



Volume A – Works Requirements

Bandon Flood Relief Scheme – Bridge Lane Submersible Pump
M&E Works

Report No. C008065-AYE-SP-W-05

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Project

Bandon Flood Relief Scheme Bridge Lane Submersible Pump M&E Works

Client

Office of Public Works

Document

Volume A – Works Requirements

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[1] Introduction

[1.1] General

[1.1.1] Specialist Contractor

The scope defined within this document (M&E Works) shall be carried out by a competent M&E Specialist Contractor.

[1.1.2] Health and Safety

[1.1.2.1] Legislation

The Contractor/PSCS shall comply with all relevant Acts of the Oireachtas dealing with construction safety.

[1.1.2.2] Safety, Health & Welfare at Work (Construction) Regulations

In accordance with the Safety Health & Welfare at Work (Construction) Regulations 2013, the following are nominated:

Client: Office of Public Works

Designer: Ayesa (Byrne Looby Partners Water Services Ltd), Building 2100 Cork Airport Business Park, Kinsale Road, Co. Cork

Project Supervisor for the Design Process (PSDP): Ayesa (Byrne Looby Partners Water Services Ltd), Building 2100 Cork Airport Business Park, Kinsale Road, Co. Cork

Project Supervisor for the Construction Stage (PSCS): Successful Contractor (TBC)

[2] Mechanical Equipment

[2.1] Design Criteria

[2.1.1] Performance Data

This section describes the specific mechanical, electrical and process design requirements for the Contract relating to the proposed equipment.

The provision of plant shall be in accordance with the Contract Documents and be of proven technology and robust design.

The detailed design of the Works shall be the responsibility of the Contractor, and it is recognised that the Contractor's proprietary plant and equipment may be offered and could, in respect of certain Specification clauses, be non-compliant. Where this is the case, and where the Contractor has not indicated the non-compliance in his Tender within the schedule provided, then the Specification shall take precedence.

The normal operating sequence for the Works shall be clearly defined during the Contract design stage, together with the modes of operation under all water conditions and flows. The Contractor shall demonstrate that automatic operation is possible under all conditions or indicate under which operational conditions manual intervention may be necessary.

The new Works shall be capable of prolonged unattended automatic operation with minimal operator intervention.

The material design of the new pumps and associated equipment shall be entirely compatible with the environment in which they are to operate, and the design life of the pumps shall be 20 years. In this respect, the Contractor shall demonstrate that the protective finishes have been successfully employed in similar applications.

The requirements of the pumping station shall be to pump surface water collected in the pumping station sump via a DN250 flanged ductile iron rising main over the nearby quay wall into the Bridewell River channel. The operation of the pumping plant selected shall be sufficiently flexible to cater for variations in average and peak flow conditions which can vary.

Works at the pumping station site shall include but shall not necessarily be limited to those shown on drawing C008065-1449 and as explained below:

- Provision and installation of 2No. ATEX-rated submersible pumps, each including auto-coupling stool incorporating duckfoot bend, guide rails, and lifting chain.
- Provision and installation of new pipework, within the pump sump, made from either ductile iron or fabricated epoxy coated carbon steel.
- Provision and installation of 2No. swing check or resilient hinge non-return valves.
- Provision and installation of electrical switchgear - manufacture and installation.
- Provision and installation of control equipment and instrumentation.
- Provision and installation of ultrasonic level detection with backup level sensing system.
- Provision and installation of remote monitoring via dial out system.

- Erection of all plant, commissioning and testing.

The plant shall be capable of operating to the following requirements with a friction factor (Colebrook - White) of $K_s = 0.025\text{mm}$ ultimately.

The pump performance data is as follow:

Number of Pumps	2Nr
Pump Arrangement	Duty/Assist
Pump type	Wastewater-compatible submersibles. <i>Shall be resistant to corrosion and suitable for being immersed for prolonged periods.</i>
Pump mounting	Auto-coupling stool incorporating and guiderails
Pump lifting method	AISI 316 Stainless Steel Lifting Chain
Pump control	VSD
ATEX-Rated?	ATEX Zone 2 <i>Surface water is runoff from an intersection so it could be contaminated with fuel.</i>
Floor level of pump sump	11.605m OD
Design max. pump flowrate (both units running)	70l/s
Discharge point level	15.84m OD (approx.)
Max elevation of rising main	16.09m OD
Rising main connection	DN250 PN16 Flanged pipe, either ductile iron or epoxy coated carbon steel
Rising main length (existing rising main (from pump sump to discharge point))	10.32m
Rising main length (within pump sump)	Proposed rising main length TBC by Contractor
Solids Handling capacity	50mm minimum free passage

The Contractor shall be responsible for the selection of the pumps and the associated system design, including the assessment of head losses and ensuring compatibility with the specified performance requirements. The Contractor shall provide detailed calculations and technical submittals for approval prior to procurement and installation.

[2.1.2] Operation and Control

The Contractor shall be responsible for writing a control philosophy based on the following specifications:

1. Variable speed control of the duty/assist pumps shall be based on measured level within the wet well.

2. The pump station shall operate as a duty/standby system until as and when the level within the well continues to rise even with the duty pump running at full speed.
3. The duty pump is required to start and run for a short period at the start of any storm event, to flush that pump and its downstream pipework, before the assist pump starts and takes over.
4. At the end of any storm event, the duty pump is required to start and run down to snore level to drain as much water as possible from the pump well before the next storm event (which may be a year or more later). This operation must take account of the requirements of the chosen pump model to maintain its ATEX rating.
5. Level sensing will primarily use the ultrasonic level transducer, with the float switches/level probes acting as backups in the event of the ultrasonic instrument's failure.
6. Due to the infrequency of storm events, the pumps may go for extended periods without use. To account for that, each pump shall utilise an exercise programme, where each pump will be run up to full speed for a suggested 10-15 seconds before switching off. This is to ensure that any possibility of the pumps seizing is mitigated as far as possible. The Contractor shall be responsible for selecting a pump model capable of withstanding dry operation without damage.
7. Where pump or sensor failure occurs, alarms shall be raised to the local control panel, and to telemetry via the dial out system.
8. The control panel shall incorporate connections and relay for a high-level backup float switch. This relay, when energised, will run the pump (set to auto) at a fixed speed set in the VSD. This control will be limited such that the number of start/stop operations that each pump is subject to does not go beyond that specified by the pump manufacturer (usually around 15 starts per hour). To mitigate against that, the control system shall switch between duty and standby pumps for each start/stop cycle, so that the total possible number of starts per hour is doubled.
9. The following items of equipment shall be capable of generating an equipment fault alarm and transmitting that alarm via the dial out systems:
 - a. Pumps
 - b. Ultrasonic level transducer
 - c. Backup level floats/sensors
 - d. Pump stator winding over temperature
 - e. Pump water in stator housing
 - f. Pump oil condition monitor
 - g. Pump Current Overload Trip

[2.1.3] Characteristic Curves

Characteristics of pumps and motors shall be submitted with the tender including pump curves of total head, quantity, efficiency, and kW at the coupling. Also motor efficiency power factor and kW rating shall be stated. Characteristic curves of the system with the pump curve superimposed shall be submitted with the tender.

[2.1.4] Variation in Operating Levels

The proposed operating levels shall be determined by the Contractor with respect to the as-built pump sump. The operating levels may be varied within reasonable limits if the Contractor considers some necessary for the effective operation of the Control System. Variable speed control shall be utilised with pump speed varied to minimise pump starts and stops. The operating cut-in and cutout levels shall be such as to limit the maximum number of starts to 15 per hour per pump under all operating conditions. The Contractors attention is brought to the sump geometry and capacity, which will determine the cut in/out levels. VFDs minimum operating speed shall be greater than or equal to the minimum pump operating speed as determined by the pump manufacturer.

[2.1.5] Zoning

The entire pump sump shall be regarded as an ATEX Zone 2 hazardous area and as such all equipment to be installed in the sump and valve chamber shall be suitable for installation in this atmosphere. Intrinsically safe wiring, barriers and junction boxes shall similarly be ex rated.

[2.2] Pipes, Valves & Specials

[2.2.1] Scope of Supply

The Contractor shall supply and install all pipework, bolts, gaskets, valves, and pipe supports required within the pump sump. Pipework outside of the pump sump has been constructed by others (please refer to the background information provided as part of the Contract documents for information on the infrastructure which has been constructed (i.e. civil works)). The Contractor shall include for all auxiliary piping and valves around the pumps and other apparatus.

The layout and design of pipework shall be such that as to facilitate the erection and dismantling of any section for maintenance.

[2.2.2] Pipework

The pipework shall be PN16 flanged ductile iron (to BS EN 598), or epoxy coated carbon steel pipes that are suitable for use with stormwater runoff that may be contaminated with vehicle fuel and oil. They shall be coated with a suitable corrosion-resistant epoxy compound that can withstand long term immersion in stagnant stormwater runoff from the adjacent road that may be contaminated with oil and fuel.

Flanges shall be secured with 316 stainless steel bolt sets with EPDM gaskets.

Adequate pipe bracketry shall be designed such that all pipes are protected from turbulence within the well and the non-return valves are properly supported.

All pipes shall be checked for alignment and mating of flanges or connections before being secured. They shall not be sprung into position.

All pipework is to be pressure tested with water to 1.5 times the sum of the closed valve head of the chosen pump model plus 2 bar as a surge allowance.

[2.2.3] Non-Return Valves

Non-return valves shall be swing check or resilient hinge-type and are to be fitted on the delivery side of each pump and shall be at least of equal diameter to the discharge branch.

The rate of flow through the valve at maximum pumping rate shall not exceed the valve maker's recommendation.

The non-return valves shall have closing characteristics suitable for the delivery conditions and shall fully protect the installation against the shock from reflux, however caused - particularly by a sudden power failure.

Each valve shall embody the following features:

- (a) Detachable cover plates of ample dimension to facilitate inspection and withdrawal of the flap.
- (b) Ample pockets below the flaps into which may fall any solid matters, which might otherwise prevent the flaps from closing.
- (c) Plate seats gunmetal to BS 1400.
- (d) Hinge pins of aluminium bronze, epoxy-coated ductile iron, or AISI 316 stainless steel.
- (e) Main body door and cover cast iron to BS 1452.

[2.2.4] Bolts, Nuts, and Washers

All fastenings shall be stainless steel to BS 970, Pt. 4, Grade 316, S16.

Screw threads for fastenings shall conform to BS 3643, Pt. 2.

Each bolt shall be provided with one nut and two washers.

All exposed bolt heads and nuts shall be hexagonal standard metric sizes suitable for use with PN16 flanges.

The length of all bolts shall be such that when assembly is complete the threaded portion shall fill the nut and protrude from the face of the nut by not more than half the bolt diameter.

[2.3] Pumps

[2.3.1] Pumps – General

The pump well shall be considered a DSEAR zone 2 area due to the possibility of a fuel spill getting into the well during a storm event and the potential explosive atmosphere that could cause. The pumps chosen therefore shall have a minimum requirement to meet the ATEX directive 2014/24/EU Equipment Group II Equipment Category 3 with a temperature class of T3. All parts liable to wear shall be readily renewable. The pumps shall be suitable for use with surface water with an allowance for rubbish, spilt fuel, grit, and grease content. The pump shall be capable of running down to 'snore' level when the design storm even is over, and the pump well needs to be pumped down as far as possible. The pump shall be capable of discharging into an empty pipe. The pumps shall be capable of running at snore level for up to 1 minute without overheating or other adverse effect occurring.

The Contractor shall make sure that the chosen pump model will fit through the manhole cover's clear opening space (1220mm x 675mm clear opening) to allow for the pump to be removed for maintenance purposes.

[2.3.2] Pump Impeller

The pumps shall be designed so that the impeller can be removed without disturbing the pump body. The impeller shall be designed to give a non-overloading characteristic between the limits of heads stated. The impeller shall be of appropriate construction and material, suitable for pumping surface water. It shall be designed so that rags and stringy matter will not adhere to, or clog, it.

The impeller shall be keyed and positively secured to the high tensile shaft and shall be adjusted for static and dynamic balance. The pump shall have a minimum 50mm spherical solids handling capacity.

A hand hole, when appropriate, shall be provided adjacent to the impeller eye for inspection and maintenance purposes.

The impeller shall be suitable, in all respects, for the media being pumped. The selection of the impeller type and size shall offer best efficiency, whilst considering reliability, process media and potential for blockage. It shall be fully resistant to corrosion and suitable for long term immersion.

[2.3.3] Pump Protection

The pump shall incorporate the following standard alarm monitoring equipment:

- Stator winding over temperature,
- Water in stator housing,
- Oil condition monitor,
- Current Overload Trip.

[2.3.4] Pump Guide Rails

Pumps shall each be located by means of a guide rail system complying with the following:

- Allow for the installation and removal of submersible pumps from the wet well with a portable lifting davit at surface level. Special attention must be given to ensuring that the placement of the guide rails doesn't impede raising/lowering of a pump through the manhole cover's clear opening (ie 1220mm x 675mm).
- Consist of a set of stainless steel AISI 316 twin circular rails to suit the submersible pump offered.
- Be positioned vertically parallel to each other and be secured onto the pump stool at one end and an upper guide rail holder situated near the top of the chamber on the other.

[2.3.5] Noise

The Contractor shall ensure that on completion, the Works generally meets the requirements of the following:

- Within Plant Building Max 75dB_A *,
- At any point on the Works perimeter Max 50dB_A *.

**Measurements shall be taken at 1 metre field conditions and in accordance with BS522.*

[2.3.6] Sealing of Ducts

Following completion of all mechanical and electrical installations the Contractor shall seal all gaps, holes, duct openings using a WIMES 3.02 compliant, fire retardant, gas and watertight sealing system and non-corrosive silicone-based sealant. The sealing system shall prevent the ingress of harmful or flammable gases, liquid, smoke, fire, and vermin. The efficiency of the seal shall be tested when the installation is complete using an appropriate method compliant with WIMES 3.02.

[3] Electrical Equipment

[3.1] General

All equipment shall be compliant with the relevant National, European and International electrical standards as required by the General Specification Section 4.

The complete electrical installation shall be carried out in accordance with the following:

- I.S. 10101:2020+AC1:2020 National Rules for Electrical Installations
- National Rules for Electrical Installations in Potentially Explosive Atmospheres.
- Factories (Electricity) Regulations (S.I. No. 3 1972) and any amendments thereto.
- Requirements for Electrical Installations IEE Wiring Regulations 18th Edition.
- Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC
- S.I. No. 406/1994 - European Communities (Machinery) Regulations 1994
- Requirements of the Electricity Supply Board.
- All Acts of the Oireachtas current at the designated date.
- The requirements of all Statutes and Bye Laws of the Local Authority.

The Contractor shall note that in the case of conflict with any of the above standards, rules, and regulations the most stringent requirement shall apply.

All plant and equipment to be provided shall, unless otherwise indicated, be manufactured in accordance with the latest Irish Standard (IS) or with the equivalent harmonised standards of CENELEC. Where no such standards exist, equipment shall comply with the relevant IEC Publications. Use of equipment complying with standards other than those specified shall be subject to the written approval of the Employer's Representative.

The electrical plant ratings of the Contractor's designs are to be provided for consideration by the Employer's Representative.

The Contractor shall design, supply, deliver, install and commission the electrical power system to suit the ratings and load duties of the plant and auxiliary systems of the Project.

The Contractor shall include for all attendances and co-ordination that may be required with the ESB to achieve the project programme.

The Contractor shall adhere to the following IP ratings for all motors, electrical equipment, instrumentation, enclosures and installation works:

Location	IP Rating
Plant and Process Areas (non-hose down)	IP 55
Plant and Process Areas (hose down)	IP 56

Plant and Process Areas (outdoors)	IP 56
Submersible Pumping	IP 68, Ex-rated
All Other Areas	IP 55

The Contractor shall include for galvanised cable trays as required to suit the new equipment including all necessary supports and fixings.

[3.2] Environmental Conditions

The electrical equipment and installation shall be designed and constructed for operation in the following conditions:

- Ambient Temp. Min. -10C
- Ambient Temp. Max. 30C
- Altitude N/A
- Relative humidity >95%

[3.3] Operating Voltage & Frequency

(i) LV - Main Distribution:

Voltage	400 V
Phases	3
Frequency	50 Hz
Connection	4 wire Wye solid earth neutral

(ii) LV - General Power Distribution:

Voltage	230 V
Phases	1
Frequency	50 Hz

(iii) Control Voltage – Instrumentation and Control System Interfaces

Voltage	24V DC
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All electrical equipment shall be capable of continuous operation at a voltage level in the range of 90% to 110% of the relevant nominal voltage and a frequency variation of +/-1%.

[3.4] Existing Control Kiosk and ESB Pillar

The site includes an existing pump control kiosk and ESB mini pillar which previously served a pump in the area which has now been decommissioned. The existing control kiosk is 1.1m wide x 1.2m high x 0.3m deep. Both the existing control kiosk and ESB mini pillar are to be reused to serve the proposed Bridge Lane submersible pumping station if possible subject to the Contractors design requirements. The Contractor shall survey the control kiosk and ESB pillar, highlighting and addressing any issues on their reuse and ensuring that they are fit for purpose (including painting it).

The Contractor shall also assess the existing kiosk for the need to modify it to install a generator socket outlet on one side and add ventilation openings.

The existing control kiosk sits on concrete plinth which is 1.6m long and 0.46m deep. If the Contractor's design indicates that the existing control kiosk is too small to serve the proposed submersible pumps, a provisional allowance should be made in the tendered fee proposal for the supply and installation for an appropriate larger control kiosk which could be fixed to the existing concrete plinth (i.e. if a new control kiosk is proposed, it should be dimensionally less than 1.6m x 0.46m dimensionally on plan).

[3.5] ESB Liaison

The Employer has made an application to the ESB for the provision of a permanent power supply. The Subcontractor shall confirm the adequacy of the power provision by providing load calculations especially when pump size is known (ESB application has been made on the basis that the electrical requirement will be less than 16kW, Contractor to confirm whether this allowance is adequate).

The Contractor shall include for all attendances and co-ordination with the ESB necessary to ensure the provision of an electrical supply sufficient for the demands of the full load.

[3.6] Control Panel

[3.6.1] General

The Contractor shall design, supply, install and commission a new pump control panel including incoming ESB supply metering within the existing control kiosk. If the existing kiosk cannot accommodate the ESB metering, the Contractor shall check if this can be fitted inside the ESB kiosk. Alternatively, a separate metering cabinet to ESB standards shall be provided between the ESB kiosk and the control panel kiosk. The Contractor shall liaise with the ESB regarding their exact requirements for metering.

The control panel shall be Form 2a, bottom entry and shall be suitable for operation at 400V, 3 phase, 4 wire, 60 Hz supply.

The control panel shall contain the following:

- Mains incomer (from ESB),
- Generator incomer socket outlet (for connection of mobile generator),
- Two VSD (Variable Speed Drive) starter circuits for duty/assist submersible pumps,

- Control and monitoring circuits, relays and other components,
- Remote telemetry unit (RTU) - wireless communication modules (4G, GPRS) to be provided for RTU. The RTU shall be configurable via any smart phone using SMS and can report status and alarms by SMS. Live updates can be requested by sending a text message to the RTU.
- Feeder circuits for kiosk lighting and socket outlet,
- Ultrasonic level controller,
- High- and low-level float switch backup control,
- Pumps dry run protection – to interface with low level float switch and under load monitoring in VSD,
- Stator high temperature,
- Pump and motor vibration monitoring,
- Pump and motor bearing temperature monitoring,
- Thermostatically controlled anti-condensation heater
- Three phase and full-sized neutral busbars. The busbars shall be fully braced and be made to withstand the respective short circuit at any point,
- Full length earth bars separate from the main busbars,
- Control and monitoring of pumps, level instruments and incomers,
- Instrumentation supplies and interface/termination,
- Telemetry and status signals and marshalling for plant monitoring and interface to the RTU,
- Process/hardwired/mechanical interlocks' connections and components,
- VSD and control panel ventilation fans,
- Running hours meter fitted for each pump,
- All required components (e.g., indicating lights, control transformers, fuses, reset switches, relays, e-stop, etc.) for the control panel to perform their required functions.

All incoming and outgoing ways of the control panel shall be provided with connections and gland plates that shall be suitable for the anticipated cable sizes and types.

The earth bars and enclosures of the control panel shall be effectively connected to the main earth bar.

Internal electrical lighting fittings shall be supplied and fitted to provide adequate illumination for Operation and Maintenance activities within the kiosk.

All digital inputs shall be energised when healthy. All analogue signals shall be 4-20mA

The control panel shall be arranged such that in the event of a complete incoming power failure followed by a complete restoration of power, the plant shall run again automatically without manual resetting, with the control system controlling the sequence start-up of all equipment.

Each part of the control panel shall be clearly labelled detailing function and the description and number of motors.

Terminations shall be provided in such a way as to avoid over bending of cables beyond the manufacturer's recommendations.

The terminals of incoming and outgoing circuits shall be individually shrouded by a polycarbonate material which shall allow safe visual inspection of the cable terminations while under load.

All plastic components shall be made from halogen free material.

All live parts shall be shrouded to IP20 as standard.

The panel shall incorporate all necessary circuit protections to ensure the safety of personnel and circuits. All supplies to external sockets shall be protected by suitably rated RCBOs.

To ensure adequate protection and isolation between circuits, all monitoring and control signals shall be routed through relays.

The control panel shall comply with the following regulations:

- IEC 439-1
- BS EN IEC 61439-1:2021

Details of panel design shall be submitted to the Employer's Representative for approval.

The panel shall be protected by hot dip galvanising followed by stove enamelling. Details of the panel coating specification and colour shall be forwarded to the Employer's Representative for approval.

The overall layout of the panel shall be designed to present a pleasing appearance, well organised components with all relevant information clearly displayed. General arrangement and schematic drawings of the control panel shall be submitted to the Employer's Representative for approval prior to manufacture commencement.

Title plate shall be fixed on the panels. The plate shall be colourless transparent plastic material not less than 3mm thick with bevelled edges to half thickness. Each shall be engraved with black letters on a white background.

[\[3.6.2\] Mains and Generator Incomers](#)

The mains and generator incomers shall be provided with electrical and mechanical interlocks to prevent paralleling of the two power sources. Manual changeover facility shall be provided for manual switching of the incomers (e.g. on power failure – from mains to generator supply and on return of normal power – from generator to mains supply). The manual changeover shall ensure that the incomers are lockable when in the OFF position.

The mobile generator socket shall be installed either externally at the side of the kiosk adjacent to the mobile generator hard standing or it shall be panel mounted. The socket shall be permanently connected by cable to the control panel generator incoming circuit breaker. A kiosk cable entry point shall be provided to enable the generator cables to be safely connected allowing the kiosk doors to close. This may need modifications to the existing kiosk.

The incoming generator connection shall be a 125A, IP67 with removable cap, 5 pin (3P+N+E) socket, 400V conforming to IEC 60309.

The mains incomer shall be provided with moulded case circuit breakers (MCCB), generator incomer and socket outlet with RCBO and MCB for panel lighting. Isolating handle shall be padlockable in the 'OFF' position. The mains and generator incomers shall be suitably rated 4 pole type breaker and shall have provision for visual indication of the 'On' and 'Off' positions.

The incomers shall include all connections for incoming supply cables including neutral and earth connections.

The incomers shall be provided with surge and phase failure protection devices that shall send an alarm to telemetry. Surge protection devices shall be in compliance with IS 10101 and shall incorporate type 1+2 combined lightning current and surge arresters for 5-conductor systems (L1, L2, L3, PE, N), consisting of protective plugs and base element. The unit shall incorporate optical status indicators, and a remote indication contact for error indication. Phase failure relays shall be adjustable and shall be initially set to provide a healthy signal when the supply voltages are within +/- 10%. To prevent signal bouncing, the relays shall be combined with adjustable timers to delay the activation of the relays (e.g. by 30 seconds).

The panel shall incorporate multifunction power meters on the mains and generator incomers monitoring line voltages, current (via CT clamps), power, frequency and phase angle. The power meters shall have Modbus RTU communication capabilities via RS-485.

[3.6.3] Pump Starters

The pump starters shall be provided with moulded case circuit breakers (MCCBs) and VSD starters. The MCCB shall be rated according to the Contractors calculations and manufacturers recommendations for the selected VSD. Isolating handle shall be padlockable in the 'OFF' position. The pump starters MCCBs shall be 3 pole type breaker and shall have provision for visual indication of the 'On' and 'Off' positions.

VSDs shall be provided with pump monitoring devices/relays for interface to the pump motor protections in accordance with manufacturers' recommendations. VSDs shall be air cooled, designed with efficient air circulation within the panel and with air intakes having air filters to prevent entering dust and particles to the VSDs. A Modbus connection to the VFD shall be provided.

Each pump shall be fitted pump condition monitoring device (e.g. miniCAS) and a Hand/Off/Auto switch. This shall be a spring return momentary on/off/on switch.

The starters shall be provided with 400Vac/24Vdc Vac power supply unit for their control circuits. The power rating of the power supply unit shall be sufficient to supply the panel requirements plus an extra 30% output capacity. There shall also be Stop\Start push buttons, pump available lamp, a reset button on each pump section and a manual change over switches for the pumps.

The pumping plant shall be provided with the following protection hardwired interlocked with the operational control of the pumps:

- Dry run protection- The control panel shall incorporate connections and relay for the low-level float switch which will stop the pump when activated and inhibit the pump from running until manually reset. This relay will be connected into the motor control circuit and will only permit the pumps to operate if the relay is energised. The low-level float switch positioning shall be above the pump snore level and shall be determined by the Contractor during installation. The VSD shall also be provided with underload detection to provide the same dry running protection of the pump. The Contractor shall set the current setting within the VSD for the activation of this underload detection. This must not inhibit the planned snore operation of the pumps as detailed above.
- Current overload,
- Overtemp generated from stator thermistors,

- Oil seal failure generated from moisture sensor.

Overload protection shall be provided by electronic trip on starters of the pumps. Reset facilities shall be provided such that it will not be necessary to open the panel to reset the overload.

Starters are to be provided with thermal overload devices.

[3.6.4] Panel Indications

The panel shall contain indicator LEDs for the following:

- Mains supply ON,
- Generator supply ON,
- Pump Running,
- Pump Available,
- Pump Trip,
- Pump stator winding over temperature,
- Pump leak,
- RTU system fault,
- Backup control activated,
- Surge protection – red LED, to illuminate if surge protection has activated,
- 24V supply healthy – white LED, to be taken directly from 24V PSU output,
- Mains incomer phase failure – red LED, to illuminate if phase imbalance exceeds 5% (adjustable),
- Generator incomer phase failure – red LED, to illuminate if phase imbalance exceeds 5% (adjustable),
- High level – red LED to be illuminated if water level exceeds high level,
- Low level – red LED to be illuminated if water level drops below low level,
- Ultrasonic controller fault – red LED, to illuminate if ultrasonic controller fails or loss of echo fault.

The panel shall incorporate a lamp test function, whereby all lamps are activated by a non-latching pushbutton.

[3.7] Electric Motors

[3.7.1] General

Electric motors shall be of high torque low starting current type suitable for use with VSDs and a 3-phase 400V 50 Hertz power supply and shall comply with BS EN 60034, BS EN 60034 and BS 5000 as appropriate. Motors shall be totally enclosed drip proof, weatherproof and watertight for submersible installation. Drip-proof and weatherproof motors shall incorporate anti-condensation heaters so controlled that the heater is switched off when the motor is energised.

Motors shall be rated for continuous duty. The power factor of each motor shall not be less than 0.98 at duty point. Should the power factor be less than 0.98 the Contractor shall install at this own

expense suitable equipment to correct the power factor to that required. An automatic cut-out shall be incorporated in each motor to operate in the event of overheating.

All motors in the submersible pumping stations shall be suitable for installation in Zone 2 hazardous area and comply with CENELEC/EURONORM Standard EN 50 014 and EN 50 018 covering flameproof high efficiency motors certified EEX d IIB T3 by BASEEFA.

[3.8] Telemetry

The following status and alarms shall be made available to the telemetry system. All digital inputs shall be energised when healthy and provided via volt free contacts. All analogue signals shall be 4-20mA.

- 24Vdc supply healthy,
- Mains incomer phase fail,
- Generator incomer phase failure,
- Surge protection activated,
- High level alarm,
- Low level alarm,
- Ultrasonic controller fault,
- Emergency stop activated,
- Start signal,
- Pump running,
- Pump operating speed,
- Pump trip,
- Pump over temp,
- Pump leak,
- Pump in Auto,
- Hydrostatic pressure sensor,
- Level from Level measurement controller,
- Power meter.

All alarms shall be transmitted to Cork County Council's (CCC) SCADA network via an RTU with 4G/GPRS module.

The Contractor shall provide the necessary hardware and systems integration works in CCC SCADA to ensure that the signals are received from the pump station.

[3.9] Electrical Work

[3.9.1] Regulations

The electrical work shall be carried out in accordance with the following requirements:

- (a) The National Rules for Electrical Installations, Parts 1 and 2.6.
- (b) The National Rules for Electrical Installations in Potentially Explosive Atmospheres.
- (c) Electrical supply regulations as laid down by the ESB.

[3.9.2] Within Potentially Explosive Atmospheres

The Subcontractor shall endeavour not to install equipment within potentially explosive atmospheres. However, where this cannot be avoided then all equipment and fittings used within the area shall be provided with an ATEX compliance certificate relevant for the area in which the equipment is to be mounted and a Client's Acceptance of Equipment Installed within a Potentially Hazardous Area shall be completed.

Any electrical installation carried out within a potentially explosive atmosphere shall be tested and the installation certified using the specific NICEIC test documentation as required by the DSEAR manual.

[3.9.3] General Cabling

Cabling within the control panel shall be carried out in surface mounted cable trays.

Cables shall be PVC insulated multicore with copper conductor and shall conform to the requirements of BS 6004. All cables shall be 600/1000-volt grade. The armour of PVC SWA PVC cable shall not be used as a circuit protective conductor. A separate cable or core of the PVC SWA PVC shall be utilised for this purpose.

The voltage drop shall not exceed 5% on all motive power runs.

The insulation shall be colour coded or sleeved to indicate phase neutral and earth as follows:

Phase 1	Brown
Phase 2	Black
Phase 3	Grey
Neutral	Blue
Earth	Green/Yellow

All control wiring is to be included within the tender.

All control and signal wiring to be run in separate ducts and trucking in screened cable.

All cables per circuit are to be identified as per the cable schedule.

The complete installation shall comply with current ETCI regulations and shall be RECI certified.

All earthing shall be via a dedicated earthing cable to the main earth bar.

Proper segregation between power, signal and instrumentation cables shall be observed to avoid electrical interference.

[3.9.4] Cable Sizes

The Contractor shall supply, install, terminate, test, commission and identify all power, control, protection and instrumentation cabling necessary for the operation of the installations supplied under the Contract.

The cabling installation shall be approved by the Employer's Representative and shall comply with the subsequent requirements of this section.

The Contractor shall size and select power and control cabling to suit the final approved power circuit loading and plant ratings together with the specified protection and plant control and monitoring systems. The Contractor shall replace any cable approved and or installed and subsequently found to be inadequate.

Power cable sizing calculations using approved software shall be provided. The cable sizing calculations shall include proposed cable type, current carrying capacity, method of installation, grouping, ambient temperature, all associated derating factors and other information needed for the calculations, resulting voltage drop, resulting derated cable capacity and tripping times.

All multicore cables provided for the plant protection, control and monitoring systems shall incorporate 20% plus 2 spare cores. All spare cores shall be terminated.

The Contractor shall provide a complete cable schedule for all cables used in the plant installations. This schedule shall include the following details:

- i) Type of cable
- ii) Size of conductor
- iii) Number of cores – used and spare
- iv) Voltage rating of cable
- v) Full load current rating of cable
- vi) Cable number/tag and source/destination details
- vii) Length of cable

Cabling shall be mechanically always protected. For internal installations cabling shall be run in galvanised steel trays.

The Contractor shall conform to the following:

- Power/Control - PVC/SWA/PVC, 600/1000V grade, control cables shall be minimum 1.5mm² cross-sectional area while power cables shall have a minimum cross-sectional area of 2.5mm².

- Instrumentation for use in 4-20mA signals - Individual twisted pair cables PVC/SWA/PVC, minimum 0.75mm² cross-sectional area. Individual screening of each twisted pair, as well as an overall screen of the complete cable, shall be used in this instance. Grounding will be at one end.

The insulation colour of cables shall be in accordance with ETCI regulations.

[3.9.5] Emergency Stop

The Contractor shall provide and install latched mushroom emergency push button for each pump to IP68 protection, complying with the requirements of the Machinery Directive. The emergency stop button shall be installed on the door of the control panel and shall be provided with guard or cover to prevent unintentional activation. An emergency stop risk assessment shall be provided to confirm the requirement and location of the e-stop.

The emergency stop activation shall over-ride all other control and prevent operation of the pumps when triggered. The pumps shall not be capable of restarting until the emergency stop button is reset.

The pump name and number shall be clearly labelled on the emergency stop and shall correspond to the description and number labelled at its control panel starter and at the pump itself.

[4] Instrumentation

[4.1] Level Monitors

The control panel shall include a non-contact ultrasonic level controller interfacing to an ultrasonic transducer, ATEX-rated for use in a pump station wet well. The transducer shall have a minimum measuring range of 3m. The controller shall operate on mains 230Vac or 24V dc. The ultrasonic controller shall incorporate a keypad for programming and accessing data. The controller shall have one analogue output for each pump to be controlled via interface with VSD, output relays for high level and loss of echo alarms and one spare relay. The controller shall be configured so that the analogue outputs from the controller or pump control relays shall be energised to activate the pumps via the VSD. The controller shall be configured so that the high-level alarm and loss-of-echo relays are energised when healthy and de-energise in the event of an alarm/fault. The 4-20mA output of the transmitter shall have minimum resolution of 0.1% to transmit the current water level. The controller shall provide for pump duty and assist cycling and shall be adjustable by the operator. The level controller measurement and display units shall be configurable and shall include the option to display in metres and millimetres. The level controller shall be capable of offsetting the dreading displayed by a user defined value.

The level transducer shall be located below the access cover of the wet well and shall be removable and easily accessible without the need to enter confined spaces or for maintenance staff to lean out over an open chamber. The transducer shall be provided complete with stainless steel mounting brackets and fixings.

A hydrostatic pressure transducer shall be fitted to the pump station. This will be powered by the 24V dc supply. The unit shall have a minimum measurable range of 6m water column and shall measure from zero. The unit shall provide an analogue output of 4-20mA to interface with the RTU. This

measurement will be provided to the telemetry system for monitoring purposes but will not be used to control the pumps.

High level float switches shall also be installed for backup control and low level for dry run protection. The Contractor shall allow for components in the control panel to provide the backup control. The float switches shall be provided with barrier or cage to prevent debris from entangling on the floats. The float switches shall send an alarm to the telemetry when activated.

A UPS shall be included to provide a minimum of 12hours supply to the high level sensor, controller and the RTU for text alert to ensure that local pumping station operators are notified if there is a risk of flooding in the event of a power loss/failure.

[5] Tests On Completion

[5.1] General

The Contractor shall ensure that the Tests are carried out under the approval of the Employer's Representative and offer all items of plant for inspection, examination and witness testing by the Employer's Representative.

The Contractor shall provide commissioning services and shall supervise, manage and co-ordinate all commissioning activities.

The Contractor shall be responsible for the operation and maintenance of any process unit(s) introduced prior to the commencement of the Tests on Completion.

If any part of the Works fails to pass the Tests on Completion, the Contractor shall repeat them under the approval of the Employer at his own cost.

The Contractor shall carry out tests under the approval of the Employer's Representative, and in doing so shall include within his scope for all resources, equipment, instrumentation and consumables necessary.

The Tests on Completion scope of supply is deemed to cover the following plant and equipment as a minimum:

- Pump sets
- Pipework and valve installation (note pump sets to be spaded off during pressure test to protect pump set mechanical seals)
- Instrumentation
- Telemetry system

The Tests on Completion shall not commence until the whole of the Works is complete and ready for Testing.

The schedule for the introduction of process unit(s), commissioning, testing and Tests on Completion shall be included in the Contractors Programme for the execution of the Works.

After the successful conclusion of Tests on Completion to the satisfaction of the Employer's Representative, the Contractor shall submit a Construction Completion Report, which the Employer's Representative shall approve prior to the issue of the Take-over certificate.

[5.2] Commissioning Documentation

The Contractor shall forward all commissioning documentation to the Employer's Representative for approval prior to the inclusion in the commissioning manual.

The Contractor shall forward to the Employer's Representative for approval of his proposed commissioning plan/method statement and professional and commercial details of any subcontractor proposed to be utilised during the commissioning process prior to the commencement of any commissioning activities by the Contractor.

The Contractor shall be responsible for collating and issuing commissioning information for the Employer's Representative's approval.

The Contractor shall maintain a commissioning manual, which shall be a full record of all commissioning activities. These shall include but shall not necessarily be limited to the following:

- (i) Approved installation and arrangement drawings of all plant and equipment.
- (ii) Factory Test Certificates (Originals).
- (iii) Manufacturers installation and commissioning literature.
- (iv) Method statements and procedures for the commissioning of the whole Works and its various sub-sections as approved by the Employer's Representative.
- (v) Calibration certificates for all commissioning test instrumentation and equipment (Originals).
- (vi) Records of all approved plant and equipment installation tests.
- (vii) Records of all approved plant and equipment pre-commissioning tests.
- (viii) Records of all approved plant and equipment commissioning tests.
- (ix) Calibration certification for all instrumentation used in the operation of the works.
- (x) Certification of the safe working capacity of lifting equipment.
- (xi) CE certification.
- (xii) RECI Certification.
- (xiii) Functional Design Specification.
- (xiv) Any other item deemed necessary by the Employer's Representative.

All items of Plant and Materials shall be tested to demonstrate that they operate in accordance with the information provided in the Functional Design Specification (FDS) when operated in both manual and automatic control and that all processes and equipment interact and control in unison.

The Contractor shall include all completed and approved test record sheets within his Construction Completion Report.

The Tests on Completion shall be deemed to have failed either fully or partially, if the following occurs:

- i) The plant or equipment comprising the Works fails to meet the criteria set out in the Tests on Completion method statement.
- ii) The Contractor fails to operate the plant or equipment comprising the Works in compliance with the manufacturer's manuals or other written instructions.

iii) The Contractor fails to maintain the plant or equipment comprising the Works in compliance with the manufacturer's manuals or other written instructions

iv) The Contractor fails to maintain adequate or accurate records, in the view of the Employer's Representative, relating to the operation of performance of any plant or equipment comprising the Works.

All records of the Tests on Completion shall be maintained by the Contractor within the Commissioning Manual.

The commissioning manual shall be available for inspection by the Employer's Representative at all reasonable times.

The Contractor shall ensure that the installation and commissioning of the plant as per the manufacturers recommendations is completed and signed-off before proceeding to the Tests on Completion for the works prior to pumping.

[5.3] Consumables

For the commissioning and testing period the Contractor shall be responsible for the supply of all consumables used during the commissioning and testing period of the Contract, including but not limited to, water, power, chemicals and spare parts.

[5.4] Testing Of Motors

Witness testing will normally be waived on standard types of small motors made by approved manufacturers and small components used in the manufacture of units of plant.

Test certificates, which shall include the following information, shall be provided for all motors:

- (a) Standard to which the motor is manufactured.
- (b) Class of insulation.
- (c) Size and type of cables fitted.
- (d) Type of bearings, sizes and lubricants.
- (e) Type and rating of heaters.
- (f) Line current on all phases.
- (g) Phase current balance.
- (h) Efficiency and power factor at 100%, 75% and 50% of full load.

[5.5] MCC Type Tests and Routine Tests

Type tested switchgear assemblies shall be certified by an approved Testing Authority as having passed short circuit testing in accordance with IEC 61439. Details of testing procedures not covered in the above Specifications shall be submitted by the Contractor.

Each switchboard shall be so designed and constructed that it will withstand for the specified period without damage, the thermal and mechanical stresses which might arise under short circuit conditions up to the prospective busbar short circuit current.

A routine high voltage pressure test shall be carried out with all isolators closed and power fuses fitted. The panels shall withstand for one minute 2kV across the following points:

- (i) Phase to phase
- (ii) Phase to neutral
- (iii) Phase to earth
- (iv) Neutral to earth

An insulation resistance test shall be made immediately following the routine pressure test and using a 500V testing instrument. This test shall be made with all isolators closed and power fuses fitted but having all electronic components, time switches and control equipment likely to suffer damage under test, removed. An insulation resistance of not less than 20 megohms shall be obtained between each of the following points:

- (i) Phase to phase
- (ii) Phase to neutral
- (iii) Phase to earth
- (iv) Neutral to earth

Works tests on busbars in accordance with the requirements for routine tests to Section 6 of BS 159 shall be included.

[5.6] Site Testing and Commissioning Underground Cables

Cables laid underground shall be tested in accordance with the appropriate specification for insulation resistance, cable continuity and continuity of earth circuit in the presence of the Employer's Representative's Representative.

[5.7] Site Testing and Commencing Of Electrical Circuits

The connections of all electrical circuits shall be proved to be correct and the whole installation shall be tested for insulation resistance and earth loop resistance, in the presence of the Employer's Representative's Representative, by the Contractor. Any faults or defects shall be remedied at the Contractor's expense.

Certificates in accordance with "IS 10101 National Rules for Electrical Installation" shall be issued to the ESB and a copy supplied to the Employer's Representative's Representative.

The Contractor shall provide the Employer's Representative's Representative with a fully detailed cable schedule.

The schedule shall list each cable with the following information:

- (i) a unique reference number,
- (ii) details of route (source and destination),
- (iii) cable type and details,
- (iv) estimated length,
- (v) full load current,
- (vi) voltage drop,
- (vii) earth loop impedance,

[5.8] Return To Site for Retesting

At least six months after the date of the Employer's Representative's taking over certificate and within the maintenance period, each electrical circuit shall, in the presence of the Employer's Representative or of the Employer's Representative's Representative, be re-tested by the Contractor who shall trace and correct all faults and replace any material found defective without further cost to the Purchaser provided that any such faults or defects are the Contractor's liability.

An inspection certificate in accordance with Clause 6.6 of the "National Rules for Electrical Installations Part 1: General Requirements" shall be provided in triplicate to the Employer's Representative.

[5.9] Control System Site Acceptance Testing

All signals to be available for future use within the MCC marshalling box and cables shall be tested as appropriate but including as a minimum insulation resistance, continuity and continuity of earth circuit in the presence of the Employer's Representative. All joints made during the installation of the cables which prove faulty when tested shall be remade and re-tested to the satisfaction of the Contractor as notified to the Employer's Representative in advance of the system being installed.

The connection of all signal circuits shall be proved to be correct and the whole installation shall be tested in the presence of the Employer's Representative with instruments provided by the Contractor. Certificates of acceptance shall be issued to the Employer's Representative prior to work commencing on site. The Contractor shall detail in his tender his proposals for testing all signal wiring.

[5.10] Valves And Pipework

Pipes shall be tested in sections and complete. The sections of pipe shall be filled with water and air released. After filling and pressurisation and achievement of the normal working pressure the pipeline shall be allowed to stabilise.

The pipeline pressure shall then be raised to the test pressure (1.5 x the closed valve head of the pump model chosen plus 2 bar as a surge allowance) and kept at this pressure for not less than one hour. If the pressure is maintained by pumping, the pump shall be switched off and the pipeline left for a further hour.

[5.11]Pre-Start Up

[5.11.1] Cleansing.

On completion of erection and before any operation, internal surfaces of the pressure pipework, tanks and sumps etc. shall be cleaned thoroughly in such a way as to remove all oil grit and other deleterious matter.

[5.11.2] Initial Start-Up

When supply to the control panels has been energised testing shall continue in the following manner.

- a) Each item of plant shall be tested to ensure correct rotation.
- b) Each valve shall be tested under normal system conditions to ensure correct operation.
- c) Each instrumentation loop shall be tested to ensure correct operation.
- d) Each relevant item of plant shall be tested to ensure “Manual Control” functions.
- e) Each relevant item of plant shall be tested to ensure “Remote Control” functions.

[5.12]Motors

Motors shall be tested in accordance with BS EN 60034-6:1994 or equivalent and typed test certificates shall be submitted with each motor.

[5.13]Test Certificates

The result of all works and site tests carried out by the Contractor shall be recorded, certified and submitted to the Employer’s Representative.

[5.14]Installation Inspection

During erection of the plant the Employer’s Representative shall inspect the installation from time to time in the presence of the Contractor’s Supervisor to establish conformity with the requirements of the Specification.

[5.15]Pre-Commissioning Tests (Electrical)

After completion of erection and prior to electrical connections being made to the plant, the Contractor shall carry out insulation and continuity tests as stated below. The Employer’s Representative reserves the right to witness these tests, and the Contractor should give him three days’ notice prior to tests being made.

Insulation and continuity tests shall be carried out on motors, cables and all other equipment, with the alternator disconnected from the system.

Testing shall generally be in accordance with the current Edition of IEE Wiring Regulations. All values shall be tabulated and three copies, each forwarded to the Employer’s Representative. Calibration

Certificates for each test instrument used shall be submitted to the Employer's Representative. All test instruments shall have been calibrated during the previous 12 months.

The Contractor shall carry out functional tests on all circuits of the Control Panel to the satisfaction of the Employer's Representative prior to any power cable connections being made. Following cable connection, rotational and plant running tests shall be carried out with overloads, timers, etc being set.

[6] Operation and Maintenance Requirements

[6.1] General

The general mechanical and electrical design of the plant and particularly that of the bearings, contacts and other wearing parts shall be governed by the need for long periods of service without frequent maintenance and attention being necessary and by safety and health considerations for those that shall be carrying out the maintenance.

All component parts of the plant shall be manufactured to a strict system of limits and complete interchangeability of similar parts is required, where possible.

All items of plant for which spare parts may be required shall have attached to them untarnishable metal plates clearly showing the manufacturers name, serial numbers and basic information as to rating, etc. in sufficient detail to allow the unit or assembly to be identified in correspondence and when ordering spare parts.

All parts subject to wear shall be readily accessible. Provision shall be made for taking up wear in all bearings and other wearing parts and easy replacement if adjustment is not practicable.

Suitable packers and/or shims shall be fitted for ease of adjustment and realignment of all machinery units, particular attention shall be given to combined sets.

[6.2] Operation And Maintenance Manuals

The Contractor shall provide a digital copy of instructions for the operation, maintenance and overhaul of the plant installed, in the form of manuals. These manuals shall clearly set out in an easily understandable form, the steps to be taken by the Employer's staff to run and maintain the plant supplied. Drawings shall be adequately referenced and detailed to enable spares to be readily ordered, and future modifications made if required.

The manuals shall be provided in three stages:

Stage 1 – **Draft** These shall be provided for the purposes of training and shall contain all manufacturer's data, marked-up construction drawings and details of all commissioning tests and operating set points.

Stage 2 – **Final 1st** The O&M documents at this stage shall be provided to the Employer on Substantial Completion and shall be fully completed.

Stage 3 – **Final 2nd** The O&M documents shall be reviewed by the Contractor and where changes have been made to the plant during the 12-month warranty period, these shall be included in revised O&M manuals and issued to the Employer prior to the release of the Defects Certificate.

Manuals shall be submitted in PDF format with drawings in both PDF and AutoCAD .dwg formats.

The Contractor shall note that failure to provide compliant manuals approved by the Employer's Representative shall be deemed to be a non-compliance with the Specification and shall prevent Taking-Over by the Employer.

[6.3] Lubrication Requirements

Ball and roller bearings shall be 'sealed for life' and shall be interchangeable with similar items from alternative makers. Parts lists shall include alternative reference numbers and makers.

Adequate and, as far as is practicable, automatic means of lubrication shall be provided for all moving parts. Where continual grease or oil feeding is required the capacity of the reservoir shall be sufficient for not less than seven days continuous service.

[6.4] Tools

The Contractor shall include for the supply of a complete set of tools, spanners and any other instrument or tool required for normal maintain suitable for the plant installed.

[6.5] Services Requirements

Unless otherwise specified all items of plant shall be rated for continuous service at the specified duties under the prevailing atmospheric and operational conditions on site.

[6.6] Spares And Spares Packaging

The Contractor shall forward proposals for supplying spares as recommended by all specialist manufacturers for one year's operation to the Employer's Representative for approval.

In the submission, the Contractor shall itemise and price all other spares which he considers appropriate.

Electrical equipment shall be sealed in polythene or similar bags with a liberal supply of desiccant. Other items shall be protected to avoid corrosion and spoilage for a minimum of twelve months after delivery. Each package shall have attached to it an untarnished metal plate giving information for identification. This shall include the maker's name and reference description.

The packages of items of spares shall be collected by the Contractor into consignments of reasonable size and then packed in secure cases each of which shall contain a contents list. Where electrical items are involved, the cases shall be of tongue and groove boarding. Each case shall be durably marked with the Contract number and site address and shall be sent to a location to be decided by the ER, but not further than 20km from the Site after detailed instructions of dispatch have been received from the Employer's Representative.