacing of support brackets etc.

**10.1.6 Site Fabricating**

All bends, toes, sweeps, offsets etc. will be fabricated by neatly cutting and mitring and welding on site by means of hot air tools and PVC welding rod.

**10.1.7 Prefabricated Fittings**

If prefabricated fittings are used they shall be joined using PVC jointing material.

**10.1.8 Cable Ties**

The base of the tray shall be perforated to take normal polyethylene, nylon or Rilsan cable ties.

**10.1.9 Ventilation Space**

The tray will be sufficiently sized to allow adequate space for 1 No. only full layer of cables, with sufficient space for ventilation. Where tray widths greater than 600 mm are required, two or more adequately sized cable tray runs will be allowed for.

**10.1.10 Support Spacing**

All supports will be fixed horizontally at 1.5 metre centres unless particularly heavy runs require closer spacing.



**10.1.11 Supports**

PVC Cable tray supports shall be formed from 316-S31 "Marine Grade" stainless steel unistrut and shall not exceed a spacing of 1.5 metre centres, and fixed to wall or beams by means of 2 No. 8 mm 316-S31 stainless steel bolts, nuts and spring washers. The cable tray shall in turn be bolted to the unistrut members by 2 No. 6 mm 316-S31 stainless steel mushroom head bolts, nuts and washers, care being taken to ensure that the head of the bolts are uppermost in cable tray.

**10.1.12 Flat Wall Surfaces**

Where cable tray is installed on even flat wall surfaces, it shall be mounted on 316-S31 Unistrut purpose made stand-off brackets fixed on wall, giving a space factor of at least 21 mm from the back of the cable tray to the wall as previously described.

**10.1.13 Cable Ties**

The tray base shall be perforated to receive normal cable ties.

**10.1.14 Retention of Cable Formation**

The cables shall be so arranged that where a cable (or cables) branch from the 'run', either from the top, bottom or sides, the remaining cable formation is not disturbed.

**10.1.15 Bends**

Where cables branch from the sides top or bottom of the cable runs, the bends so formed shall be determined by the largest size cable.

**11.0 ACCESSORIES****11.1 Bonding**

All non-current carrying metalwork shall be earth bonded.

**11.2 Weatherproof Equipment**

Accessories for use outside a building (including damp or wet locations within a building) shall be of an approved weatherproof type.

**11.3 Hazardous Locations**

Accessories for use in hazardous locations shall be of an approved flameproof type to the Class particularly specified.

#### 11.4 Connection Boxes

Most sensors and instruments will not be capable of taking PVC/SWA/PVC glands. A connection box to IP65 will be taken for each item which will take the armoured cable and also final flexible connection to sensor.

#### 11.5 Cable Transits

The electrical contractor shall supply cable transit from the Hawke HCX range (or equal to approval). Cable transit shall be sized with 25% spare capacity for future cables. Installation of cable transit frames will be by the Civil Contractor.

#### 12.0 EARTHING

##### 12.1 Compliance With Regulations

The Earthing Installation shall be done in accordance with relevant Regulations of the National Rules for Electrical Installations, ET-101 of the Electro- Technical Council of Ireland 1991.

##### 12.2 Earth Rods/Grids

Main earthing to consist of earth rods not less than 1800 mm in length or less than 16 mm diameter driven vertically into the ground and to be complete with all recommended fittings and accessories enclosed in a pit and sealed by means of an Armstrong cover and flange.

The earth rods shall be connected to a 70mm<sup>2</sup> bare earth conductor grid as shown on the drawings. The earth grid shall be bonded to the structural rebar and the lightning protection air termination grid.

##### 12.3 Position of Earth Bars

Main earth bars, complete with suitable mounting insulators, shall be positioned in the switch-rooms about 300 mm above floor level.

##### 12.4 Aluminium Conductors

Aluminium cables must not be used as earthing conductors in case of subjection to electrolytic corrosion.

##### 12.5 Labelling

The connection to the earth electrode must be clearly and permanently labelled "Safety Electrical Connection- Do not Remove.

**12.6 Non-Protected Earthing Conductors**

Where earthing conductors are buried, and not protected against corrosion, minimum cross sectional areas are 25 mm<sup>2</sup> for copper and 50 mm<sup>2</sup> for steel.

**12.7 Protected Earthing Conductors**

Where buried and protected against corrosion, but not mechanically protected, minimum cross-section for both copper and steel is 16 mm<sup>2</sup>, but the steel must be coated.

**12.8 Earthing Terminal**

A main earthing terminal or bar must be provided for each installation to collect and connect together all protective and bonding conductors.

**12.9 Disconnection**

It must be possible to disconnect the earthing conductor from the main earthing terminals, but only by using tools.

**12.10 Supplementary Earth**

Where metallic conduit is used as the protective conductor to a socket outlet, the earthing terminal of the socket outlet must be connected to the earth terminal of the box by a separate conductor.

**12.11 Separate Additional Protective Conductor**

A separate additional protective conductor is required where flexible conduit is used, to supplement the earthing facility of the conduit itself.

**12.12 Main Equipotential Bonding**

Main equipotential bonding conductors, with a cross-sectional area of not less than half that of the earthing conductor, minimum 6 mm<sup>2</sup>, connect the earthing terminal with the services concerned and as close as possible to their point of entry to the building.

**12.13 Supplementary Bonding**

Supplementary bonding conductors will also be required in an area such as a kitchen or bathroom.

**12.14 Socket Outlet Circuits**

The maximum disconnection time for a protective device to open will be 0.4S for circuits feeding socket outlets.

**12.15 Fixed Equipment Circuits**

The maximum disconnection time for a protective device to open for circuits feeding fixed equipment will be 5 seconds.

**12.16 Minimum Cross-Sectional Area of Protective Conductors**

The minimum cross-sectional area of protective conductors in relation to the area of associated phase conductors shall be as follows:

Cross-Sectional Area of Phase Conductor	Minimum Cross-Sectional Area of the Corresponding Protective Conductor
$S$ $m^2$	$S_p$ $mm^2$
$S < 16$	$S_p - S$
$16 \leq S \leq 35$	$S_p - 16$
$S > 35$	$S_p = S/2$

**12.17 Requirement of ELCB**

When the impedance of the fault or the impedance of the earth fault loop is too high to allow enough current to ensure that the protective device opens quickly, an earth leakage circuit breaker of the residual current type shall be installed.

**12.8 ELCB Operating Current for Indirect Contact**

The National Rules for Electrical Installations, Second Edition 1991 and the IEE Regulations impose an operating current of 30 mA for devices intended to protect against indirect contact.

**12.19 Extra-Low Voltage Circuits**

Plugs and socket outlets of safety extra-low voltage circuits shall not have a protective conductor connection.

**12.20 Value of Earth Resistance**

The earthing arrangement shall be such that the value of resistance from the consumer's main earthing terminal to earth is 0.25 ohms maximum.

### 12.21 Type of Earth Electrode

The following types of earth electrodes are recognised for the purposes of the National Rules for Electrical Installations Second Edition 1991:-

Earth rods or pipes; Earth tapes or wires; Earth plates; Earth electrodes embedded in foundations; Metallic reinforcements of concrete; Metallic pipe systems; Lead sheaths and other metallic coverings of cables.

### 12.22 Resistance of Earth Electrodes to Corrosion

The materials used and the construction of earth electrodes shall be such as to withstand damage due to corrosion.

### 12.23 SWA Armour

In addition to utilising the SWA cable armour for earthing, a separate protective conductor, as detailed in 13.16 above shall be provided for each item of equipment.

## 13.0 LOW VOLTAGE SWITCHGEAR ASSEMBLIES

### 13.1 Code of Practice

The Code of Practice for the design, selection and erection of low voltage (not exceeding 1000 V ac). Switchgear Assemblies shall be that as specified by the Electro-Technical Council of Ireland 1991, - Publication No. ET-201.

### 13.2 Factory Built Assembly Complying with IEC Publication

Switchgear complying with I.E.C. Publication 439 is acceptable subject to the following two deviations:-

- (i) Open-type or dead-front-type Switchgear 439 assemblies are not permissible.
- (ii) Where a cubicle door is provided to give access to circuit breakers, fuses or the like for maintenance or inspection purposes, bare busbars and associated conductors should be protected from inadvertent contact by persons while that door is open.

This will normally consist of a barrier which can be removed only by means of tools. It is not necessary to prevent deliberate attempts to touch live parts.

When busbars are installed in the bottom of a switchboard, they should be protected against direct contact by complete insulation or by an enclosure giving a degree of protection of at least IP 20.

### 13.3 Compliance with Legal Requirements

The Low Voltage Switchgear Assemblies shall comply in all respects with the legislation comprising (i) the "Safety, Health & Welfare at Work Acts" and (ii) the Factories (Electricity) Regulations (S.I. No. 3: 1972).

### 13.4 Access to Panels

Clear working space of at least 1.2 m should be provided in front of the board. When there is access at the back, clear working space of at least 0.91m must be provided.

### 13.5 Recommendation For Degree of Protection

The degree of protection of the enclosure for custom built assemblies should be at least IP 54.

### 13.6 General Specification

Metalwork Manufacturer: ABB, Logstrup, Holec Tabula or equal to approval.

Type of Switchgear: ABB, Merlin Gerin (or equal to approval)  
 Type of Control Gear: ABB, Sprecher & Schuh/Allen Bradley, Telemecanique (or equal to approval)  
 Type of Assembly: Fixed Form 4 to IEC 439  
 Type of Enclosure: Metal, with stove enamel cellulose paint finish

### 13.7 Certification

A Factory Built Assembly should have a certificate from a recognised test organisation in a CENELEC country to the effect that the FBA complies with IEC Publication 439 or an equivalent national standard. Certification may consist of type approval or individual certification.

### 13.8 Routine Tests

Routine tests should be made on every assembly whether factory or custom built, these tests are intended to detect faults in material and workmanship or possible damage after assembly or manufacture.

### 13.9 Housings

Housings shall be manufactured from zinc coated steel of minimum thickness, 14 SWG finished in stove enamel cellulose paint.

### 13.10 Voltage Rating

Switches and control gear to be not less than 500 Volt rating.

**13.11      Fuses**

Fuses shall be of the NH type.

**13.12      Cable Entry Glands**

All switchboards and sub-distribution boards shall be suitable for bottom cable entry glands, etc.

**13.13      Ordering Switchboards**

Before a firm order is placed for the supply of switchboards etc. the contractor shall furnish the Engineers with details and drawings of proposals for acceptance. No switchboard etc. shall be delivered to site unless it has been inspected and approved in writing by the Engineers prior to dispatch by the manufacturers, the contractor shall give sufficient notice to the Engineers in writing, stating when switchboards etc. are ready for inspection.

**13.14      MCC Multi-Cubicle**

The M.C.C. shall be the multi-cubicle type, non-withdrawable F.B.A. (factory built assembly). Incoming supply shall be bottom entry and at one side of the panel. Outgoing feeds will be bottom exit and the panel will have gland plates suitably drilled to accept PVC/SWA/PVC. cables unless otherwise stated.

**13.15      Metal Enclosure**

The M.C.C. will be suitable for 400 volt three phase AC 50 Hz supply. Switchgear enclosures shall be moulded or metal enclosed and should be of sturdy and rigid construction. The enclosure will have a degree of protection to I.P. 54. Enclosures must prevent danger from electric shock due to "direct contact" and indirect contact in accordance with Chapter 41 of the "National Rules for Electrical Installations" Second Edition 1991, including Amendment A1 1997.

**13.16      Floor Mounting**

The M.C.C. shall be suitable for floor mounting with access from the front so that panel can be located with rear flush against a wall.

**13.17      Main Incomer**

An incoming switch fuse shall be provided for isolating the entire panel and this must have a means for padlocking. The incoming circuit shall be provided with a voltmeter and ammeter, each with phase selection. The incoming circuit will be provided with a kW. hr. meter with a pulse output suitable for connection to a Telemetry/PLC system.

### 13.18 Busbars

Busbars shall be fed at one end and run the full length of the switchboard at the top and they shall be accessible from the front. They shall be copper construction and in their own compartment. Vertical busbars shall also be of copper construction and in their own compartment. Busbar connections are made to individual starters except for the very small starters (15 kw and below) which are made in 10 mm<sup>2</sup> cable.

### 13.19 Motor Starters

Motor starters shall either be Direct-on-Line or Star Delta. Direct on-Line starters will be up to but excluding 4 Kw with above this being Star-Delta. Each starter circuit will consist of a combined MCB/thermal overload relay with anti-single phase protection and a contactor. The MCB/overload would be electrically reset from a push button projecting through the compartment door and should be fitted with at least 2 Nr. N/O and N/C auxiliary contacts. The combined MCB/overload should be complete with the facility to padlock in the OFF position or alternatively a padlockable isolator should be fitted ahead of the MCB/overload.

Each circuit will be provided with outgoing terminals to accommodate a remote stop/start push button station.

Each starter will have a 24V interface relay which will be controlled from the telemetry system on auto. In addition each starter shall have the required number of relays to provide the necessary 'volt free' contacts for the PLC system as indicated in the main specification.

To allow for drive interlocking requirements, two outgoing control wiring terminals will be provided for each starter. These shall be wired into each control circuit immediately after the thermal overload tripping contact and shall be linked out at the terminal block when required.

Star Delta starters shall also contain the necessary additional contactors and timers for automatic changeover.

### 13.20 Control Voltage

Control voltage shall be 110 volts A.C. with one pole earthed. The 110V supply shall be provided by a suitably sized control transformer (with 50% spare capacity) which shall be located in the MCC cubicle with adequate allowance for ventilation.

### 13.21 Cable Duct

The MCC shall have adequate PVC slotted cable ducts running alongside the starters to allow for the required number of cables to the starters.



**13.22 Inadvertent Contract**

Where a cubicle door is provided to give access to CBs, starters, etc., bare busbars and associated conductors should be protected from inadvertent contact by persons while the door is open. This should consist of an insulated barrier which can be removed only by means of a tool.

**13.23 Ammeter**

All drives to be provided with an ammeter with phase selection switch mounted in the compartment door. All drives are to be provided with facility to connect a thermistor actuated alarm and a thermistor actuated cut out.

**13.24 Earthed**

A copper earth bar shall run the full length of the board. This shall be suitably drilled to allow bolt on connections of an earth continuity conductor for each circuit. The frame of each cubicle will be connected by a separate conductor to the protective conductor.

**13.25 Technical Information**

The manufacturer should supply the following technical information:-

- (1) Short circuit strength test certificates or reports (Short circuit level will be 50 K.A.)
- (2) Adequate technical instructions, wiring diagrams and schematic diagrams.
- (3) Instructions for maintenance.
- (4) Operating characteristics of fuses, circuit breakers and miniature circuit breakers.
- (5) Standards with which complete assembly complies.
- (6) Recommended spare parts lists.

**13.26 Commissioning Test**

Commissioning tests should include the following:-

- (1) Checking of operation of mechanical devices.
- (2) Checking of conductors and external cables for effectiveness of electrical connections.
- (3) Checking of protective devices for correctness of settings or fuse ratings.

- (4) Checking labelling of circuits.
- (5) Checking that degree of protection against ingress of solid objects and moisture is not impaired.
- (6) Checking that there is no mechanical damage.
- (7) Dielectric test which will consist of a voltage of at least 1000 V a.c. RMS but not exceeding 2500 V a.c. RMS should be applied for about 1 minute, as follows:-
  - (i) Between all live parts and the frame.
  - (ii) Between each pole and all the other poles connected to the frame.

Where there is a protective (earthing) conductor insulated from the exposed parts, this conductor is regarded as a separate circuit, i.e. it should be tested with the same voltage as the main circuit to which it belongs.

This test may be made with all switches closed, or alternatively, each section may be tested separately. There should be no failure of the insulation as a result of this test.

Certain items which are not designed for this test voltage (e.g. measuring instruments, solid state devices) should be disconnected at their terminals for the test.

- (8) Check of continuity of protective (earthing) circuit.

Testing must be witnessed by Consultant/Client and ample notice must be given of date of tests to facilitate witnessing.

### 13.27 Thermistor

A thermistor relay or thermal switch is to be included in each pump starter.

### 13.28 Type 2 Co-Ordination

Each M.C.C. Starter shall have full 'Type 2' co-ordination in accordance with IEC 947 Part 4 In addition, certification is to be furnished by the M.C.C. Builder that any combined MCB/Overload and contactor combination which is proposed to be used in the M.C.C. has undergone the 'P' and 'Q' tests associated with BS 4941 (IEC 292) Type 'C' co-ordination.

## 14.0 **POWER FACTOR CORRECTION**

### 14.1 **Standards**

The capacitors shall comply with IEC 831, Parts 1 and 2 and BS 16500.

### 14.2 **Power Rating**

The power rating shall be subject to the following tolerance.

-5 or + 10%	For Capacitor Units
-0 or + 10%	For Capacitor Banks

### 14.3 **Rated Frequency and Voltage**

The rated frequency for capacitors shall be 50 Hz. and the rated voltage shall be 400 V.

### 14.4 **Internal Fuses**

Each element of the capacitors shall be fitted with internal individual element fuse links for overcurrent protection.

### 14.5 **Discharge Resistors**

Capacitors shall be fitted with discharge resistors.

### 14.6 **Switchgear**

Switchgear shall be equipped with either switchfuse units or circuit breaker rated at 125% of rated current of the capacitor unit or bank.

### 14.7 **Automatic Switching**

The power factor correction capacitor controller shall be capable of automatically switching a minimum of 12 capacitor steps and shall be of Novar manufacture or equal and approved.

### 14.8 **Power Factor Level**

Power Factor Equipment shall be supplied to maintain the overall plant power factor at least 0.95 lagging.

### 14.9 **Damping Reactors**

All capacitor units or banks to be fitted with damping reactors. These to be sized based on current surges arising from switching of capacitors.

**14.10 Liquid Free**

The di-electric shall be zinc metalised polypropylene film or equal to approval and shall be liquid free.

**14.11 Steel Container**

The capacitor elements are to be incorporated in a steel container with inert non toxic granular filling to surround every element. Aluminium cooler plates are to be provided to effect heat dissipation from the elements to the container case.

**14.12 Manufacture**

Capacitors shall be similar to those as manufactured by ASEA Brown Boveri, Roderstein or equal approved manufacture.

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**CORK COUNTY COUNCIL**  
**CORK MAIN DRAINAGE SCHEME – PHASE 2**  
**LITTLE ISLAND CONTRACT**  
**MECHANICAL & ELECTRICAL WORKS**

**CONTRACT DOCUMENTS**

**VOLUME 2**

**SPECIFICATION**

**AND**

**SCHEDULE OF PRICES**

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**County Hall**  
**Cork.**

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**Job Nr.: A5090**

**August 2002**

**REVISION CONTROL TABLE****User Is Responsible For Checking The Revision Status Of This Document**

For and on behalf of E.G. Pettit & Company					
Rev. Nr	Description of Changes	Prepared by	Checked by	Approved by	Date
A	For approval	J. McCarthy/ T.Crowley	FMcG	GO'S	Dec. 1999
B	Issued for Tender	J. Slattery	TC	FMcG	August 2002

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**Preamble**

The complete set of Contract Documents for the Cork Main Drainage Scheme Phase 2 – Little Island Contract – Mechanical & Electrical Works consists of two volumes and the Contract Drawings.

The Preliminary Safety & Health Plan is provided for information only.

Volume 1: Instructions to Tenderers and Conditions of Contract  
Document Nr.: A5090-N-S-04

Volume 2: **Specification and Schedule of Prices**  
Document Nr.: A5090-N-S-05

Contract Drawings

Preliminary Safety and Health Plan  
Doc. Nr.: A5090-N-H -01

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**APPENDIX 1      GENERAL ELECTRICAL SPECIFICATION**

**APPENDIX 2      SCHEDULE OF PRICES**

## 1.0 SCOPE OF CONTRACT

This Contract is for the provision, installation and commissioning of Mechanical and Electrical equipment for new pumping stations to be provided in Little Island, as part of the Cork Main Drainage Scheme. The proposed new pumping stations will pump wastewater from the Little Island area to the site of the future wastewater treatment plant. Existing outfalls will remain in use until the treatment plant has been constructed.

The proposed new pumping stations are as follows:-

1. Wallingstown Pump Station
2. Flaxfort Pump Station
3. Courtstown Pump Station

A separate Civil Works Contract will be undertaken by others for the construction of the pumping stations. The scope of this Contract shall include for collaboration with the Civil Works Contractor to ensure full and satisfactory completion.

## 2.0 LIST OF DRAWINGS

A5090-N001	Location Plan
A5090-N002	Wallingstown Pump Station – Site Plan & Pump Station Layout
A5090-N003	Wallingstown Rising Main & Gravity Sewer - Plan and Longitudinal Section (Sheet 1 of 2)
A5090-N004	Wallingstown Rising Main & Gravity Sewer – Plan and Longitudinal Section (Sheet 2 of 2)
A5090-N005	Flaxfort Pump Station – Site Plan and Pump Station Layout
A5090-N006	Flaxfort Pump Station – Pump house Plan, Sections and Elevations
A5090-N007	Flaxfort Pump Station – Pump house Details
A5090-N008	Flaxfort Rising Main – Plan and Longitudinal Section (Sheet 1 of 2)
A5090-N009	Flaxfort Rising Main – Plan and Longitudinal Section (Sheet 2 of 2)
A5090-N010	Courtstown Pump Station – Site Plan & Pump Station Layout
A5090-N012	Courtstown Rising Main & Gravity Sewer – Plan and Longitudinal Section
A5090-N018	Miscellaneous Details (Sheet 1 of 3).
A5090-N019	Miscellaneous Details (Sheet 2 of 3)
A5090-N020	Miscellaneous Details (Sheet 3 of 3)
A5090-N021	Typical Stairs, Access Ladders and Platform Details
A5090-E001	Wallingstown Pump Station – Domestic Electrics
A5090-E002	Flaxfort Pump Station – Domestic Electrics
A5090-E003	Courtstown Pump Station – Domestic Electrics

### 3.0 WALLINGSTOWN PUMP STATION

(Refer to Drg. A5090-N002/N003/N004/N018/E001)

Wallingstown pump station structure will be constructed by the Civil Works Contractor to the details shown in Drg. Nr. A5090-N002 under a separate contract.

This Contract provides for the supply and installation of the following equipment within Wallingstown pump station.

1. 3 Nr. Pumps
2. Associated delivery pipework, valves and fittings.
3. Electrical installation including control panel, pump starters and wiring of all equipment, as specified elsewhere in this specification.
4. 1 nr. kiosk as described in Clause 11.0.
5. 1 nr. electromagnetic flow meter complete with pipework and fittings.
6. Davits and lifting chains as described in Clause 8.0.
7. 1 nr. painted metal door and associated frame and ancillaries to kiosk enclosure as described on Drg. Nr. A5090-N018.

The Contractor shall supply and install 3 Nr. fixed speed submersible pumps to the wet chamber as shown on Drawing Nr. A5090-N002. The pumps shall operate as 1 Nr. duty / 1 Nr. assist / 1 Nr. standby.

All pumps shall have equal duties. The combined output with 2 Nr. pumps pumping shall be 150 l/s against a total head of 21.7m. The Contractor shall state the output when one pump is in operation. The Contractor shall also state the efficiencies of the pump for 1 pump and 2 pump operation.

The pumps shall be capable of handling raw sewage and passing solids of up to 100mm diameter. The pump rotational speed for each pump shall not exceed 1450 rpm.

The required pump performance shall be based on the following data.

- |   |            |
|---|------------|
| • Nr. of pumps:                                   | 3 Nr.      |
| • Pump design flow:<br>(2 Nr. pumps in operation) | 150 l/s    |
| • Sump invert level                               | -2.895m OD |
| • Header chamber outlet level                     | 11.215m OD |
| • Nr. of rising mains                             | 1 Nr.      |
| • Diameter of rising main                         | 350mm dia. |
| • Length of rising main                           | 754m       |

- Estimated friction and fitting losses 7.6m
- Static Head 14.11m
- Total Head at pumps 21.71m

The operation of the pumps shall be controlled by an ultrasonic level controller. The level controller shall provide a 4-20 mA signal with a minimum of 5 set points for pump control to operate as follows:-

Set Point 1 Low level cut out of duty and duty assist pump

Set Point 2 Cut-in of duty pump

Set Point 3 Cut-in of assist pump

Set Points 4 & 5 Spare

The Contractor shall also supply and install two level switches. One switch shall provide low level alarm and cut out of pumps. The second switch shall provide high level alarm. These level switches shall be conductivity type or float type level switches.

The ultrasonic level controller shall also transmit an analogue signal to the telemetry outstation for level indication.

The output of the pumps shall be monitored by an electro-magnetic type flowmeter mounted on the rising main. The Contractor shall supply and install the electro-magnetic flow meter c/w any pipe fittings necessary to suit the proposed meter diameter and shall also provide the required straight lengths of pipework upstream and downstream of the meter. Refer to Drg. Nr. A5090-N018. This flowmeter shall be capable of providing flow rate and totalisation both locally at the on-site kiosk and remotely back to the control centre at Atlantic Pond Pumping Station via the telemetry outstation.

The Contractor shall provide and install the internal pipework as detailed in the pipework schedule on the drawing Nr. A5090-N002. The Contractor shall also supply external pipework and fittings to the extent indicated on the drawings.

All electrical and mechanical equipment installed in the wet well shall be suitable for Zone 1 Hazardous Area, operation.

The Contractor shall supply and install a control panel which shall be housed in a kiosk as detailed on Drg. Nr. A5090-N018.

The following shall be supplied and installed by the Contractor :-

- 3 Nr. (1 Duty/1 Assist/1 Standby) fixed speed pumps as specified.
- All pipework, fittings, valves as described.
- 1 Nr. ultrasonic level controller and 2 Nr. level switches.
- 1 Nr. electro-magnetic type flowmeter c/w pipework and fittings.
- Provide control panel and separate telemetry enclosure.
- Davits and lifting chains, etc all as described in Clauses 8 and 18.

## 4.0

**FLAXFORT PUMP STATION**

(Refer to Drg. Nr. A5090-N005/N006 / N007 / N008 / N009 / E002)

At Flaxfort pump station the scope of the Mechanical and Electrical (M & E) Contract provides for the supply, installation and commissioning of the following equipment.

1. 4 Nr. Pumps
2. Associated suction and delivery pipework, valves and fittings, terminating outside the pump station as shown on Drg. Nr. A5090-N007.
3. 1 Nr. Sump Pump and associated pipework, valves, grating and fittings.
4. Electrical installation including main ESB incoming panel, motor control panel, general distribution board, wiring of all equipment, lighting heating and small power, as described elsewhere in this specification and drawing Nr. A5090-E002.
5. Telemetry System
6. Fire Alarm System
7. Intruder Alarm System
8. Electric Crane for lifting the pumps and crane beam
9. Rotating Bar Screens
10. 6mm Overflow Screens
11. Electromagnetic flow meter and associated pipework, control equipment.
12. Domestic Electrics.
13. 2 nr. Fire Extinguishers.
14. Ventilation System (refer to Section 16.11)
15. Galvanised steel access stairs, walkways, handrails, all as shown on Drg. Nrs. A5090-N021 and A5090-N007.
16. Hand Dryer

The Contractor shall supply and install 4 Nr. fixed speed pumps. The combined output with 3 Nr. pumps pumping shall be 504 l/s (6 DWF) against a total head of 26m. The pumps shall operate as 1 Nr. Duty, 2 Nr. Assist and 1 Nr. Standby. The pumps will be submersible type pumps, suitable for operation in a dry installation and capable of handling raw sewage and passing solids of up to 100mm diameter.

The required pump performance shall be based on the following data.

- Nr. of Pumps: 4 Nr.
- Design Flow (3 pumps): 504 l/s (6 DWF)
- Sump Invert level: -3.15m OD
- Header Chamber Outlet Level: 11.0m OD
- Nr. of Rising Mains 1 Nr.
- Internal Diameter of Rising Main 555.2mm (HDPE) & 500mm (DI)
- Length of Rising Main 1827(i.e. 12m DI & 1815m HDPE)
  
- Estimated Friction and fitting Losses 11.4m
- Static Head 14.55m
- Total Head 25.95m

The operation of the pumps shall be controlled by an ultrasonic level controller. The level controller shall provide a 4-20mA signal with a minimum of 5 set points for pump control to operate as follows:-

- |                 |                             |
|-----------------|-----------------------------|
| Set Point Nr. 1 | Cut out of pumps            |
| Set Point Nr. 2 | Cut in of duty pump         |
| Set Point Nr. 3 | Cut in of Assist Pump Nr. 1 |
| Set Point Nr. 4 | Cut in of Assist Pump Nr. 2 |
| Set Point Nr. 5 | Spare                       |

The Contractor shall also supply and install two level switches. One switch shall provide low level alarm and cut out of pumps. The second switch shall provide high level alarm. These level switches shall be conductivity type or float type level switches.

The ultrasonic level controller shall also transmit an analogue signal to the telemetry outstation for level indicator.

The output of the pumps shall be monitored by an electro-magnetic type flowmeter mounted on the rising main. The Contractor shall supply and install the electro-magnetic flow meter c/w any pipe fittings necessary to suit the proposed meter diameter and shall also provide the required straight lengths of pipework upstream and downstream of the meter. This flowmeter shall be capable of providing flow rate and totalisation both locally at the Pumphouse and remotely back to the control centre at Atlantic Pond Pumping Station.

The Contractor shall provide and install the internal pipework as detailed in the pipework schedule. The Contractor shall also supply and install external pipework and fittings to the flow meter chamber as discussed.

A sump pump (IL = -4.6m OD) shall be supplied and installed in a sump in the dry well of the pumping station. The pump sump shall have a capacity of 5 l/s and shall discharge into the wet well at an invert level at 1.8m OD. The Contractor shall supply and install all pipework, valves, gratings, fittings etc. associated with the sump pump as shown on the drawing.

The Contractor shall supply and install all power and signal cables which shall be terminated at a new control panel. The Contractor shall supply and install the control panel which shall be located in the pumphouse.

The Contractor shall also supply and install the domestic electrical equipment as shown on Drg. Nr. A5090-E002.

The Contractor shall supply and install 2 nr. fire extinguishers with wall mounting brackets suitable for use with electrical fires.

The Contractor shall provide a telemetry system in accordance with Section 14.0 of this specification.

#### 4.1 Electrical Crane Specification

The Contractor shall supply and install a two directional electric crane, including crane beam as indicated on Drg. Nr. A5090-N007. The Civil Contractor shall supply and install support steelwork to levels provided by the Contractor. The crane will be used to lift the pumps from the dry well. The minimum requirements are:

- Minimum rating of 2 tonnes
- Non rotating lift
- True vertical lift in crane travel direction.

The power supply shall be 400V, 50 Hz 3 phase.

The crane control shall be by means of single pendant push-button station controlling all functions. Limit switches shall be fitted to limit up and down travel as well as horizontal travel at the ends of the crane beam.

The crane shall be provided with the following:

- Wire Rope
- Swivel Hook and Safety Lock to Suit Pumps
- One electrical and one independent mechanical load braking system.
- Hardened and ground gears in oil bath gear boxes.
- All lubricants shall be factory installed and shall not require changing over the normal life of the cranes.
- Total drift from true vertical shall not exceed 2%.
- The crane and controls shall be designed to be user friendly and to simplify routine maintenance.
- Cranes shall be enamel paint coated, colour Safety Yellow (RAL 1021).

- The capacity of the crane shall be clearly marked on each side of each crane beam.
- The capacity of each trolley/hoist shall be clearly marked on each hoist block.
- Paint colours and capacity markings shall be in accordance with relevant legislation.

#### 4.2 Rotating Bar Interceptor Specification

The Contractor shall supply and install a rotating bar interceptor screen (RBI) manufactured by Biwater, or approved equivalent, in the inlet chamber to Flaxfort Pump Station as shown on Drg. Nr. A5090-N007. The RBI shall be constructed from Grade 316 stainless steel and shall have 100mm spacings between the bars.

The RBI shall be fully automatic with independent hydraulic drives for each bar and shall be suitable for use in a hazardous area. A spreader beam shall be supplied to facilitate the removal of the RBI.

The RBI shall be fitted within a sliding guide rail with lifting lugs to facilitate easy removal for maintenance.

The motor controls for the RBI shall be located in the control panel. The Contractor shall be responsible for the supply and installation of the RBI including all wiring and commissioning.

#### 4.3 6mm Overflow Screen

The Contractor shall supply and install a 6mm screen at the overflow weir. This screen shall be manufactured by Rotomat, Type RoK 1 or approved equivalent.

This screen is to be maintained in a clear condition by a rotating auger on the periphery to transport screenings towards the screening discharge into the inlet chamber.

The design flow through the screen will be 701 l/s. The motor/gearbox shall be a submersible explosion proof type.

#### 4.4 Steelwork

The Contractor shall fabricate and install the access stairs, walkways, handrails, etc. in the dry well of the pump station at the locations shown on Drg. Nr. A5090-N021 and A5090-N007. The Contractor shall submit fabrication drawings for approval and comply with the specification below and the requirements detailed on Drg. A5090-N021.



General Steelwork Specification

“The National Structural Steelwork Specification for Building Construction, 3<sup>rd</sup> Edition, 1994” shall form part of this Specification.

Connections are to be designed to BS 5950 : Part 1 : 1990. Standard connections as detailed in the BCSA Publication Manual or connections shall form the basis of the connection design and the price shall reflect such connections.

There are no restrictions on the steelwork manufacturing process.

Holes for HSFG bolts may not be punched.

*Workmanship*

Workmanship generally is to be as the NSSS.

Site welding procedures must be approved prior to their use. All site welds are to be subject to non-destructive testing. Fabrication or erection attachments shall be removed from all exposed steelwork.

*Erection*

The Contractor shall agree an erection sequence in conjunction with the Engineer to suit the construction programme.

*Protective Treatment*

All steelwork to be galvanised in accordance with BS 729.

*Materials*

Steel used in the building shall be Grade 43 to ISEN 10020.

Bolts shall be grade 8.8 high tensile steel and shall be zinc or cadmium plated. Holding down bolts shall be Grade 4.6 mild steel.

The Contractor shall provide all necessary certificates to authenticate the material properties.

**5.0**

**COURTSTOWN PUMP STATION**

(Refer to Drg. Nr. A5090-N010 / N012 / E003)

Details of the proposed pump station are shown on Drg. Nr. A5090-N010.

This contract provides for the supply and installation of the following equipment.

1. 2 Nr. Pumps
2. Associated delivery pipework, valves and fittings.
3. Electrical installation including control panel, domestic electrics, pump starters and wiring of all equipment as specified elsewhere in this specification.
4. 1 nr. kiosk as described in Clause 11.0
5. 1 nr. electromagnetic flow meter complete with pipework and fittings.
6. Davits and Lifting chains as described in Clause 8.0
7. 1 nr. painted metal door, associated frame and ancillaries to kiosk enclosure as described on Drg. Nr. A5090-N018.

The Contractor shall supply and install 2 Nr. fixed speed submersible type pumps in Courtstown pump station. The pumps shall operate as 1 Nr. Duty and 1 Nr. Standby

The output from each pump shall be 18 l/s against a total head of 21.6m.

The required pump performance shall be based on the following data:

• Nr. of Pumps	2 Nr.
• Pump Design Flow (1 Nr. Pump in Operation)	18 l/s
• Sump Invert Level	0.6m OD
• Header Chamber Outlet Level	11.000m OD
• Nr. of Rising Mains	1 Nr.
• Diameter of Rising Main	150mm
• Length of Rising Main	1271m
• Estimated Friction and Fitting Losses	11.2m
• Static Head	10.4m
• Total head	21.6m

The operation of the pumps shall be controlled by an ultrasonic level controller. The level controller shall provide a 4-20mA signal with a minimum of 4 set points for pump control to operate as follows:-

Set Point 1            Low level cut out of duty pump

Set Point 2            Cut-in of duty pump

Set Points 3 & 4      Spare

The Contractor shall also supply and install two level switches. One switch shall provide low level alarm and cut out of pumps. The second switch shall provide high level alarm. These level switches shall be conductivity type or float type level switches.

The ultrasonic level controller shall also transmit an analogue signal to the telemetry outstation for level indication.

The output of the pumps shall be monitored by an electro-magnetic type flowmeter mounted on the rising main. The Contractor shall supply and install the electro-magnetic flow meter c/w any pipe fittings necessary to suit the proposed meter diameter and shall also provide the required straight lengths of pipework upstream and downstream of the meter. This flowmeter shall be capable of providing flow rate and totalisation both locally at the on-site kiosk and remotely back to the control centre at Atlantic Pond Pumping Station.

The pumps shall be suitable for use with raw sewage and shall have a solid passing capacity of 80 mm. The pump rotational speed for each pump shall not exceed 1450 RPM. The Contractor shall state the efficiency of the pump.

The Contractor shall provide and install the internal pipework as detailed in the pipework schedule on Drg. Nr. A5090-N010. The Contractor shall also supply and install external pipework and fittings to 1.0m beyond the flowmeter assembly.

All electrical and mechanical equipment installed in the wet well shall be suitable for Zone 1 Hazardous Area operation. The Contractor shall supply and install the control panel and kiosk to the requirements set out in Sections 11 and 15 of the Specification. The control panel shall be housed in the kiosk at the location shown on Drg. Nr. A5090-N010.

The following shall be supplied and installed by the Contractor:-

- 2 Nr. (1 duty/1 standby) fixed speed pumps as specified
- All pipework, fittings, valves as described.
- 1 Nr. ultrasonic level controller and 2 Nr. level switches.
- 1 Nr. electro-magnetic type flowmeter c/w pipework and fittings
- Provide kiosk, control panel and separate telemetry enclosure.
- Davits and lifting chains etc all as described in Clauses 8 and 18.
- 1 nr. baffle plate in the wet well.

## 6.0 POWER SUPPLY

A 3-phase 400V 50 Hz power supply will be available for each station. Power will be brought to the installed kiosk or pumphouse control panel through an underground cable. The Contractor shall include for the installation of ESB meters and fuses in the control Panel. Reference should be made to other sections in this Specification concerning power supply regulations and requirements.

## 7.0 PUMPS

All pumps shall be capable of delivering specified flows against the head stated and suitable for the duty specified when running at a speed of not more than 1450 rev./min. Characteristic curves shall be supplied with the tender

showing the power absorbed at all heads. Pumps shall be of the non-overload type and the kilowatts absorbed when working against the minimum head shall not be greater than that absorbed when working against closed delivery valves.

Pumps shall be of the unchokable single stage centrifugal submersible type and should be suitable for pumping untreated sewage containing fibrous and solid matter, as well as grit. In the wet well the pumps shall be able to operate continuously either submerged or partially submerged. They shall be capable of being started against a closed valve and against all operating conditions, including being run on a regular basis for short periods in order to keep the wet wells free from silt.

All pump installations shall be provided with Automatic Changeover facility for duty/standby arrangements (8 hour period).

The manner of operation shall be described, in the tender i.e. programmable logic controller or similar approved.

Each pump installation shall include a hard-wired low level cut-out system to prevent dry pump operation.

The impellers shall be of cast iron material. They shall be machined all over and flow passages shall be filed smooth. They shall be balanced carefully, both separately and mounted on shaft, and they shall be suitably keyed to the shaft and rigidly fixed in position. Impellers shall not be pinned to the shaft nor rely on shaft rotation for locking. The impellers shall be fitted with grit repelling ridges.

All pumps shall be capable of passing solids up to 100mm except for those in Courtstown Pumping Station which shall be capable of passing solids up to 80 mm.

Provision shall be made in the design of the pumps to take any out-of- balance thrust created in the pumps.

The rotating assembly shall be statically balanced in accordance with BS 6861, Part 1 or equal.

Sealing rings shall be of silicone carbide or other suitable material and shall be renewable but rigidly fixed in position.

The speed shall be not greater than 1450 rpm.

The pumps shall be automatically started and stopped at the required levels by approved equipment, a separate control being provided for each pump. The controls shall be adjustable at other levels if necessary. A hand operated sequence changeover switch shall be provided also in order that the duty may be changed from pumpset to pumpset. Also, a facility shall be provided in the control system to enable standby pumps to cut in automatically should the duty pumps fail.

The motor starters shall be direct on-line type for each pump motor 4kw or under and automatic Star Delta for each pump motor in excess of 4kw, the best of their kind and of approved manufacture. They shall be arranged to operate either by automatic switches or manual control.

The power factor shall at all times be 0.95 or greater. The capacitors shall be mounted in the motor control panel.

Each pump shaft shall be of high tensile steel, accurately ground and of ample section to transmit the power required at maximum load.

Each casing shall be of substantial construction in close grained grey cast iron and shall have machined supports suitable for mounting on base plates. The pumps shall be provided with a drain point.

The Contractor shall ensure that the pump installation/pipework arrangements are such as to prevent air locks. Each tender must be accompanied by drawings and full descriptions of the pumps and guaranteed performance curves showing the following:-

- (a) Efficiency plotted against delivery.
- (b) Kilowatts against delivery.
- (c) Head plotted against delivery.

## 8.0 SUBMERSIBLE PUMP REMOVAL

Submersible pumps shall be capable of being lifted vertically and easily out of the wet well using the guide rails provided by the pump manufacturer without the need to enter the wet well. When the pump is lowered on its guide rails, it shall couple to the delivery pipe under its own weight.

Guide rails, galvanised mild steel or approved equivalent, shall be fixed firmly in place with galvanised steel brackets, stainless steel nuts and bolts. Insulating washers and bushes shall be used on all material interfaces to prevent galvanic action.

Davits and davit sockets shall be provided and suitably positioned for straight lifting of pumps. Both davits and sockets shall have safe working loads indelibly marked on them and test certificates shall be provided. Davits shall be galvanised and be of the removable type. Each davit socket shall have a minimum safe working load of 500 kg.

Galvanised mild steel lifting chains shall be provided. These shall be short link chains to BS 4942, Parts 1, 2 and 3, or equal, incorporating a large link (min. 50mm) at not more than one metre intervals to facilitate lifting.

Pump cables shall accord with 5345 Part 1 or equal, and include a flexible metal screen or armour. The cables shall be suitable for use in Zone 1 Hazardous Areas.

## 9.0 ELECTRICAL MOTORS

### 9.1 Submersible Motors

Motors shall have protection as defined in BS 5345 or equal.

Motors shall be housed in a watertight casing manufactured to BS 5501 or equal, and shall be suitable for continuous operation, either submerged or partially submerged in sewage.

Motors and switchgear shall be designed for up to 15 starts per hour. Motors shall be continuously rated and non-overloading, i.e., sized to cover the maximum power absorbed by the pump under all operating conditions.

The motors shall be suitable for 400 volt, 3 phase, 50 hertz supply and their construction shall be in accordance with the appropriate National Standards and latest modifications and they shall comply with all such requirements as regards test rating, sustained overloads, temperature rise, types of enclosure and general testing. Careful dynamic balance shall be required in conjunction with the dynamic features of the pumps.

The bearings shall be of the lubricated for life maintenance free variety and suitable provision shall be made for thrust effect and adequate protection incorporated against ingress of suspended grit or sand. All parts of the motors shall be protected against corrosion. The motors shall be suitable for automatic operation. Casings shall be of cast iron, gunmetal or bronze. The motors shall be the product of an approved manufacturer and constructed throughout of first class materials and workmanship. The efficiency and power factor at full load shall be stated when tendering, also rotor volts and amps, and full load current on 400 volt supply. Graphs will be required for pump motors to show variation in overall efficiency, pump discharge and current demand as the working head varies.

Pump motors shall be fitted with either thermal switches or thermistor impregnated in their windings to detect pump failure or overheating of a pump motor. These shall be wired back to the appropriate protection relays in the pump starter.

Pump motors shall be fitted with earth fault and moisture detection (seal failure), which shall be wired back to the appropriate protection relays in the pump starter.

### 9.2 Electrical Motors - (General)

The electric motors shall be three phase TEFC IP67, totally enclosed submersible type and suitable for 400 volt, 3 phase, 50 hertz supply, manufactured by an approved firm, and of the best materials and workmanship. Their construction shall be in accordance with the latest National Standards and shall comply with all such requirements as regards test rating, sustained overloads, temperature rise, and general testing. The winding shall be impregnated against dampness. Motor bearings fitted with ball or roller

bearings shall be designed to take the weight of the motor, which shall be balanced to run without vibration.

The efficiency and power factor of all motors at full load shall be stated when tendering. The power factor shall at all times be 0.95 or greater. Capacitors shall be mounted in a separate cubicle.

The electric motors shall be suitable for use in a hazardous area classified Zone 1 - thus the motors shall be rated EEx'd' or EEx'e'.

## 10.0 PUMP TESTS AND IDENTIFICATION

Performance tests shall be in accordance with Clause 35 of the General Conditions of Contract.

Pumps and motors shall be tested at the manufacturer's premises to BS 5316 Part 1 : Class C or equal, in order to demonstrate that they are capable of achieving the specified operating conditions. These tests shall be witnessed by a representative of the Engineer. Pump data sheets shall be provided before the pumps are delivered to site.

Pump and motor characteristic curves shall be provided based on the readings taken during the tests and shall cover the whole working range of the pump from closed delivery valve to fully opened valve.

Each pump shall be indelibly labelled with details of pump output (in terms of flow and head), make, size, impeller type, power rating and serial number. Labels shall be fixed adjacent to the motor starter panel and in a clearly visible position near to the top of the wet well. Labels near to the top of the well shall state "Pump Nr. 1", "Pump Nr. 2", etc.

Volumetric tests shall be carried out on site in the presence of the Engineer to verify the theoretical performance of each pump.

## 11.0 KIOSKS FOR WALLINGSTOWN & COURTSTOWN PUMP STATIONS

The electrical control panel, telemetry equipment and the ESB's incoming supply and meters shall be housed in a weatherproof, ventilated and lockable kiosk to be located at each of the 2 Nr. pumping stations.

The kiosks and the control panels shall be factory built, of vandalproof 10 mm galvanised mild steel construction complete with lock/sliding bar and padlock, primed and painted green with corrosion resistant paint and shall be free standing.

The kiosks shall be positioned as shown on Drg. Nrs. A5090-N002/N010. The doors shall be lockable and shall be retained in the 90° open position with stays.

The kiosks shall be mounted on a plinth at least 150mm above the surrounding paved area and sealed with mastic to prevent the entry of water.

The kiosks shall be cross ventilated with one high and one low vermin proof ventilation grille on opposite sides. An interior light shall be provided.

A warning notice (made from durable plastic) will be required on the outside of the kiosk (in black letters on a yellow background) 'DANGER - Electrical Apparatus', together with a standard flash symbol.

Rubber insulating mats will be required inside the kiosks.

Each kiosk shall house the following equipment:-

- (a) ESB's incoming supply, meters and distribution equipment in separate enclosures.
- (b) Connection for mobile generator;
- (c) Telemetry outstation;
- (d) Control panel;
- (e) Intruder Alarm;

## 12.0 ESB'S INCOMING SUPPLY, METERS AND EQUIPMENT

One section of the kiosks at Wallingstown and Courtstown shall contain a board on which the ESB can mount its meters, CT's and equipment. Access to this section of the kiosk shall be via a lockable, hinged, external door.

At Flaxfort Pumping Station the Contractor shall allow a lockable polyester coated steel IP 44 rated enclosure into which the ESB can mount its meters, CT's and equipment.

The ESB's earth electrode shall not be used as the sole means of earthing. A separate earth electrode shall be installed and the Corporation will require this to interconnect with the ESB's earth electrode.

An allowance of €50,800 provided in the Schedule of Prices for the ESB Power Supplies to the 3 nr. Pumping Stations.

## 13.0 CONNECTION FOR MOBILE GENERATOR

A five pin pilot appliance inlet to BS 4343 or equal shall be mounted inside the kiosks at Wallingstown and Courtstown in order that a mobile generator can be connected. A flap shall be fitted to the outside of the kiosk and shall be outward opening, hinged at the top, secured from within with a shoot bolt and provided with a stay to retain the flap in a horizontal position to facilitate entry of the cable connector.



## 14.0 TELEMETRY SYSTEM

The Contractor shall provide and install (in a separate enclosure) for each of the 3 Nr. pumping stations, a telemetry outstation and equipment from the Control Microsystem SCADAPAK series of compact PLCs or approved equivalent. The telemetry outstations for Wallingstown and Courtstown pump stations shall be located with the kiosks described in Clause 11.0. The outstation for Flaxfort pump station shall be located in the control panel within the pumphouse building. The outstation shall monitor and record the operation of the pumping station and transmit information back to the main control centre at Atlantic Pond P.S. via standard dial up telephone lines. The SCADAPAK outstation, or approved equivalent, shall be configured to communicate with the main central station PC in Atlantic Pond Pumping Station which shall be running 'In-Touch' software or approved equivalent. The Contractor shall include modems which incorporate an auto-dialing facilities capable of dialing at least 2 nr. telephone numbers and capable of transmitting any or all of the following signals:-

### Wallingstown Pump Station

- a) Mains Power Failure
- b) Level Controls Failure
- c) Pump Nr. 1 Running
- d) Pump Nr. 1 Tripped
- e) Pump Nr. 2 Running
- f) Pump Nr. 2 Tripped
- g) Pump Nr. 3 Running
- h) Pump Nr. 3 Tripped
- i) Hours Run For Each Pump Motor
- j) Intruder Alarm at Kiosk
- k) Instantaneous Flow
- l) Totalised Flow
- m) Water level in sump

### Flaxfort Pump Station

- a) Mains Power Failure
- b) Level Controls Failure
- c) Pump Nr. 1 Running
- d) Pump Nr. 1 Tripped
- e) Pump Nr. 2 Running
- f) Pump Nr. 2 Tripped
- g) Pump Nr. 3 Running
- h) Pump Nr. 3 Tripped
- i) Pump Nr. 4 Running
- j) Pump Nr. 4 Tripped
- k) Sump Water Level
- l) Hazardous Gas Occurrence
- m) Hours Run for Each Pump Motor
- n) Intruder Alarm
- o) Instantaneous Flow

- p) Totalised Flow

#### **Courtstown Pump Station**

- a) Mains Power Failure
- b) Level Controls Failure
- c) Pump Nr. 1 Running
- d) Pump Nr. 1 Tripped
- e) Pump Nr. 2 Running
- f) Pump Nr. 2 Tripped
- g) Sump Water Level
- h) Hours Run for Each Pump Motor
- i) Intruder Alarm
- j) Instantaneous Flow
- k) Totalised Flow

A P.C. sum of €38,000 has been included in the Schedule of Prices to include for the costs of providing dedicated phone lines to the pumping stations.

### **15.0 CONTROL PANEL (GENERAL)**

The control panel shall be of welded steel construction, dust and damp protected to IP54 to BS EN 60529:1992. It shall be built in accordance with BS EN 60439-1:1990 Form 4 and to the fault capacity as specified by the ESB. The component parts of the control panel shall be in accordance with BS EN 60947 : Parts 1 to 7 inclusive.

Tenders shall clearly state the manufacturer of the control equipment offered. The panel shall be in accordance with the current Factories Act and shall conform to current Codes of Practice for design, construction and erection and shall be adequately vented to dissipate heat build-up and satisfy the switchgear controls.

Switchgear shall be built in accordance with IEC 439 and the ETCI Code of Practice for the design, selection and erection of low voltage switchgear assemblies and be in accordance with Appendix 1 - General Electrical Specification of this Document. The MCC shall be the multi-cubicle type, non withdrawable FBA (factory built assembly). Incoming supply shall be bottom entry as specified by the Engineer. Outgoing feeds will be bottom exit and the panel will have gland plates suitably drilled to accept PVC/SWA/PVC cables, unless otherwise stated.

The equipment will be suitable for 400 volt three phase AC 50 Hz supply. Switchgear enclosures shall be metal enclosed or moulded type and shall be of sturdy and rigid construction. The enclosure will have a degree of protection to IP 54. Enclosures must prevent danger from shock due to 'direct contact' in accordance with Clause 4.2 and indirect contact in accordance with Clause 4.3 of the "National Rules for Electrical Installation, Third Edition, 2000.

A full length copper earth bar shall be fitted at the rear of the panel, terminating at the main incoming cable sealing chamber. All earth wires from the various items will be connected at this earth bar.

Access to each compartment shall be by front hinged doors with lockable handles. Each door shall be mechanically interlocked with its isolator, which shall have facilities for locking in the "off" position.

Anti-condensation heaters for switchgear starters and motors shall be 110V type, with auto-off switch on the appropriate starter panel.

Indicator lights shall be of the multiple LED Cluster type, with a transformer and shall be provided where specified. They shall comply with BS EN 60073: 1993. They shall be of Schneider Harmony protected LED type or equivalent.

Circuitry shall include 'fail safe' features and in addition, shall be such that on restoration of power after an AC failure, the healthy drive is not locked out. This shall enable the plant to run unmanned in the auto position.

Each section of the panel shall have outward opening hinged covers, rigidly constructed from sheet steel and shall be provided with jointing material to ensure a seal when closed.

The control panel will be required to incorporate the following equipment and facilities:-

- Incoming supplies, metering and distribution section.
- Pump control section.
- Pump starter section.
- Cable marshalling section containing the earth bar.

Each section above shall be provided with a thermostatically controlled anti-condensation heater operating on 110 Volts.

## 15.1 Incoming Supplies and Distribution Section

This section of the control panel shall comprise:-

- (a) Two triple pole and switched neutral fuse-switches, mechanically interlocked and having a common door interlocked handle assembled to form a switch for the mains and standby generator supplies. The switch shall be labelled "Mains/Off/Generator". Three HRC fuses shall be fitted to both switches, except where a separate mains supply switchfuse is fitted (in the ESB's metering section). In this case, solid copper links shall be fitted to the mains switch. Alternatively, one supply changeover switch (mechanically interlocked with the door) and separate "red spot" type fuse holders for the mains and generator power supplies.
- (b) Phase failure, phase reversal and low voltage protection relay to provide a "mains failure" telemetry signal. Contacts will be needed to

stop the pumps upon detection of a fault. The contacts shall be time delayed (adjustable up to three minutes) upon re-energisation of the supply to ensure that the supply has been fully restored before a pump starts.

- (c) Set of fuses and neutral link for phase failure relay and voltmeter.
- (d) The following equipment shall be mounted on the door of the incoming supplies and distribution section:-
  - Voltmeter, scaled 0 to 500 Volts and 7 position selector switch.
  - One splash-proof IP 54, 13 Amp BS 1363 socket, with 10 mA RCD protection.
  - 230V/24V AC 500 VA transformer and all associated wiring, MCBs and 24V industrial socket outlet for a hand lamp.
  - Rating plate stating voltage, frequency, full load current and utilisation category.
  - A fuse-fed single phase and neutral MCB distribution board (for sump lighting etc.) with integral isolator and hinged cover. All MCB's shall be capable of being padlocked in the "off" position. Note: If required, this unit can be separate from the control panel.
  - A "press to test" common pushbutton facility for testing all indicator lamps.

## 15.2 Pump Control Section

This section of the control panel shall include:-

- (a) SP and N double pole isolating switch having auxiliary contacts and door interlocked handle.
- (b) 230:110 Volt control circuit transformer. One end of the secondary shall be connected to earth and fuse protection provided.
- (c) Separate fuses and links for level controller, control circuits and back-up float control.
- (d) Back-up float switch level control relays and period timer to operate the pump for a set period (using a high level float switch in the wet well) in the event of failure of the level control system. A low level float switch level control relay shall also be provided to stop the pump (using a low level switch in the wet well).
- (e) A separate high level float switch relay shall be fitted for high level alarm (operated from a separate float switch in the wet well). Note:

The wet well is classified as Zone 1, therefore, all connections to float switches will need to be intrinsically safe via barrier connections.

- (f) All necessary relays and timers.
- (g) An ultrasonic level controller shall be installed in this section of the control panel enabling adjustment to pump start and stop levels to be made at the panel. (Pump starting and stopping shall be automatically controlled by an ultrasonic, sewage level sensing device installed by the Mechanical Contractor in the wet well). Separate level control alarm points (with indicating light emitting diodes (LED's) shall be provided for duty start, standby start, stop, high level alarm and ultrasonic failure alarm. The controller shall also be required to incorporate a "run-on" facility (with key switch over-ride) which periodically allows pumping to continue below the normal stop level - in order to keep the wet well free of silt. Auto-rotation of pump duties is needed every 8 hours.
- (h) The following equipment shall be mounted on the door of this section of the control panel:-
  - Pump duty selector switches.
  - LED's indicating duty start, standby start, etc. (as in (g) above).
  - Pilot lamp - back-up control on.

**Notes:**

All equipment installed in the wet well shall comply with BS 5345 or equal and be suitable for Zone 1 applications.

**15.3**

**Pump Starters**

This section of the control panel shall contain:-

- (a) TP an N isolating switch having auxiliary contacts and a door interlocked handle;
- (b) 230:110 volt control circuit transformer. One end of the secondary shall be earthed and fuse protection provided;
- (c) Control circuit fuses and links;
- (d) Motor starters in each pumping station for the following:

**Wallingstown Pump Station**

Pump Nr. 1  
Pump Nr. 2  
Pump Nr. 3

**Flaxfort Pump Station**

Pump Nr. 1  
 Pump Nr. 2  
 Pump Nr. 3  
 Pump Nr. 4

**Courtstown Pump Station**

Pump Nr. 1  
 Pump Nr. 2

- (e) 3 phase thermal overload with single-phasing protection and external hand reset. Additionally, motor "over temperature" protection will be required.

**Notes:**

- (i) Power factor correction equipment will be required. Power factor shall be maintained at not less than .95 lagging.
- (ii) Capacitors shall be separately fused and labelled with the safe discharge time and undercurrent/under power sensing.
- (iii) Contactors shall be rated at motor full load current +20%.
- (f) The following equipment shall be mounted on the doors of these two sections of the control panel:-
- Stopped/available lamp.
  - Emergency Stop push button.
  - Run/off/auto switch
  - Ammeter, hours run meter (5 digit)
  - Fault reset pushbutton (yellow)
  - Motor tripped lamp (separate lamps for O/L, thermistor, earth fault, thermal switch and seal failure).
  - Motor running lamp
  - Start/Stop pushbuttons for operation in "hand" position.
  - Main isolator for starter (door interlocked)
  - Lamp Test Facility
- (g) The panel shall also include for the following:-
- The emergency stop pushbutton for each pump shall have reset facilities only at the control panel.
  - Individual motor protection for earth fault and moisture detection (seal failure).
  - Thermistor motor protection relay (where applicable).
  - Control circuit test switch.
  - Some means of detecting pump failure or overheating of a pump motor if a pump "runs dry". This may involve installing a low level float switch in the wet well or installing underpower

protection, or fitting three thermal switches in motor stator windings.

#### 15.4 Cables Section

Outgoing cables and bus wiring cables shall be located in a vertical section of the control panel adjacent to the starter panel. This section of the panel shall not be less than 250mm wide. Pump starter, telemetry and auto-control cubicle terminals, shall be located within their respective compartments. Telemetry terminals shall be coloured orange.

Volt-free contacts shall be provided and hard wired through to a terminal block in this section of the kiosk to monitor the operational state of the station as indicated elsewhere in this specification.

One common solid earth bar shall be installed in this section of the control panel and all circuit earths, mounting plates, gland plates, door and metal work shall be connected to this earth bar.

#### 15.5 Other Control Panel and Electrical Requirements

- (a) Main and sub-main cables shall carry the phase colour indicated by the ESB's main cable, i.e., brown, red, yellow for the phases and blue for neutral.
- (b) Cables shall be permanently labelled at each end and where they enter ducts or chambers and labels shall correspond with those on the drawings and schedules.
- (c) Separate cable ways shall be provided inside the control panel to allow complete segregation of wiring between each section of the control panel. "Bus-wiring" from the incoming supply section to each isolator shall be mechanically protected from all other wiring and suitable for the current rating of the main fuses.
- (d) All internal control wiring shall have numbered identification ferrules in accordance with the wiring diagram. All equipment, including switchgear, isolators, distribution boards, junction boxes, level controllers, pump motor control panels, individual contactors, relays, fuses, etc., shall be clearly labelled (self adhesive plastic tape shall not be used). Wiring diagrams shall be located inside the kiosk.
- (e) Indicator lamps shall be of the multiple LED Cluster type and their lenses shall be coloured:-

RED	=	Hazardous Condition
GREEN	=	Running
WHITE	=	Stopped/available
YELLOW	=	Tripped

in accordance with BS EN 60204.

- (f) Control circuits, indicator circuits and heater circuits shall be separately fused. Starters and distribution equipment shall be designed so that following a fault, there is no need to replace anything other than fuses or the item which has failed.
- (g) Fuses shall be HRC cartridge type to BS 88 or equal. If not mounted directly on isolating switches, they shall be fitted in fuse holders. Each fuse holder shall have a fixed base and withdrawable carrier to house the fuse. There shall be no access to live connections on the fuse holder when the fuse carrier is connected to the fixed base. The electrical connections in the fixed base shall be shrouded to prevent hand contact when the fuse carrier is removed.
- (h) A spare set of fuses and indicator lamp bulbs shall be provided in each section of the control panel.
- (i) All isolating switches shall be padlockable in the "off" position. Live side connections shall be shrouded to IP30 and marked with the circuit voltage. The "on" and "off" states of the isolator shall be clearly displayed on both the door of the panel and inside the panel when the door is open.
- (j) All doors on the control panel shall be lockable.
- (k) The control panel shall be corrosion protected to provide a minimum 20 year life expectancy.
- (l) Local padlockable switched isolator units are required for each pump (suitable for Zone 1 Hazardous Area).
- (m) There shall be a minimum distance of 1 metre between the outer edge of control panel doors (when opened at 90° to the control panel) and the nearest fixed object.
- (n) With the exception of anti-condensation heaters, components shall not be mounted on the top, sides or bottom of the control panel, except as approved by the Engineer.
- (o) All control panel doors shall be appropriately labelled with engraved plastic material (fixed by screws / rivets) and:-

Main lettering shall not be less than 6mm;  
 Minor lettering shall not be less than 3mm;  
 Danger / Warning lettering shall not less than 6mm;  
 Labels indicating Danger shall be red with white lettering;  
 Labels indicating Warning shall be yellow, with black lettering;  
 All other labels shall be white with black lettering;

All doors shall have appropriate warning labels whether equipment can be isolated or not.



- (p) Voltage transformers shall have an earthed screen between primary and secondary windings.
- (q) Ammeters and voltmeters shall be 72mm square.
- (r) Any terminals which may be live when a cubicle is isolated by its own isolator shall be covered with a clear shroud marked "Danger - Live Terminals" and the voltage. The shroud shall be secured with screws.

## 15.6 Earthing

1. Earthing shall comply with ETCI Regulations for Electrical Installations and with the ESB's requirements. All metal equipment on the site of the pumping station, e.g., pump guide rails/wires, covers, ladders, metallic services and rising main shall be bonded to earth. Copper skinned earth electrodes shall be driven into the ground external to the kiosk/building. Rods shall be minimum 15mm diameter, in 1.25m lengths and shall be driven to a minimum depth of 5m and fitted with a hardened steel tip and driving cap, and have internal screw and socket joints. Rods shall be connected with a purpose made clamp below ground level in inspection pits, with removable covers. The earthing lead shall be routed using 25mm heavy gauge polythene conduit.
2. The resistance of the earth electrodes shall be such that the total earth loop impedance will allow sufficient current to flow to operate the protection devices within the time specified in the IEE Regulations for Electrical Installations. Additionally, residual current devices may be used where appropriate. If used, they shall be fitted with an external test button, external reset and tripped lamp.
3. A typical arrangement of earth bonding shall comprise PVC insulated cable, coloured green/yellow of not less than 16mm<sup>2</sup> C.S.A. The surfaces of all equipment/pipes to which earthing bonds are to be fixed shall be cleaned free from paint and other non-conducting materials and the bare surfaces coated with petroleum jelly. All earth connections shall be made using bolted, tinned, compression type cable lugs, petrolatum taped on completion to seal the lug and any bare copper from the atmosphere. Metal equipment/pipes shall not be used as an earth conductor for other earth connections.
4. At the points of connection with the earth electrode rods in the inspection pits and the E.S.B.'s earth electrode, a label shall be permanently attached and state "Safety - Electrical Earth - Do Not Remove". Where the earth electrodes provided by the Contractor interconnect with the E.S.B.'s earth electrodes, a removable test link shall be provided. A stud terminal shall also be provided and connected to the independent earth electrode system - for use with a mobile generator. A label shall be fixed adjacent to the stud terminal

stating "Bolted earth connection must be made before generator is connected with main plug and socket".

## 15.7 **Other Requirements Relating to Pumping Stations**

Separate underground ducts shall be provided into the control panel for power cables and communication lines. The Contractor will be informed of their location.

Ducts shall be a minimum 450mm below surface with long radius bends and 100mm nominal diameter, unless otherwise agreed. The duct carrying the pump cables shall enter the wet well at a higher level so that the cables can be easily reached from the top of the wet well. Initially, ducts shall be provided with draw cords and finally they shall be thoroughly sealed with an approved purpose made sealant against the ingress of gas and moisture at entry to the control panel, wet well and valve chamber to prevent the passage of gas to the control panel.

## 16.0 **ELECTRICAL SPECIFICATION - GENERAL**

### 16.1 **Installation**

The whole of the electrical installation in connection with the plant herein specified shall be carried out in accordance with the electrical specification set out in Appendix 1 of this document.

### 16.2 **Domestic Electrics - Lighting and Equipment**

The Mechanical Plant Contractor shall supply and install the light fittings and associated equipment as specified on Drg. Nrs. A5090-E001, A5090-E002 and A5090-E003.

### 16.3 **Site Socket Outlets**

The Contractor shall supply and install socket outlets in accordance with this specification. In addition, he shall supply the required power cabling to these units from the General Power Distribution Board in the kiosks or building as appropriate.

### 16.4 **Temporary Site Electrics**

The Contractor shall include for provision of all power and lighting for his works and as required for safe working conditions during the construction phase of the project.

### 16.5 **Instruments - General**

The Contractor shall include for the supply, installation, calibration, testing and commissioning of all the instruments detailed in this document. Instruments within sumps shall be suitable for use in a Zone 1 Hazardous Area.

All instrument locations are to be agreed with the Engineer on site before installation and shall be permanently accessible for maintenance/ calibration.

#### 16.6 Instrument and Valve Actuators - Power Supply

The Contractor shall note that apart from instruments that are powered by the 24V, 4-20 mA loop from the telemetry panel, instruments and valve actuators shall be powered by 110V A.C. These instruments include flowmeters and level sensors.

#### 16.7 Bonding

All equipment items such as pumps, davits, pipework, etc. shall be bonded to the main earth bar in the kiosk or to adjacent main bonding cables on cable trays or ladders.

Equipment items and pipework shall be bonded in 16mm<sup>2</sup> PVC covered copper cabling while cable tray shall have a 25mm<sup>2</sup> PVC earth cable run on each cable tray route and lugged directly to each cable tray section. A 70mm<sup>2</sup> PVC covered copper earth cable shall be run on each cable ladder route and lugged directly to each cable ladder section.

PVC/SWA/PVC power cabling to all motors shall be of the 4 core type with the fourth core acting as the earth conductor.

#### 16.8 Gas Detection

The Contractor shall include for the supply and installation of an approved gas detection units at Flaxfort Pumping Station to monitor the occurrence of hazardous gases, as follows:-

- Hydrogen Sulphide	0 - 20 ppm
- Methane	0 - 100% LEL
- Oxygen Concentration	0 - 25% Vol.
- Combustible Gas	0 - 100% LEL

The detection units shall be connected to the telemetry system.

One system shall monitor the gases in the wet well and the other unit shall measure gases in the dry well.

The gas detection monitoring panel shall comprise the following items, which shall be of Monicon Technology Ltd. manufacture (or equivalent).

- 1 Nr. 16 Channel Euro Rack System
- 1 Nr. 14 Channel Mother Boards
- 2 Oxygen Cards
- 2 Hydrogen Sulphide Cards
- 2 Combustible Gases Cards
- 2 Oxygen Concentration Cards
- 4 Blank Fronts for Spare Channels

- Intrinsically Safe Barrier Enclosure
- 8 Intrinsic Safety Zener Barriers
- Power Supply Unit/Battery Charger
- Standby Battery Back-Up (12V 24 Amp/Hour)
- Rital Wall Mounted 19" Enclosure, complete with swing frame and glass door
- Annunciator with Master Reset and Accept
- 2 nr. Output Drivers for Alarm Sirens
- Output Drivers for Traffic Light Units
- 2 nr. Alarm VFC Contact Output

### Gas Control Cards

Each gas control card shall provide the following functions:

- Digital display of gas concentration
- Instrument Status Display
- 3 adjustable alarm levels
- 4 - 20 mA output
- Alarm level relay output
- Fault relay output

Cards shall be of Monicon Technology manufacture, Models MC500-D or MC1000-D (or equivalent).

### Hazardous Area

The gas detection sensors shall be located in Zones 1 or 2 Hazardous Areas. All equipment installed in hazardous areas shall be rated either intrinsically safe (EEx ia IIC T4) or flameproof (EEx ds IIC T6).

### Hydrogen Sulphide & Oxygen Sensors

Hydrogen Sulphide and oxygen sensors shall be of the electrochemical micro fuel cell type, designed to be maintenance free and stable over long periods of time. The cell shall be fitted in polyester junction boxes along with associated electronic circuitry to form complete gas detection assemblies. Detectors shall be Monicon Technology, type MC-1000 or equivalent.

### Combustible Gases Sensors

Combustible gas sensors shall be of the catalytic bead type, with an active head to measure gas concentrations and a reference head to compensate for changes in temperature, pressure, etc. The cells shall be fitted in polyester junction boxes to form complete gas detection assemblies. Detectors shall be Monicon Technology type, CGS 500 or equivalent.

### Gas Detection Sensors

The gas detection sensors for the wet and dry wells shall monitor the gas concentrations extracted from the sampling tubing from these areas. The sensors

shall be mounted, in suitable sampling chambers. The sampled gases shall be returned to the appropriate well

### Traffic Light

The Contractor shall supply and install 2 nr. sets of traffic light sensors.

The traffic light unit monitoring the dry well shall be located over the external door of the building. The traffic light unit monitoring the wet well shall be mounted on the wall of the building facing the inlet screen chambers. The traffic light units shall provide visible indication of the air quality, as follows:-

- Green Lamp on: All Clear
- Amber Lamp on: Possible Problem / Pre-Alarm
- Red Lamp on: Alarm Condition

### Alarm Sounders

Electric sounders with output level at 100 dBA shall be located within the building to give audible indication of gas alarm condition if an alarm condition occurs when the gas detection equipment is switched on.

### Tender Details

Full details of the proposed gas monitoring systems, including gas sampling systems for duct mounted sensors shall be submitted with the tender.

## 16.9

### Portable Gas Detection

The Contractor shall supply 1 nr. portable gas detection system.

The portable gas detection system shall monitor three gases and alarm as follows:-

<u>Gas</u>	<u>Range</u>	<u>Alarm Level</u>
Oxygen	0 - 25%	19% - 24%
Hydrogen Sulphide	0 - 75 ppm	10 ppm
Combustible Gases	0 - 100 LEL	20%

### Certification & Make

The unit shall be certified to Ex ias IIC T4 for use in Zone 1 Hazardous Area, of Custodian manufacture or equal to approval.

### Shoulder Strap

The unit shall be supplied with a shoulder strap, carrying holster and waist strap.

## Battery

The portable gas detection units shall be powered from a rechargeable sealed battery pack, and each unit shall be provided with a battery charger suitable for operation from a standard 230V 13A socket.

### 16.10 Intruder Alarm

Wallingstown and Courtstown pumping station kiosks shall each be fitted with an intruder alarm system comprising the following:-

- Magnetic reed switch with inertia sensor on all external doors
- Main Control Panel with digital communicator for connection to telemetry system

In Flaxfort pumping station magnetic contacts shall be fitted on all external doors and windows and linked to a control panel. The control panel shall comprise of a digital communicator for connection to telemetry system.

The intruder alarm system shall be as supplied by Burgalarm Security or approved equivalent.

### 16.11 Ventilation System

#### 16.11.1 General:

The Contractor shall include for the supply, installation and commissioning of ventilation installation which shall be installed in Flaxfort Pumping Station. The Contractor shall demonstrate in his bid documents the capabilities of the plant, equipment manufacturer and supplier to comply with good manufacturing practice by means of a method statement and technical documentation detailing components of manufacture in compliance with this Specification.

The maximum permissible noise level from any item of equipment shall be 55 dB(A), measured 1.0 m from the equipment. The Contractor shall allow for and provide attenuation for every item of plant equipment and at all air intake and discharge points from the building emitting noise to establish a site boundary noise level not exceeding 45 dB(A).

#### 16.11.2 Scope of Work:

The scope of works is to provide ventilation to the dry well of the Flaxfort Pumping station. The ventilation system shall be designed to prevent the build-up of noxious odours and toxic or combustible gases.

The gases which could be present in the dry well include Methane (CH<sub>4</sub>), Hydrogen Sulphide (H<sub>2</sub>S) and Carbon Dioxide (CO<sub>2</sub>).

The proposed ventilation air change rates and volumes flow rates for the dry well as follows:

Area Rate	Air Change Rate/Hr	Air Volume Flow
Dry Well	4.0 AC/hr	0.5 m <sup>3</sup> /s

### 16.11.3 Description of Operation

Air for ventilation purposes is supplied to one end of the lower section of the dry well and is extracted at the other end of the dry well.

The ventilation system consists of

1 nr. supply air fan  
1 nr. exhaust air fan  
Associated ductwork.

The fresh air intake will be through louvres located above ceiling level, in one of the gable walls. The exhaust point will be through louvres located above ceiling level, on the opposite gable wall.

### 16.11.4 Centrifugal Fans

The fan housings, casings and impellers shall be of a plastic corrosion resistant construction and shall be manufactured from the following materials, uPVC, PVDF, PPS, FRP or a combination of these materials, and the entire assembly shall be tested in accordance with BS 6583:1985 and shall perform strictly in accordance with BS 878, Part 1, Class A tolerance.

The corrosion resistant centrifugal fans shall be of the single inlet type, for use with belt drives.

The fans shall be of heavy duty construction with all welded on vacuum-moulded casings, welded air tight, with a discharge flange supplied as standard.

The fan impeller shall be of the backward inclined aerofoil type and shall be designed for optimal aerodynamic performance and efficiency and shall be non overloading with an efficiency of not less than 80% of the total input power.

The fan impeller blade assembly and hub shall be welded using the latest thermoplastic jointing techniques and shall be shrink-fitted on the bearing shaft.

The fan impeller, blades, hub, assembly and shaft shall be statically and dynamically balanced at the manufacturer's factory premises and shall be certified, and a test certificate shall be issued.

The fan impeller shaft shall be supported by a heavy duty plummer block bearing housings with integral self-aligning bearings and have extended grease points mounted to the access side of the fan.

The fan shall contain special airtight seals at the extended bearing housing.

The bearings shall be precision located in position, and so arranged that the bearings may be replaced without the requirement for realignment.

The fans selected shall operate in the middle range of their characteristic and shall be capable of a 15% increase in the specified resistance without changing the fans or motors.

The fans shall be tested in accordance with BS 848: Part 2: 1985 and the sound power levels shall be submitted to the Engineer for approval.

The fan scrolls shall be fitted with drain plugs at the lowest point of the scroll.

The fan scrolls shall be fitted with an access plate on the back hub of the scroll to facilitate access for cleaning, the access plate shall be readily available irrespective of fan orientation or handling.

The fan shall be fitted with flexible collars at inlet and outlet.

The air intake shall have a facility to minimise the air gap by use of telescopic adjusting rings.

The fan and drive motor assembly shall be mounted on a strong bearing stainless steel support or pedestal and the entire assembly shall be mounted on a common stainless steel base frame, isolated from its supporting structure by stainless steel spring compression anti-vibration mountings.

The fan manufacturer shall provide a marked up fan curve showing the selected duty point operating position, and the duty point for spare capacity.

The pulleys and taper lock bushes shall be treated with heavy duty co-seal for anti-corrosion protection for exposure in corrosive atmospheres.

The pulley shall be attached, located and aligned on drive shaft by means of taper lock bushes. Pulleys shall be co-seal treated cast steel pulleys and fixed to the taper lock bush by means of Allen bolts. The taper lock bush shall be fixed to the fan shaft by means of a key. One set of pulleys and taper lock bushes will be made available should they be required for duty adjustment.

The supplied fan shall contain an air flow volume measuring device. This device consists of two pressure sensing points permanently incorporated within the fan, one point taken from a pressure ring on the inlet cone, the second point on the atmospheric discharge side of the fan. This device shall be tubed to a through terminal box mounted on the inside of the fan support pedestal or base frame.

An electronic air flow volume measuring facility comprising a pressure transmitter, suitable for incorporation into the ventilation unit control panel shall be provided, with an output of 4 to 20mA for an independent SCADA control system



Each fan shall be provided with a calibration curve with a tolerance of  $\pm 5\%$ . The standard volume meter with the calibrations set for each fan type and size has a tolerance of  $\pm 10\%$ , the fan manufacturer shall advise any additional costs, if any, for the  $\pm 5\%$  tolerance over the standard  $\pm 10\%$  tolerance.

Fan/motor speed combinations of 1:1 ratio shall be avoided to reduce the occurrence of beat frequency oscillations B.F.O., a minimum of 10% differential is required when selecting fan/motor speed combinations.

The fan split pedestal bearings shall have attached vibration transducers (accelerometers) with a sensitivity of 100 mV/G of vibration wired to an externally mounted terminal box in 2 pair PVC screened cable with a minimum conductor size of 0.75mm sq.

The fan, impeller, motor pulleys and frame assembly shall be statically and dynamically balanced to meet the requirements of VD1 2060 Group M machines - 1.5 to 2.5 mm/sec RMS between 5 Hz to 500 Hz.

The entire drive assembly shall be bolted and anchored to the box section frame work of the fan section with clamps or coated steel angle to avoid damage to the anti-vibration mounts during transportation to the site location.

The entire drive assembly shall be bolted to the floor using Tico isolation pads and stainless steel holding down bolts.

The spring compression anti-vibration mountings shall have a tolerance on perpendicularity of  $\pm 2\text{mm}$  to avoid grounding, flanking or bridging of the metal enclosure surrounding the spring, the use of rubber "snubbers" as limit stops will not be permitted.

Anti-vibration mountings which include adjustable damping devices shall not be over tightened whereby the overall isolator stiffness is dictated by that of the damping device rather than the spring assembly.

Each anti-vibration mount of the enclosed or open spring type shall be identifiable by a label or a reference colour code.

The spring member shall be located by a top and bottom retaining element, the latter shall include a bonded ribbed neoprene "noise stop" pad to the underside of at least 6mm thickness with a provision of holding down fixings. The spring mounting shall include a proprietary built in levelling facility with locking nuts.

The spring elements shall be of the helical type, at least 50mm dia. and have a horizontal stiffness not less than 130% of the vertical stiffness, to ensure stability the outside spring diameter shall be a minimum of 0.8 times the specified vertical operating height. The spring elements shall be rated such that a 50% overload capacity is available before the spring becomes coil bound.

It is the fan manufacturer's responsibility to ensure that all anti-vibration mounts/isolators installed meet specification and are suitable for the loads,

operating and environmental conditions which prevail within the pumping station.

The maximum and minimum environmental condition which will prevail within the pumping station shall be:

Maximum Conditions: +28.0°C DB  
+21.0°C WB - 70% RH

Minimum Conditions: + 10.0°C DB  
+ 8.0°C WB - 90% RH

### **Motors**

The fan motors shall be as manufactured by Hawker Siddeley Brook Crompton Parkinson electric motor company or equal to approval and shall be in accordance with the appropriate sections of BS 4999, BS 5000, IEC 34-1 and IEC 72.

The drive motors shall be protected to Eexd IIC T4 in accordance with EN 50 014 and EN 50 018.

All motors will be speed controlled and shall have thermistor protection, thermistor wiring shall be terminated in an externally mounted hot dip galvanised steel enclosure containing a 'THERMOT' control unit which operates at a trip temperature of 110°C.

Hot dip galvanised steel guards shall be provided around the motor, fan, drive belts and pulleys. The guards shall be provided with locations to enable tachometer readings to be taken. The guards shall be demountable to facilitate the maintenance personnel.

The guards shall be sufficiently large to accommodate drives throughout the full range of possible drive arrangements for the specified fan. The belt drive shall comply with BS 1440 and BS 3790 and have a horsepower rating of not less than 160% of motor rated horsepower and be capable of transmitting at least the rated power output of the driving motor with one belt removed.

The fan and motor assembly shall be mounted on heavy duty steel channel base frame.

The base frame shall be provided with secondary adjustable rails which the drive motor shall be mounted, the rails shall be located to provide position adjustment to accommodate all pulley sizes available for that fan/motor combination. The base frame shall be designed to allow for all motor size increases possible for the selected fan. The fan motor base frame shall be of stainless steel or mild steel hot dipped galvanised construction.

### **16.11.5 Ducting Installation**

This Specification sets forth the minimum requirements for the Contractor for the installation of plant and equipment and by the Contractor; for the fabrication

and installation of duct systems and their components in accordance with applicable standards and drawings noted in this Specification. The Contractor shall also accomplish specified duct leakage testing and provide start up assistance as noted in this specification.

This Contractor shall furnish all required labour, materials, tools, equipment, scaffolding, supervision and incidentals required to completely accomplish the work specified herein. The installed systems shall be tested by the Contractor, as specified, herein, and be accepted by the Owner prior to the Contractor leaving the work site.

Any conflicts arising between the requirements of this specification and the drawings shall be called to the attention of the Engineer for resolution prior to proceeding with the work.

All work shall be performed in a first class manner by individuals who are qualified and experienced in the applicable trades.

All work shall be accomplished in accordance with the requirements of any and all applicable codes or regulations. This Contractor shall obtain and pay for any and all required permits or licenses required for the work to be accomplished.

Asbestos materials or materials containing asbestos shall not be utilised in any equipment or components furnished by the Contractor.

#### **Installation Of Equipment**

The Contractor shall be responsible for all equipment furnished for installation by him, from the time of his receipt of the equipment until the installation has been accepted by the Owner. Any damage occurring to the equipment during this time shall be corrected at the Contractor's expense.

The Contractor shall remove these items from storage area, unpack as necessary, transport, handle, assemble and install the items where indicated on the applicable drawings.

This Contractor shall fabricate and install all ductwork, duct supports and all secondary and miscellaneous steel which is necessary for the installation of the ductwork system.

The Contractor shall purchase and install all components, as (i.e. balancing dampers, fire dampers, grills, diffusers) specified and all other air distribution devices and accessories.

All specified duct insulation shall be furnished and installed by this Contractor.

This Contractor shall co-ordinate his work with the Controls Contractor regarding installation of instrumentation, controls and all required interfacing with ductwork during construction.

### **Preparation For Delivery And Cleaning Of Equipment And Ductwork**

All equipment, components, ductwork and sub-assemblies shall be thoroughly cleaned of all water, sand, grit, weld spatter, grease, oil and other foreign materials before preparation for shipment. It is necessary that the equipment be delivered in a "rust-free" condition. All openings shall be capped with dust-proof plastic or metal closures, and all edges sealed or taped to provide a dust-tight closure. All machine surfaces and threads shall be protected against damage during shipment. Each assembly furnished under this specification shall be packaged in such a manner as to provide ample protection from damage during handling, shipment and weather protected outdoor storage at plant site.

All ductwork covers shall be maintained in a dust-tight condition by the Contractor during shipment and storage prior to erection.

All ductwork shall be cleaned of dirt or debris prior to installation. In addition any ductwork discovered with dirt or debris shall be washed thoroughly with an approved cleaning agent specified by the Engineer. Once cleaned all ductwork shall be inspected and certified prior to installation.

All ductwork shall be maintained in a clean condition during and after installation. The Contractor shall install dust-tight covers over all openings in erected ductwork at the end of each working day, and maintain the covers in a condition acceptable to the Engineer until adjacent equipment or ductwork is installed.

Prior to start-up and blow-down of the ventilation system the plant and equipment and associated interconnecting ductwork shall be inspected with the engineer for cleanliness, correct installation and fitting of components, fire dampers, instrumentation, access doors and volume control dampers.

The appropriate certificates shall be signed by the inspector and witnessed by the Engineer. The contractor shall allow for a final cleaning of the Plant and Equipment and the interconnecting ductwork with an approved cleaning agent.

The Contractor shall furnish and securely attach an aluminium nameplate to each equipment item he is supplying. The following information as applicable, is to be included: Manufacturer's name, model number, serial number, date of manufacture, rated air volume, static pressure, kW rating, purchase order number and item number. In addition the Contractor shall supply and securely attach a plastic nameplate showing the Client's equipment Plant Number and designation. This applies to each equipment item and instruments he is supplying and also all the plant equipment items listed in Section 2.7.11.0 of this Specification.

The Contractor will provide duct markers in accordance with DW 142 Appendix C and will mark each individual duct component and section with its own unique identification notation as required by this specification.

Crates and packages shall be appropriately marked with ink, paint or indelible material. Markings shall include the item number, description, purchase order number and destination.

The Contractor shall furnish quantities and types of vendor prints as noted on the inquiry or requisition associated herewith.

All prints, reproducibles and other documents submitted by the Contractor shall have the following information plainly marked on them:

- A. The name of the Client.
- B. The project site location
- C. The equipment item number and/or applicable system identification.

Metric units of measurement shall be used on all documents and drawings produced.

All correspondence, drawings, instructions, etc. shall be in the English language.

### **Equipment Installation**

Specific information for the equipment to be installed by this Contractor is indicated in the specifications identified in this section of this Specification.

All equipment shall be moved, lifted and handled in strict accordance with manufacturer's written instructions.

Should this Contractor require the assistance of any manufacturer regarding handling, installation, assembly or other instructions regarding installation of equipment furnished by the Contractor, he shall, at his own expense, obtain this information or assistance. All equipment shall be completely assembled by this Contractor, ready for operation, with all components and materials in place and adjusted. All required levelling, adjustment, shimming and grouting associated with equipment installation shall be by this Contractor. Therefore attendances will be required from the Suppliers or Manufacturers.

### **Ductwork, Dampers, Diffusers, Grilles and Accessories**

All ductwork, supports and joints shall be fabricated and installed in accordance with the applicable requirements of HVAC "Specification for Sheet Metal Ductwork", DW/142 latest edition and tested in accordance with the requirements of HVCA "Ductwork Leakage Testing" DW/143 latest edition.

Ductwork shall be installed as indicated on the applicable ductwork drawings. The duct runs shall be field checked and co-ordinated with the other disciplines.

Any discrepancies or interferences shall be called to the attention of the Engineer for resolution prior to duct fabrication or installation.

The position of the diffusers, grills as shown on the Drawings are in approximate locations. Actual terminal diffuser and grill locations shall be installed as shown on drawing, only after checking for interferences with other disciplines. Duct runs leading to the above terminals must be co-ordinated with all other disciplines for interferences prior to fabrication or installation.

The Contractor shall allow in his costs for a max. of 500mm long, duct connection between ceiling mounted diffuser and grille plenum boxes.

Shop drawings of the ductwork runs, fittings, supports and accessories shall be furnished to the Engineer for approval, prior to purchase or fabrication. Reference drawings indicating other disciplines work will be submitted to Contractor for clarification.

The Contractor shall provide co-ordination drawings for all ventilation systems, to the approval of the Engineer, from drawings of other services which will be provided to him.

At the completion of the installation "As Built" drawings shall be furnished by the Contractor which reflect the "as installed" configuration of the ductwork. The drawings shall locate and identify all duct installed components, devices and control components.

Unless otherwise noted on the applicable drawings, ductwork shall be classified in accordance with DW/142. Standard - Part two: Ductwork classification and air leakage standard as follows:

Service	Design Pressure Positive	Duct Pressure Class	Leakage Class	Leakage Rates
Mild Steel Galvanised Supply and Extract Ductwork	800 Pa	Medium	B	0.69 l/s/m <sup>2</sup>
Polypropylene Supply and Extract Ductwork	800 Pa	Medium	B	0.69 l/s/m <sup>2</sup>

### Tests

Supply and return ductwork for all areas shall be leak tested in accordance with HVCA's DW/143 ductwork leakage testing procedure and this specification prior to applying insulation.

### Materials Of Construction

With the following exceptions, and except where noted on the drawings, all rigid ductwork, fittings and accessories shall be hot dip galvanised sheet in accordance with BS 2989, Grade Z2, Coating Type.

Flexible metal ducts shall be of the same material as the rigid duct system to which they connect.

All ductwork supports shall be fabricated from hot dipped galvanised mild steel shapes.

All sealant utilised in the ductwork seams and joints shall be high quality grade sealant approved by the Engineer from the Silastic range.

### Rectangular Ductwork Systems

#### **Seams And Joints**

- A. Longitudinal seams shall be Pittsburgh Lock seam with sealant applied to the entire seam length during manufacture of the ductwork.
- B. Cross joints shall be mezz or zest duct flange system, flanged joints with flanges spot welded to the ductwork on 75 mm centres. A sealant shall be utilised between the flange and cut along the full contact length. Joint gasket shall be Neoprene nominal height 16 mm nominal thickness 6 mm.
- C. The duct work shall be internally free of sharp edges and obstructions and it shall be so constructed that, when erected, it shall be rigid and free of movement or drumming and truly airtight under all conditions. Rectangular Section Ductwork shall be of the following gauges, thickness, joint/ stiffener spacings, angle section for cross joints / intermediate stiffeners, all dimensions being in mm.

A	B	C	D	E	F	G
Up to 400 Over 400	0.6	0.8	2500	2500	2500	25 x 25 x 3 MSG
Up to 600 Over 600	0.6	0.8	1500	1500	1500	25 x 25 x 3 MSG
Up to 1250 Over 1250	0.8	0.8	1250	1250	1250	30 x 30 x 4 MSG
Up to 1600	1.0	1.0	800	800	800	40 x 40 x 4 MSG

- A Duct size (longer side)
- B Metal thickness - Medium Pressure
- C Metal thickness - High Pressure
- D Maximum spacing between joints/stiffeners without beading or cross bracing
- E Ditto with beading at 300 centres
- F Ditto with cross bracing
- G Minimum angle section for cross joints and intermediate stiffeners. (MSG)
- D. Longitudinal joints shall consist of a ground seam, the two halves of the joint being pre-formed through a rolling machine. All transverse joints

shall be of the slide on flanged type J3, J4 and J5. All flanged joints, stiffening, beading and cross breaking shall be constructed and installed strictly in accordance with the recommendations of the C.I.B.S.E. and the requirements of the H.V.C.A. DW/142 standard.

### Ductwork Support

Duct work supports shall be spaced at not greater than 2.5 m intervals according to the gauge of the material.

Horizontal duct runs in ceiling space shall be supported by 40 x 40 x 5 m.s.g. angle cross members carried on 10 mm drops rods suspended from the floor slab above. The ductwork shall be secured by means of 40 x 40 x 3 m.s.g. flat, shaped to three sides of duct and bolted down to the angle cross member.

The vertical duct run shall be supported at floor through which it passed by extending the m.s.g. angle stiffener on two sides of the duct so that it bears on the concrete slab at four locations. The extended stiffener shall then be rawl bolted to the floor slab at each of these points.

Where intermediate supports are required between floors they shall consist of 2 no. 50 x 50 x 4 R.H.S. spanning the short dimension of the duct and arranged so that the m.s.g. angle stiffeners on two sides of the duct bear on them. The m.s.g. angle stiffeners shall then be bolted to each R.H.S. member at one point.

The duct shall not have direct contact with any of its supports at any point. Isolation shall be achieved by interposing a gasket of suitable material such as EPDM rubber of 5 mm thickness between the duct work and its supports.

All ductwork with duct sides over 400 mm, require intermediate cleats/clamps at 400 mm MAXIMUM spacing.

Where a change of shape is necessary to accommodate the duct, and the cross-sectional area must be maintained, the slope should not exceed 22.5 degrees on any side. Where a change in shape includes local reduction in cross-sectional area, the slope should not exceed 15 degrees on any side and the reduction in area should not exceed 20%.

Where duct work expansions and contractions are required, the following directions shall apply in their fabrication.

An expansion shall be made upstream of a branch connection and a contraction down- stream of a branch connection. The slope of either an expansion or a contraction shall not exceed 22.5 degrees on any side. Where this slope is not practicable, it may be increased provided that splitters are positioned to bisect the angle between any side and the centre line of the duct.

Right angle bends, square bends and twin square bends shall be provided with double thickness airfoil turning vanes. Twin radius bends of unequal dimensions shall be provided with splitters. The vanes shall be constructed from galvanised mild steel and they shall be supported with galvanised mild steel bars at 50 mm



centres. They shall be securely attached at each end either to the duct or to the internal runners and the runners shall be fastened to the duct by means of rivets at 50 mm centres. The inner face radius of the vanes shall be 50 mm and the number of guide vanes for a given width of duct shall not be less than as indicated in the following table:

<u>Duct Width</u> mm	<u>Min. No. of</u> <u>Turning Vanes</u>
100	3
150	5
200	6
250	8
300	9
400	12
500	15
600	18
800	24
1,000	30
1,200	36
1,400	42

Turning vanes shall in all cases be of patent manufacture such as "Barber & Colman" Zest or Mezz.

Branches shall be taken off straight sections of duct and not from tapers. The connection of the branch to the main duct shall be made by cleats, rivets or bolts and an approved sealant shall be used as detailed in this specification between the main branch and the duct.

### Circular Ductwork Systems

The air conditioning ductwork generally shall be of Circular section, spiral wound.

All circular ductwork and fittings shall be of patent manufacture.

- A. Longitudinal seams in circular ductwork shall be spiral wound and dimensions shall conform to Eurovent duct standard 2/3 Series R10.
- B. Cross joints shall be of socket and spigot type with factory fitted double sealing gasket of homogenous, durable EPDM rubber. Sealant shall be utilised in all cross joints. Fasteners shall be mechanically closed rivets on 150 mm centres.
- C. All cross joints shall be sealed externally using shrinkable cross linked Polyclean Tube/Tape coated internally with a specially formulated hot metal adhesive such as that as manufactured by PEXEP of Nostola, Finland and distributed by M/S Ventac & Co. Ltd., Dublin.

- D. Branch connections to mains shall be made with flanged Spigot connections mechanically fastened to the main. Fasteners shall be on 100 mm centres. A sealant shall be used between the branch connection and the main. Shoe branch connections shall not be provided on supply main connections.
- E. Where spirally wound circular ducts are used the minimum sheet thickness shall be as per the following Table.

<u>Max. Dia.</u>	<u>Min. Sheet Thickness</u>	<u>Min. Stiffeners Requirement</u>
200	0.6	None
710	0.8	None
900	1.0	None
1000	1.0	None (if Factory Manufactured)
1524	1.2	Yes

Stiffeners shall be external type, provided as required. Stiffeners on galvanised duct shall be galvanised steel attached by bolting or riveting. Bolts or rivets shall be properly sealed.

Stiffeners on stainless steel duct work shall be stainless steel welded to the ductwork.

#### Fittings

Bends, change shapes, expansions and contractions shall be as indicated on the applicable drawings. Long radius bends shall be utilised where indicated.

#### Fire Dampers

Fire dampers shall be installed where indicated on the applicable drawings, and as per the attached schedule. Fire dampers shall be furnished and installed in accordance with the requirements of HVCA DW/142, standard.

Fire dampers shall be fusible link actuated and shall comply with BS 5588 Part 9 offset hinge type or multileaf type with minimum fire rating of two (2 no.) hours. Fire dampers shall be installed utilising a method approved by the applicable Fire Authority. Fire dampers shall be listed and approved by the Fire Authority equivalent to Factory Mutual Insurance Company (FM) or Underwriters Laboratory, Inc. (UL) and the relevant sections of BS 476. Fire damper body material shall be identical to the duct material where they are installed, all as supplied by M/s Ventac & Co. Dublin - Action Air Fire Shield Series 201 and 301, complete with installation frame, and internal single pole microswitch for controls interface.

#### Balancing and Shut-Off

Circular balancing dampers shall be of patent manufacture up to and including 500mm dia. as shown on the drawings.

Rectangular balancing dampers with both circular and rectangular spigots for ductwork above 630 mm dia. circular and 550 x 550 mm rectangular shall be as manufactured by M/s Actionair Air Distribution Equipment and distributed by M/s Ventac & Co. Ltd., Dublin, Ireland and shall be type Air/Shield Aero-seal, spigot Casing: Type SPG. All dampers shall conform to DW/142 standard, for air leakage requirements for the specific pressure classification.

### **Diffusers**

Supply air diffusers shall dispense the air uniformly throughout the conditioned space so that at the 1500mm level it shall have a velocity not greater than 0.25 m/s in the general areas.

### **Contractor Co-Ordination**

This Contractor shall co-ordinate his work with the LT Electrical Contractor to facilitate installation of control devices duct taps, access door locations and any other required inter-facing between the ductwork and the control system requirements.

### **Connections for Automatic Controls**

All air flow differential pressure switches shall be tubed up using 4 mm dia. instrument air piping, final connection to fan unit shall be by chrome plated bulkhead fittings mechanically sealed both sides for pressures up to 1000 PA.

### **P.P.S. Ductwork**

All P.P.S. ducting, fittings and accessories shall be in accordance with BS 4514.

P.P.S. ducting shall be installed in accordance with the recommendations of DW151 and shall be tested in accordance with DW143 standard.

Jointing of P.P.S. ducting can be by solvent welding or Thermal fusion. In either case the manufactures recommendation for welding shall be followed.

If welded joints are used, weld filler rod material should be compatible with that of the duct being welded.

Supports should be of sufficient size to provide low point load an underside of ducts. Supports should provide lateral restraint whilst permitting axial movement. Ductwork brackets and clamps should be chosen to allow axial movement, metal clips shall be free of sharp edges which would damage the duct.

All fittings to be of patent manufacture, socket type to suit ducting.

All dampers to be socket weld end, parallel slide, P.P.S. body, with stainless steel disc and lockable hand actuator.

### **Testing And Commissioning**

The ductwork for all systems shall be leak-tested on site after erection:

Leak-testing shall be performed with all specified components installed, dampers, fire dampers, access doors and air flow measuring stations, and before the external duct insulation has been applied. The testing shall take place before installation of take-offs for flexible duct connections to ceiling terminal diffuser plenums and connection of return air ductwork to return air plenums. Plant Equipment, fans and flexible duct connections to equipment shall not be included in the testing.

The supply air ductwork installation of each system shall have a maximum leakage of one per cent (1.0%) of the total specified supply air handling capacity of the system when positively pressurised to 110% of the system design pressure stated in Schedule of Pressures of this specification. The return air ductwork shall have a maximum leakage of one per cent (1.0%) of the total specified return air capacity of the system when positively pressurised to 110% of the system design pressure.

The Contractor shall co-ordinate the ductwork leakage testing with the Engineer, who shall have the option of testing the installation in its entirety or in sections; the total of the leakage rates measured when tested in sections, shall not exceed one per cent (1.0%) of the rated capacity of the system.

Ductwork testing shall be performed in accordance with the Air Leakage Testing Procedure described in Appendix B of HVCA Standard DW/142, and each test shall be recorded in accordance with this standard. The Contractor shall be responsible for preparing and maintaining reports on each test and shall submit a complete report at the completion of the testing to the Engineer on original headed paper, as specified in this specification.

The Contractor shall notify the Engineer prior to each test and shall have the Engineer sign the report as approval of the test.

The Contractor shall immediately repair any ductwork section which has failed the leakage test, furnishing all material and man power necessary, and shall retest the section. The Contractor shall be responsible for as much repair and testing as is necessary to meet the leakage requirements.

### **Commissioning Assistance**

Upon completion of the installation of the ventilation systems, the Contractor shall notify the Engineer who shall, with the Contractor, inspect the system for cleanliness and conformance to specification prior to commissioning. All dirt and debris shall be removed from inside equipment and ductwork and any problems with the installation shall be corrected by the Contractor.

The Contractor shall be present as the system is energised and shall be prepared to immediately correct any problems discovered in his work. The system shall run for a minimum of twenty-four (24) hours to flush the ductwork system; to be

determined and agreed with the Engineer, the system shall then be shut down and the terminal set of filters, where applicable, shall be installed by the specified supplier. The system shall then run again for a minimum of twenty-four (24) hours prior to testing.

Testing and Balancing of the ventilation systems other than leakage testing, shall or may be performed by an independent Contractor / Engineer, if so this Contractor shall be present during testing and balancing and shall be prepared to immediately correct any problems in his installation discovered during this time.

As part of the commissioning the Contractor's Commissioning Department shall produce a report showing flows measured from each outlet diffuser and grille cell and compare them with design flows.

Tests shall be carried out on every electrical / mechanical control item and sensor to prove their operation and these shall also be recorded in the commissioning report/controls operation checklist provided by the Contractor.

Air flow rates in ducts will be measured by pilot tube and air measuring stations or measurement contact stations. Air flows to be adjusted nominal value by means of branch dampers and dampers in air terminal devices, or ceiling mounted terminal supply and extract adjustable modules.

### **Guarantee**

All equipment and component parts shall be guaranteed against fault in design, defective or improper material, poor workmanship and failure from normal usage for one year after being placed in the specified service. If any defects or malperformance occurs during the guarantee period, the Contractor shall make all necessary or desirable alterations, repairs and replacements free of charge.

### **Specifications, Standards, Drawings And Inspection/ Commissioning Data Sheets**

The following industry, association and government codes standards shall be followed as applicable to the design, fabrication, assembly and testing of all equipment furnished under this Ventilation Specification.

DW/142 Specification for Sheet Metal Ductwork.

DW/143 Specification for Testing Ductwork

DW/151 Specification for Polypropylene Ductwork

BS-2989 Specification for continuously hotdip zinc coated steel.

BS-1449 Specification for steel plate, sheet and strip

AWS D9.1 or British Equivalent

## 17.0 PIPES AND VALVES

All pipework shall be flanged jointed ductile iron pipework to BS EN 598 to NP 16 standard unless otherwise stated on the drawings or elsewhere in this specification.

Flanged pipes shall be jointed with 3 mm thick rubber gaskets in accordance with BS No. 2494. The rings shall cover the whole surface of the flanges and shall be pierced to take the bolts. All flanges shall be machined. The layout of the pumps and pipes, as shown on the drawings, shall be adhered to as far as is practicable. It is desirable that the positions of the pumps, motors, valves, shall form an orderly layout. All bends shall be of the longest radius that the layout permits.

All sluice valves shall be to BS 5150:1990, double flanged and shall be manufactured by an approved manufacturer and shall be of the best quality. They shall have gunmetal faces and external screws. All sluice valves shall close clockwise. The directions of closing shall be shown on each hand wheel and an indicating gear on each headstock shall indicate whether the valves are open or shut. Valves shall be drop tight when tested to a pressure of 20 bar.

Non return valves shall be to BS 5153 (1991), single flap type, easy to inspect and not liable to choke.

## 18.0 CRANAGE EQUIPMENT

The Contractor shall supply a portable lifting davit suitable for the removal of the pumps from Wallingstown and Courtstown.

All crange equipment shall be tested when constructed to the SW loads stamped on the equipment, and test certificates shall be obtained from the Factory Inspectorate of the Department of Labour authenticating the safety of the equipment.

## 19.0 PAINTING

All exposed pipework shall be cleaned and primed with zinc phosphate acrylated or chlorinated rubber, such as HGW A5228 in two coats and finished with two top coats of chlorinated or acrylated rubber high build zinc phosphate paint such as HGW A5099.

External cast iron pipework and valves shall be primed with similar primer in two coats and finished with one coat of chlorinated or acrylated rubber micaceous iron oxide paint such as HGW A4953 dark grey and one coat of HGW A5009 silver grey paint.

Plastic pipes shall be lightly sanded and coated with two coats of acrylated rubber paint to an approved colour.

All pumps and motors shall be finished with two coats of acrylated or chlorinated rubber high build finishing coats. Pumps are to be checked beforehand to

ascertain quality of primer coating so that danger of lifting of primer coat is avoided.

A colour scheme will be provided by the Engineer and paint colours will conform with this scheme.

## 20.0 DRAWINGS

The dimensions shown on the drawings accompanying this Specification are provisional. The Contractor shall ensure that the plant and equipment can be accommodated within the proposed building. Final working drawings will be prepared by the Engineer on receipt from Contractor of approved drawings, for the construction of the structures and buildings.

## 21.0 WORKING DRAWINGS

The successful tenderer will be required to submit to the Engineer **for approval** within the agreed period after the award of the Contract, three hard copies and one CD ROM (AutoCAD Release 14 or better) of the working drawings for the pumping plant, showing layout of pumps, pipe sizes, valves and specials with full dimensions of foundation blocks, ducts and pipes.

## 22.0 FINAL DRAWINGS

After completion of the installation three sets of hard copies and one CD ROM of drawings compatible with AutoCAD Release 2002 (or latest edition) shall be provided showing the layout of the plant, including a wiring diagram.

## 23.0 WORKING INSTRUCTIONS

The Contractor shall provide three bound copies of a complete set of Operating Manuals for the operation and maintenance of the pumps, and installed equipment and instruct the Caretaker appointed by Cork County Council in their operation and routine maintenance. For the latter purpose the Contractor shall provide instructions for the operation of the plant by his Erector, for a period of one week after completion of the erection, but Cork County Council will be responsible for the provision of all power and consumable stores required during this period. Any necessary adjustments to the plant are to be made in this period.

## 24.0 MATERIALS CERTIFICATION

Nothing stated in this Specification is to be construed as discriminating against products and materials manufactured in any of the Member States of the European Community.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Community are called for, this requirement shall be read as including items to a relevant national standard of any Member State of the European Community, which provides an equivalent guarantee of safety and suitability.

Where items certified by the National Standards Authority of Ireland as complying with an Irish Standard are called for, the provisions of Circular Letter BM 2/87 as amended by Circular Letter BC 14/92 shall apply, i.e. the requirement shall be read as either certified by the National Standards Authority of Ireland as complying with Irish Standard, or shall be certified as complying a relevant national standard of another Member State of the European Community, which provides an equivalent guarantee of safety and suitability. Certification to be by the National Standards Authority of Ireland.

## 25.0 EXTENDED MAINTENANCE PERIOD

It is envisaged that the Pumping Stations will not be fully commissioned and brought into use until approx, three years after the completion of the installation. For this reason, a special defects liability period of 48 months will be required. An item has been included in the Schedule of Prices for this special defects liability period. A provisional item has also been included for each additional month by which the defects liability period may be extended. The Contractor shall ensure that all guarantees for plant and equipment shall be extended by an equivalent period.

The Contractor shall be required to carry out all routine maintenance necessary to ensure the plant installed under this contract is kept in proper working order for the duration of the special defects liability period. The Contractor shall describe the maintenance which he proposes to carry out and the intervals at which this maintenance is necessary. An item has been included in the Schedule of Prices to be priced by the Contractor.

## 26.0 ATTENDANCE

The Civil Works Contractor will be provide unskilled labour in attendance on the Pumping Contractor's skilled erectors. However, the following shall be the responsibility of the Pumping Contractor:

- a) Transportation of all the plant to the site.
- b) Cranage for both off-loading and during the period of erection.
- c) Supply and generation of electricity during erection by either a portable generator or other means available to the Treatment Contractor.
- d) All skilled labour required in the installation of the plant.



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**APPENDIX 1**

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**GENERAL ELECTRICAL SPECIFICATION**

Doc. Nr. A5090-N-S-05-B

1 (Appendix 1)

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## GENERAL ELECTRICAL SPECIFICATION

### 1.0 SPECIFIC REQUIREMENTS

#### 1.1 Nominal Voltage

400 V - 3 phase - 50Hz

#### 1.2 Control Voltage

110V - 1 phase - 50 Hz.

#### 1.3 Zone 1 Equipment

All electrical equipment in the Wet Well area to be suitable for use in a Zone 1 Hazardous Area.

#### 1.4 Cable Glands

All electrical equipment in the Wet Well area to be terminated with an EIWF gland and shroud.

#### 1.5 Power Cables

All power cables to be 600V Grade PVC/SWA/PVC to BS 6346 or armoured/screened flexible type for submersible pump motors.

#### 1.6 Power Cables - Motors

Minimum size power cable for motor to be 2.5mm<sup>2</sup>

#### 1.7 Cable Tray

All cable trays in the Wet Well area to be PVC type c/w lidding.

#### 1.8 Final Drops

All drops to electrical equipment from cable trays to be in stainless steel dairy tubing.

#### 1.9 Power Factor Correction

The Contractor is to provide power factor correction capacitors to maintain 0.95 lagging.

#### 1.10 Information for Approval

The Contractor is required to submit the following for approval before construction:

A Electrical layout drawings.

- B Power loadings
- C MCC layouts
- D MCC control schematics
- E Cable schedules

## 2.0 GENERAL REQUIREMENTS

### 2.1 Manufacturer and Type

Where "manufacturer" is used in the specification of materials it shall mean the firm under whose name the particular product is marketed. Where "type" is used it shall mean the proprietary brand name, reference or other quality by which the product is identified.

### 2.2 Proprietary Names, Rates

Where the phrase "or other approved" is used the rates or prices shall be held to be based on the particular commodity specified.

### 2.3 Proprietary Names

The phrase "or other approved" shall be deemed included whenever materials are specified by proprietary name.

### 2.4 Supplied Goods

Where materials and components are to be supplied by Nominated Suppliers under Prime Cost or Provisional Sums, whether specified to be fixed only or otherwise used or incorporated in the Works, they shall include taking delivery, unloading, handling on site, providing adequate storage and being responsible for safekeeping, assembly, hoisting, placing in position and fixing, providing all necessary materials for fixing, returning packing materials, carriage paid to the Nominated Supplier in good condition and obtaining credits for them.

### 2.5 Builder's Work

The Contractor shall allow in his tender for the correct setting out and marking of all such builder's work and for superintending and directing tradesmen detailed to execute such work.

### 2.6 Leave Installation in Complete Working Order

All tenders submitted shall be complete and shall include for all work, incidental or otherwise, to leave the complete installation in satisfactory working order. All cable runs and equipment locations shall be agreed with the Engineer before builder's work is commenced.

## 2.7 Compliance with Specification

The electrical installation shall comply with Specifications and drawings provided at the beginning of the Contract, and with further drawings or details that may be supplied at a later date.

## 2.8 Site Visits

The Contractor is advised to visit the site and ascertain the facilities of access thereto and the general convenience of working. He must take these matters into account when tendering and no charge will be allowed in consequence of the Contractor's failure to do this.

## 2.9 Safety and Health Requirements

### 2.9.1 Safety, Health and Welfare Legislation

The Contractor's attention is directed to Clause 30 of the Instructions to Tenderers relating to Health and Safety requirements. The provisions of the following legislation, and all amendments thereto, shall be fully complied with:-

- (i) The Factories Act (1955)
- (ii) The Safety, Health and Welfare at Work Act, 1989
- (iii) The Safety, Health and Welfare (General Application) Regulations S.I. 44 of 1993.
- (iv) The Safety, health and Welfare (Construction) Regulations S.I.481 of 2001.

### 2.9.2 Emergency Telephone Numbers

The Contractor shall maintain a list of emergency telephone numbers on permanent display in the site offices during the currency of the Contract. Access to a telephone shall be maintained at all times while construction activities are being performed.

### 2.9.3 Protective Clothing

The Contractor shall supply his operatives with approved protective clothing, helmets, boots, etc in accordance with the requirements of the relevant safety legislation. The Contractor shall ensure that his operatives wear these protective items at all times.

In addition to the above, when working in public property, high visibility vests must be worn at all times.

## 2.10 Site Meetings

Site Meetings will generally be held twice a month and the Contractor shall arrange to attend these meetings and to have all Sub-Contractors employed by him present at these meetings. When requested by the Engineer, manufacturers or suppliers of products shall also attend.

Minutes of these meetings will be recorded by the Engineer and forwarded to all present. A further copy shall be forwarded to the Employer, who may, or may not, attend these meetings.

### 2.11 Commissioning

The Electrical Contractor shall have sole responsibility for the complete and satisfactory commissioning of all equipment and systems supplied and/or installed under this Contract and he shall allow for this in his tender. No system or plant shall be deemed to be commissioned until such time as the Contractor demonstrates to the satisfaction of the Engineer that the system or plant is operating as specified.

### 2.12 Site Supervision

The Contractor shall maintain a competent person-in-charge (site agent, foreman or working charge-hand) on the site during working hours throughout the duration of the Contract.

The Engineer shall be informed in writing of the name and seniority of the person in charge who shall not be replaced without their prior approval. The person-in-charge shall be authorised to act on the Contractor's behalf and to receive instructions from the Engineer.

### 2.13 Standards

The provisions of the latest revised editions and amendments of the following Irish and British Standards and Codes of Practice shall be held to be incorporated in this specification unless otherwise stated in this specification or on the drawings.

IS 273	Cables with PVC or XLPE insulation 600/1000V with or without SWA.
IS - 3217	Code of Practice for Emergency Lighting by NSAI.
IS - 3218	Code of Practice for Fire Detection and Alarm Systems for buildings by NSAI.
BS 31	Specification Steel Conduit and fittings for electrical wiring.
BS 731	Flexible steel conduit for cable protection.
BS 1432	Specification for copper for electrical purposes: high conductivity copper rectangular conductors with drawn or rolled edges.
BS 1433	Specification for copper for electrical purposes - rod and bar.

BS 2874	Specification for copper and copper alloy rods and sections.
BS 4568	Specifications for steel conduit.
BS 4678	Cable Trunking.
BS 5308	Specification for instrumentation cable.
BS 6004	Specification for PVC insulated cables.
BS 6121	Mechanical Cable Glands
BS 6346	Specification for PVC Insulated Cables for electricity supply.
BS 6360	Specification for conductors in insulated cables and cords.
BS 6651	Code of Practice for Protection of Structures against Lightning.
BS 6746	Specification for PVC insulation and sheath of electric cables.
BS 7655	Specification for insulating and sheathing materials for cables.
IEC 439	Specification for Low Voltage Switchgear and Control Gear.
IEC 529	Classification of Enclosures.
IEC 947	Specification for Low Voltage Switchgear and Control Gear.

#### 2.14 **Construction of Enclosures**

All electrical equipment shall be robust construction. Enclosures shall be weatherproof except for equipment installed indoors. Unless otherwise specified in the Contract Documents, the enclosures shall be dust and damp proof to IP 54 to IEC 529.

#### 2.15 **Guarantee**

All items of plant equipment, apparatus or materials supplied under this contract, whether of the Contractor's own make or supplied by another Contractor, shall be guaranteed against faulty workmanship or materials for a period of 12 months from the date of the Engineer's certificate of virtual completion. Any such faulty equipment shall be removed and replaced at the Contractor's expense.

**2.16**      **Progress Meetings**

During installation, periodical progress meetings shall be held on site, and the Electrical Contractor shall, when requested, send an official representative to these meetings. This representative shall be prepared to answer questions relating to the programme of the electrical work. Detailed progress reports shall be submitted to the Engineer when requested, showing the amount of work already completed, work in progress and still to complete and work force available.

**2.17**      **Training**

The Contractor shall hand over to the staff appointed by the Client, three sets of Maintenance and Operating Instructions for all items of plant supplied by him under this Contract and shall ensure that these instructions are fully understood by the staff as soon as the items are installed.

**2.18**      **As Installed Drawings**

The Contractor shall include for supplying to the Client three sets of paper prints of all "as installed" drawings. In addition, the Contractor shall supply for use by the Client, a set of the "as-installed" drawings on computer disk prepared using the appropriate release of AUTOCAD.

**2.19**      **Regulations**

The Electrical Services Installation shall be carried out with this Specification and shall comply with the following regulations and requirements in so far as they are applicable.

1. National Rules for Electrical Installations, Third Edition 2000 of the Electro Technical Council of Ireland.
2. "Requirements for earthing in Electrical Installations" of the Electricity Supply Board.
3. The Factory (Electrical) Regulations 1972.
4. The Regulations of Local Authorities.

**2.20**      **Identification Of Cables**

All distribution, power, control and miscellaneous circuit cables shall be identified by cable reference numbers. Normally, these reference numbers will be shown on the Purchaser's cable schedules and/or drawings. Each cable shall be fitted with indestructible marking collars bearing the appropriate cable number. The marking collars shall be fitted at each termination and, where applicable, in each draw pit and at each point of entry and exit from a main or sub-main trench.



**2.21 Identification of Conductors**

All cable cores except those of special cables (i.e. cables with numbered cores) shall be numbered as per the cable termination schedules to identify them. The cores of cables connected to equipment having marked terminals shall be identified with interlocking ferrules bearing markings corresponding to those given in the cable termination schedules. Core numbers shall read outwards from terminals.

**2.22 Labelling**

All switchgear, distribution boards, outgoing cables etc. shall be clearly labelled to denote the service or equipment they control by means of approved plastic band with 5 mm high engraved lettering. Fuse or MCB sizes and circuit numbers must be clearly indicated adjacent to each device to facilitate identification and replacement. Where more than one phase conductor is connected to switchgear or distribution boards, clear indication of danger and of the voltage between phases which exists at such points, must be given. All labelling or types of labelling must be approved by the Engineer before installation.

**2.23 Testing**

When the installation is completed, it shall be tested in the presence of the Engineers or their representatives, in accordance with the relevant section of the ETCI Regulations. Tests shall be carried out for insulation resistance to earth and between adjacent conductors, for polarity of all switches, for continuity of live and protective conductors, particularly ring final circuits for earth loop impedance and for mechanical operation. Tests shall also be carried out for polarity of socket outlets, distribution boards etc.

The Engineers, may, if they require to do so, test the installation in sections. Two weeks written notice must be given to the Engineers by the Contractor of his intention to test the installation.

**2.24 Supply of Materials**

All materials, required to execute the contract shall be supplied by the Contractor unless otherwise specified.

**2.25 Immediate Ordering**

To avoid any undue delay in the completion of the work, the Contractor shall immediately place on order all materials to execute the contract, as soon as final instructions are given. Every effort shall be made to obtain all components as quickly as possible.

**2.26 Delay in Delivery of Equipment**

The Contractor shall advise at all stages of the work, delay in delivery of equipment which may affect completion dates.

**2.27 Supply of Equipment**

The Contractor shall supply and erect all equipment necessary to carry out the Electrical Installation, including all necessary tools, leads, ladders, scaffolding etc.

**2.28 Temporaries, Compliance with National Regulations**

During the term of the contract the Contractor shall make use of the electrical systems on site and attach thereto all electrical equipment owned by the Contractor in such a manner that at all times, the requirements of the local and national regulations are fully observed.

**2.29 Damage and Loss**

The Contractor shall be responsible for the damage or loss of electrical materials or equipment until the installation is handed over.

**2.30 Removal of Rubbish**

From time to time during the progress of works, the Contractor shall remove all rubbish, surplus materials, empty cartons, cases, cable drums etc., from all parts of the site where he is not immediately engaged on installation work.

**2.31 Completion of Contract**

Upon completion, the whole of the Electrical Installation shall be left clean and tidy, all rubbish and dust shall be removed from switchgear and switchgear enclosures.

**3.0 EQUIVALENCE OF STANDARDS**

3.1 It shall be noted that nothing stated in this Specification, is to be construed as discriminating against products and materials manufactured in any of the Member States of the European Community.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard Specification of a Member State of the European Community are called for, this requirement shall be read as including items to a relevant National Standard of any Member State of the European Union, which provides an equivalent guarantee of safety and suitability. Any reference to a National Standard shall be deemed to include amendments and addenda, if any, current at the Designated Date.

Where items certified by the National Standards Authority of Ireland as complying with an Irish Standard are called for, the provisions of Circular Letter BM 2/87, as amended by Circular Letter BC 14/92, shall apply, i.e. the requirement shall be read as either certified by the National Standards Authority of Ireland as complying with the Irish Standard, or shall be certified as complying with a relevant National Standard of another Member State of the

European Community, which provides an equivalent guarantee of safety and suitability. Certification to be by the National Standards Authority of Ireland.

#### 4.0 CABLE TRUNKING INSTALLATION

##### 4.1 General Specification

##### 4.1.1 Trunking

All trunking shall be the product of approved manufacturers.

##### 4.1.2 BS

All cable trunking shall be to BS 4678.

##### 4.1.3 Sheet Steel

Cable trunking shall be manufactured from sheet mild steel formed and treated with electrically deposited zinc.

##### 4.1.4 Galvanised

Cable trunking to be hot dip galvanised.

##### 4.1.5 Ends and Cuts

All ends and cuts shall be painted with two coats of galvanised paint.

##### 4.1.6 Bridge Pieces

Steel trunking smaller than 100 mm x 100 mm, with plain edges shall be fitted with bridge pieces at not greater than 0.9 m intervals to give side rigidity.

##### 4.1.7 Up to 50 mm x 50 mm Base

Steel trunking gauges shall not be less than 20 SWG for sizes up to 50 mm x 50 mm.

##### 4.1.8 Up to 75 mm Base

Steel trunking gauge shall be not less than 18 SWG for sizes up to 75 mm base.

##### 4.1.9 Up to 152 mm Base

Steel trunking gauge shall be not less than 16 SWG for sizes up to 152 mm base.

##### 4.1.10 Covers

All covers to steel trunking shall have trimmed edges and shall be fixed to trunking with patent spring clips or by screw fixings.

**4.1.11 Bends, etc.**

Standard manufacturer's steel couplings, bends, etc., and other fittings shall be used on steel trunking.

**4.1.12 Joints**

All joints between trunking sections shall be mechanically sound and shall be such to ensure that cables being drawn in shall not suffer any damage or abrasion.

**4.1.13 Earth Link**

A copper earth link shall be provided between each length of sheet steel trunking and fittings to give an efficient earth throughout the system.

**4.1.14 Trunking Installation**

All trunking shall be erected and fixed into position before installation of cables.

**4.1.15 Earthing Wire**

All trunking shall have a bare copper earthing wire run inside it which shall be bonded to it at intervals in addition to the earthing strap already called for.

**4.1.16 Conduit Connections**

All conduit connections to cable trunking shall be made off by means of flanged coupling, copper compression washer and smooth bore long reach hex. head male brass bush.

**4.1.17 Vertical Ducts**

Cable trunking in vertical ducts shall be installed with the cover facing outwards.

**4.1.18 Ceiling Spaces**

All trunking installed in ceiling spaces shall have the cover facing downwards.

**4.1.19 End-Caps**

'End Caps' shall be fitted to all trunking terminations.

**4.1.20 Wall Supports**

Cable trunking shall be supported by brackets which shall be wall mounted.

**4.1.21 Overhead Supports**

Cable trunking shall be supported from overhead by threaded bar fixed to the top of the trunking.

**4.1.22 Hanger Brackets**

Cable trunking shall be supported from overhead by threaded bar fixed to hanger brackets.

**4.1.23 Standard Fixing**

Standard Fixing of trunking to wall or ceiling structures shall be by means of 'bridge' type brackets formed from mild steel bar 25 mm x 6 mm, erected at not more than 1m centres.

**4.1.24 Brackets**

The brackets shall be formed to provide a nominal clear space of 50 mm between trunking and wall or ceiling structure; drilled clear for fixing bolts of size M8 with flat face equal in width to the trunking it is to support, and painted with two coats of aluminium or proprietary rust inhibitive paint prior to fixing.

**4.1.25 Ohmic Resistance**

The electrical resistance of any trunking system or combined trunking conduit system, or plant or apparatus attached thereto, and taken at any point of the installation and measured between such point and the "Earth Electrode" shall not exceed one half ohm.

**4.2 Compartmented Cable Trunking****4.2.1 Segregated Compartments**

Compartmented Cable Trunking shall be manufactured as standard trunking with the addition of one steel fillet or two steel fillets spot welded and so fixed as to provide two or three completely segregated compartments within the cable trunking, as particularly specified.

**4.2.2 Fittings**

Where such compartmented cable trunking is particularly specified the fittings for such trunking shall also be filleted and in tee or intersection fittings steel 'crossover' pieces shall be fitted to maintain the segregation of the compartments.

## 5.0 CONDUIT INSTALLATION

### 5.1 General Specification

#### 5.1.1 BS

Steel conduit shall in all cases be heavy gauge, welded steel tube, galvanised finish and shall be in accordance with BS 31 1940 as amended to requirements of metric equivalent BS 4568.

#### 5.1.2 Electrically and Mechanically Continuous

Conduits shall be a continuous and effective mechanical means of protection for cables and shall be electrically continuous throughout the complete conduit system.

#### 5.1.3 Outlets

No conduit shall be run in such a way as to form a "U" without outlet or in any other way that would provide a trap for condensed moisture. Suitable drainage outlets shall be provided where condensation is likely to occur.

#### 5.1.4 Routing of Conduit

The routes of all conduits, (if not indicated on the drawings), and positions of all "outlet points" and "draw in" positions shall be accurately marked out on site for the approval of the Engineer before work commences.

#### 5.1.5 Conduit Boxes

Conduit systems shall include sufficient conduit boxes to ensure an easy "draw-in" or "out" of the cables. Inspection boxes of adequate size shall be provided at any point where a cable connection is made. Boxes shall be of malleable cast iron or pressed steel and shall comply with BS 31 1940 Class B.

#### 5.1.6 Sets

The radius of "sets" (bends) in conduit shall not be less than six times the external diam. of the conduit and not more than one such set shall be installed in any one conduit "run" without a conduit box to ensure an easy draw-in of cables.

#### 5.1.7 Set Formation

All "sets" shall be made cold and any "set" that distorts the conduit shall be rejected by the Engineer.

**5.1.8**      **Damage**

The Contractor shall take all precautionary measures as may be necessary to safeguard installed conduits, boxes etc., from damage or disturbance during the progress of the works.

**5.1.9**      **Foreign Bodies**

Special precautions shall be taken to prevent the ingress of moisture, silt, brick chippings, concrete, etc. into the conduits and boxes immediately these are installed and during the progress of the works.

**5.1.10**     **Burrs**

The inside of conduits where cut and threaded shall be reamed, to remove all burrs before the next length of conduit or conduit box is attached.

**5.1.11**     **Threads**

Conduit shall be threaded by means of efficient and sharp dies, in no circumstances will torn or loose threads be accepted.

**5.1.12**     **Thread Lengths**

Where practical all threads shall be half the length of the appropriate standard coupling, or flanged coupling; the full length of the conduit box conduit entry and half the length of a standard coupling at a "running coupling" position.

**5.1.13**     **Tightening Fittings**

All conduit joints at couplings, boxes, etc., shall be screwed up tight by means of a mechanical tool (e.g. pipe wrench).

**5.1.14**     **Size**

No conduit diameter less than 20mm may be installed.

**5.1.15**     **Telephone Conduit**

For telephone systems, 25 mm steel conduit shall be used throughout.

**5.1.16**     **Conduit Boxes**

The conduit shall be fixed to boxes by means of couplings and male bushes.

**5.1.17**     **Drainage**

Steel conduits buried in floor screed shall have minimum cover of 35 mm of concrete and shall be provided with drainage points to discharge any water which may accumulate. Drainage points shall consist of plugged tees turned down with 6 mm holes drilled in the plugs for release of water.

**5.1.18**      **Ventilation**

All conduits shall have ventilation outlets at their highest and lowest points to allow free circulation of air.

**5.1.19**      **Fixing Methods**

Surface conduits shall be fixed with approved saddles while crampets may be used for conduits recessed in wall chases, etc. Recessed conduits shall have a minimum cover of 10 mm of plaster.

**5.1.20**      **Checking**

Prior to introducing wiring to any conduit system, the system shall be checked and tested to ensure maximum mechanical and electrical continuity throughout.

**5.1.21**      **Flexible Metallic Conduit**

Where conduit is used for wiring to any electrical equipment which may be subject to vibration, flexible galvanised steel conduit must be installed, with suitable adapters and fittings for connection to conduit boxes.

**5.1.22**      **Flexible Metallic Conduit BS**

All flexible metallic conduit shall be in accordance with BS 731.

**5.1.23**      **Flexible Conduit Earth Bond**

Flexible conduits shall be provided with external earth bands.

**5.1.24**      **Space Factor**

The number of cables drawn into, or laid in, an enclosure of a wiring system shall be such as to comply with Section 521 and Table 52A of the National Rules for Electrical Installations Third Edition 2000. A space factor of 45% shall not be exceeded.

**5.1.25**      **Draw-In Boxes Spacing**

Where conduit is to be installed from point to point in a straight run with no bends, draw-in boxes shall be provided every 10 metres of conduit run.

**5.1.26**      **Damage**

Where the galvanised coating is damaged during installation it shall be immediately coated with galvanised paint.



**5.1.27 Other Services Clearance**

All conduits shall be installed so as to clear all gas, hot water, steam pipes and refrigeration plant pipes by a minimum of 300 mm to the satisfaction of the Engineer.

**5.1.28 Bonding**

Where the conduit is in contact with any other metal work of any description, an efficient and permanent metallic connection shall be made between the conduit and the metal work.

**5.1.29 Hermetic Seal**

Where conduits are required to pass into or out of ducts, or from the inside to the outside of buildings, or in any other position where a considerable variation in temperature exists between different sections of the building free circulation of air must be prevented between the conduit systems of each section by inserting a conduit box in an approved position, the box to be fitted with plastic compound (after the cables have been drawn in) to hermetically seal off the conduit system at that point.

**5.1.30 Finished Plastered ceilings**

Conduit boxes are to be positioned flush with the finished plastered ceilings.

**5.1.31 Suspended Ceilings**

Conduit boxes are to be positioned on the surface on the underside of slab in the case of suspended ceilings.

**5.1.32 Wall Finishes**

The Electrical Contractor must acquaint himself with the wall finishes of the various rooms, etc.

**5.1.33 Separate Earth**

An earth cable shall be installed in all conduits and looped into earth terminals of outlets where required. It shall in turn be connected to the earth terminal of the relevant distribution board. This earth cable shall be of 2.5 mm<sup>2</sup> PVC covered stranded copper type.

**5.2 Surface Conduit Systems (Internal)****5.2.1 Architectural Feature Aligning**

Conduits fixed on the surface of walls, ceilings, etc. shall be run truly vertical, horizontal or parallel with the Architectural features of the building.

**5.2.2 Fixing**

Conduits shall be securely fixed by means of spacer bars and saddles with brass R.H. wood screws of 32 mm length and PVC Rawlplugs, or brass R.H. machine bolts, nuts and washers as the location and structure requires.

**5.2.3 Boxes, Switch Boxes, etc.**

Conduit boxes, switch boxes, and socket outlet boxes shall be drilled and countersunk (so that screw heads do not project into the boxes and securely fixed by means of brass countersunk wood screws of 32 mm length and PVC rawlplugs, or brass countersunk machine bolts, nuts and washers as the location and structure requires.

**5.2.4 Exclusion of 'Hilti' Method or Equivalent**

The "Hilti" method or equivalent of fixing saddles or conduit boxes, etc., shall not be accepted by the Engineer.

**5.2.5 Fixing to Steel Girders**

Where conduits, boxes or other fittings are to be fixed to steel girders or steel beams, pipe hooks of an approved pattern shall be employed.

**5.2.6 Drilling of Steel Girders**

Holes shall not be drilled in steel girders or steel beams without written sanction by the Engineer.

**5.2.7 Fixing Spacings**

Fixings shall be spaced at 1 metre for 20mm diameter, and 25 mm diameter conduits and at 1.2 metres for 32 mm diameter conduits and above. In addition, fixings shall be provided at each side of a "set" or conduit box.

**5.3 Water Tightness**

Conduit systems which are to be "cast" in concrete floors, walls or roof structures shall be made watertight throughout.

**5.3.1 Surface Cover**

Such conduits shall have a minimum covering of at least 25 mm of concrete from any "face" of floor, wall, roof or ceiling structure.

**5.3.2 Finishing Flush With Floor**

Where conduit systems are to be "cast" in floors, walls or roof structures the conduits shall be fixed and "set" so that boxes will finish flush with the finished face of the structure.

### 5.3.3 Temporary Lids

To restrict the movement of boxes during "pouring" and prevent the ingress of concrete, temporary lids shall be fixed to the boxes and the lids drilled and fitted with a machined bolt of sufficient length either to protrude through the shuttering and be secured by means of washer and nut, or to protrude through the "pour" so as to locate such boxes.

### 5.3.4 Chases

Conduit systems are to be fixed to plaster finished concrete, brick or stone walls and are to be concealed. Such conduits shall be secured in "chases" of sufficient depth so that the conduit finishes flush with the "base" wall and the Architects specified thickness of plaster will be maintained throughout.

## 5.4 Surface Conduit Systems (External)

### 5.4.1 Water Tightness

Conduit systems shall be made effectively watertight throughout.

### 5.4.2 Fittings

All conduit boxes, adaptable boxes, fittings etc., shall be of the watertight pattern with machined faces to boxes and lids, tapped conduit thread entries and external fixing lugs.

### 5.4.3 Boxes

Boxes shall be further rendered watertight by means of PVC., or Neoprene gaskets or watertight jointing compound insertion, as instructed on site by the Engineers.

### 5.4.4 Internal Drilling

Boxes or fittings shall not be internally drilled for fixings.

## 6.0 WIRING

### 6.1 P.V.C. Cable In Conduit And Trunking

#### 6.1.1 BS

Conductors shall be tinned high conductivity annealed copper with Type T1 of BS 6746 PVC insulation and shall comply with BS 6004 and BS 6360.

#### 6.1.2 Colour Coding

All phase cables shall be coloured brown, red and yellow according to the phase to which they are connected, and all neutral cables shall be coloured blue.

**6.1.3 Conductors**

Conductors shall be stranded and shall not be smaller than 1.5 mm<sup>2</sup> unless otherwise specified.

**6.1.4 Installation of Cables**

Cables shall not be drawn into conduits or trunking until all such conduits or trunking lengths are firmly fixed and screwed in place.

**6.1.5 Loop-in System**

Wiring in general, shall be arranged on the loop-in system with conductors looped from outlet to outlet.

**6.1.6 Joints**

No joints in cabling will be allowed between outlets under any circumstances.

**6.1.7 Neutral Links**

Neutral cables shall be provided with links only at fusing positions.

**6.1.8 Fuses**

Fuses may only be installed in phase cables.

**6.1.9 Connections**

All connections at outlets, etc. shall be of the screwed type and no twisted or soldered connections shall be permitted.

**6.1.10 Temperature Limitations**

PVC insulated and sheathed cables shall not be installed in locations where the ambient temperature is likely to exceed 45°C.

**6.1.11 Segregation of Low Voltage and Extra Low Voltage**

Low voltage circuits shall be segregated from extra low voltage circuits. Where this requirement is impracticable, safety extra-low voltage circuit conductors shall be insulated in accordance with the requirements of the Regulations for the highest voltage present. (The Regulations referred to are the National Rules for Electrical Installations ET 101/2000 of the Electro Technical Council of Ireland).

**6.1.12 Segregation of Large and Small Cables**

Insulated sheathed single (or multi) core cables of 16 mm sq. size or larger, shall not be laid in the same trunking compartment with smaller size cables.

**6.1.13 MICS and PVC**

M.I.C.S. cables shall not be installed in cable trunkings with PVC cables.

**6.1.14 Binding Circuits**

Each circuit shall be bound separately at 2 metre intervals along the complete length of the trunking system, with waxed binding twine or PVC. PVC adhesive backed tape, and a plastic identification "tag" shall be attached indicating to which switchboard, distribution board, link box, plant or apparatus such circuit is connected. Such identification tag shall be visible upon removal of one (1 No.) length of trunking lid.

**6.1.15 Transition of Different Cables Type**

Where it is particularly specified that final circuit connections shall be a different type cable to the standard type cable throughout the installation, for example:

- a. P.V.C. to M.I.C.S. or vice versa.
- b. P.V.C. to Heat Resistant.
- c. P.V.C. to Flexible Cord.

Such transition (c) shall take place via plug and socket or (a), (b) or (c) within a conduit box or adaptable box. Such transition shall not take place within a cable trunking.

**6.1.16 Porcelain Shrouded Connectors**

The joint between the cores in the conduit box or adaptable box shall be made with approved loose type glazed porcelain shrouded pinching screw connectors of a rating not less than the cables which are being jointed.

**6.1.17 Cables in Excess of 10 mm<sup>2</sup>**

Where a transition joint is required on cables in excess of 10 sq.mm. compression type spade lugs shall be affixed to the cables and made off on to rigidly fixed porcelain (or other approved insulating material) based terminals or busbar assembly.

**6.2 PVC - SWA PVC Cables****6.2.1 BS**

PVC insulated, PVC sheathed steel wire armoured and PVC sheathed over all shall comply in all respects with IS 273/BS6346 and shall be 600/1000 volt grade.

**6.2.2 Manufacturer's Fittings**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories shall be used.

**6.2.3 Copper Conductor**

The conductor shall be of standard annealed high conductivity copper complying with the latest relevant BS shaped and respiralled for minimum overall size.

**6.2.4 Manufacturer**

Cables shall be similar to those as manufactured by "Pirelli General Cable Works Ltd.", "BICC Ltd." or equivalent.

**6.3 XLPE - SWA PVC Cables****6.3.1 BS**

XLPE insulated, PVC sheathed steel wire armoured and PVC sheathed over all shall comply in all respects with BS 5467 and shall be 600/1,000 volt grade.

**6.3.2 Manufacturer's Fittings**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories shall be used.

**6.3.3 Copper Conductor**

The conductor shall be of standard annealed high conductivity copper complying with the latest relevant BS shaped and respiralled for minimum overall size.

**6.3.4 Manufacturer**

Cables shall be similar to those as manufactured by "Pirelli General Cable Works Ltd.", "BICC Ltd." or equivalent.

**6.4 Screened Cables****6.4.1 Type**

Screened cables for instruments, etc. shall be of the PVC insulated individual screening per pair of wires and overall screened and PVC sheathed type. They shall comply with BS 5308.

**6.4.2 Installation**

The cables shall be installed in accordance with manufacturer's instructions and standard manufacturer's glands, terminations and other accessories, shall be used.

**6.4.3 Conductor**

The Conductor shall be of stranded annealed high conductivity copper of cross sectional area specified in the cable schedule.

**6.4.5 Manufacture**

Cables shall be as manufactured by Pirelli General Cable Works Ltd., Belden or equivalent.

**6.4.6 Underground Locations**

Where screened cables are installed in underground ducts or other underground locations, they shall be further protected by a single layer of helically wound galvanised wires and final extruded sheath of PVC.

**6.4.7 Intrinsically Safe Circuits**

The outer sheath of cables of intrinsically safe circuits shall be colour coded blue for ease of identification.

**6.5 M.I.C.S. Cables****6.5.1 BS**

Mineral insulated, copper sheathed cables shall comply with BS 6207.

**6.5.2 Insulation and Size**

They shall be 600 volt grade with solid conductors which shall not be less than 1.5 sq. mm cross sectional area.

**6.5.3 Manufacturer's Fittings**

All cables, glands, etc. shall be installed in accordance with manufacturer's recommendations and manufacturer's standard fittings and accessories shall be used throughout.

**6.5.4 Stripping Insulation**

Where connections are made to M.I.C.S. cables, the copper sheath shall be stripped back to the required position and all mineral insulation removed from the exposed cores.

**6.5.5 Insulation Sleeving**

Small lengths of appropriately coloured Neoprene or equivalent insulating sleeving shall be placed over the cores before making connections to ensure that no short circuiting occurs.

**6.5.6 Cable Sealing**

Cables must be properly sealed in all cases so that no moisture may get to the mineral insulation and cause a breakdown in the cables.

**6.5.7 Galvanised Boxes**

Standard B.E.S.A. galvanised boxes or equivalent shall be used at all outlets, fitted with standard manufacturer's sealing glands.

**6.5.8 Loop-In system**

Wiring shall be arranged on the loop-in system with cables looping from outlet to outlet and no joints will be allowed in the cables under any circumstances.

**6.5.9 Connections**

All connections which shall be made at outlets only, shall be of the screwed type and no twisted or soldered connections shall be permitted.

**6.5.10 Surface Mounted**

All M.I.C.S. cables shall be run on the surface.

**6.5.11 Electrical Continuity**

Cables shall be electrically continuous across all joints.

**6.5.12 Fixing**

Fixing shall be by means of approved copper saddles.

**6.5.13 External Use**

Where M.I.C.S. cable is used outdoors, it shall have an overall P.V.C. sheathing:-

**6.5.14 Spacing of Clips**

**Max. spacing of clips for mineral insulated cables**

<u>Overall Diam. of Cable</u>	<u>Horizontal</u>	<u>Vertical</u>
Not exceeding 9 mm 600 mm	800 mm	
Not exceeding 15 mm 900 mm	1200 mm	



Not exceeding 20 mm 1500 mm 2000 mm  
20 - 40 mm - -

### 6.5.15 High Temperatures

M.I.C.S. cables shall not be installed in locations where the ambient temperature is likely to exceed 1000°C unless sanctioned by the Engineer.

### 6.5.16 Terminations

M.I.C.S. cables at terminations shall be protected and sealed with ring type glands incorporating screw-on type seals, anchoring beads, neoprene sleeving and "cold" plastic compound, (tropical compound where the ambient temperature exceeds 55°C). The whole assembled in a manner in compliance with the recommendations of the manufacturer of the cable.

## 6.6 Underground Cables

### 6.6.1 LT and Signal Cables

Underground LT and signal cables shall be run in 100mm PVC pipes laid a minimum of 600mm below grade.

### 6.6.2 Armoured

LT and signal cables underground shall be of a type incorporating an armour or metal sheath, or both.

### 6.6.3 Type of Cable

Underground L.T. cables shall be PVC/SWA/PVC or XLPE/SWA/PVC and shall comply in all respects with BS 6346 or BS 5467 respectively and shall be 600/1,000 volt grade.

### 6.6.4 Excavation

The Civil Contractor will supply all labour for trench excavation and reinstatement.

### 6.6.5 Wavin Pipes

The Civil Contractor will supply and lay all Wavin pipes.

### 6.6.6 Signal Cables

All signal cables installed underground shall run their entire length in separate 100mm PVC ducts run with a minimum of 600mm separation from LT ducts.

### 6.6.7 Joints

Joints in cables installed underground shall not be accepted by the Engineer.

**6.7 Flexible Cords****6.7.1 250 Volt Grade**

Flexible cords shall be 250 volt grade minimum three core.

**6.7.2 Conductors**

The conductors shall be stranded, high conductivity flexible copper, insulated and sheathed with vulcanised rubber on PVC and braided overall with a glazed cotton sheath.

**6.7.3 Heat Resisting Flexible Cord**

Heat resisting flexible cords shall have stranded nickel plated annealed copper conductors insulated with yarn or woven tape braided with glass fibre and the whole impregnated with varnish.

**6.8 Telephone Cables****6.8.1 Telephone Cables**

Telephone cables shall be single core or multicore as particularly specified with high conductivity copper conductors of size not less than 0.5 mm sq., P.V.C. insulated and extrusion sheathed overall; and impedance rating not less than 50 ohms.

**6.8.2 Underground Located**

When telephone cables are installed in underground or external surface locations, they shall be further protected by a single layer of helically wound galvanised wires and final extruded sheath of P.V.C.

**7.0 LIGHTING FITTINGS****7.1 Type and Installation**

All light fittings shall be of a type and pattern specified and shall be installed as shown on drawings.

**7.2 Cleaning**

The Electrical Contractor shall be responsible to see that all fittings are properly cleaned at time of installation.

**7.3 Damage**

Any fittings showing damage, marks or scratches shall be replaced by the Electrical Contractor.

**7.4 Final Circuit**

Internal lighting circuits shall be run in 1.5 sq. mm cable radial circuits, with not more than 2 kw of incandescent lighting load or 1.7 kW of fluorescent lighting, discharge lighting.

**7.5 Lighting Fixture List**

A legend for the various light fittings used in the installation shall be contained on the drawings.

**7.6 Fluorescent Fittings**

Low wattage and fluorescent fittings shall be connected to fixed wiring by PVC single or multicore (including earth) conductors.

**7.7 Chain Suspended Terminations**

Chain suspended fittings shall be fed by a PVC multicore cable with an earth conductor and terminated at the fitting by a nylon stuffing gland.

**7.8 PVC Flex**

The Contractor shall allow a length of 1 m, 3 core heat resistant cable for final terminations to fluorescent luminaries.

**7.9 Fluorescent Tubes**

Fluorescent tubes shall be Philip Colour 840 or equivalent.

**7.10 PVC Insulated Cables**

PVC insulated cable shall not be connected direct to lamp holders or used for internal wiring of lighting fittings where they may be affected by the heat of the lamps.

**7.11 Energy Saving Fittings**

All fittings shall be energy saving fittings.

**7.12 Hazardous Area Light Fittings & Accessories**

All light fittings used in Hazardous Areas shall be suitably rated. A legend for the hazardous area fittings is contained on the drawings.

**7.13** All cables, cable glands and accessories shall be suitably rated for use in a Zone 1 Hazardous Areas.

**7.14 Lighting Switches 20A**

Lighting switches shall be of 20 Amp rating SP as shown on drawing.

**7.15 Lighting Switches Height above FFL**

Switches shall in all cases be mounted at 1350 mm above finished floor level to under-side of the switch boxes.

**7.16 Multi-Gang Switch Boxes**

Where the number of switches are grouped in one location multi-gang switch boxes shall be used. Where more than one phase is incorporated in a switchbox the box shall be divided so that not more than one phase is in any one compartment and the front plate shall be engraved "Danger 400 Volts" in red lettering.

**7.17 Lighting Switches Ex Rated**

Lighting switches in hazardous areas shall be rated 16 Amps, protected to EExde IIC T6. They shall be of CEAG manufacture or equivalent.

**8.0 EMERGENCY LIGHTING FITTINGS****8.1 Type and Installation**

All emergency light fittings shall be of a type and pattern specified and shall be installed as shown on drawings.

**8.2 Cleaning**

The Electrical Contractor shall be responsible to see that all fittings are properly cleaned at time of installation.

**8.3 Damage**

Any fittings showing damage, marks or scratches shall be replaced by the Electrical Contractor.

**8.4 Final Circuit**

Internal lighting circuits shall be run in 1.5 sq. mm cable radial circuits, with not more than 2 kW of incandescent lighting load or 1.7 kw of fluorescent lighting, discharge lighting.

**8.9 Lighting Fixture List**

A legend for the various light fittings used in the installation shall be contained on a separate drawing.

**8.10 Fluorescent Fittings**

Low wattage and fluorescent fittings shall be connected to fixed wiring by PVC single or multicore (including earth) conductors.

**8.11 PVC Chain Suspended Terminations**

Chain suspended fittings shall be fed by a multicore cable with an earth conductor and terminated at the fitting by a nylon stuffing gland.

**8.12 PVC Flex**

The Contractor shall allow a length of 1m, 3 core heat resistant cable for final terminations to fluorescent luminaries.

**8.13 PVC Insulated Cables**

PVC insulated cable shall not be connected direct to lamp holders or used for internal wiring of lighting fittings where they may be affected by the heat of the lamps.

**8.14 Fixing**

Emergency luminaries and exit signs shall be surface mounted on the wall or ceiling as indicated on the drawings.

**8.15 Hazardous Area**

Emergency lighting fittings used in the hazardous areas as identified in the Zone section drawings shall be suitably rated for Zone 1 or Zone 2 as specified on the drawing.

**9.0 SOCKET OUTLETS****9.1 Socket Outlet Legend**

A legend for the various socket outlets used in the installation is contained on the drawings. Alternatives shall be to the Engineer's prior approval.

**9.2 Industrial Plugs and Sockets**

Industrial plugs and sockets shall be to BS 4343 or DIN 49462/63.

**9.3 Industrial Sockets Mounting Height**

Industrial sockets shall be wall mounted at 1200mm above finished floor level unless otherwise noted on the drawings.

**9.4 16A Socket Circuits**

16A rated sockets may be wired in unlimited numbers on radial circuits where diversity permits.

## 9.5 Sockets Other Than 16A

All sockets except 16A must be wired on a separate circuit.

## 10.0 CABLE TRAY INSTALLATION

### 10.1 PVC Cable Tray

#### 10.1.1 Installation

The Electrical Contractor shall include for the complete PVC cable tray installation, as indicated on the drawings and as specified herein, and shall include for all supports.

#### 10.1.2 PVC Cable Trays

Cable trays shall be rigid PVC and have wide flanged edges and shall be fitted with lidding throughout.

#### 10.1.3 Manufacturer

Cable trays shall be of Planet Wattohm manufacture or of Unex manufacture supplied respectively by Ellickson Engineering Ltd., Waterford and EWL Electric, or equivalent.

#### 10.1.4 Fittings

Joints, bends, tees, turn ups, turn downs, reducers and the like shall be factory made unless otherwise approved.

#### 10.1.5 Size and Supports

Cable trays shall be of sufficient size to accommodate all the cables in each individual cable run and shall be firmly supported and fixed so that the total weight of the cable and trays shall be carried without undue sagging. Reference shall be made to manufacturer's recommendations regarding spacing of support brackets etc.

#### 10.1.6 Site Fabricating

All bends, toes, sweeps, offsets etc. will be fabricated by neatly cutting and mitring and welding on site by means of hot air tools and PVC welding rod.

#### 10.1.7 Prefabricated Fittings

If prefabricated fittings are used they shall be joined using PVC jointing material.

#### 10.1.8 Cable Ties

The base of the tray shall be perforated to take normal polyethylene, nylon ties.

**10.1.9 Ventilation Space**

The tray will be sufficiently sized to allow adequate space for 1 No. only full layer of cables, with sufficient space for ventilation. Where tray widths greater than 600 mm are required, two or more adequately sized cable tray runs will be allowed for.

**10.1.10 Support Spacing**

All supports will be fixed horizontally at 1.5 metre centres unless particularly heavy runs require closer spacing.

**10.1.11 Supports**

PVC Cable tray supports shall be formed from 316-S31 "Marine Grade" stainless steel unistrut and shall not exceed a spacing of 1.5 metre centres, and fixed to wall or beams by means of 2 No. 8 mm 316-S31 stainless steel bolts, nuts and spring washers. The cable tray shall in turn be bolted to the unistrut members by 2 No. 6 mm 316-S31 stainless steel mushroom head bolts, nuts and washers, care being taken to ensure that the head of the bolts are uppermost in cable tray.

**10.1.12 Flat Wall Surfaces**

Where cable tray is installed on even flat wall surfaces, it shall be mounted on 316-S31 Unistrut bracket or equivalent purpose made stand-off brackets fixed on wall, giving a space factor of at least 21 mm from the back of the cable tray to the wall as previously described.

**10.1.13 Cable Ties**

The tray base shall be perforated to receive normal cable ties.

**10.1.14 Retention of Cable Formation**

The cables shall be so arranged that where a cable (or cables) branch from the 'run', either from the top, bottom or sides, the remaining cable formation is not disturbed.

**10.1.15 Bends**

Where cables branch from the sides top or bottom of the cable runs, the bends so formed shall be determined by the largest size cable.

**11.0 ACCESSORIES****11.1 Bonding**

All non-current carrying metalwork shall be earth bonded.

**11.2 Weatherproof Equipment**

Accessories for use outside a building (including damp or wet locations within a building) shall be of an approved weatherproof type.

**11.3 Hazardous Locations**

Accessories for use in hazardous locations shall be of an approved flameproof type to the Class particularly specified.

**11.4 Connection Boxes**

Most sensors and instruments will not be capable of taking PVC/SWA/PVC glands. A connection box to IP65 will be taken for each item which will take the armoured cable and also final flexible connection to sensor.

**11.5 Cable Transits**

The electrical contractor shall supply cable transit from the Hawke HCX range (or equivalent). Cable transit shall be sized with 50% spare capacity for future cables. Installation of cable transit frames will be by the Civil Contractor.

**12.0 EARTHING****12.1 Compliance With Regulations**

The Earthing Installation shall be done in accordance with relevant Regulations of the National Rules for Electrical Installations, ET-101 of the Electro - Technical Council of Ireland 2000.

**12.2 Earth Rods/Grids**

Main earthing to consist of earth rods not less than 1800 mm in length or less than 16 mm diameter driven vertically into the ground and to be complete with all recommended fittings and accessories enclosed in a pit and sealed by means of an Armstrong or equivalent cover and flange.

The earth rods shall be connected to a 70mm<sup>2</sup> bare earth conductor grid as shown on the drawings. The earth grid shall be bonded to the structural rebar and the lightning protection air termination grid.

**12.3 Position of Earth Bars**

Main earth bars, complete with suitable mounting insulators, shall be positioned in the switch-rooms about 300 mm above floor level.

**12.4 Aluminium Conductors**

Aluminium cables must not be used as earthing conductors in case of subjection to electrolytic corrosion.



**12.5 Labelling**

The connection to the earth electrode must be clearly and permanently labelled "Safety Electrical Connection- Do not Remove".

**12.6 Non-Protected Earthing Conductors**

Where earthing conductors are buried, and not protected against corrosion, minimum cross sectional areas are 25 mm<sup>2</sup> for copper and 50 mm<sup>2</sup> for steel.

**12.7 Protected Earthing Conductors**

Where buried and protected against corrosion, but not mechanically protected, minimum cross-section for both copper and steel is 16 mm<sup>2</sup>, but the steel must be coated.

**12.8 Earthing Terminal**

A main earthing terminal or bar must be provided for each installation to collect and connect together all protective and bonding conductors.

**12.9 Disconnection**

It must be possible to disconnect the earthing conductor from the main earthing terminals, but only by using tools.

**12.10 Supplementary Earth**

Where metallic conduit is used as the protective conductor to a socket outlet, the earthing terminal of the socket outlet must be connected to the earth terminal of the box by a separate conductor.

**12.11 Separate Additional Protective Conductor**

A separate additional protective conductor is required where flexible conduit is used, to supplement the earthing facility of the conduit itself.

**12.12 Main Equipotential Bonding**

Main equipotential bonding conductors, with a cross-sectional area of not less than half that of the earthing conductor, minimum 6 mm<sup>2</sup>, connect the earthing terminal with the services concerned and as close as possible to their point of entry to the building.

**12.13 Supplementary Bonding**

Supplementary bonding conductors will also be required in an area such as a kitchen or bathroom.

**12.14 Socket Outlet Circuits**

The maximum disconnection time for a protective device to open will be  $0.4S$  for circuits feeding socket outlets.

**12.15 Fixed Equipment Circuits**

The maximum disconnection time for a protective device to open for circuits feeding fixed equipment will be 5 seconds.

**12.16 Minimum Cross-Sectional Area of Protective Conductors**

The minimum cross-sectional area of protective conductors in relation to the area of associated phase conductors shall be as follows:

Cross-Sectional Area of Phase Conductor	Minimum Cross-Sectional Area of the Corresponding Protective Conductor
$S$ $\text{mm}^2$	$S_p$ $\text{mm}^2$
$S < 16$	$S_p = S$
$16 \leq S \leq 35$	$S_p = 16$
$S > 35$	$S_p = S/2$

**12.17 Requirement of ELCB**

When the impedance of the fault or the impedance of the earth fault loop is too high to allow enough current to ensure that the protective device opens quickly, an earth leakage circuit breaker of the residual current type shall be installed.

**12.8 ELCB Operating Current for Indirect Contact**

The National Rules for Electrical Installations, Third Edition 2000 and the IEE Regulations impose an operating current of 30 mA for devices intended to protect against indirect contact.

**12.19 Extra-Low Voltage Circuits**

Plugs and socket outlets of safety extra-low voltage circuits shall not have a protective conductor connection.

**12.20 Value of Earth Resistance**

The earthing arrangement shall be such that the value of resistance from the consumer's main earthing terminal to earth is 0.25 ohms maximum.

**12.21 Type of Earth Electrode**

The following types of earth electrodes are recognised for the purposes of the National Rules for Electrical Installations Second Edition 1991:-

Earth rods or pipes; Earth tapes or wires; Earth plates; Earth electrodes embedded in foundations; Metallic reinforcements of concrete; Metallic pipe systems; Lead sheaths and other metallic coverings of cables.

**12.22 Resistance of Earth Electrodes to Corrosion**

The materials used and the construction of earth electrodes shall be such as to withstand damage due to corrosion.

**12.23 SWA Armour**

In addition to utilising the SWA cable armour for earthing, a separate protective conductor, as detailed in 12.16 above shall be provided for each item of equipment.

**13.0 LOW VOLTAGE SWITCHGEAR ASSEMBLIES****13.1 Code of Practice**

The Code of Practice for the design, selection and erection of low voltage (not exceeding 1000 V ac). Switchgear Assemblies shall be that as specified by the Electro-Technical Council of Ireland 1991, - Publication No. ET-201.

**13.2 Factory Built Assembly Complying with IEC Publication**

Switchgear complying with I.E.C. Publication 439 is acceptable subject to the following two deviations:-

- (i) Open-type or dead-front-type Switchgear 439 assemblies are not permissible.
- (ii) Where a cubicle door is provided to give access to circuit breakers, fuses or the like for maintenance or inspection purposes, bare busbars and associated conductors should be protected from inadvertent contact by persons while that door is open.

This will normally consist of a barrier which can be removed only by means of tools. It is not necessary to prevent deliberate attempts to touch live parts.

When busbars are installed in the bottom of a switchboard, they should be protected against direct contact by complete insulation or by an enclosure giving a degree of protection of at least IP 20.

### 13.3 Compliance with Legal Requirements

The Low Voltage Switchgear Assemblies shall comply in all respects with the legislation comprising (i) the "Safety, Health & Welfare at Work Acts" and (ii) the Factories (Electricity) Regulations (S.I. No. 3: 1972).

### 13.4 Access to Panels

Clear working space of at least 1.2 m should be provided in front of the board. When there is access at the back, clear working space of at least 0.91m must be provided.

### 13.5 Recommendation For Degree of Protection

The degree of protection of the enclosure for custom built assemblies should be at least IP 54.

### 13.6 General Specification

Metalwork Manufacturer: ABB, Logstrup, Holec, Tabula or equivalent  
 Type of Switchgear: ABB, Holes, Merlin Gerin (or equivalent)  
 Type of Control Gear: ABB, Sprecher & Schuh/Allen Bradley, Telemecanique (or equivalent)  
 Type of Assembly: Fixed Form 4 to IEC 439  
 Type of Enclosure: Metal, with stove enamel cellulose paint finish

### 13.7 Certification

A Factory Built Assembly should have a certificate from a recognised test organisation in a CENELEC country to the effect that the FBA complies with IEC Publication 439 or an equivalent national standard. Certification may consist of type approval or individual certification.

### 13.8 Routine Tests

Routine tests should be made on every assembly whether factory or custom built, these tests are intended to detect faults in material and workmanship or possible damage after assembly or manufacture.

### 13.9 Housings

Housings shall be manufactured from zinc coated steel of minimum thickness, 14 SWG finished in stove enamel cellulose paint.

### 13.10 Voltage Rating

Switches and control gear to be not less than 500 Volt rating.

**13.11**      **Fuses**

Fuses shall be of the HRC cartridge type to BS 88 or equivalent.

**13.12**      **Cable Entry Glands**

All switchboards and sub-distribution boards shall be suitable for bottom cable entry glands, etc.

**13.13**      **Ordering Switchboards**

Before a firm order is placed for the supply of switchboards etc. the contractor shall furnish the Engineers with details and drawings of proposals for acceptance. No switchboard etc. shall be delivered to site unless it has been inspected and approved in writing by the Engineers prior to dispatch by the manufacturers, the contractor shall give sufficient notice to the Engineers in writing, stating when switchboards etc. are ready for inspection.

**M.C.C.****13.14**      **Multi-Cubicle**

The M.C.C. shall be the multi-cubicle type, non-withdrawable F.B.A. (factory built assembly). Incoming supply shall be bottom entry and at one side of the panel. Outgoing feeds will be bottom exit and the panel will have gland plates suitably drilled to accept PVC/SWA/PVC. cables unless otherwise stated.

**13.15**      **Metal Enclosure**

The M.C.C. will be suitable for 400 volt three phase AC 50 Hz supply. Switchgear enclosures shall be moulded or metal enclosed and should be of sturdy and rigid construction. The enclosure will have a degree of protection to I.P. 54. Enclosures must prevent danger from electric shock due to "direct contact" and indirect contact in accordance with Chapter 41 of the "National Rules for Electrical Installations" Third Edition 2000.

**13.16**      **Floor Mounting**

The M.C.C. shall be suitable for floor mounting with access from the front so that panel can be located with rear flush against a wall.

**13.17**      **Main Incomer**

An incoming switch fuse shall be provided for isolating the entire panel and this must have a means for padlocking. The incoming circuit shall be provided with a voltmeter and ammeter, each with phase selection. The incoming circuit will be provided with a kW. hr. meter with a pulse output suitable for connection to a Telemetry/PLC system.

**13.18 Busbars**

Busbars shall be fed at one end and run the full length of the switchboard at the top and they shall be accessible from the front. They shall be copper construction and in their own compartment. Vertical busbars shall also be of copper construction and in their own compartment. Busbar connections are made to individual starters except for the very small starters (15 kw and below) which are made in 10 mm<sup>2</sup> cable.

**13.19 Motor Starters**

Motor starters shall either be Direct-on-Line or Star Delta. Direct on-Line starters will be up to but excluding 4 Kw with above this being Star-Delta. Each starter circuit will consist of a combined MCB/thermal overload relay with anti-single phase protection and a contactor. The MCB/overload would be electrically reset from a push button projecting through the compartment door and should be fitted with at least 2 Nr. N/O and N/C auxiliary contacts. The combined MCB/overload should be complete with the facility to padlock in the OFF position or alternatively a padlockable isolator should be fitted ahead of the MCB/overload.

Each circuit will be provided with outgoing terminals to accommodate a remote stop/start push button station.

Each starter will have a 24V interface relay which will be controlled from the telemetry system on auto. In addition each starter shall have the required number of relays to provide the necessary 'volt free' contacts for the PLC system as indicated in the main specification.

To allow for drive interlocking requirements, two outgoing control wiring terminals will be provided for each starter. These shall be wired into each control circuit immediately after the thermal overload tripping contact and shall be linked out at the terminal block when required.

Star Delta starters shall also contain the necessary additional contactors and timers for automatic changeover.

**13.20 Control Voltage**

Control voltage shall be 110 volts A.C. with one pole earthed. The 110V supply shall be provided by a suitably sized control transformer (with 50% spare capacity) which shall be located in an MCC cubicle with adequate allowance for ventilation.

**13.21 Cable Duct**

The MCC shall have adequate PVC slotted cable ducts running alongside the starters to allow for the required number of cables to the starters.

**13.22 Inadvertent Contract**

Where a cubicle door is provided to give access to CBs, starters, etc., bare busbars and associated conductors should be protected from inadvertent contact by persons while the door is open. This should consist of an insulated barrier which can be removed only by means of a tool.

**13.23 Ammeter**

All drives to be provided with an ammeter with phase selection switch mounted in the compartment door. All drives are to be provided with facility to connect a thermistor actuated alarm and a thermistor actuated cut out.

**13.24 Earthed**

A copper earth bar shall run the full length of the board. This shall be suitably drilled to allow bolt on connections of an earth continuity conductor for each circuit. The frame of each cubicle will be connected by a separate conductor to the protective conductor.

**13.25 Technical Information**

The manufacturer should supply the following technical information:-

- (1) Short circuit strength test certificates or reports (Short circuit level will be 50 K.A.)
- (2) Adequate technical instructions, wiring diagrams and schematic diagrams.
- (3) Instructions for maintenance.
- (4) Operating characteristics of fuses, circuit breakers and miniature circuit breakers.
- (5) Standards with which complete assembly complies.
- (6) Recommended spare parts lists.

**13.26 Commissioning Test**

Commissioning tests should include the following:-

- (1) Checking of operation of mechanical devices.
- (2) Checking of conductors and external cables for effectiveness of electrical connections.
- (3) Checking of protective devices for correctness of settings or fuse ratings.
- (4) Checking labelling of circuits.

- (5) Checking that degree of protection against ingress of solid objects and moisture is not impaired.
- (6) Checking that there is no mechanical damage.
- (7) Dielectric test which will consist of a voltage of at least 1000 V a.c. RMS but not exceeding 2500 V a.c. RMS should be applied for about 1 minute, as follows:-
  - (i) Between all live parts and the frame.
  - (ii) Between each pole and all the other poles connected to the frame.

Where there is a protective (earthing) conductor insulated from the exposed parts, this conductor is regarded as a separate circuit, i.e. it should be tested with the same voltage as the main circuit to which it belongs.

This test may be made with all switches closed, or alternatively, each section may be tested separately. There should be no failure of the insulation as a result of this test.

Certain items which are not designed for this test voltage (e.g. measuring instruments, solid state devices) should be disconnected at their terminals for the test.

- (8) Check of continuity of protective (earthing) circuit.

Testing must be witnessed by Consultant/Client and ample notice must be given of date of tests to facilitate witnessing.

### 13.27 Thermistor

A thermistor relay or thermal switch relay is to be included in each pump starter.

### 13.28 Type 2 Co-Ordination

Each M.C.C. Starter shall have full 'Type 2' co-ordination in accordance with IEC 947 Part 4. In addition, certification is to be furnished by the M.C.C. Builder that any combined MCB/Overload and contactor combination which is proposed to be used in the M.C.C. has undergone the 'P' and 'Q' tests associated with BS 4941 (IEC 292) Type 'C' co-ordination.



## 14.0 POWER FACTOR CORRECTION

### 14.1 Standards

The capacitors shall comply with IEC 831, Parts 1 and 2 and BS 16500.

### 14.2 Power Rating

The power rating shall be subject to the following tolerance.

-5 or +10%	For Capacitor Units
-0 or +10%	For Capacitor Banks

### 14.3 Rated Frequency and Voltage

The rated frequency for capacitors shall be 50 Hz. and the rated voltage shall be 400 V.

### 14.4 Internal Fuses

Each element of the capacitors shall be fitted with internal individual element fuse links for overcurrent protection.

### 14.5 Discharge Resistors

Capacitors shall be fitted with discharge resistors.

### 14.6 Switchgear

Switchgear shall be equipped with either switchfuse units or circuit breaker rated at 125% of rated current of the capacitor unit or bank.

### 14.7 Automatic Switching

The power factor correction capacitor controller shall be capable of automatically switching a minimum of 12 capacitor steps and shall be of Novar manufacture or equivalent.

### 14.8 Power Factor Level

Power Factor Equipment shall be supplied to maintain the overall plant power factor at least 0.95 lagging.

### 14.9 Damping Reactors

All capacitor units or banks to be fitted with damping reactors. These to be sized based on current surges arising from switching of capacitors.

**14.10 Liquid Free**

The di-electric shall be zinc metalised polypropylene film or equal to approval and shall be liquid free.

**14.11 Steel Container**

The capacitor elements are to be incorporated in a steel container with inert non toxic granular filling to surround every element. Aluminium cooler plates are to be provided to effect heat dissipation from the elements to the container case.

**14.12 Manufacture**

Capacitors shall be similar to those as manufactured by ASEA Brown Boveri, Roderstein or equivalent.

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**APPENDIX 2**

**SCHEDULE OF PRICES**

Doc. Nr. A5090-N-S-05-B

1 (Appendix 2)

## SCHEDULE OF PRICES

<u>Item</u>	<u>Description</u>	<u>Amount</u> €
1.0	<b><u>Preliminaries</u></b>	
1.1	Provide for all insurances as required under the Contract.	
1.2	Provide for all packing, transport, freight, crantage and carting of all plant and materials, including offloading, storage on site, securing, protection, etc.	
1.3	Provide for meeting all the requirements of safety under the Safety, Health & Welfare at Work (Construction) Regulations, 2001, the Safety Health & Welfare at Work (General) Regulations and the Factories Act.	
1.4	Provide for co-ordinating work on site with other contractors.	
1.5	Provide for mobilisation of site facilities, including welfare facilities, power, water, telephones etc.	
1.6	Provide for maintenance of site facilities for the duration of the Contract, including welfare facilities, power, water, telephones, etc.	
1.7	Provide for all temporary works required for the installation on site, including construction plant, temporary power supply, small tools, task lighting for the completion of the Contract.	
1.8	Provide for all necessary cranes and lifting equipment for the completion of the Contract.	
1.9	Provide for all ladders and scaffolding for the completion of the Contract.	
1.10	Provide for mobilisation of Contractor's Management Supervision and Staff.	
	<b>c/f</b>	

<u>Item</u>	<u>Description</u>	<u>Amount</u> €
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**b/f**

- |      |  |  |
|------|--|--|
| 1.11 | Provide for Contractor's Management supervision and staff salaries, expenses and overheads for the completion of the Contract, including attendances at site meetings. |  |
| 1.12 | Provide for carrying out the works in accordance with the terms and requirements of the Specification.   |  |
| 1.13 | Provide for provision of programmes, reports, etc., as specified.  |  |
| 1.14 | Provide for QC Procedures and Testing, as per the Specification.   |  |
| 1.15 | Provide for all consumables.   |  |
| 1.16 | Provide for all shop fabrication working/drawings and sketches.  |  |
| 1.17 | Provide for Final Drawings.  |  |
| 1.18 | Provide for performance testing and commissioning all plant and equipment.   |  |
| 1.19 | Provide for full instruction of the Employer's staff in the operation of the plant.  |  |
| 1.20 | Provide for all costs in relation to site cleanliness and maintenance.   |  |

**c/f**

<u>Item</u>	<u>Description</u>	<u>Amount</u> €
	<b>b/f</b>	
1.21	Provide for all costs for complying with the Tender Documents.  Form of Tender  Form of Agreement  Form of Repayment Bond  Instructions to Tenderer  Conditions of Contract  Special Conditions  Specifications  Information to be provided by the Tenderer	
1.22	Provide for Provisional Sum for the provision of power supplies to the pumping stations	€50,800.00
1.23	Provide a Provisional Sum to be expended in whole or in part by Engineer for spares	€12,600.00
1.24	Provide Provisional Sum to be expended in whole or in part by the Engineer for tools.	€6,300.00
1.25	Provide a Provisional Sum for the provision of telephone lines to the telemetry outstation.	€38,000.00
1.26	Provide for other costs of any kind to comply with this Specification which are not specifically scheduled above and/or which have not been allowed for elsewhere in the Schedule of Prices.	
	<b>c/f</b>	

<u>Item</u>	Description	Amount €
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b/f

(The Contractor is required to list all items allowed for in this lump sum in the space provided below).

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1.27 Provide for special defects liability period of 48 months as per Clause 25 of the Specification.

1.28 The Contractor shall enter a rate per month for each additional month by which the special defects liability period is extended.

Rate only € \_\_\_\_\_ per month.

1.29 Provide for extension of all manufacturers' guarantees for plant and equipment by a period of 36 months.

1.30 Provide for routine maintenance of the pumping plant and motor control equipment as described in Clause 25 of the Specification.

Rate per year € \_\_\_\_\_ for 3 years .

**Total**  
**(Forward to Summary)**

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**2.0 Mechanical/Electrical Works**

<b><u>Item</u></b>	<b>Description</b>	<b>Amount €</b>
2.1	Wallingstown Pump Station:	
	a) 3 nr. (2 duty, 1 standby) fixed speed foul pumps as per Clause 3.0	
	b) All pipework, valves, fittings as per Drg. Nr. A5090-N002.	
	c) Ultrasonic level controller and level switches.	
	d) 1 nr. electro magnetic type flow meter with pipework and fittings.	
	e) Davits and lifting chains.	
	f) 1 nr. painted metal door, associated frame and ancillaries to kiosk enclosure as described on Drg. Nr. A5090-N018.	
2.2	Flaxfort Pumping Station:	
	a) 4 nr. (3 duty, 1 standby) fixed speed foul pump as per Clause 4.0.	
	b) All pipework, valves, fittings as per Drg. A5090-N007.	
	c) 1 nr. sump pump complete with pipework, grating and fittings.	
	d) Ultrasonic level controller and level switches.	
	e) 1 nr. electro-magnetic type flow meter complete with pipework and fittings.	
	f) Davits and lifting chains	
	g) Electric crane and crane beam.	
	h) 1 nr. rotating bar interceptor.	
	i) 1 nr. overflow screen.	
	j) All steelwork for stairs, walkways, handrails, etc.	
	<b>c/f</b>	



<u>Item</u>	<u>Description</u>	<u>Amount</u> €
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b/f

## 2.3 Courtstown Pumping Station:

- a) 2 nr. foul pumps (1 duty/1 standby)
- b) All pipework, valves, fittings as per drg. Nr. A5090-N010
- c) 1 nr. ultrasonic level controller and 2 nr. level switches.
- d) 1 nr. electro-magnetic type flow meter with pipework and fittings.
- e) Davits and lifting chains.
- f) 1 nr. baffle plate.
- g) 1 nr. painted metal door, associated frame and ancillaries to kiosk enclosure as described on Drg. Nr. A5090-N018.

## 2.4 Control Panels and Electrics:

- a) 2 nr. kiosks at Wallingstown Pump Station and Courtstown Pump Station as described.
- b) 3 nr. telemetry outstation in separate enclosures as specified.
- c) Control panels at each of the pumping stations.
- d) All power and signal cabling including earthing and bonding necessary for the whole of the works.
- e) Domestic Electrics as shown on Drg. A5090-E001/E002/E003.

c/f

<u>Item</u>	<u>Description</u>	<u>Amount</u> €
	b/f	
2.5	Miscellaneous:	
a)	Gas detection systems to Flaxfort Pumping Station. (Clause 16.8)	
b)	Portable gas detection system as described. (Clause 16.9)	
c)	Intruder alarms at Control Kiosks and Control Building. (Clause 16.10)	
d)	Painting of pumps and pipework. (Clause 20)	
e)	One year's supply of lubricants	
f)	2 nr. fire extinguishers to Flaxfort Pumping Station. (Clause 4.0)	
g)	Portable Lifting Davit (Clause 18)	
h)	Ventilation System to Flaxfort Pumping Station (Clause 16.11)	
i)	1 nr. hand dryer to Flaxfort Pumping Station.	
	<b>Total</b>	_____
	<b>(Forward to Summary)</b>	=====

**SCHEDULE OF PRICES**

<b><u>Item</u></b>	<b><u>Description</u></b>	<b><u>Amount</u></b> €
<b>3.0</b>	<b><u>Daywork Labour Schedule</u></b>	
	The Contractor to allow for the following:-	
<b>3.1</b>	Foreman	
	50 hrs. @ T x 1	
	25 hrs. @ T x 1½	
	25 hrs. @ T x 2	
<b>3.2</b>	Chargehand	
	200 hrs. @ T x 1	
	100 hrs. @ T x 1½	
	50 hrs. @ T x 2	
<b>3.3</b>	Electrician/Tradesman	
	200 hrs. @ T x 1	
	100 hrs. @ T x 1½	
	50 hrs. @ T x 2	
<b>3.4</b>	Apprentice Electrician	
	100 hrs. @ T x 1	
	50 hrs. @ T x 1½	
	25 hrs. @ T x 2	
<b>3.5</b>	Starter Equipment Specialist Engineer	
	50 hrs. @ T x 1	
	25 hrs. @ T x 1½	
	25 hrs. @ T x 2	
	<b>Total</b>	_____
	<b>(Forward to Summary)</b>	_____

**Note:** The rates stated above should be the Contractor's fully inclusive rates for the operatives and include for all insurances, expenses, site allowances, tool money, subsidence and percentage additions which are applicable.

**SCHEDULE OF PRICES****SUMMARY**

<b><u>Description</u></b>	<b><u>Amount</u></b> €
Section 1 Preliminaries	
Section 2 Mechanical/Electrical Works	
Section 3 Daywork Schedule	
Contingency sum to be expended only on the instruction of the Engineer.	<u>€15,800.00</u>
<b>Sub-Total</b>	
Add VAT @ 12.5 %	_____
<b>Sub-Total</b>	
<b><u>Allow for Bond</u></b>	
The Contractor shall obtain from an approved Company or Society, a Guarantee Bond for the due and proper completion of the works within the time limit in the contract and shall pay all premiums and fees required for same, including the cost of the Solicitor.	_____
<b>Total Amount to Form of Tender</b>	=====

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