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SECTION B

1.0 BESBOROUGH PUMPING STATION (Refer to Drg. Nrs. A5088-N108, N111 and E001)

1.1 Details of the proposed pumping station are shown on Drg. Nrs. A5088-N108, N111 and E001.

The rising main has been constructed in three sections, under three different contracts. For the different sections of rising main, refer to the following drawings:-

- Besborough Pump Station to Mahon Technology Estate Road — A5088-N0109 & A5088-N110
- Mahon Technology Estate Road to Ballinure Header Chamber Site — A5615-N002
- Ballinure Header Chamber Site to Ballinure Header Chamber — A5087-N221

The Besborough Pumping Station is a new below ground reinforced concrete structure. The pumping station consists of a wet well and valve chamber as indicated on the drawings. The M&E Contractor will be required to connect the pump discharge pipework to a length of pipe laid through the wall of the valve chamber by the Civil Contractor. Work on the installation of the pumps and pipework will therefore be confined to the inside of the new concrete structure. The Civil Contractor is to lay ducts for the cables between the electrical kiosk and the ESB connection, and the electrical kiosk and the pumps. The electrical kiosk is to be housed in an enclosure to be built by the Civil Contractor.

It is intended that 3 Nr. fixed speed foul pumps (1 Nr. duty, 1 nr. assist and 1 Nr. standby) shall pump through a 350 mm diameter DI rising main to connect to existing pipework near the Mahon Technology Estate Road.

The pumps shall be of similar type and shall be arranged such that when two pumps are operating together, the combined output is 126l/s (6 DWF) and when one pump is operating, the output shall not be less than 84 l/s (4DWF).

Invert level of incoming sewer	= 1.800m OD
Floor level of pump sump	= -0.80m OD
Header Manhole discharge level	= 21.70m OD
Nr. of rising Mains	= 1 Nr
Internal diameter of rising main	= 350mm
Length of Rising main	= 1467m
Estimated friction and fitting losses (2 pumps operating)	= 7.95m
Static head	= 22.00m
Total head (2 pumps operating)	= 29.95m

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 6 set points for pump control to operate as follows:

Set Point 1	Low level cut out of duty pump
Set Point 2	Low level cut out of Assist Pump
Set Point 3	Low level cut out of Standby Pump
Set Point 4	Cut in of duty pump
Set Point 5	Cut in of Assist Pump
Set Point 6	Cut in of Standby Pump
Set Points 7 & 8	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 total flow from the pumping station during storm conditions will vary between 84 l/s (1 Nr. duty) and 126 l/s (1 Nr. duty and 1 Nr. assist).

It shall be the M&E Contractor's responsibility to assess the friction losses in the system across the range of flows required. In addition, the Tenderer shall state the efficiencies of these pumps for the full range of flows.

12 The following shall be supplied and installed by the M&E Contractor:-

- 3 Nr. (1 duty, 1 assist, 1 standby) fixed speed submersible pumps, with equal duties such that two pumps in parallel will deliver 126 l/s against the total head determined from the above data.
- Include for all suction pipes, delivery pipework to connect to the 350mm DI rising mains, sluice valves, non-return valves, bends, tapers, guide rails, control equipment , electrics and float controls, etc.
- 1 nr. kiosk as per Clause 7.0.
- Domestic Electrics
- Include for all signal cabling and wiring back to the control panel.
- Davits and lifting chains as per Clause 4.0 "Pump Removal" below.
- Gas Detection Unit as per Clause 12.8 below.
- 2 Nr. rescue type breathing apparatus tanks.

- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.

- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.

1.3 Hazardous Area Classification

The H.A.C. is set out as follows:-

Area	Classification
Pump Sumps	Zone 1
Inlet Chamber	Zone 1
Valve Chambers	Zone 2
All other areas	Non-Hazardous

2.0 RONAYNE'S COURT PUMPING STATION
(Refer to Drg. Nr. A5088- N117, N118 and E002)

2.1 Details of the proposed pumping station are shown on Drg. Nr. A5088-N117, N118 and E002.

The rising main has been constructed in the sections, under three different contracts. For the different sections of rising main, refer to the following drawings:-

- Ronayne's Court Pump Station
  Mahon Technology Estate Road — A5088-N112 & A5088-N113

- Mahon Technology Estate Road
  Ballinure Header Chamber Site — A5615-N002

- Ballinure Header Chamber Site
  Ballinure Header Chamber — A5087-N221

Ronayne's Court Pumping station is an existing pumping station with a wet well/dry well arrangement. There is a superstructure which houses the reception, office, store, control room, ESB substation and motor gallery. The M&E sub-contractor will be required to carry out modifications to the pumps and pipework in the dry well of the pumping station. The new pumps and pipework are to be installed between the existing suction and delivery pipework, so the M&E Contractor will have to work within these existing levels. New concrete support plinths are to be constructed to suit the position and level of the new pumps. The M&E Contractor is required to install 2 nr. new sump pumps, to drain the floor of the dry well. These sump pumps are to discharge into the wet well and opes will need to be formed through the existing wall for this discharge pipework. A new screed is to be laid on the floor of the dry well, falling towards the new sump pumps. The sump pumps are to be installed in 1000 x 1000 x 750 deep sumps to be formed in the floor of the dry well. The existing hand operated hoist is to be replaced by an electrical crane. The new electrical crane is to be fitted to the existing support beam. This support beam is a 150 mm wide x 250 mm deep UB section and

runs the full length of the superstructure. The existing beam is rated for a safe working load of 3000 kg. The new control panel is to be housed in the existing control room. The M&E Contractor is to ensure that at least two pumps remain operational at all times during the initial installation and modifications to the installed pumps at a later date.

An allowance has been made in the Schedules of Prices for the following building work that will be required when the modifications to the pumps are carried out, (See drawing A5088-N130 – "Detail of Bypass Valve arrangement at Ronayne's Court Pumping Station").

- Excavate to expose the fittings at the point where the new twin 700mm diameter rising mains connect to the existing 800mm diameter rising mains.
- Undo dismantling joints on twin 700mm diameter rising mains, remove blank flanges and refit dismantling joints.
- Undo dismantling joints on twin 800mm diameter rising mains, install 800mm diameter blank flanges and refit dismantling joints.
- Backfill excavation and reinstate asphalt surfacing.

2.1.1 Combined Flow Pumps

The existing 4 pumps are to be replaced with 4 new fixed speed submersible flow pumps. These 4 new pumps will initially continue to pump to an existing header chamber, through 2x800mm rising mains. After a period of approximately 2 years, the pumps will be required to pump to a new header manhole located 1712m away from the pump station. The pumps will pump to the new header manhole through twin 700mm rising mains.

The pumps shall be of similar type and shall be such that when two pumps are operating together, (1 nr. on each rising main), the combined output is 643.4 l/s (4.5 DWF) and when four pumps are operating together (2 nr. on each rising main), the combined output shall not be less than 1144 l/s (8DWF), against a total head resulting from the following parameters, (same flow requirements for the Initial and Ultimate conditions detailed below):-

Initial Requirement (for a perid of approx. 2 years)

Invert level of incoming sewer	-3.51m OD
Floor level of Pump sump	-5.71m OD
Header manhole discharge level	5.17m OD
Nr. of rising mains	2
Internal diameter of rising mains	800mm
Length of rising main	38m
Estimated Suction and fittings losses (per rising main, 2 pumps operating)	0.4m
Static head	10.9m
Total head (per rising mains, 2 pumps operating).	11.3m

Ultimate Requirement

Invert level of incoming sewer	= -3.51m OD
Floor level of pump sump	= -5.71m OD
Header manhole discharge level	= 21.7m OD
Nr. of rising Mains	= 2 Nr.
Internal diameter of Rising Main	= 700
Length of rising main	= 1712m
Estimated friction and fitting losses (per rising main, 2 nr. pumps operating)	= 5.25m
Static head	= 26.96m
Total head (per rising main, 2 nr. pumps operating)	= 32.21m

The M&E Contractor shall include in his Tender a proposal on how the changeover is to be effected. A detailed description of the modifications to be carried out to the pumps after the initial approx. 2 year period, as well as performance details of the pumps for the initial and ultimate conditions, to be included in the proposal and submitted with the Tender.

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 4 set points for pump control to operate as follows:

Set Point 1	Low level cut out of duty pump
Set Point 2	Low level cut out of assist pump
Set Point 3	Cut in of duty pump
Set Point 4	Cut in of Assist Pump
Set Points 5 & 6	Spare

The M&E 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 total flow from the pumping station will vary between 321,75 l/s (1 Nr. pump operating on 1 rising main) and 1144 l/s (4 Nr. pumps operating on 2 rising mains).

It shall be the M&E Contractor's responsibility to assess the friction losses in the system across the range of flows required. In addition, the Tenderer shall state the efficiencies of pumps for the full range of flows.

11.2 Sump Pumps

It is intended that 2 Nr. fixed speed sump pumps shall be installed in the dry well to pump through 80mm diameter ductile iron mains, discharging in the wet well.
The pumps shall be of similar type and shall have an output of 6 l/s each against a total head resulting from the following parameters:-

	Sump Pump Nr. 1	Sump Pump Nr. 2
Floor level of pump sump	= -6.41 l/s	= -6.41m OD
Rising Mains discharge level	= 2.00m OD	= 2.00m OD
Nr. of rising mains	= 1 Nr	= 1 Nr
Internal diameter of rising main	= 80mm	= 80mm
Length of rising main	= 18m	= 13.2m OD
Estimated friction and fitting losses	= 0.48m	= 0.35m
Static Head	= 8.26m	= 8.26m
Total head	= 8.74m	= 8.61m

The operation of the pumps shall be controlled by a manual switch.

It shall be the M&E Contractor's responsibility to assess the friction losses in the system for the flow required. In addition, the Tenderer shall state the efficiencies of the pumps for the given flows.

21 The following shall be supplied and installed by the M&E Contractor:-

- 4 Nr. (2 duty, 2 assist) fixed speed combined flow submersible pumps, with equal duties such that four pumps in parallel will deliver 1144 l/s against the total head determined from the above data.
- Include for all suction pipes, delivery pipework to connect to the twin 700mm ductile iron rising mains, sluice valves, non-return valves, bends, tapers, guide rails, control equipment, electrics and float controls etc.
- 2 Nr. fixed speed submersible sump pumps capable of delivering 6 l/s against the total head determined from the above data.
- 1 Nr. kiosk as per Clause 7.0.
- Domestic Electrics
- Include for all signal cabling and wiring back to the control panel.
- New electrical crane to replace existing hand operated hoist.
- Gas Detection Unit as per clause 12.8 below.
- 2 Nr. rescue type breathing apparatus tanks.
- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.
- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.
- All concrete support plinths to new pumps and pipework.
- Breaking out and sealing opes plus other builders work.

2.3 Hazardous Areas Classification

The H.A.C. is set out as follows:-

Area	Classification
Pump Sumps	Zone 1
Inlet Chamber	Zone 1
Dry Well	Zone 2
All other areas	Non-Hazardous

3.0 SUBMERSIBLE PUMPS

3.1 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 end suction type and should be suitable for pumping untreated sewage containing fibrous and solid matter, as well as grit. They 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 "on snore" 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, such as a programmable logic controller or similar approved.

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

3.2 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 the 2 Nr. sump pumps which shall be capable of passing solids up to 50 mm. The pumps shall be provided with a spiral bottom plate with shearing edges and cutter inlet or equivalent to enable the cutting or shredding of large solids.

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.

3.3 The speed shall be not greater than 1450 rpm.

3.4 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. A facility shall also be provided in the control system to enable standby pumps to cut in automatically should the duty pumps or assist pumps fail.

3.5 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.

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

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

3.8 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.

3.9 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.

4.0 SUBMERSIBLE PUMP REMOVAL

4.1 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.

4.2 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.

4.3 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.

4.4 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.

4.5 Pump cables shall accord with BS5345 Part 1 or equal, and include a flexible metal screen or armour. The cables shall be suitable for use in Zone 1 Hazardous Areas.

5.0 ELECTRICAL MOTORS

5.1 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.

5.2 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.

Each unit shall be provided with an adequately designed cooling system. A water jacket which encircles the stator housing shall be provided. The water jacket shall be provided with a separate circulation of the pumped liquid. A cooling fluid circulation pump will not be allowed. Cooling media channels and parts shall be non-clogging. Provision for external cooling and flushing shall be provided. Thermal sensors shall be provided to monitor the stator temperatures.

6.0 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.

7.0 KIOSKS

The electrical control panel, telemetry equipment and the ESB's incoming supply and meters at Besborough pumping station shall be housed in a weatherproof, ventilated and lockable kiosk, and at Ronayne's Court in the control room of the existing pump station building.

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

The kiosk at Besborough Pump Station shall be positioned as shown on Drg. Nr. A5088N108. The doors should be lockable and shall be retained in the 90° open position with stays.

Each kiosk shall be mounted on a plinth at least 150mm above the surrounding ground level and sealed with mastic to prevent the entry of water.

The kiosk shall be cross ventilated with one high and one low vermin proof ventilation grille on opposite sides. An interior light should be provided. Each equipment enclosure oulined in Section 9.0 below shall be provided with a thermostatically controlled anti-condensation heater operating on 110 Volts.

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 each kiosk.

Each kiosk shall house the following equipment:-

(a) ESB's incoming supply, meters and distribution equipment in separate enclosures. (Described in Clause 8.0).

(b) Connection for mobile generator; (Described in Clause 9.0)

(c) Telemetry outstation; (Described in Clause 10.0)

(d) Control panel; (Described in Clause 11.0).

8.0 ESB'S INCOMING SUPPLY, METERS AND EQUIPMENT

One section of each kiosk 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.

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.

9.0 CONNECTION FOR MOBILE GENERATOR

A five pin pilot appliance inlet to BS 4343 or equal shall be mounted inside each kiosk in order that a mobile generator can be connected. A flap shall be fitted to the outside of each 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.

10.0 TELEMETRY OUTSTATION

The Contractor shall provide and install (in a separate enclosure) within the kiosk for each pumping station, a telemetry outstation and equipment to monitor and record the operation of the pumping station and for transmission back to the Corporation's telemetry control. The following operational states will be monitored:-

(a) Mains power failure;
(b) Level control system failure;
(c) Nr. 1 Pump tripped (starter);
(d) Nr. 2 Pump tripped (starter);
(e) Nr. 3 Pump tripped (starter);
(f) Nr. 4 Pump tripped (starter); (Ronayne's Court only)
(g) Nr. 1 Pump running;
(h) Nr. 2 Pump running;
(i) Nr. 3 Pump running;
(j) Nr. 4 Pump running; (Ronayne's Court only)
(k) Sump water levels in each sump
(l) Hours run (for each pump motor).
(m) Hazardous gas occurrence.
(n) Intruder Alarm Activation

An allowance is provided in the Schedule of Basic Prices for a telemetry link/equipment from each pumping station to the Cork Corporation Central Control System.

11.0 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 2 - General Electrical Specification of this Document. The MCC shall be of the multi-cubicle type, non withdrawable FBA (factory built assembly) type. 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 should 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, Second Edition, 1991, including Amendment A1, 1997.

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 Telemecanique or ABB manufacture or equal approved.

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.

11.1 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.
- 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 should 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.

11.2 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) 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 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.

(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.

- Open/Close switch for penstock actuator.
- Open and Closed indication for penstock actuator.
- Penstock actuator Fault/Tripped indication.

Notes:

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

11.3 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: Pumps and in the case of Ronayne's Court Pumping Station, lifting equipment.

(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 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 contain 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.

11.4 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.

11.5 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.

11.6 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 $16mm^2$ 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".

11.7 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 150mm 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.

12.0 ELECTRICAL SPECIFICATION - GENERAL

12.1 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 2 of this document.

12.2 Domestic Electrics – Lighting, etc.

The Contractor shall supply and install the light fittings and associated equipment as specified on Drg. Nr. A5088-E001 & A5088 E002.

12.3 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 each kiosk.

12.4 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.

12.5 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.

12.6 Instrument and Valve Actuators - Power Supply

The Contractor should 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.

12.7 Earthing

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^2 PVC covered copper cabling while cable tray shall have a 25mm^2 PVC earth cable run on each cable tray route and lugged directly to each cable tray section. A 70mm^2 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.

12.8 Gas Detection

The Contractor shall include for the supply and installation of an approved gas detection unit at the main sump in both the Besborough and Ronayne's Court Pumping Stations, 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.

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

- 1 Nr. 16 Channel Euro Rack System
- 1 Nr. 14 Channel Mother Boards
- 1 Oxygen Card
- 1 Hydrogen Sulphide Card
- 1 Combustible Gases Card
- 1 Oxygen Concentration Card
- 4 Blank Fronts for Spare Channels
- Intrinsically Safe Barrier Enclosure
- 4 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
- Output Drivers for Alarm Sirens
- Output Drivers for Traffic Light Units
- Common 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 approved equivalent).

Hazardous Area

The gas detection sensors shall be located in a Zone 1/2 Hazardous Area. 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 sumps shall monitor the gas concentrations in the extracted in the sampling tubing from these areas. The sensors shall be mounted, in suitable sampling chambers. The sampled gases shall be returned to the sumps

Traffic Light

Traffic light units shall be located on the control panel door within the kiosk to 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 kiosk 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.

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:-

Gas	Range	Alarm Level
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.

12.9 Intruder Alarm

The 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

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

13.0 PIPES AND VALVES

13.1 All pipework within the three pumping stations shall be provided and laid by the Contractor as per Clause 13.6 below.

13.2 All pipework shall be ductile iron pipe to BS EN 598, to PN 16 Standard.

13.3 Flanged pipes shall be jointed with rubber gaskets to BS No. 2494, 10 mm thick. The rings shall cover the whole surface of the flanges and shall be pierced to take the bolts. All flanges shall be machined. All bends shall be of the longest radius that the layout permits.

13.4 All sluice valves shall be to BS 5150:1990, 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 handwheel and an indicating gear on each headstock shall indicate whether the valves are open or shut. Non-return valves shall be to BS 5153:(1991).

13.5 The pipework as shown on the drawings shall be supplied, laid and tested by the Contractor in the two pumping stations. **The Test Pressure for the Pipework shall be 10 Bar.**

13.6 Pump Mains

The mains shall be Ductile Iron Class K9 unless otherwise noted.

13.6.1 Ductile Iron Pipework

All pumps shall be fitted with a reflux valve on the delivery side and a sluice valve between the reflux valve and the rising main. Sluice valves shall be wedge gate type to BS 5150 or equal. Reflux valves to BS 5153 shall be single flap type, easy to inspect and clean and not liable to choke.

14.0 PAINTING

Painting of pumps, pipework and fittings etc shall be to BS 3416:1991 and shall be strictly in accordance with manufacturer's instructions.

Pumping equipment shall be factory coated with an epoxy primer and chloric rubber finish.

15.0 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 copies 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 opes to allow the construction of the structures to get underway.

16.0 FINAL DRAWINGS

After completion of the installation, three sets of drawings compatible with AUTOCAD shall be provided showing the layout of the plant, including a wiring diagram.

17.0 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 Corporation 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 Corporation 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.

18.0 SITE COMPOUND/ACCOMMODATION/BUILDINGS

18.1 Site Compound:

The Employer will not provide a designated area for a Site Compound. The Mechanical/Electrical Contractor will be required to obtain at his own cost a site compound for site huts, lock up storage, canteen, etc. which he may wish to provide for his own use.

18.2 Site Huts & Accommodation:

The Contractor shall, at his own cost, supply all temporary buildings, sheds, messrooms, stores, washing and first aid facilities required under the relevant statutory regulations for his employees on site and upon completion of his works remove same. No temporary buildings shall be erected on the site without first obtaining the consent of the Engineer as to the positions on which they are to be erected.

The Contractor should be aware that temporary living accommodation, including residential caravans, for contractor's employees will not be permitted within the boundary of the Employer's property and land.

18.3 General:

The Contractor shall be responsible for arranging electricity and water connections to his accommodation. Likewise upon completion/removal of the accommodation, these connections shall be removed and all areas made good and returned to their original conditions.

All Contractors' facilities shall be of high quality and the Engineer shall have power to order the removal from site of any facility which in his opinion is unacceptable.

19.0 CRANE SPECIFICATION

19.1 Scope

This specification is for the supply, delivery and installation of 1 nr. electrical monorail hoist to replace the existing hand operated hoist.

19.1.1 Cranes Required

1 nr. crane is required – Monorail Hoist – 1 nr.

19.1.2 Crane Support Beams

The existing crane support beam runs the full length of the pumping station superstructure. The beam is supported off the roof slab beams at intermediate locations along the length of the superstructure, resulting is an effective span of approximately 4.8 m. The existing crane support beam is rated for safe working load of 3000 kg and is a 150 mm wide x 250 mm deep UB section.

The M &E Contractor will be required to retrofit the new electrical crane to this existing crane support beam.

19.1.3 Crane Rails

The crane rails for the new electrical crane are to be fitted to the existing crane support beams to the crane supplier's specification.

19.1.4 Monorail Hoists

Loading: Minimum rating will be 3 tonnes. These cranes will lift pumps, valves and pipework within the dry well.

Minimum Requirements:

- 1 nr. 3 tonne hoists
- Non rotating lift
- True vertical lift in hoist travel direction.

19.1.5 Electrical Supply

Power supply will be 400V, 50 Hz 3 phase.

The complete electrical installation will form part of the scope.

19.1.6 Controls

The crane shall be controlled by a single pendant push-button station, controlling all functions.

The pendant shall be suspended from the roof beams in the existing superstructure. The pendant shall be supplied complete with track, supports and control cables. Control cables shall be flat, festooned systems for operating along the entire length of the superstructure.

The hoist and trolley shall be capable of simultaneous or independent operation at all speeds.

Control enclosures shall be suitable for operation in the stated environmental conditions.

The hoist shall be equipped with limit switches for both up and down limits.

Hoists shall be equipped with overload controls to prevent accidental damage to equipment.

The trolley shall be equipped with end of travel limit switches in both directions.

19.1.7 Mechanical Design

All parts shall be designed to cater for load impact, truck impact, acceleration/deceleration forces and material wear and fatigue.

The crane shall have guide rollers on both trucks.

Bumpers shall be provided on all trolleys.

The hoist shall be wire rope type.

The hoist block shall be equipped with swivel hooks and safety locks.

The hoist shall have one electrical and one independent mechanical load braking system.

The hoist shall have hardened & 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 cranes and controls shall be designed to be user friendly and to simplify routine maintenance.

19.1.8 Paint & Markings

The crane shall be enamel paint coated, colour Safety Yellow (RAL 1021).

The capacity of the crane shall be clearly marked on each side of each bridge beam.

The capacity of the trolley/hoist shall be clearly marked on the hoist block.

Paint colours and capacity markings shall be in accordance with relevant legislation.

19.1.9 Design & Operation Criteria

(a) Installation will be indoors with maximum ambient temperature of 28°C and maximum ambient humidity of 70% RH.

The superstructure is classified as Zone 2.

(b) Power supply will be 3 phase/400V/50Hz.

(c) Usage will be moderate - approximately 6 pick ups per hour.

(d) Effective span 4.8 m

(e) Trolley speeds - standard 2 speed: 15/55 m/min

(f) Hoist speeds - standard 2 speed: 0.75/5.0 m/min

(g) Equipment design, construction and materials shall conform to 1993 and 1994 ESN.

(h) All wiring power/control panels, control enclosures and electrical components shall conform to regulations ETCI/IEE/ESB.

(i) If any alterations to equipment are required to meet applicable codes, regulations, standards or to obtain approvals, the supplier shall make such changes at his own expense.

19.1.10 Spare Parts

(a) The Contractor shall include for spare parts for the first two (2) full years of operation which the Supplier recommends be maintained in inventory.

(b) The criteria for estimating operating life shall be:

i For parts which are known to experience wear during normal use, the operating life is defined as the period until the part is expected to have worn down to the extent that replacement is required.

ii For parts which have a service life given in hours, the operating life is defined as the period until replacement is recommended by the manufacturer assuming constant, 24 hour per day, usage.

iii For parts which are easily damaged, the operating life is defined as the average life based on the Supplier's previous experience, taking the initial operator training period and the overall lack of operator experience into account.

(c) The supplier shall provide manufacturers data (name and part number) for purchased components including sensors and electric motors, for the Employer's review. The Employer may require that components be replaced with those of another manufacturer in order to standardise components and to keep the required spares inventory to a minimum.

19.1.11 Warranties and Guarantees.

Materials and Workmanship

(a) The Contractor shall warrant that all materials, equipment and components supplied by or through the Contractor shall be free of defects and that all workmanship shall be first class, suitable for industrial usage and environment.

Performance

(a) The Contractor shall guarantee that the equipment and/or system shall meet the operating rates and product quality parameters specified in this document.

(b) If the equipment and/or system does not meet the specified performance, the Contractor must take all necessary remedial action to achieve the specified performance, at no cost to the Employer.

(c) Upon the Employer's completion of equipment installation, the Contractor shall collaborate with the Engineer to carry out any tests considered necessary to determine the proper functioning and performance of all of the elements of the installation and shall, at his own cost, make any modifications, adjustments, corrections and/or changes required to achieve a fully operational installation.

19.2 Information To Be Provided With The Tender

The Tenderer shall provide with his tender the following data:

- Preliminary drawings.
- Recommended rail specification.
- Drift from true vertical lift for proposed hoists.
- Details of safety standards/regulations with which equipment offered complies.
- Details of system controls and operation.
- Quality Assurance system operated by Supplier company.

19.3 Factory Inspections

The Employer or his agent shall at any time, with a minimum of 2 working days notice, enter the Contractors premises with a view to inspecting the state of progress of manufacture/assembly of the cranes. The inspection may also include review of quality manuals and other documentation.

The Contractor shall, if requested, make arrangements for the Employer or his agent to enter the premises of sub-Contractors, sub-fabricators etc. so that progress can be reviewed and materials/equipment/assemblies etc. inspected. A minimum of 2 working days notice shall be given for such visits/inspections.

19.4 Installation

As a minimum, the contractor shall:

- Ensure equipment is suitably packed so that offloading and installation can be easily carried out.
- Provide for on-site supervision of off-loading and installation/erection by the supplier.

19.5 Documentation

19.5.1 Drawings

(a) The Contractor shall issue Preliminary Drawings for review and mark-up by the Engineer.

(b) The Contractor shall provide complete Drawings for the equipment and must, as a minimum, include the following:-

(i) General arrangements of equipment (minimum scale 1:50).

(ii) Principal dimensions of equipment (distances from equipment centre lines or elevations relative to equipment base plate), accessories, etc. in millimetres.

(iii) The necessary clearances around the equipment required for operation or maintenance.

(iv) Any details of soleplates, anchors, base plates, guards, kickplates or supports considered necessary for proper installation of equipment.

(v) The size, type and dimensioned location of any and all service connections required.

(vi) Electrical and instrumentation schematics.

19.5.2 Manuals

(a) The Contractor shall issue 3 nr. properly bound manuals for the equipment at the same time as (or before) the equipment is handed over for the Employer's use.

(b) The manuals shall be written in English and must be clearly marked with the project name and number, equipment name and number . Where appropriate, drawings and documents shall be provided in MS Word and AutoCAD 14 format.

(c) The Contractor's standard manuals will generally be acceptable, providing they include, as a minimum, the following information:

(i) Data sheets, procedures and drawings in sufficient detail to allow the Employer to commission, operate, monitor, evaluate and maintain the equipment.

(ii) A description of each component of the equipment, including service rating, limits of rating etc.

(iii) Drawings detailing erection and assembly markings on component pieces (if applicable).

(iv) Recommended maintenance schedule

(v) Complete lubrication procedures.

(vi) Complete operating instructions

(vii) Certified performance data

(viii) Parts list, as detailed in item 19.5.3 below.

19.5.3 Parts Lists

(a) Complete parts lists, including drawings where required, shall be provided to identify each part by name and number.

(b) Original Equipment Manufacturer (OEM) name and part numbers must be shown cross-referenced to the Supplier's part numbers.

(c) The parts list shall include the price for each item

(d) The parts lists must include an estimate of the time to manufacture and deliver all parts not normally kept in stock.

20.0 COMPLIANCE WITH SAFETY AND HEALTH REQUIREMENTS

Clause 6.3 of the Instructions to Tenderers sets out the Contractors' obligations with regard to compliance with the Safety, Health and Welfare at Work (Construction) Regulations 1995 (S.I. Nr. 138 of 1995). Further to Clause 4.0 "Safety & Health" in Section A, in accordance with these Regulations a Preliminary Safety Plan has been prepared for the proposed scheme and is included in the Contract Documents for information purposes only.

An item has been included in the Schedule of Prices to facilitate the inclusion of all costs which may be incurred by the Contractor to comply with the Health, Safety and Welfare Regulations as required by Clause 4.0, Section A of this document.

21.0 CONTRACTOR'S RESPONSIBILITY

The Contractor's responsibility shall include the following specific requirements:-

(a) Provision and transportation of all the plant to the two sites.

(b) Cranage for both off loading and during the period of erection, all necessary scaffolding and site storage for the duration of the contract.

(c) Supply and generation of electricity during erection by either a portable generator or other means available.

(d) All skilled and unskilled labour required in the installation of the plant.

(e) Attendance of a skilled operator for five full working days to instruct the Caretaker in the proper maintenance and running of the pumping stations. This time shall be an extra on the normal time spent on the plant during the commissioning, completion tests and taking over tests.

22.0 WORKS / MATERIALS STANDARDS

22.1 Compliance with Standards:

All works and materials required under the Contract shall be in compliance with the requirements of this Specification and the standards referred to therein.

22.2 Equivalence of Standards

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 Union.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Union are called for, this requirement shall be read as including relevant national standards of any Member State of the European Union, 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 DOE Circular Letters **BM2/87 and 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 the relevant national standard of another Member State of the European Union, which provides an equivalent guarantee of safety and suitability.

23.0 TENDER

The Tenderer shall state in his Tender the country of manufacture of the various items of equipment in his proposed plant. He shall state the currency exchange rate of the Euro on which he is basing his tender price for the various items. In the submission of his Final Account, the Contractor shall furnish both quotations and invoices for all the equipment imported and on which he is claiming increases due to currency exchange rates.

In the event of an increase in the value of the Euro, the Engineer reserves the right to make adjustments to the Final Account based on the exchange rate of the Euro on the Designated Date and on the currency valuation on the date written on the invoices supplied.

24.0 SPARE PARTS AND LUBRICANTS

One year's supply of each kind of oil and grease shall be supplied in good quality metal containers.

The Tenderer will be required to include his recommended list of spares together with a separate quotation for these items as per Form of Tender/Schedule of Prices.

25.0 CUSTOMS CLEARANCE AND DUTIES

Customs duties shall not be included in the Tender but all VAT charges shall be included. Tender prices quoted shall be **cost delivered to site.**

26.0 PROGRAMME

The various items of the mechanical and electrical installation shall be fully completed within specified durations as outlined in the Form of Tender.

27.0 CERTIFICATE OF COMPLETION (TAKING OVER CERTIFICATE)

The Certificate of Completion ("Taking-Over Certificate") will be issued by the Engineer when the Works have passed the Tests on Completion, in accordance with Sections 28 and 29 of the General Conditions of Contract.

28.0 EXTENDED MAINTENANCE PERIOD

It is envisaged that the Pumping Stations will not be fully commissioned and brought into use until approx, two years after the completion of the installation. For this reason, a special defects liability period of 36 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.

29.0 DAMAGES FOR DELAY IN COMPLETION

If the Contractor fails to complete the Works, in accordance with the Contract and as per the various clauses in the Conditions of Contract, within the time fixed for the completion of the Works or any extension of such time, and the Purchaser shall have suffered any loss from such failure, there shall be deducted from the Contract Price such sums as are outlined in the Appendix to the Form of Tender. Clause 35 of the **Conditions of Contract** "Peformance Tests" shall apply in the event of Test failures.

30.0 INSTALLED AND ABSORBED POWER

Tenders shall be accompanied by the following information:-:

(a) Full description of pumps.
(b) Head plotted against delivery for each pump type.
(c) Overall efficiency of pumps and motors.
(d) Speeds of pumps and motors.
(e) HP of each motor.
(f) Efficiency plotted against delivery for each pump.
(g) HP plotted against delivery for each pump
(h) NPSH plotted against delivery for each pump
(i) Pedestal arrangement for each pump
(j) Power cable arrangement.

NOTE: For Besborough pump station, the above information is to be provided for both 1 and 2 Nr. pumps operating. For Ronayne's Court Pump Station, the above information is to be provided for 1 Nr. pump operating per rising main and 2 Nr. Pumps operating per rising main for both the initial and ultimate arrangements.

31.0 OPTIONAL EQUIPMENT

All optional equipment as per the tender specification must be priced as instructed and included in the Schedule of Prices in the appropriate manner.

32.0 GENERAL

32.1 The whole of the Works shall be completed in a workmanlike manner to the satisfaction of the Engineer and the site shall be left clean and tidy with the plant in perfect working order. The guarantees in respect of the performance of the plant shall be fulfilled before the work will be accepted as complete.

LIST OF DRAWINGS

Drg. Nr.	Title
A5088-N101	Location Plan.
A5088-N108	Besborough Pumping Station – Site Plan and Location Map.
A5088-N109	Besborough Rising Main – Plan and Longitudinal Section (Sheet 1 of 2)
A5088-N110	Besborough Rising Main – Plan and Longitudinal Section (Sheet 2 of 2)
A5088-N111	Besborough Pumping Station – Proposed layout.
A5088-N112	Tramore Valley Rising Mains – Plan & Longitudinal Section (Sheet 1 of 2)
A5088-N113	Tramore Valley Rising Mains – Plan & Longitudinal Section (Sheet 2 of 2)
A5088-N117	Ronayne's court Pumping Station – Location Plan and Proposed General Layout.
A5088-N118	Ronayne's Court Pumping Station – Existing Layout.
A5088-N119	Ronayne's Court Pumping Station – Proposed Layout.
A5088-N130	Tramore Rising Mains – Miscellaneous Details.
A5088-E001	Besborough Pumping Station- Domestic Electrics.
A5088-E002	Ronayne's Court Pumping Station – Domestic Electrics.
A5615-N002	Plan and Longitudinal Section for Rising Mains.
A5087-N221	Rising Main Connection Details at Ballinure Header Chamber.

Contents

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^2

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 necesary 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.

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^2 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^2 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^2

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 prespiralled 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 prespiralled 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

Overall Diam. of Cable	Horizontal	Vertical
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 copperconductors 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 shalll 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 $70mm^2$ 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^2 for copper and 50 mm^2 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^2, 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^2, 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 S	Minimum Cross-Sectional Area of the Corresponding Protective Conductor Sp
m^2	mm^2
$S < 16$	$Sp - S$
$16 \leq S \leq 35$	$Sp - 16$
$S > 35$	$Sp = S/2$

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, Telemechanique (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^2 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 paclockable 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.

CORK CORPORATION

CORK MAIN DRAINAGE SCHEME

INTERCEPTOR SEWER NR. 4

CONTRACT DOCUMENTS

for

MECHANICAL/ELECTRICAL SUB-CONTRACT

BELLEVUE VILLAS PUMPING STATION

TIVOLI INDUSTRIAL ESTATE PUMPING STATION

TIVOLI PUMPING STATION

VOLUME 2

SPECIFICATION

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Job Nr. A5251 **October 2001**

Revision Control Table

The User is Responsible for Checking the Revision Status of this Document

Rev.	Description of Changes	Prepared by	Checked by	Approved by	Date
A	Issued for Tender	G.Sim	KC	GO'S	October 2001

PREAMBLE

The complete set of Contract Documents for the Mechanical/Electrical Sub-Contract consists of three volumes and the Contract Drawings:-

The Preliminary Safety and Health Plan is provided for information purposes only.

Volume 1: Instructions to Tenderers
Conditions of Contract
Document Nr. A5251-N-S-06

Volume 2: Specification
Section A – Scope of Works
Section B – Scope of Supply, Installation and Commissioning
Document Nr. A5251-N-S-07

Volume 3: Schedule of Prices
Document Nr. A5251-N-S-08

Contract Drawings

Preliminary Safety & Health Plan
Document Nr. A5251-N-H-01
(Ref. Volume 2, Section A, Clause 4.0)

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SCOPE OF WORKS

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GENERAL ELECTRICAL SPECIFICATION

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SECTION A

1.0 OUTLINE OF SCHEME

1.1 This Mechanical/Electrical Sub-Contract is for the supply, installation, testing and commissioning of foul and storm pumps, associated controls, electrics, pipework, fittings and ancillaries in the proposed Tivoli Pumping Station, Tivoli Industrial Estate Pumping Station and Bellevue Villas Pumping Station in Cork City, Ireland.

The Civil Works will be constructed by others under the Cork Main Drainage Scheme – Interceptor Sewer Nr. 4 Contract.

Under the Civil Works Contract foul flows originating in the Lower Glanmire Road, Tivoli and Silversprings area east of Trafalgar Hill will be intercepted, along with surface water from the rear roofs and yards of existing properties and surface water run-off below the 3.386m OD contour level, and carried to the Tivoli Pumping Station. Similarly the Bellevue Villas Pumping Station will serve the area between Myrtle Hill Terrace and Trafalgar Hill. The pump flows from Bellevue Villas will be carried via a rising main and gravity sewer to Tivoli Pumping station. Tivoli Industrial Estate Pumping Station will serve Tivoli Industrial Estate. The pump flows from Tivoli Industrial Estate Pumping Station will be carried via a rising main and gravity sewer to Tivoli Pumping Station.

2.0 SCOPE OF CONTRACT

2.1 This Contract provides for the supply, installation, testing and commissioning of mechanical and electrical equipment in prepared reinforced concrete structures, including all ancillary works, for the pumping of wastewater.

2.2 The Tender for this Contract shall include for the delivery of all equipment to site, for all cranage required, and for all skilled and unskilled labour necessary for the installation of the plant, for testing, commissioning and for the maintenance of the plant for a period of 12 months in accordance with the tests set out in this Specification.

2.3 The Contract calls for the carrying out of the required work in conjunction with the Civil Works Contractor. No extra costs will be allowed for working in co-operation with this Contractor.

2.4 This Contract will be a direct contract between the Civil Works Contractor and the Mechanical Plant Contractor. The concrete structures will be built by the Civil Engineering Contractor.

3.0 DRAWINGS

3.1 The drawings defining the general scope of the work are listed in Appendix 1 of this document. Tenderers shall ensure that their proposed plant can be adequately accommodated within the structures. Minor variations may be accommodated.

3.2 The appointed contractor shall obtain approval from the Engineer of all plant installation drawings prior to commencing fabrication work. Such drawings shall indicate all builder's work necessary for the satisfactory installation of the plant. Any proposed variations from the tender drawings must be clearly identified.

4.0 SAFETY & HEALTH

4.1 The Preliminary Safety & Health Plan for the Civil Works Contract, Interceptor Sewer Nr. 4 (Doc. Nr. A5251-N-H-01) is included in these documents for information purposes only. The Civil Contractor will be appointed the Project Supervisor for Construction Stage and will hold overall responsibility for safety and health on site. Refer to Clause 21.0 "Compliance with Safety & Health Requirements" in Section B.

5.0 FLOWS

5.1 Tivoli Pumping Station

The design inflows to the pumping station are as follows:
6 DWF = 396 l/s.
1:5 yr. return period storm = 564 l/s
1:20 yr. return period storm = 627 l/s.
The total design flow is to be split between twin 450mm PE rising mains with a minimum velocity of 1.2 m/s in each rising main. Each rising main will be served by a set of 3 nr. pumps operating on a 1 nr. duty//1 nr. assist/1 nr. standby basis. The 2 nr. duty pumps shall deal with the 6 DWF flow. The 2 nr. duty and 2 nr. assist pumps shall deal with the 5 year return period storm. The 2 nr. standby pumps shall provide the extra capacity required to pump the 20 year storm and/or provide backup in case of pump failure. The operation of the emergency gravity overflow is restricted at periods of high tide due to the low lying elevation of the site.

5.2 Tivoli Industrial Estate Pumping Station

The total design inflow to the puming station is 90.7 m^3/day. 7 l/s will be pumped forward by pumps, 1 nr. duty and 1 nr. standby.

5.3 Bellevue Villas Pumping Station

The total design inflow to the pumping station is 15 l/s. 30 l/s will be pumped forward by the pumps, 1 nr. duty and 1 Nr. standby.

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1.0 TIVOLI PUMPING STATION
(Refer to Drg. Nrs. A5251-N606, N607 and E001

1.1 Details of the proposed pumping station are shown on Drg. Nrs. A5251-N606, N607 and E00I.

It is intended that 6 Nr. fixed speed foul pumps (2 Nr. duty, 2 nr. assist and 2 Nr. standby) shall pump through twin 450 mm diameter PE rising mains to a manhole on the Marina, near Atlantic Pond.

The pumps shall be of similar type and shall be arranged such that when four pumps are operating together, the combined output is 564l/s and when six pumps are operating together, the combined output shall not be less than 627 l/s, against a total head resulting from the following parameters:-

Invert level of incoming sewer	= -3.291m OD
Floor level of pump sump	= -8.400m OD
Header Manhole discharge level	= -0.700m OD
Nr. of rising Mains	= 2 Nr.
Internal diameter of rising main	= 410mm
Length of Rising main	= 336m
Estimated friction and fitting losses	= 5.85m
Static head	= 6.70m
Total head	= 12.51m

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 6 set points for pump control to operate as follows:

Set Point 1	Low level cut out of duty pump
Set Point 2	Low level cut out of Assist Pump
Set Point 3	Low level cut out of Standby Pump
Set Point 4	Cut in of duty pump
Set Point 5	Cut in of Assist Pump
Set Point 6	Cut in of Standby.
Set Points 7 & 8	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 total flow from the pumping station during storm conditions will vary between 198.0 l/s (1 Nr. duty) and 627 l/s (2 Nr. duty, 2 nr. assist and 2 Nr. standby).

It shall be the Contractor's responsibility to assess the friction losses in the system across the range of flows required. In addition, the Tenderer shall state the efficiencies of these pumps for the full range of flows.

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

- 6 Nr. (2 duty, 2 assist, 2 standby) fixed speed submersible pumps, with equal duties such that four pumps in parallel will deliver 564 l/s against the total head determined from the above data.

  Include for all suction pipes, delivery pipework to connect to the twin 450mm PE rising mains, sluice valves, non-return valves, bends, tapers, guide rails, control equipment , electrics and float controls, etc.

- 2 Nr. 400 mm diameter on-line magnetic flow meters with local digital flow indication and resettable totaliser to be included, complete with transducer for digitised information downloading.

- 1 nr. kiosk as per Clause 9.0.

- 2 Nr. rotating bar interceptor screens as per Clause 8.0.

- Domestic Electrics

- Include for all signal cabling and wiring back to the control panel.

- Include for supplying flanged puddle collars to the Civil Contractor, to suit 100mm, 300mm and 400mm diameter pipework.

- Davits and lifting chains as per Clause 5.0 "Pump Removal" below.

- Gas Detection Unit as per Clause 14.8 below.

- 2 Nr. rescue type breathing apparatus tanks.

- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.

- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.

- 2 Nr. 600mm square electrically actuated, C.I., wall mounted penstock.

- 1 nr. 750 mm square electrically actuated CI wall mounted penstock.

1.3 Hazardous Area Classification

The H.A.C. is set out as follows:-

Area	Classification
Pump Sumps	Zone 1
Inlet Chamber	Zone 1

Valve Chambers	Zone 2
All other areas	Non-Hazardous

2.0 TIVOLI INDUSTRIAL ESTATE PUMPING STATION
(Refer to Drg. Nr. A5251- N604 and E003)

2.1 Details of the proposed pumping station are shown on Drg. Nr. A5251-N604 and E003.

It is intended that 2 Nr. fixed speed foul pumps (1 Nr. duty and 1 Nr. standby) shall pump through a 90mm diameter MDPE rising main to manhole MH 495 within Port of Cork Property

The foul pumps shall be of similar type and shall be such that when one pump is operating, the output is 5 l/s against a total head resulting from the following parameters:-

Invert level of incoming sewer	=	-1.524m OD
Floor level of pump sump	=	-2.824m OD
Header manhole discharge level	=	1.300m OD
Nr. of rising Mains	=	1 Nr.
Internal diameter of Rising Main	=	79.8m
Length of rising main	=	336m
Estimated friction and fitting losses	=	13.42m
Static head	=	3.47m
Total head	=	16.90m

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 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.

It shall be the Contractor's responsibility to assess the friction losses in the system for the flow required. In addition, the Tenderer shall state the efficiencies of these pumps for the flow required.

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

- 2 Nr. (1 Nr. duty, 1 Nr. standby) fixed speed submersible pumps, with equal duties such that each pump will deliver 5 l/s.
- Include for all suction pipes, delivery pipework to connect to the 90mm MDPE rising main, sluice valves, non-return valves, bends, tapers, guiderails, control equipment, electrics and float controls etc.
- 1 nr. kiosk as per Clause 9.0
- Include for all signal cabling and wiring back to the control panel.
- Domestic Electrics
- Davits to be installed in existing roof slab as per Clause 5.0 'Pump Removal' below.
- Gas Detection Unit as per Clause 14.8 below.
- 2 Nr. rescue-type breathing apparatus tanks.
- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.
- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.
- Removable safety barrier to surround pump sump opening

2.3 Hazardous Areas Classification

The H.A.C. is set out as follows:-

Area	Classification
Pump Sump	Zone 1

3.0 BELLEVUE VILLAS PUMPING STATION
(Refer to Drg. Nrs. A5251- N605 and E002)

3.1 Details of the Proposed Pumping Station are shown on Drg. Nr. A5251-N605 and E002.

It is intended that 2 nr. fixed speed foul pumps (1 nr. duty and 1 nr. standby) shall pump through a 200 mm HDPE rising main to manhole MH 451A, near Woodhill Villas, on the Lower Glanmire Road.

The foul pumps shall be of similar type and shall be such that when one pump is operating the output is 30 l/s against a total head resulting from the following parameters:

Invert level of incoming sewer	=	-1.518m OD
Floor level of sump	=	-3,868m OD

Header manhole discharge level	=	1.60m OD
Nr. of rising mains	=	1

Internal diameter of Rising Main	=	200mm
Length of rising Main	=	344m
Estimated friction and fitting losses	=	2.02m
Static head	=	4.72m
Total head	=	6.74m

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 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.

It shall be the Contractor's responsibility to assess the friction losses in the system for the flow required. In addition, the Tenderer shall state the efficiencies of these pumps for the flow required.

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

- 2 nr. (1 nr. duty, 1 nr. standby) fixed speed submersible pumps, with duties such that each pump will deliver 30 l/s.

  Include for all suction pipes, delivery pipework to connect to the 200 mm DI rising main, sluice valves, non-return valves, bends, guiderails, control equipment, electrics and float controls, etc.

- 1 nr. kiosk as per Clause 9.0
- Domestic Electrics
- Davits to be installed in existing roof slab as per Clause 5.0 'Pump Removal' below.
- Include for all signal cabling and wiring back to control panel.
- Gas Detection as per Clause 14.8 below.
- 2 Nr. rescue-type breathing apparatus tanks.
- Lifting gear, including tripod suitable for lifting personnel and 15.0 m cable.
- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.
- Removable safety barrier to surround pump sump opening.

3.3 Hazardous Areas Classification

The HAC is set out as follows:

Area	Classification
Pump Sump	Zone 1

4.0 PUMPS

4.1 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 horsepower 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 end suction type and should be suitable for pumping untreated sewage containing fibrous and solid matter, as well as grit. They 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 "on snore" 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, such as a programmable logic controller or similar approved.

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

4.2 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 the Tivoli Industrial Estate Pumping Station which shall be capable of passing solids up to 50 mm. The pumps shall be provided with a spiral bottom plate with shearing edges and cutter inlet or equivalent to enable the cutting or shredding of large solids.

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.

4.3 The speed shall be not greater than 1450 rpm.

4.4 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 or assist pumps fail.

4.5 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.

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

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

4.8 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.

4.9 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.

5.0 SUBMERSIBLE PUMP REMOVAL

5.1 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.

5.2 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.

5.3 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.

5.4 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.

5.5 Pump cables shall accord with BS5345 Part 1 or equal, and include a flexible metal screen or armour. The cables shall be suitable for use in Zone 1 Hazardous Areas.

6.0 ELECTRICAL MOTORS

6.1 Submersible Motors

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

6.1.2 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.

6.1.3 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.

6.1.4 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.

6.1.5 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.

6.1.6 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.

6.1.7 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.

6.2 Electrical Motors - (General)

6.2.1 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.

6.2.2 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.

7.0 PUMP TESTS AND IDENTIFICATION

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

7.2 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.

7.3 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.

7.4 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.

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

8.0 ROTATING BAR INTERCEPTOR SCREEN

A rotating bar interceptor (RBI) screen shall be provided and installed in each inlet chamber to the Tivoli Pumping Station, as shown on Drg. Nr. A5251-N606. The RBI shall be constructed from Grade 316 stainless steel and shall have 100 mm 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 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. The RBI screen shall be manufactured by Biwater or approved equivalent.

9.0 KIOSKS

9.1 The electrical control panel, telemetry equipment and the ESB's incoming supply and meters at each of the 3 nr. pumping stations shall be housed in a weatherproof, ventilated and lockable kiosk.

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

9.3 Each kiosk shall be positioned as shown on Drg. Nrs. A5251N604, N605 and N607. The doors should be lockable and shall be retained in the 90° open position with stays.

9.4 Each kiosk shall be mounted on a plinth at least 150mm above the surrounding ground level and sealed with mastic to prevent the entry of water.

9.5 The kiosk shall be cross ventilated with one high and one low vermin proof ventilation grille on opposite sides. An interior light should be provided. Each equipment enclosure oulined in Section 9.8 below shall be provided with a thermostatically controlled anti-condensation heater operating on 110 Volts.

9.6 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.

9.7 Rubber insulating mats will be required inside each kiosk.

9.8 Each kiosk shall house the following equipment:-

(a) ESB's incoming supply, meters and distribution equipment in separate enclosures. (Described in Clause 10.0).

(b) Connection for mobile generator; (Described in Clause 11.0)

(c) Telemetry outstation; (Described in Clause 12.0)

(d) Control panel; (Described in Clause 13.0).

10.0 ESB'S INCOMING SUPPLY, METERS AND EQUIPMENT

10.1 One section of each kiosk 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.

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.

11.0 CONNECTION FOR MOBILE GENERATOR

11.1 A five pin pilot appliance inlet to BS 4343 or equal shall be mounted inside each kiosk in order that a mobile generator can be connected. A flap shall be fitted to the outside of each 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.

12.0 TELEMETRY OUTSTATION

12.1 The Contractor shall provide and install (in a separate enclosure) within the kiosk for each pumping station, a telemetry outstation and equipment to monitor and record the operation of the pumping station and for transmission back to the Corporation's telemetry control. The Employer will provide for the cabling for such transmission. The following operational states will be monitored:-

(a) Mains power failure;
(b) Level control system failure;
(c) Nr. 1 Pump tripped (starter);
(d) Nr. 2 Pump tripped (starter);
(e) Nr. 3 Pump tripped (starter); (Tivoli Pumping Station only)
(f) Nr. 4 Pump tripped (starter); (Tivoli Pumping Station only)
(g) Nr. 5 Pump tripped (starter); (Tivoli Pumping Station only)
(h) Nr. 6 Pump tripped (starter); (Tivoli Pumping Station only)
(i) Nr. 1 Pump running;
(j) Nr. 2 Pump running;
(k) Nr. 3 Pump running; (Tivoli Pumping Station only)
(l) Nr. 4 Pump running; (Tivoli Pumping Station only)

(m) Nr. 5 Pump running; (Tivoli Pumping Station only)
(n) Nr. 6 Pump running; (Tivoli Pumping Station only)
(o) Sump water levels in each sump
(p) Hours run (for each pump motor).
(q) Hazardous gas occurrence.
(r) Penstock Actuator tripped. (Tivoli Pumping Station only)
(s) Actuated penstock open (Tivoli Pumping Station only)
(t) Actuated penstock closed. (Tivoli Pumping Station only)
(u) Rotating bar screen trip-out. (Tivoli Pumping Station only)
(v) Intruder Alarm Activation

12.2 An allowance is provided in the Schedule of Basic Prices for a telemetry link/equipment from each pumping station to the Cork Corporation Central Control System.

13.0 CONTROL PANEL (GENERAL)

13.1 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 2 - General Electrical Specification of this Document. The MCC shall be of the multi-cubicle type, non withdrawable FBA (factory built assembly) type. 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 should 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, Second Edition, 1991, including Amendment A1, 1997.

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 Telemecanique or ABB manufacture or equal approved.

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.

13.2 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.
- 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 should 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.

13.3 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) 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 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.

(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.
- Open/Close switch for penstock actuator.
- Open and Closed indication for penstock actuator.
- Penstock actuator Fault/Tripped indication.

Notes:

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

13.4 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: Pumps and in the case of Tivoli Pumping Station, 2 nr. rotating bar interceptor screens, actuated penstocks (3 nr). Power supplies for instrumentation as specified.

(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 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 contain 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.

13.5 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.

13.6 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.

13.7 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^2 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".

13.8 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 150mm 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.

14.0 ELECTRICAL SPECIFICATION - GENERAL

14.1 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 2 of this document.

14.2 Domestic Electrics – Lighting, etc.

The Contractor shall supply and install the light fittings and associated equipment as specified on Drg. Nr. A5251-E001, E002 and E003.

14.3 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 each kiosk.

14.4 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.

14.5 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.

14.6 Instrument and Valve Actuators - Power Supply

The Contractor should 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.

14.7 Earthing

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^2 PVC covered copper cabling while cable tray shall have a 25mm^2 PVC earth cable run on each cable tray route and lugged directly to each cable tray section. A 70mm^2 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.

14.8 Gas Detection

The Contractor shall include for the supply and installation of an approved gas detection unit at the main sump in each of the pumping stations, i.e. Tivoli, Tivoli Industrial Estate and Bellevue Villas 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.

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

- 1 Nr. 16 Channel Euro Rack System
- 1 Nr. 14 Channel Mother Boards
- 1 Oxygen Card
- 1 Hydrogen Sulphide Card
- 1 Combustible Gases Card
- 1 Oxygen Concentration Card
- 4 Blank Fronts for Spare Channels
- Intrinsically Safe Barrier Enclosure
- 4 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
- Output Drivers for Alarm Sirens
- Output Drivers for Traffic Light Units
- Common 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 approved equivalent).

Hazardous Area

The gas detection sensors shall be located in a Zone 1/2 Hazardous Area. 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 sumps shall monitor the gas concentrations in the extracted in the sampling tubing from these areas. The sensors shall be mounted, in suitable sampling chambers. The sampled gases shall be returned to the sumps

Traffic Light

Traffic light units shall be located on the control panel door within the kiosk to 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 kiosk 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.

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:-

Gas	Range	Alarm Level
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.

14.9 Penstock Actuators in Tivoli Pumping Station

The 3 Nr. penstock actuators, one in each inlet chamber and one between the wet wells, shall be fitted with integral starters and local open/close controls with emergency stop facility. They shall also have local/remote operational capability. The actuators shall be suitable for use in a Zone 1 Hazardous Area and be rated for ingress protection to I.P. 67. Open/Close control shall also be available for the actuator in the Pump Control Panel.

14.10 Intruder Alarm

The 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

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

15.0 PIPES AND VALVES

15.1 All pipework within the three pumping stations shall be provided and laid by the Contractor as per Clause 15.6 below.

15.2 All pipework shall be ductile iron pipe to BS EN 598, to NP 16 Standard.

15.3 Flanged pipes shall be jointed with rubber gaskets to BS No. 2494, 10 mm thick. The rings shall cover the whole surface of the flanges and shall be pierced to take the bolts. All flanges shall be machined. All bends shall be of the longest radius that the layout permits.

15.4 All sluice valves shall be to BS 5150:1990, 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 handwheel and an indicating gear on each headstock shall indicate whether the valves are open or shut. Non-return valves shall be to BS 5153:(1991).

15.5 The pipework as shown on the drawings shall be supplied, laid and tested by the Contractor in the three pumping stations. **The Test Pressure for the Pipework shall be 10 Bar.**

15.6 <u>Pump Mains</u>

The mains shall be Ductile Iron Class K9 unless otherwise noted.

15.6.1 <u>Ductile Iron Pipework</u>

All pumps shall be fitted with a reflux valve on the delivery side and a sluice valve between the reflux valve and the rising main. Sluice valves shall be wedge gate type to BS 5150 or equal. Reflux valves to BS 5153 shall be single flap type, easy to inspect and clean and not liable to choke.

16.0 PAINTING

Painting of pumps, pipework and fittings etc shall be to BS 3416:1991 and shall be strictly in accordance with manufacturer's instructions.

Pumping equipment shall be factory coated with an epoxy primer and chloric rubber finish.

17.0 WORKING DRAWINGS

17.1 The successful tenderer will be required to submit to the Engineer **for approval** within the agreed period after the award of the Contract, three copies 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 opes to allow the construction of the structures to get underway.

18.0 FINAL DRAWINGS

18.1 After completion of the installation, three sets of drawings compatible with AUTOCAD shall be provided showing the layout of the plant, including a wiring diagram.

19.0 WORKING INSTRUCTIONS

19.1 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 Corporation 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 Corporation 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.

20.0 SITE COMPOUND/ACCOMMODATION/BUILDINGS

20.1 Site Compound:

The Employer will not provide a designated area for a Site Compound. The Mechanical/Electrical Contractor will be required to obtain at his own cost a site compound for site huts, lock up storage, canteen, etc. which he may wish to provide for his own use.

20.2 Site Huts & Accommodation:

The Contractor shall, at his own cost, supply all temporary buildings, sheds, messrooms, stores, washing and first aid facilities required under the relevant statutory regulations for his employees on site and upon completion of his works remove same. No temporary buildings shall be erected on the site without first

obtaining the consent of the Engineer as to the positions on which they are to be erected.

The Contractor should be aware that temporary living accommodation, including residential caravans, for contractor's employees will not be permitted within the boundary of the Employer's property and land.

20.3 General:

The Contractor shall be responsible for arranging electricity and water connections to his accommodation. Likewise upon completion/removal of the accommodation, these connections shall be removed and all areas made good and returned to their original conditions.

All Contractors' facilities shall be of high quality and the Engineer shall have power to order the removal from site of any facility which in his opinion is unacceptable.

21.0 COMPLIANCE WITH SAFETY AND HEALTH REQUIREMENTS

Clause 6.3 of the Instructions to Tenderers sets out the Contractors' obligations with regard to compliance with the Safety, Health and Welfare at Work (Construction) Regulations 1995 (S.I. Nr. 138 of 1995). Further to Clause 4.0 "Safety & Health" in Section A, in accordance with these Regulations a Preliminary Safety Plan has been prepared for the proposed scheme and is included in the Contract Documents for information purposes only.

An item has been included in the Schedule of Prices to facilitate the inclusion of all costs which may be incurred by the Contractor to comply with the Health, Safety and Welfare Regulations as required by Clause 4.0, Section A of this document.

22.0 CONTRACTOR'S RESPONSIBILITY

22.1 The Contractor's responsibility shall include the following specific requirements:-

(a) Transportation of all the plant to the three sites.

(b) Cranage for both off loading and during the period of erection, all necessary scaffolding and site storage for the duration of the contract.

(c) Supply and generation of electricity during erection by either a portable generator or other means available.

(d) All skilled and unskilled labour required in the installation of the plant.

(e) Attendance of a skilled operator for five full working days to instruct the Caretaker in the proper maintenance and running of the pumping

stations. This time shall be an extra on the normal time spent on the plant during the commissioning, completion tests and taking over tests.

23.0 WORKS / MATERIALS STANDARDS

23.1 Compliance with Standards:

All works and materials required under the Contract shall be in compliance with the requirements of this Specification and the standards referred to therein.

23.2 Equivalence of Standards

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 Union.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Union are called for, this requirement shall be read as including relevant national standards of any Member State of the European Union, 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 DOE Circular Letters **BM2/87 and 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 the relevant national standard of another Member State of the European Union, which provides an equivalent guarantee of safety and suitability.

24.0 TENDER

24.1 The tenderer shall state in his tender the country of manufacture of the various items of equipment in his proposed plant. He shall state the currency exchange rate of the Euro on which he is basing his tender price for the various items. In the submission of his Final Account, the Contractor shall furnish both quotations and invoices for all the equipment imported and on which he is claiming increases due to currency exchange rates.

24.2 In the event of an increase in the value of the Euro, the Engineer reserves the right to make adjustments to the Final Account based on the exchange rate of the Euro on the Designated Date and on the currency valuation on the date written on the invoices supplied.

25.0 SPARE PARTS AND LUBRICANTS

25.1 One year's supply of each kind of oil and grease shall be supplied in good quality metal containers.

25.2 The tenderer will be required to include his recommended list of spares together with a separate quotation for these items as per Form of Tender/Schedule of Prices.

26.0 CUSTOMS CLEARANCE AND DUTIES

26.1 Customs duties shall not be included in the Tender but all VAT charges shall be included. Tender prices quoted shall be **cost delivered to site.**

27.0 PROGRAMME

27.1 The various items of the mechanical and electrical installation shall be fully completed within specified durations as outlined in the Form of Tender.

28.0 CERTIFICATE OF COMPLETION (TAKING OVER CERTIFICATE)

28.1 The Certificate of Completion ("Taking-Over Certificate") will be issued by the Engineer when the Works have passed the Tests on Completion, in accordance with Sections 28 and 29 of the General Conditions of Contract.

29.0 EXTENDED MAINTENANCE PERIOD

29.1 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.

30.0 DAMAGES FOR DELAY IN COMPLETION

30.1 If the Contractor fails to complete the Works, in accordance with the Contract and as per the various clauses in the Conditions of Contract, within the time fixed for the completion of the Works or any extension of such time, and the Purchaser shall have suffered any loss from such failure, there shall be deducted from the Contract Price such sums as are outlined in the Appendix to the Form of Tender. Clause 35 of the **Conditions of Contract** "Peformance Tests" shall apply in the event of Test failures.

31.0 INSTALLED AND ABSORBED POWER

31.1 Tenders shall be accompanied by the following information:-:

(a) Full description of pumps.
(b) Head plotted against delivery for each pump type.
(c) Overall efficiency of pumps and motors.
(d) Speeds of pumps and motors.
(e) HP of each motor.
(f) Efficiency plotted against delivery for each pump.
(g) HP plotted against delivery for each pump
(h) NPSH plotted against delivery for each pump
(i) Pedestal arrangement for each pump
(j) Power cable arrangement.

32.0 OPTIONAL EQUIPMENT

32.1 All optional equipment as per the tender specification must be priced as instructed and included in the schedule of prices in the appropriate manner.

33.0 GENERAL

33.1 The whole of the Works shall be completed in a workmanlike manner to the satisfaction of the Engineer and the site shall be left clean and tidy with the plant in perfect working order. The guarantees in respect of the performance of the plant shall be fulfilled before the work will be accepted as complete.

LIST OF DRAWINGS

Drg. Nr.		Title
A5251-	N300	Location Plan
	N302	Layout Plan IS 4 – Sheet 2 of 4
	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
	E002	Bellevue Villas Pumping Station General & Emergency Lighting
	E003	Tivoli Industrial Estate Pumping Station General & Emergency Lighting
A5087	N226	Tivoli Crossing Plan and Longitudinal Sections

Contents

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^2

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 necesary 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.

APPENDIX 1

LIST OF DRAWINGS

APPENDIX 2

GENERAL ELECTRICAL SPECIFICATION

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SECTION A

1.0 OUTLINE OF SCHEME

1.1 This Mechanical/Electrical Sub-Contract is for the supply, installation, testing and commissioning of foul and storm pumps, associated controls, electrics, pipework, fittings and ancillaries in the proposed Tivoli Pumping Station, Tivoli Industrial Estate Pumping Station and Bellevue Villas Pumping Station in Cork City, Ireland.

The Civil Works will be constructed by others under the Cork Main Drainage Scheme – Interceptor Sewer Nr. 4 Contract.

Under the Civil Works Contract foul flows originating in the Lower Glanmire Road, Tivoli and Silversprings area east of Trafalgar Hill will be intercepted, along with surface water from the rear roofs and yards of existing properties and surface water run-off below the 3.386m OD contour level, and carried to the Tivoli Pumping Station. Similarly the Bellevue Villas Pumping Station will serve the area between Myrtle Hill Terrace and Trafalgar Hill. The pump flows from Bellevue Villas will be carried via a rising main and gravity sewer to Tivoli Pumping station. Tivoli Industrial Estate Pumping Station will serve Tivoli Industrial Estate. The pump flows from Tivoli Industrial Estate Pumping Station will be carried via a rising main and gravity sewer to Tivoli Pumping Station.

2.0 SCOPE OF CONTRACT

2.1 This Contract provides for the supply, installation, testing and commissioning of mechanical and electrical equipment in prepared reinforced concrete structures, including all ancillary works, for the pumping of wastewater.

2.2 The Tender for this Contract shall include for the delivery of all equipment to site, for all carriage required, and for all skilled and unskilled labour necessary for the installation of the plant, for testing, commissioning and for the maintenance of the plant for a period of 12 months in accordance with the tests set out in this Specification.

2.3 The Contract calls for the carrying out of the required work in conjunction with the Civil Works Contractor. No extra costs will be allowed for working in co-operation with this Contractor.

2.4 This Contract will be a direct contract between the Civil Works Contractor and the Mechanical Plant Contractor. The concrete structures will be built by the Civil Engineering Contractor.

3.0 DRAWINGS

3.1 The drawings defining the general scope of the work are listed in Appendix 1 of this document. Tenderers shall ensure that their proposed plant can be adequately accommodated within the structures. Minor variations may be accommodated.

3.2 The appointed contractor shall obtain approval from the Engineer of all plant installation drawings prior to commencing fabrication work. Such drawings shall indicate all builder's work necessary for the satisfactory installation of the plant. Any proposed variations from the tender drawings must be clearly identified.

4.0 SAFETY & HEALTH

4.1 The Preliminary Safety & Health Plan for the Civil Works Contract, Interceptor Sewer Nr. 4 (Doc. Nr. A5251-N-H-01) is included in these documents for information purposes only. The Civil Contractor will be appointed the Project Supervisor for Construction Stage and will hold overall responsibility for safety and health on site. Refer to Clause 21.0 "Compliance with Safety & Health Requirements" in Section B.

5.0 FLOWS

5.1 Tivoli Pumping Station

The design inflows to the pumping station are as follows:
6 DWF = 396 l/s.
1:5 yr. return period storm = 564 l/s
1:20 yr. return period storm = 627 l/s
The total design flow is to be split between twin 450mm PE rising mains with a minimum velocity of 1.2 m/s in each rising main. Each rising main will be served by a set of 3 nr. pumps operating on a 1 nr. duty//1 nr. assist/1 nr. standby basis. The 2 nr. duty pumps shall deal with the 6 DWF flow. The 2 nr. duty and 2 nr. assist pumps shall deal with the 5 year return period storm. The 2 nr. standby pumps shall provide the extra capacity required to pump the 20 year storm and/or provide backup in case of pump failure. The operation of the emergency gravity overflow is restricted at periods of high tide due to the low lying elevation of the site.

5.2 Tivoli Industrial Estate Pumping Station

The total design inflow to the puming station is 90.7 m^3/day. 7 l/s will be pumped forward by pumps, 1 nr. duty and 1 nr. standby.

5.3 Bellevue Villas Pumping Station

The total design inflow to the pumping station is 15 l/s. 30 l/s will be pumped forward by the pumps, 1 nr. duty and 1 Nr. standby.

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1.0 TIVOLI PUMPING STATION
(Refer to Drg. Nrs. A5251-N606, N607 and E001

1.1 Details of the proposed pumping station are shown on Drg. Nrs. A5251-N606, N607 and E00I.

It is intended that 6 Nr. fixed speed foul pumps (2 Nr. duty, 2 nr. assist and 2 Nr. standby) shall pump through twin 450 mm diameter PE rising mains to a manhole on the Marina, near Atlantic Pond.

The pumps shall be of similar type and shall be arranged such that when four pumps are operating together, the combined output is 564l/s and when six pumps are operating together, the combined output shall not be less than 627 l/s, against a total head resulting from the following parameters:-

Invert level of incoming sewer	= -3.291m OD
Floor level of pump sump	= -8.400m OD
Header Manhole discharge level	= -0.700m OD
Nr. of rising Mains	= 2 Nr.
Internal diameter of rising main	= 410mm
Length of Rising main	= 336m
Estimated friction and fitting losses	= 5.85m
Static head	= 6.70m
Total head	= 12.51m

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 6 set points for pump control to operate as follows:

Set Point 1	Low level cut out of duty pump
Set Point 2	Low level cut out of Assist Pump
Set Point 3	Low level cut out of Standby Pump
Set Point 4	Cut in of duty pump
Set Point 5	Cut in of Assist Pump
Set Point 6	Cut in of Standby.
Set Points 7 & 8	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 total flow from the pumping station during storm conditions will vary between 198.0 l/s (1 Nr. duty) and 627 l/s (2 Nr. duty, 2 nr. assist and 2 Nr. standby).

It shall be the Contractor's responsibility to assess the friction losses in the system across the range of flows required. In addition, the Tenderer shall state the efficiencies of these pumps for the full range of flows.

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

- 6 Nr. (2 duty, 2 assist, 2 standby) fixed speed submersible pumps, with equal duties such that four pumps in parallel will deliver 564 l/s against the total head determined from the above data.

  Include for all suction pipes, delivery pipework to connect to the twin 450mm PE rising mains, sluice valves, non-return valves, bends, tapers, guide rails, control equipment , electrics and float controls, etc.

- 2 Nr. 400 mm diameter on-line magnetic flow meters with local digital flow indication and resettable totaliser to be included, complete with transducer for digitised information downloading.

- 1 nr. kiosk as per Clause 9.0.

- 2 Nr. rotating bar interceptor screens as per Clause 8.0.

- Domestic Electrics

- Include for all signal cabling and wiring back to the control panel.

- Include for supplying flanged puddle collars to the Civil Contractor, to suit 100mm, 300mm and 400mm diameter pipework.

- Davits and lifting chains as per Clause 5.0 "Pump Removal" below.

- Gas Detection Unit as per Clause 14.8 below.

- 2 Nr. rescue type breathing apparatus tanks.

- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.

- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.

- 2 Nr. 600mm square electrically actuated, C.I., wall mounted penstock.

- 1 nr. 750 mm square electrically actuated CI wall mounted penstock.

1.3 **Hazardous Area Classification**

The H.A.C. is set out as follows:-

Area	Classification
Pump Sumps	Zone 1
Inlet Chamber	Zone 1

Valve Chambers	Zone 2
All other areas	Non-Hazardous

2.0 TIVOLI INDUSTRIAL ESTATE PUMPING STATION
(Refer to Drg. Nr. A5251- N604 and E003)

2.1 Details of the proposed pumping station are shown on Drg. Nr. A5251-N604 and E003.

It is intended that 2 Nr. fixed speed foul pumps (1 Nr. duty and 1 Nr. standby) shall pump through a 90mm diameter MDPE rising main to manhole MH 495 within Port of Cork Property

The foul pumps shall be of similar type and shall be such that when one pump is operating, the output is 5 l/s against a total head resulting from the following parameters:-

Invert level of incoming sewer	=	-1.524m OD
Floor level of pump sump	=	-2.824m OD
Header manhole discharge level	=	1.300m OD
Nr. of rising Mains	=	1 Nr.
Internal diameter of Rising Main	=	79.8m
Length of rising main	=	336m
Estimated friction and fitting losses	=	13.42m
Static head	=	3.47m
Total head	=	16.90m

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 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.

It shall be the Contractor's responsibility to assess the friction losses in the system for the flow required. In addition, the Tenderer shall state the efficiencies of these pumps for the flow required.

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

- 2 Nr. (1 Nr. duty, 1 Nr. standby) fixed speed submersible pumps, with equal duties such that each pump will deliver 5 l/s.
- Include for all suction pipes, delivery pipework to connect to the 90mm MDPE rising main, sluice valves, non-return valves, bends, tapers, guiderails, control equipment, electrics and float controls etc.
- 1 nr. kiosk as per Clause 9.0
- Include for all signal cabling and wiring back to the control panel.
- Domestic Electrics
- Davits to be installed in existing roof slab as per Clause 5.0 'Pump Removal' below.
- Gas Detection Unit as per Clause 14.8 below.
- 2 Nr. rescue-type breathing apparatus tanks.
- Lifting gear, including tripod suitable for lifting personnel and 15.0m cable.
- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.
- Removable safety barrier to surround pump sump opening

2.3 Hazardous Areas Classification

The H.A.C. is set out as follows:-

Area	Classification
Pump Sump	Zone 1

3.0 BELLEVUE VILLAS PUMPING STATION
(Refer to Drg. Nrs. A5251- N605 and E002)

3.1 Details of the Proposed Pumping Station are shown on Drg. Nr. A5251-N605 and E002.

It is intended that 2 nr. fixed speed foul pumps (1 nr. duty and 1 nr. standby) shall pump through a 200 mm HDPE rising main to manhole MH 451A, near Woodhill Villas, on the Lower Glanmire Road.

The foul pumps shall be of similar type and shall be such that when one pump is operating the output is 30 l/s against a total head resulting from the following parameters:

Invert level of incoming sewer	=	-1.518m OD
Floor level of sump	=	-3,868m OD

Header manhole discharge level	=	1.60m OD
Nr. of rising mains	=	1

Internal diameter of Rising Main	=	200mm
Length of rising Main	=	344m
Estimated friction and fitting losses	=	2.02m
Static head	=	4.72m
Total head	=	6.74m

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 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.

It shall be the Contractor's responsibility to assess the friction losses in the system for the flow required. In addition, the Tenderer shall state the efficiencies of these pumps for the flow required.

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

- 2 nr. (1 nr. duty, 1 nr. standby) fixed speed submersible pumps, with duties such that each pump will deliver 30 l/s.

  Include for all suction pipes, delivery pipework to connect to the 200 mm DI rising main, sluice valves, non-return valves, bends, guiderails, control equipment, electrics and float controls, etc.

- 1 nr. kiosk as per Clause 9.0
- Domestic Electrics
- Davits to be installed in existing roof slab as per Clause 5.0 'Pump Removal' below.
- Include for all signal cabling and wiring back to control panel.
- Gas Detection as per Clause 14.8 below.
- 2 Nr. rescue-type breathing apparatus tanks.
- Lifting gear, including tripod suitable for lifting personnel and 15.0 m cable.
- 2 Nr. safety harnesses suitable for lifting personnel in vertical position.
- Removable safety barrier to surround pump sump opening.

3.3 Hazardous Areas Classification

The HAC is set out as follows:

Area	Classification
Pump Sump	Zone 1

4.0 PUMPS

4.1 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 horsepower 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 end suction type and should be suitable for pumping untreated sewage containing fibrous and solid matter, as well as grit. They 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 "on snore" 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, such as a programmable logic controller or similar approved.

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

4.2 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 the Tivoli Industrial Estate Pumping Station which shall be capable of passing solids up to 50 mm. The pumps shall be provided with a spiral bottom plate with shearing edges and cutter inlet or equivalent to enable the cutting or shredding of large solids.

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.

4.3 The speed shall be not greater than 1450 rpm.

4.4 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 or assist pumps fail.

4.5 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.

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

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

4.8 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.

4.9 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.

5.0 SUBMERSIBLE PUMP REMOVAL

5.1 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.

5.2 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.

5.3 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.

5.4 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.

5.5 Pump cables shall accord with BS5345 Part 1 or equal, and include a flexible metal screen or armour. The cables shall be suitable for use in Zone 1 Hazardous Areas.

6.0 ELECTRICAL MOTORS

6.1 Submersible Motors

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

6.1.2 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.

6.1.3 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.

6.1.4 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.

6.1.5 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.

6.1.6 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.

6.1.7 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.

6.2 Electrical Motors - (General)

6.2.1 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.

6.2.2 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.

7.0 PUMP TESTS AND IDENTIFICATION

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

7.2 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.

7.3 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.

7.4 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.

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

8.0 ROTATING BAR INTERCEPTOR SCREEN

A rotating bar interceptor (RBI) screen shall be provided and installed in each inlet chamber to the Tivoli Pumping Station, as shown on Drg. Nr. A5251-N606. The RBI shall be constructed from Grade 316 stainless steel and shall have 100 mm 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 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. The RBI screen shall be manufactured by Biwater or approved equivalent.

9.0 KIOSKS

9.1 The electrical control panel, telemetry equipment and the ESB's incoming supply and meters at each of the 3 nr. pumping stations shall be housed in a weatherproof, ventilated and lockable kiosk.

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

9.3 Each kiosk shall be positioned as shown on Drg. Nrs. A5251N604, N605 and N607. The doors should be lockable and shall be retained in the 90° open position with stays.

9.4 Each kiosk shall be mounted on a plinth at least 150mm above the surrounding ground level and sealed with mastic to prevent the entry of water.

9.5 The kiosk shall be cross ventilated with one high and one low vermin proof ventilation grille on opposite sides. An interior light should be provided. Each equipment enclosure oulined in Section 9.8 below shall be provided with a thermostatically controlled anti-condensation heater operating on 110 Volts.

9.6 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.

9.7 Rubber insulating mats will be required inside each kiosk.

9.8 Each kiosk shall house the following equipment:-

(a) ESB's incoming supply, meters and distribution equipment in separate enclosures. (Described in Clause 10.0).

(b) Connection for mobile generator; (Described in Clause 11.0)

(c) Telemetry outstation; (Described in Clause 12.0)

(d) Control panel; (Described in Clause 13.0).

10.0 ESB'S INCOMING SUPPLY, METERS AND EQUIPMENT

10.1 One section of each kiosk 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.

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.

11.0 CONNECTION FOR MOBILE GENERATOR

11.1 A five pin pilot appliance inlet to BS 4343 or equal shall be mounted inside each kiosk in order that a mobile generator can be connected. A flap shall be fitted to the outside of each 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.

12.0 TELEMETRY OUTSTATION

12.1 The Contractor shall provide and install (in a separate enclosure) within the kiosk for each pumping station, a telemetry outstation and equipment to monitor and record the operation of the pumping station and for transmission back to the Corporation's telemetry control. The Employer will provide for the cabling for such transmission. The following operational states will be monitored:-

(a) Mains power failure;
(b) Level control system failure;
(c) Nr. 1 Pump tripped (starter);
(d) Nr. 2 Pump tripped (starter);
(e) Nr. 3 Pump tripped (starter); (Tivoli Pumping Station only)
(f) Nr. 4 Pump tripped (starter); (Tivoli Pumping Station only)
(g) Nr. 5 Pump tripped (starter); (Tivoli Pumping Station only)
(h) Nr. 6 Pump tripped (starter); (Tivoli Pumping Station only)
(i) Nr. 1 Pump running;
(j) Nr. 2 Pump running;
(k) Nr. 3 Pump running; (Tivoli Pumping Station only)
(l) Nr. 4 Pump running; (Tivoli Pumping Station only)

(m) Nr. 5 Pump running; (Tivoli Pumping Station only)
(n) Nr. 6 Pump running; (Tivoli Pumping Station only)
(o) Sump water levels in each sump
(p) Hours run (for each pump motor).
(q) Hazardous gas occurrence.
(r) Penstock Actuator tripped. (Tivoli Pumping Station only)
(s) Actuated penstock open (Tivoli Pumping Station only)
(t) Actuated penstock closed. (Tivoli Pumping Station only)
(u) Rotating bar screen trip-out. (Tivoli Pumping Station only)
(v) Intruder Alarm Activation

12.2 An allowance is provided in the Schedule of Basic Prices for a telemetry link/equipment from each pumping station to the Cork Corporation Central Control System.

13.0 CONTROL PANEL (GENERAL)

13.1 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 2 - General Electrical Specification of this Document. The MCC shall be of the multi-cubicle type, non withdrawable FBA (factory built assembly) type. 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 should 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, Second Edition, 1991, including Amendment A1, 1997.

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 Telemecanique or ABB manufacture or equal approved.

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.

13.2 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.
- 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 should 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.

13.3 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) 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 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.

(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.
- Open/Close switch for penstock actuator.
- Open and Closed indication for penstock actuator.
- Penstock actuator Fault/Tripped indication.

Notes:

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

13.4 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: Pumps and in the case of Tivoli Pumping Station, 2 nr. rotating bar interceptor screens, actuated penstocks (3 nr). Power supplies for instrumentation as specified.

(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 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 contain 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.

13.5 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.

13.6 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.

13.7 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^2 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".

13.8 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 150mm 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.

14.0 ELECTRICAL SPECIFICATION - GENERAL

14.1 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 2 of this document.

14.2 Domestic Electrics – Lighting, etc.

The Contractor shall supply and install the light fittings and associated equipment as specified on Drg. Nr. A5251-E001, E002 and E003.

14.3 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 each kiosk.

14.4 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.

14.5 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.

14.6 Instrument and Valve Actuators - Power Supply

The Contractor should 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.

14.7 Earthing

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^2 PVC covered copper cabling while cable tray shall have a 25mm^2 PVC earth cable run on each cable tray route and lugged directly to each cable tray section. A 70mm^2 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.

14.8 Gas Detection

The Contractor shall include for the supply and installation of an approved gas detection unit at the main sump in each of the pumping stations, i.e. Tivoli, Tivoli Industrial Estate and Bellevue Villas 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.

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

- 1 Nr. 16 Channel Euro Rack System
- 1 Nr. 14 Channel Mother Boards
- 1 Oxygen Card
- 1 Hydrogen Sulphide Card
- 1 Combustible Gases Card
- 1 Oxygen Concentration Card
- 4 Blank Fronts for Spare Channels
- Intrinsically Safe Barrier Enclosure
- 4 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
- Output Drivers for Alarm Sirens
- Output Drivers for Traffic Light Units
- Common 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 approved equivalent).

Hazardous Area

The gas detection sensors shall be located in a Zone 1/2 Hazardous Area. 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 sumps shall monitor the gas concentrations in the extracted in the sampling tubing from these areas. The sensors shall be mounted, in suitable sampling chambers. The sampled gases shall be returned to the sumps

Traffic Light

Traffic light units shall be located on the control panel door within the kiosk to 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 kiosk 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.

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:-

Gas	Range	Alarm Level
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.

14.9 Penstock Actuators in Tivoli Pumping Station

The 3 Nr. penstock actuators, one in each inlet chamber and one between the wet wells, shall be fitted with integral starters and local open/close controls with emergency stop facility. They shall also have local/remote operational capability. The actuators shall be suitable for use in a Zone 1 Hazardous Area and be rated for ingress protection to I.P. 67. Open/Close control shall also be available for the actuator in the Pump Control Panel.

14.10 Intruder Alarm

The 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

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

15.0 PIPES AND VALVES

15.1 All pipework within the three pumping stations shall be provided and laid by the Contractor as per Clause 15.6 below.

15.2 All pipework shall be ductile iron pipe to BS EN 598, to NP 16 Standard.

15.3 Flanged pipes shall be jointed with rubber gaskets to BS No. 2494, 10 mm thick. The rings shall cover the whole surface of the flanges and shall be pierced to take the bolts. All flanges shall be machined. All bends shall be of the longest radius that the layout permits.

15.4 All sluice valves shall be to BS 5150:1990, 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 handwheel and an indicating gear on each headstock shall indicate whether the valves are open or shut. Non-return valves shall be to BS 5153:(1991).

15.5 The pipework as shown on the drawings shall be supplied, laid and tested by the Contractor in the three pumping stations. **The Test Pressure for the Pipework shall be 10 Bar.**

15.6 <u>Pump Mains</u>

The mains shall be Ductile Iron Class K9 unless otherwise noted.

15.6.1 <u>Ductile Iron Pipework</u>

All pumps shall be fitted with a reflux valve on the delivery side and a sluice valve between the reflux valve and the rising main. Sluice valves shall be wedge gate type to BS 5150 or equal. Reflux valves to BS 5153 shall be single flap type, easy to inspect and clean and not liable to choke.

16.0 PAINTING

Painting of pumps, pipework and fittings etc shall be to BS 3416:1991 and shall be strictly in accordance with manufacturer's instructions.

Pumping equipment shall be factory coated with an epoxy primer and chloric rubber finish.

17.0 WORKING DRAWINGS

17.1 The successful tenderer will be required to submit to the Engineer **for approval** within the agreed period after the award of the Contract, three copies 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 opes to allow the construction of the structures to get underway.

18.0 FINAL DRAWINGS

18.1 After completion of the installation, three sets of drawings compatible with AUTOCAD shall be provided showing the layout of the plant, including a wiring diagram.

19.0 WORKING INSTRUCTIONS

19.1 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 Corporation 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 Corporation 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.

20.0 SITE COMPOUND/ACCOMMODATION/BUILDINGS

20.1 Site Compound:

The Employer will <u>not</u> provide a designated area for a Site Compound. The Mechanical/Electrical Contractor will be required to obtain at his own cost a site compound for site huts, lock up storage, canteen, etc. which he may wish to provide for his own use.

20.2 Site Huts & Accommodation:

The Contractor shall, at his own cost, supply all temporary buildings, sheds, messrooms, stores, washing and first aid facilities required under the relevant statutory regulations for his employees on site and upon completion of his works remove same. No temporary buildings shall be erected on the site without first

obtaining the consent of the Engineer as to the positions on which they are to be erected.

The Contractor should be aware that temporary living accommodation, including residential caravans, for contractor's employees will not be permitted within the boundary of the Employer's property and land.

20.3 General:

The Contractor shall be responsible for arranging electricity and water connections to his accommodation. Likewise upon completion/removal of the accommodation, these connections shall be removed and all areas made good and returned to their original conditions.

All Contractors' facilities shall be of high quality and the Engineer shall have power to order the removal from site of any facility which in his opinion is unacceptable.

21.0 COMPLIANCE WITH SAFETY AND HEALTH REQUIREMENTS

Clause 6.3 of the Instructions to Tenderers sets out the Contractors' obligations with regard to compliance with the Safety, Health and Welfare at Work (Construction) Regulations 1995 (S.I. Nr. 138 of 1995). Further to Clause 4.0 "Safety & Health" in Section A, in accordance with these Regulations a Preliminary Safety Plan has been prepared for the proposed scheme and is included in the Contract Documents for information purposes only.

An item has been included in the Schedule of Prices to facilitate the inclusion of all costs which may be incurred by the Contractor to comply with the Health, Safety and Welfare Regulations as required by Clause 4.0, Section A of this document.

22.0 CONTRACTOR'S RESPONSIBILITY

22.1 The Contractor's responsibility shall include the following specific requirements:-

(a) Transportation of all the plant to the three sites.

(b) Cranage for both off loading and during the period of erection, all necessary scaffolding and site storage for the duration of the contract.

(c) Supply and generation of electricity during erection by either a portable generator or other means available.

(d) All skilled and unskilled labour required in the installation of the plant.

(e) Attendance of a skilled operator for five full working days to instruct the Caretaker in the proper maintenance and running of the pumping

stations. This time shall be an extra on the normal time spent on the plant during the commissioning, completion tests and taking over tests.

23.0 WORKS / MATERIALS STANDARDS

23.1 Compliance with Standards:

All works and materials required under the Contract shall be in compliance with the requirements of this Specification and the standards referred to therein.

23.2 Equivalence of Standards

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 Union.

Where items to an Irish Standard Specification, a British Standard Specification, or any other standard specification of a Member State of the European Union are called for, this requirement shall be read as including relevant national standards of any Member State of the European Union, 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 DOE Circular Letters **BM2/87 and 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 the relevant national standard of another Member State of the European Union, which provides an equivalent guarantee of safety and suitability.

24.0 TENDER

24.1 The tenderer shall state in his tender the country of manufacture of the various items of equipment in his proposed plant. He shall state the currency exchange rate of the Euro on which he is basing his tender price for the various items. In the submission of his Final Account, the Contractor shall furnish both quotations and invoices for all the equipment imported and on which he is claiming increases due to currency exchange rates.

24.2 In the event of an increase in the value of the Euro, the Engineer reserves the right to make adjustments to the Final Account based on the exchange rate of the Euro on the Designated Date and on the currency valuation on the date written on the invoices supplied.

25.0 SPARE PARTS AND LUBRICANTS

25.1 One year's supply of each kind of oil and grease shall be supplied in good quality metal containers.

25.2 The tenderer will be required to include his recommended list of spares together with a separate quotation for these items as per Form of Tender/Schedule of Prices.

26.0 CUSTOMS CLEARANCE AND DUTIES

26.1 Customs duties shall not be included in the Tender but all VAT charges shall be included. Tender prices quoted shall be **cost delivered to site.**

27.0 PROGRAMME

27.1 The various items of the mechanical and electrical installation shall be fully completed within specified durations as outlined in the Form of Tender.

28.0 CERTIFICATE OF COMPLETION (TAKING OVER CERTIFICATE)

28.1 The Certificate of Completion ("Taking-Over Certificate") will be issued by the Engineer when the Works have passed the Tests on Completion, in accordance with Sections 28 and 29 of the General Conditions of Contract.

29.0 EXTENDED MAINTENANCE PERIOD

29.1 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.

30.0 DAMAGES FOR DELAY IN COMPLETION

30.1 If the Contractor fails to complete the Works, in accordance with the Contract and as per the various clauses in the Conditions of Contract, within the time fixed for the completion of the Works or any extension of such time, and the Purchaser shall have suffered any loss from such failure, there shall be deducted from the Contract Price such sums as are outlined in the Appendix to the Form of Tender. Clause 35 of the **Conditions of Contract** "Peformance Tests" shall apply in the event of Test failures.

31.0 INSTALLED AND ABSORBED POWER

31.1 Tenders shall be accompanied by the following information:-:

(a) Full description of pumps.
(b) Head plotted against delivery for each pump type.
(c) Overall efficiency of pumps and motors.
(d) Speeds of pumps and motors.
(e) HP of each motor.
(f) Efficiency plotted against delivery for each pump.
(g) HP plotted against delivery for each pump
(h) NPSH plotted against delivery for each pump
(i) Pedestal arrangement for each pump
(j) Power cable arrangement.

32.0 OPTIONAL EQUIPMENT

32.1 All optional equipment as per the tender specification must be priced as instructed and included in the schedule of prices in the appropriate manner.

33.0 GENERAL

33.1 The whole of the Works shall be completed in a workmanlike manner to the satisfaction of the Engineer and the site shall be left clean and tidy with the plant in perfect working order. The guarantees in respect of the performance of the plant shall be fulfilled before the work will be accepted as complete.