SECTION C1: OPERATIONAL INFORMATION REQUIREMENTS

Refer to Attachment A1 (Non-Technical Summary) for a brief description of the plant, process and design capacity of the Waste Water Works. Volume 4 of the Contract Documents for the WWTP is included and this gives a more detailed description of the WWTP and the collection and conveyance system. Reference is also made to Attachment C2 (Outfall Design & Construction) of this Application which includes a description of the WWTP process.

Relevant Contract Documents are also included in respect of some of the larger pumping stations:

- Atlantic Pond Pumping Station;
- Ronayne's Court & Bessboro Pumping Stations;
- Tivoli, Tivoli Industrial Estate & Bellevue Pumping Stations;
- Flaxfort, Wallingstown & Courtstown Pumping Stations;
- Victoria Cross & Crosses Green Pumping Stations.

These give a more detailed description of the conveyance system. Further details can be seen in the Drawings at Attachment B4 (Location of Secondary Discharge Points) of this Application.

Drawings are included showing the various Interceptor Sewer Catchments that comprise the Waste Water Works. Each Catchment has a number of Storm Water Overflows to provide hydraulic relief and prevent flooding at times of heavy and prolonged rainfall. Details relating to the Storm Overflows can be seen at Attachment B5 (Location of Storm Water Overflows) of this Application.

CORK MAIN DRAINAGE SCHEME PHASE III

CARRIGRENAN WASTEWATER TREATMENT PLANT AND OUTFALL

VOLUME 4

EMPLOYER'S REQUIREMENTS

PARTICULAR REQUIREMENTS FOR DESIGN

E.G. PETTIT & COMPANY
SPRINGVILLE HOUSE
BLACKROCK ROAD
CORK

MOTT MacDONALD
DEMETER HOUSE
STATION ROAD
CAMBRIDGE
CB 21 2RS
ENGLAND

JOB NR. A5124

FEBRUARY 2001

Carrigrenan WWTP and Outfall

Volume 4

Employer's Requirements

Particular Requirements for Design

Revision Control Table

User Is Responsible For Checking The Revision Status Of This Document

Rev Nr.	Description of Change	Prepared By	Checked By	Approved By	Date
A	Initial Submission	J. Coates	DOS	GOS	May 1999
B	Issued for Tender	J.Coates	DOS	GOS	Sept.'99
C	Issued for Tender	J. Coates	DO'S	GO'S	Oct. 1999
D	Addenda Included	J.A. Salmon	P. Halifax	GOS	Feb. 2001

Cork Main Drainage Phase III

Carrigrenan WWTP & Outfall

Summary of Documents

Volume 1 Instructions to Tenderers
Form of Tender
Appendix to Form of Tender
Form of Agreement
Form for Joint and Several Liability of Tenderer
Parent Body Guarantee and Legal Opinion
Declaration of Insurance Cover
Form of Works Performance Guarantee
Indemnity; Port of Cork Company and Passage Docks
Forms of Collateral Warranty and Legal Opinions
Conditions of Contract

Volume 2 **Design-Build**

Conditions of Contract Part II A
Schedule of Terms of Payment for Design-Build Works
Form of Performance Bond for Design Build Works
Form of Guarantee for Advance Payment
Form of Appointment of Project Supervisor for Design Stage
Form of Appointment of Project Supervisor for Construction Stage
Technical Schedules
Employer's Requirements, Design Build Works

Volume 3 **Operation and Maintenance**

Conditions of Contract Part II B
Schedule of Terms of Payment for Operation & Maintenance Works
Form of Performance Bond for Operation & Maintenance Works
Form of Licence Agreement
Schedule of Modular Expansion of the Works
Employer's Requirements, Operation and Maintenance

Volume 4 **Employer's Requirements, Particular Requirements for Design**
Volume 5 **Employer's Requirements, General Civil Specification**
Volume 6 **Employer's Requirements, General Mechanical Specification**
Volume 7 **Employer's Requirements, General Electrical Specification**
Volume 8 **Employer's Requirements, General ICA Specification**
Volume 9 **Employer's Requirements, Tender Invitation Drawings**
Volume 10 **Ground Investigation**
Volume 11 **Environmental Impact Statement and Addendum**
Volume 12 **Supplementary Information**
Volume 13 **Tender Invitation Drawings (on CD format).**

Carrigrenan WWTP and Outfall

Volume 4

Employer's Requirements

Particular Requirements For Design

Table of Contents

1.0 GENERAL

1.1 Introduction

This Volume describes the minimum requirements for the design of the Works and in particular includes the process design requirements.

The specification of the Works shall be in accordance with the requirements of this Volume and the Employer's Requirements for Civil, Mechanical, Electrical and ICA contained in Volumes, 5, 6, 7 and 8 respectively and shall be of proven technology and robust design.

The Works shall be designed to allow for future expansion on a modular basis for increases in influent or the addition of Nitrogen or Phosphorus removal. The Contractor shall demonstrate how this would be achieved.

1.2 Codes and Standards

The Works shall be designed, manufactured, constructed, tested and operated in accordance with all relevant Irish Statutory Regulations, Codes of Practice and harmonised European Standards. Where harmonised European Standards do not exist Irish Standard Specifications and Codes of Practice or their equivalent in other EU Member States should be used.

Where Plant or Materials 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 standard and reliability.

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.

Nothing in the Employer's Requirements shall be construed as discriminating against products and materials manufactured in any of the Member States of the European Community.

Compliance with these standards and regulations shall be a minimum requirement. Plant or Materials offered to other standards shall be equal or superior in standard to that specified and full details shall be supplied to the Employer's Representative to demonstrate this. The Employer reserves the right to reject or approve any Plant or Materials manufactured to a different standard which he considers to be unacceptable.

1.3 C.E. Marking

All Plant and materials supplied shall be CE marked to show conformance with relevant EU legislation including the EU Machinery Directive 89/392/EEC, the Low Voltage and Electromagnetic Compatibility Directives. All appropriate documentation including EC Certificates of Conformance, evidence of standards applied, shall be provided to the

Employer's Representative.

1.4 Design Life

Unless stated otherwise in the Employer's Requirements, the design life of the Works shall be:-

60 years minimum for Civil Engineering and Building Works (including underground services and pipes)
40 years for roads and external pipework
25 years minimum for Mechanical and Electrical and Instrumentation Works
25 years minimum for steel tanks.
12 years for SCADA Software.

1.5 Units of Measurement

All correspondence, drawings, data sheets, calculations, labels, nameplates, field instruments etc shall be expressed in metric units, in accordance with BS 5555, unless stated otherwise in the Specifications.

1.6 Health & Safety Requirements

The provisions of the relevant legislation and all amendments thereto, shall be fully complied with at all times. In particular the following shall be complied with:-

The Factories Act (1955)

The Safety, Health and Welfare at Work Act (1989)

The Safety Health and Welfare (General Applications) Regulations S.I. 44 of 1993

The Safety Health and Welfare (Construction) Regulations S.I. 138 of 1995.

A complete list of Irish Health and Safety legislation is available from the Health and Safety Authority, Publication Department, 10 Hogan Place, Dublin 2 and all of the relevant, legislation shall apply to the Works.

The Contractor shall comply with the relevant provisions of "Safe Working in Sewers and Sewage Works" published by the National Joint Health and Safety Committee for the water service in the UK.

1.7 HAZOP

The Contractor shall carry out a Hazard and Operability Study (HAZOP) for the Works at an appropriate stage in the design. Modifications to the Contractor's design or construction that are required as a result of the HAZOP shall be implemented by the Contractor at his expense.

The HAZOP shall be carried out in accordance with the recommendations of Chapter 2 of "HAZOP and HAZAN Notes on the Identification and Assessment of Hazards" by Trevor A. Kletz published by the UK Institution of Chemical Engineers.

The following shall be included in the studies:

The design, including all process and instrumentation diagrams, all single line diagrams, plant layout drawings, pipeline drawings and block diagrams for the control system.

An ICA design appraisal

A Chairman and Technical Secretary will be approved by the Employer's Representative.

A two stage approach shall be used. The first stage will be carried out at the stage when Process and Instrumentation diagrams are available and the results shall then be used to further develop the design. The second stage will review both the P&I final diagrams and the ICA systems to ensure that the overall system design provides adequate operational security.

1.8 Plant Access and Maintainability

The plant shall be designed and installed for ease of operation and maintenance and to allow access or removal without disturbing adjacent Plant and pipework etc. whenever possible. The Contractor shall ensure that all working areas have adequate access, lifting arrangements, lighting, heating and ventilation. All Plant or Materials that may be manually handled during the course of normal operations shall be provided with adequate lifting and transport arrangements. Suitable lighting shall be provided for all manual operations.

1.9 Drawings

Refer also to Volume 2 Section 3 of the Employer's Requirements "Construction Documentation for Review".

All drawings shall be in accordance with BS 8308 with dimensions in metric units.

ISO standard size sheets shall be used. Symbols used in electrical wiring and schematic diagrams shall conform with BS1646, BS 1553 and BS EN 60617. All electrical drawing shall include a key legend of symbols and references used.

Tender Invitation Drawings

The Tender Invitation Drawings are those prepared by or on behalf of the Employer and issued by the Employer with the invitation to tender. These are included in Volume 9 of the Contract Documents.

The drawings are issued for the purposes of illustrating and clarifying the Works described in the Employer's Requirements.

Tender Invitation Drawings include drawings issued as part of the planning application or subsequent amendment thereof and are the drawings for which planning permission has been granted. These drawings are listed under the Title of 'Planning Drawings' in Volume 9.

Some drawings are issued for information only and these are listed in Volume 9.

Contractor's Tender Drawings

These drawings are those submitted by the Contractor as part of the Contractor's Proposals.

Construction Drawings

Drawings submitted by the Contractor to the Employer's Representative during the course of the Contract for information or review shall become Construction Documents. Drawings issued for construction by the Contractor shall be clearly marked "For Construction".

As Built Drawings

These shall be prepared by the Contractor to constitute a permanent record of the Works as completed or executed. The format and other requirements of As Built Drawings are described in Section 3 of the Employer's Requirements in Volume 2.

1.10 Climatic Conditions

The Works are located in an exposed area in a marine environment at an altitude of less than 100m where the general atmosphere should be assumed to be salt laden. The Contractor shall be responsible for determining the Conditions that will be encountered at the Site.

The Works shall be suitable for continuous operation in all climatic conditions likely to be encountered at the site and Plant or Materials located outside shall be suitable for a temperature range of at least 5° C below the minimum to 5°C above the maximum temperatures recorded in the area by the Meteorological Service. As a minimum they shall be suitable for the following:-

Temperature –10° C to + 35° C
Humidity 100% (for enclosures).

Insulation and trace heating shall be provided where necessary to ensure continuity of operation at temperatures below 5°C.

1.11 Asset Register

During the design of the Works the Contractor shall develop a numbering system for each item of Plant and Materials that will be compatible with his proposed Operation and Maintenance Systems as described in Volume 3.

The numbering system shall be applied to the method of physically identifying each item and to the referencing on the drawings and in the ICA and SCADA design.

The format of Asset Sheets to be included in the Operation and Maintenance Manual shall be submitted to the Employer's Representative for review.

1.12 Year 2000

All equipment supplied must be fully Year 2000 compliant, where applicable, as defined below:-

The following definition of Year 2000 Conformity is based upon the British Standard Institute's DISC PD 2000-1.

"Year 2000 Conformity" shall mean that neither performance nor functionality of the Computer System is affected by dates prior to, during and/or after the Year 2000. In

particular:

Rule 1 No value for current date will cause any interruption in operation of the Computer system.

Rule 2. Date based functionality and performance of the Computer System must behave consistently for dates prior to, during and/or after the year 2000.

Rule 3 In all interfaces and data storage of the Computer system the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing rules.

Rule 4. The year 2000 must be recognised as a leap year by the Computer system.

"Computer system" shall mean any computer, data processing equipment media or part thereof, or system of data storage and retrieval, or communications system, network, protocol or part thereof, or storage device, microchip, integrated circuit, real-time clock system or similar device or any computer software (including but not limited to application software, operating systems, runtime environments or compilers), firmware or microcode.

1.13 Provision of Spares

The Contractor shall provide spare parts and spare Plant and Materials sufficient for 2 years operation. The Contractor shall determine the spares to be provided and provide suitable storage in accordance with the manufacturer's recommendations. These shall be provided and details entered into the Asset Management Plan prior to the commencement of the Performance Tests on Completion.

The Contractor shall provide addequate facilities for transporting and installing the spare parts that is compatible with the urgency and circumstance under which they may be required to be used.

1.14 Standard Requirements of Cork Corporation

The Contractor shall comply with the requirements of Appendix C to this Volume.

2.0 COLLECTION AND DELIVERY SYSTEM

2.1 General

In this section details are provided about the system for collection and delivery of wastewater to the Site.

Drawing number A5124-N-002-A illustrates the configuration of the catchment and the major sewers, pumping stations and rising mains that will be put in place to deliver flows to the Works. The following key elements are included in the Scheme:-

Interceptor Sewers 1, 2, 3, 4
Crossings of the River Lee at:
- Atlantic Pond
- Custom House (Centre Island)

Lough Mahon Siphons Crossing
Ballinure Header Chamber
Pumping Stations and Rising Mains at:
- Atlantic Pond PS and Rising Main to Header Chamber
- Tivoli Industrial Estate PS and Rising Main to Sewer 4
- Castle Avenue PS and rising Main to Atlantic Pond
- Mahon PS and Rising Main to Header chamber
- Besborough PS and rising Main to Header chamber
- Tramore Valley PS (Refurbishment) and Rising Main To Header Chamber
- Wallingstown PS and Rising Main to Flaxfort PS
- Flaxfort PS and rising Main to the Site
- Courtstown PS and rising Main to the Site

Further details of some of the key elements are provided below and in Fig. 2.1.

2.2 Atlantic Pond Pumping Station

This new pumping station receives the majority of the flow from the catchment and passes forward all flows up to approximately 6 x DWF (2.45 m^3/sec) to the Header Chamber at Ballinure. Excess flows are discharged via a pumped overflow to the River Lee adjacent to the pumping station.

The pumping station capability can be summarised by:-

2 Nr. Duty DWF pumps each capable of 1.225 m;/s
2 Nr. Standby DWF pumps each capable of 1.225 m;/s
2 Nr. Rising Mains of 1100 ID approx. 2km long

The maximum flow delivered by each rising main served by one pump is 1.225 m;/s. Any pump can pump in either rising main, though not at the same time.

In addition there are two low flow pumps each capable of 100 l/s which operate on a duty basis which trip out on start-up of the DWF pumps.

There are two duty and two standby storm pumps, which pump storm flows to the river Lee.

All pumps are fixed speed.

2.3 Tramore Valley Pumping Station

This is the second largest pumping station in the catchment receiving flows from the south side of the catchment and transferring flows up to approximately 6 x DWF (0.894 m^3/sec). Flows in excess of this are discharged to Lough Mahon.

The pumping station capability can be summarised by:-

3 Nr. Duty/Assist/Assist pumps each capable of 0.322m;/s
2 Nr. 700 ID Rising Mains, 1.4 km long

1 Nr. pump, 1 Nr. rising Main =	0.322 m;/s
2 Nr. pumps, 2 Nr. rising Mains =	0.644 m;/s
3 Nr. pumps, 2 Nr. rising Mains =	0.894 m;/s

All pumps are fixed speed and are configured to pump to either rising main.

2.4 Mahon Pumping Station

This pumping station passes forward up to approximately 6 x DWF (0.17 m^3/sec) and its capability can be summarised by:-

2 Nr. Duty/Assist pumps each capable of 0.100 m;/s
2 Nr. Standby pumps each capable of 0.100 m;/s

There is a single 450 ID rising main 1.7 km long and maximum flow is 0.170 m;/s. All pumps are fixed speed.

2.5 Besborough Pumping Station

This pumping station will deliver flows of up to approximately 6 x DWF (0.126 m^3/sec) to the Header Chamber. Pumping capability can be summarised by:-

2 Nr. Duty/Assist pumps each of capacity 0.084m;/s
1 Nr. Standby pump of capacity 0.084m;/s

There is a single, 250 ID rising main 1.2 km long and maximum flow with 2 pumps running is 0.126m;/s. All pumps are fixed speed.

2.6 Flaxfort Pumping Station

This pumping station will deliver flows of up to approximately 6 x DWF (0.504 m^3/sec) directly to the Site. The pumping capacity can be summarised by:-

3 Nr. Duty/Assist/Assist pumps each capable of 0.21 l/s
1 Nr. Standby pump capable of 0.21 l/s

There is a single 500 ID rising main and the delivery will be:-

1 Nr. pump operating 0.210 m;/s
2 Nr. pumps operating 0.357 m;/s
3 Nr. pumps operating 0.504 m;/s

2.7 Courtstown Pumping Station

This pumping station will deliver flows up to approximately 2 x DWF (0.018 m^3/sec) directly to the Site. The pumping station consists of:-

2 Nr. Duty/Standby pumps each of capacity 0.018 m^3/s
1 Nr. Rising main 150 ID

Pumps are fixed speed.

2.8 Ballinure Header Chamber and Siphons

2.8.1 General

The Ballinure Header Chamber (BHC) receives only pumped flows and these are received from Atlantic Pond, Tramore Valley, Mahon and Besborough Pumping Stations. There is no overflow at BHC and therefore all flows received subject to limited storage at BHC will be transferred to the works via the siphons. The maximum flow received will be 3.64 m;/s.

General arrangement details of the BHC and of the siphons are included with the Tender Invitation Drawings. The BHC has been designed to:-

- Receive flows from outlying pumping stations
- Provide screening, degritting and septicity control facilities
- Provide a means of controlling the flow through the siphons

2.8.2 Principal Details

Screening and grit removal facilities will be provided for all flows passing through the Header Chamber. Details of these facilities are as follows:-

- Screens
  Three 1800 l/second band screens, each with a panel opening size of 5mm will be provided. The screens will operate on a duty/assist/standby sequence and two bypass channels will be provided.

- Grit Removal
  The grit removal facilities have been designed to remove 95% of particles greater then 0.2mm (200Φ) and of 2.65 S.G. Two hydrodynamic grit separators, each capable of handling 1805 l/second, will operate in a duty/assist sequence.

The flow discharged into the Mahon twin siphons will be pre-treated 24 hrs/day, 365 days/year except during emergency breakdown. In such an event manual screening on a by-pass channel will be provided by gravity flow through the vortex system prior to discharge through the siphons.

Comment [P J1]: Addendum 4, A4.12 (others A4.8 to A4.11 already covered)

It is envisaged that breakdowns will be infrequent and for a relatively short duration as an extensive telemetry system with call out facilities will be provided and interlocks with the Atlantic Pond Pumping Station will be provided.

The screenings will be dewatered and compacted prior to discharge from site in skips. Grit will be washed in a classifier unit prior to the grit being discharged into skips for disposal off site.

A return liquors pumping station will lift dirty washwater flows to the channels downstream of the grit removal facilities.

A potable washwater pumping station has been included.

Forced ventilation will be provided with odour scrubbing units.

The header chamber has been designed to operate against a maximum top water level at the inlet Works of +11.0m OD M.H.

The normal operating top water level at the BHC is +20.75 OD M.H. for a single pipe operation.

Discharges through the siphons have been calculated assuming a roughness coefficient of 0.6.

2.8.3 Connection between the Header Chamber & Treatment Works.

The Header Chamber is connected to the Treatment Works at Carrigrenan via twin 1.2m diameter gravity siphon pipelines laid across Lough Mahon. Either one pipeline or both pipelines can be brought into or out of service by closing penstocks located within the Header Tank.

2.8.4 Flow Within the Siphon

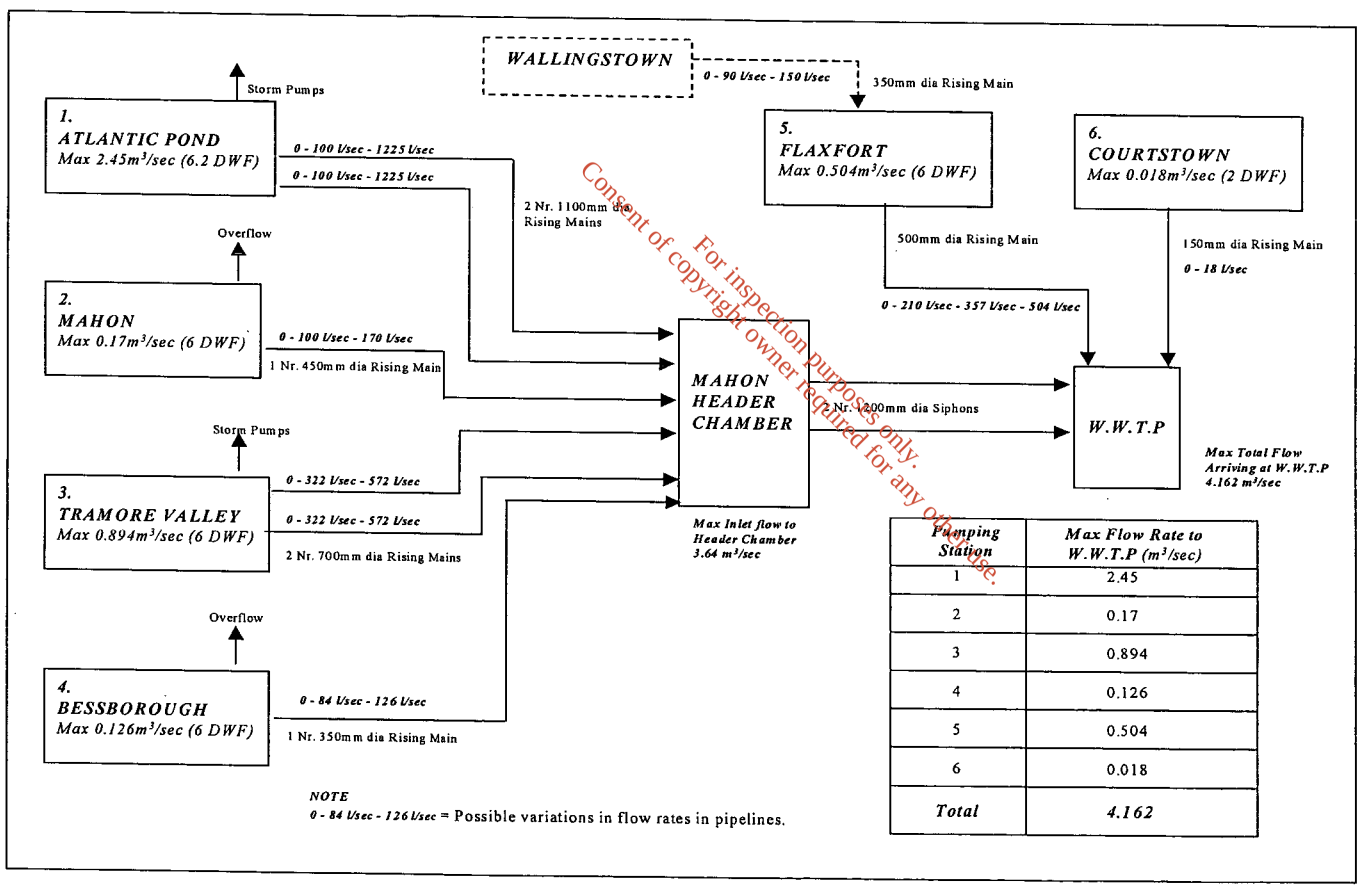
Flow within the pipelines forming the siphon will vary throughout the day. Penstocks within the Header Tank will enable the flow to be stopped in either pipeline such that certain minimum criteria can be obtained. These criteria are:-

1. Flows must achieve a velocity in excess of 1.5m/s on each day that the pipeline is brought into use, for a minimum of 30 minutes each day.
2. A sheer stress at the pipewall of 4Pa shall be reached on a regular basis
3. The duty pipeline for Dry Weather Flows shall be alternated regularly.

The operation of the header chamber will necessitate temporary closure of the penstocks each day to achieve these criteria. The timing and frequency of the closures will vary. For guidance the predicted result of a temporary closure is illustrated in the graphs in Appendix E to this Volume. The Employer however accepts no responsibility for the accuracy of the diurnal flow illustrated nor for the timing of the closures. The Contractor shall make his own assumption of the diurnal flow and shall allow for temporary closures occurring at any time of day or night.

The siphon will normally be operated with the duty pipeline penstock open, The second pipeline penstock will open as the head rises in storm flows. The changeover from one duty pipeline to the other will be either daily or following storm flows. The Contractor shall allow for either eventuality.

Figure 2.1 Schematic of Flow Delivery to Treatment Plant



Pumping Station	Max Flow Rate to W.W.T.P (m³/sec)
1	2.45
2	0.17
3	0.894
4	0.126
5	0.504
6	0.018
Total	4.162

3.0 EMPLOYER'S TENDER INVITATION DESIGN

The Employer has carried out a conceptual design of the works for the purposes of securing Planning Permission and other required licences and permits, for the purposes of discussion with local industry and for the purposes of preparing these Contract Documents.

The status of the Employer's conceptual design for the outfall is described in Section 13 of this Volume.

The Contractor shall bring to the attention of the Employer any details of the Employer's Requirements that he cannot comply with or which are in conflict with other parts of the Contract, prior to carrying out his design. The Contractor shall note that this is a requirement of the Tender submission.

4.0 ENVIRONMENTAL CONSIDERATIONS

4.1 General

As described in Volume 2, Section 2, the Contractor shall comply in all respects with the Environmental Impact Statement 1992 and its Addendum 1994, as was included in Volume 11 of the Tender Documents, and, with the planning application, the planning permission as was included in Volume 12 of the Tender Documents, and relevant national and regional legislation and guidelines.

Environmental considerations concerned with process and sludge disposal are described elsewhere in the documents.

4.2 Landscaping and Planting

The Contractor shall prepare a landscaping and planting schedule and drawings to follow as closely as possible that included with the 1994 planning drawings. The Contractor shall employ a competent and experienced specialist person to prepare these documents. They shall be submitted with the Tender and will be submitted by the Employer to the Planning Authority for approval whereupon they will have the same status as the remainder of the planning drawings.

4.3 Amenity Walkway

The Contractor shall construct an amenity walkway as shown in the planning drawings. It shall have suitable lockable access gates at either end of the Site which shall be controlled by the Contractor so that access is only permitted during the hours of daylight. Suitable signage shall be erected, warning of this fact.

4.4 Additional Amenities

Discussions between the Employer, the County Council and the Little Island Residents Association (LICA) currently ongoing, may result in the need for the Employer to provide additional amenities in the area outside the 15 ha treatment plant area. A Provisional Sum sum has been included in the Schedule of Terms of Payment for this eventuality.

The scope of these additional amenities is not known but could include such facilities as car parking, a play area and a football pitch.

4.5 Areas for Modular Expansion

Areas within the 15 ha treatment plant area that are set aside for future modular expansion shall be provided with soft landscaping such as grassing or similar, in keeping with the general landscaping proposals. The areas shall be drained to avoid ponding.

4.6 Environmental Management Plan

The Contractor shall prepare an Environmental Management Plan to cover all aspects of the impact of the Works on the environment, both during the Design Build Works and the Operation and Maintenance Works. It shall include all process areas as well as the outfall, maintenance and management of the landscaped area. (Refer to Planning conditions 5 and 6).

The Contractor shall prepare the initial plan for submission with the Tender Proposals and

shall develop and expand the plan during the Design Build Works.

5.0 INFLUENT

5.1 General

The Works shall be designed to cater for the existing industrial inputs (reserve capacity for year 2002) and the projected domestic and commercial inputs (with allowance for infiltration) for the design year of 2020. The Works shall be capable of expansion on a modular basis to provide for possible future additional inputs from new industries. The Works shall be designed to meet the Works Performance Guarantees and the Performance Standards Specified.

5.2 Wastewater Flows

The design flows have been calculated as multiples of dry weather flow (DWF). DWF comprises the following components: domestic flow, infiltration, commercial flow and industrial flow, and is calculated using the following formula:

$$DWF = (PxQ/1000) + C + I + E \qquad (m^3/d) \qquad \text{Equation 5.1}$$

Where:

P – resident population
Q – per capita water usage litres/day
C – commercial flow rate, m^3/day
I – infiltration flow rate, m^3/day
E – industrial waste water flow rate, m^3/day

The estimated resident populations for the city and its environs are:

Year 2002	161,638
Year 2020	194,817

The domestic flow has been estimated on the following figures:

Year 2002	Per capita sewage discharge of 135 litres/capita/day Commercial flow 16% of per capita discharge Infiltration of 50litres/capita/day The resultant total is therefore 206.6 litres/capita/day
Year 2020	Per capita sewage discharge of 150 litres/capita/day Commercial flow 16% of per capita discharge Infiltration of 50litres/capita/day The relevant total is therefore 224 litres/capita/day

A survey of all the industrial inputs was carried out in 1991. The major industrial inputs were surveyed again in 1998. Following discussions with the industries agreement has been reached on the required industrial reserve capacity for each of the major industries. The results of the surveys and the reserve capacities are set out in Appendix B to this volume.

The existing and future (design) inputs are summarised in Table 5.1 below:

Table 5.1

Contributing Flows	2002 DWF (Estimated)		Design DWF	
	m^3/d	m^3/s	m^3/d	m^3/s
Domestic (PxQ)	21,821		29,223	0.338
Commercial (C)	3,491		4,676	0.054
Infiltration (I)	8,082		9,741	0.113
Industrial (E)	15,720		15,720	0.182
Total	49,114	0.568	59,359	0.687

Flow will arrive at the Works from three sources:

The Lough Mahon Siphon(s)
The Flaxfort PS Rising Main
The Courtstown PS Rising Main

The breakdown in the contributions from these locations is given in Table 5.2

Table 5.2

Incoming Flow Split	2002 Estimate		2020 Design		Installed Pump Capacity (m^3/s)	DWF Multiplier
	Industry m^3/d	Total (DWF) m^3/d	Industry m^3/d	Total (DWF) m^3/d		
Header Chamber Flow	8,402	40,126	8,402	49,059	3.64	6.41
Flaxfort PS	} 7,318	8,988	7,318	10,300	0.504	4.38
Courtstown PS					0.018	
Total	15,720	49,114	15,720	59,359	4.162	6.06

The maximum flow rate to the Works of 4.162 m^3/s is equivalent to the total capacity of the pumping stations assuming that all of them operate simultaneously at their maximum capacities, assuming long term slimed conditions in the delivery pipework.

The Contractor shall allow for diurnal variations in flow and for the flow rate of return liquor flows generated during treatment.

The flows from Little Island/Glounthaune and Glanmire/Riverstown and Courtsown will be referred to later in the text as the Local Flows.

The design flows which are to receive primary and secondary treatment are summarised in Table 5.3 below. Primary Treatment shall be provided for flows up to 3 x the design DWF (m^3/s). Secondary treatment is to be provided for flows up to 2.5 x the design DWF + Infiltration (I). The minimum capacity of the primary and secondary treatment facilities shall be 2.06 m^3/s and 1.83 m^3/s respectively. Flows received at the treatment plant in excess of 2.06 m^3/s shall be treated as stormwater.

Table 5.3

Flows to Treatment	2002 DWF (Estimated)		Design DWF		DWF Multiplier	Design Peak m^3/s
	m^3/d	m^3/s	m^3/d	m^3/s		
Flow to Primary Treatment			59,359	0.687	3 DWF	2.10
Flow to Secondary Treatment			59,359	0.687	2.5 DWF + (I)	1.83
Flow to Storm Upstream of Primary						2.05

Note:

Return liquors flow rates are not included

Where there is any discrepancy between the flows specified in Table 5.3, above, and those given in Volume 1 (Appendix to the Works Performance Guarantee G30.1 – G30.6) and Volume 2 (Table 7.2.14 Employer's Requirements) the flows specified in Volume 1 and Volume 2 shall prevail.

Comment [PJ2]: Addendum 1: A1: 12

5.3 Wastewater Characteristics

The Wastewater Treatment Plant will receive domestic and industrial flows.

The following information is available on the characteristics of the Industrial inputs to the Works.

- 1992 Sampling Survey and Analytical results
- 1998 Sampling Survey and Analytical results
- Table of Reserve Capacities Agreed with Major Industries
- Typical waste limitation facilities at major industries .

This information is included as Appendix B, this Volume.

The Contractor shall interpret the survey and analytical results and determine the relevant characteristics of the anticipated industrial loads and flows in the context of achieving the required performance standards.

Septicity in the sewers in the catchment discharging to the Header Chamber will be controlled by the Employer. The flow arriving at the Header Chamber is not likely to be septic. However, the operation of the Header Chamber, as described in section 2, will result in septic sewage arriving at the Works via the siphons. The Local flows are also expected to be septic.

The flows arriving at the Works from the Header Chamber will have been screened to 5mm and degritted. The Contractor shall provide screening and degritting only for the Local flows.

The average domestic pollutant loads have been estimated based on per capita

contributions of:

60 gBOD/capita/day
126 gCOD/capita.day,
70 gSS/capita/day.

Table 5.4 sets out the average daily design loads. The Contractor shall allow for diurnal variations in loads. The Contractor shall allow for the additional loads in return liquors generated during treatment.

Table 5.4

Pollutant	Unit	Estimated Load 2002	Design Load 2020
BOD	kg/day	22,483	24,792
COD	kg/day	45,089	49,938
TSS	kg/day	20,626	23,320

Year 2002

Comment [P J3]: Addendum 1: A1 13

Population 161,638

	TSS	BOD	COD
Domestic	11,314.7	9,698.3	20,366.4
Commercial	1,810.3	1,551.7	3,258.6
Industry – major	6,262	10,000	20,001
Industry – other	1,239	1,233	1,463
	20,626	22,483	45,089

Year 2020

Population 194,817

	TSS	BOD	COD
Domestic	13,637.2	11,689	24,547
Commercial	2,182	1,870	3,928
Industry – major	6,262	10,000	20,001
Industry – other	1,239	1,233	1,463
	23,320	24,792	49,938

6.0 PERFORMANCE STANDARDS

6.1 General

The Works shall meet the environmental standards with respect to final effluent quality, sludge quality as well as satisfy odour and noise requirements. The Works shall meet the Works Performance Guarantees, and the performance standards specified for individual process units, in Table 7.2 (7.2.1 to 7.2.18) of volume 2. The main environmental standards are described in the following sections.

6.2 Final Effluent Discharge Standards

The Works shall be capable of producing final effluent meeting the standards specified in Table 6.1 below.

Table 6.1: Final Effluent Discharge Requirements

Parameter	Standard		Compliance Criteria	
	Target A	Target B	Target A	Target B
BOD, mg/l	25	50	No more than three daily samples per 60 days with a value for any one parameter or all parameters to be greater than the standard	No samples with a value for any one parameter to be greater than the standard
COD, mg/l	125	250		
TSS, mg/l	35	87.5		

Compliance with the above standards shall be monitored by daily flow proportional samples.

The above final effluent standard shall apply to the effluent stream from the secondary treatment plant. i.e. excluding storm tanks overflow.

The Contractor shall design the Works to make appropriate allowance for future upgrading to achieve Total Nitrogen and/or Total Phosphorus standards of 10 mgN/l and 1 mgP/l, respectively, expressed as an annual mean. The Contractor's design shall demonstrate how he has allowed for such upgrading.

Storm overflows shall be directed to the storm tanks. The design volume of the storm tanks specified has been determined to provide storage for the flow generated during one hour of a storm with a return period of five years.

6.3 Sludge Quality Standards

Sludge quality standards are based on US EPA Regulation 40 CFR Part 503-Class A sludge. In particular, the sludge produced at the treatment plant at the time of its use or disposal, shall meet the standards shown in Table 6.2.

Table 6.2: Sludge Quality Requirements

Parameter	Standard	Compliance Criteria
Faecal coliform concentration	1 000 MPN/gds	Continuously less than the standard
Dry solids concentration	90% (w/w)[1]	Greater than the standard
Dry Solids particle size	95% - 2 to 4mm < 2% - < 500 microns	Continuously meets the standard.
Temperature of sludge during drying (or wet bulb temperature of the gas stream)	80°C	Greater than the standard

Where: ds – refers to total dry solids
[1] – based on the weight of sludge solids excluding any added materials

If the treated sludge is to be used for agricultural application, the levels of heavy metals in the sludge shall not exceed the following limits as defined in the 1998 Waste Management Act (Use of sewage Sludge in Agriculture Regulations) SI 148.

Chromium	1200	mg/kg ds
Mercury	16	mg/kg ds
Copper	1000	mg/kg ds
Nickel	300	mg/kg ds
Zinc	2500	mg/kg ds
Cadmium	20	mg/kg ds
Lead	750	mg/kg ds

6.4 Odour Standards

The Contractor shall design the odour control system to meet the requirements specified in Table 6.3.

Table 6.3: Odour requirements

Parameter	Standard	Compliance Criteria
TON above the background level at any particular receptor at and outside the Site boundary	5 TON	less than the standard
Upper 98 percentile H_2S concentration (C_s) in the air from the stack of odour control unit	C_s as calculated from the Equation 7.4.	less than the standard in any 7 day period
H_2S concentration in the air at a height of 1 to 2 m above the floor level in treatment buildings	50 ppb during normal operation in any building other than sludge cake enclosure 200 ppb at any location during emergency operation 400 ppb at any location of sludge cake enclosure	continuously less than the standard
H_2S concentration in personnel areas stemming from the treatment processes	2 ppb	continuously less than the standard

6.5 Noise

The Works shall be designed to ensure that the following noise limits are not exceeded during operation, when measured at the receptor positions and on the Site boundary

8am to 8 pm 55dB(A) 15 Minute Leq

8pm to 8 am 45dB(A) 15 Minute Leq

6.6 Dust

The Works shall be designed to ensure that the dust emissions measured in terms of deposition of insoluble particulate matter at receptor positions and on the Site boundary shall not exceed 130 mg/m^3/d above the background level.

Dust emissions from any stack shall be continuously less than the levels identified in Section 2.5.1 – Technical Instructions on Air Quality Control – TA Luft, 1986 as measured in accordance with Section 2.6 of this publication.

7.0 PROCESS DESIGN REQUIREMENTS

7.1 General

The Employer's conceptual design, on which the planning permission was obtained included for the following treatment processes.

The treatment plant provided screening and grit removal for the Local Flows. After screening and degritting these flows combine with the main flow from the Header Chamber en route to a pre-aeration tank. The pre-aeration tank was intended to provide oxygen back into the wastewater thereby eliminating the septic conditions expected in the influent. The pre-aerated wastewater was intended to undergo primary sedimentation followed by secondary treatment in a conventional activated sludge process. The conceptual design includes for overflows to the storm tanks, the first upstream of the primary settlement tanks and the second upstream of the activated sludge plant. Storm overflows were directed to the storm tanks and returned for treatment when the storm flow condition ceased.

Sludge generated during the proposed treatment process was intended to be thickened, anaerobically digested, dewatered and thermally dried. Foul air generated during the treatment of wastewater and sludge was to be treated in the odour treatment plant.

The Contractor's process design shall not necessarily follow the Employer's conceptual design. However, any alternative designs shall comply with the Employer's Requirements (as set out below and further detailed in other volumes of this Contract) and with the conditions and principles of the planning permission as detailed in Volume 2.

Distribution chambers shall be provided at each stage of treatment in order to ensure equal division of flow to each process unit.

The Contractor shall ensure that, at each wastewater and sludge treatment stage, isolation of the process units for repair and maintenance is provided without compromising the even flow distribution to the units remaining in operation.

The Contractor shall demonstrate in his tender proposals that the plant is capable of meeting the performance requirements when one stream of each treatment stage is taken out of service for maintenance.

For maintenance purposes, facilities for draining down and cleaning of all process units and associated pipework shall be provided.

In addition to any other requirements of the specification the biological process shall be based upon technically proven processes. The processes shall have been satisfactorily performance tested at the design sludge loading rates of the works in which they are incorporated. The effluent quality produced shall be similar to that required by the Contract. Operating costs and performance shall have been established for each season.

7.2 Degree of Treatment Required for Particular Flows

Flows from the Header Chamber at Mahon will be screened and degritted upstream of the treatment plant, thus no screens and grit separators are required for these flows. The Contractor shall provide screening and grit removal for the Local Flows. The following is the degree of treatment required for the influent flows.

- All Local Flows up to 0.522 m^3/sec shall receive screening and grit removal at the works.
- Local Flows shall combine with the main inlet flow upstream of the main treatment processes. The maximum combined flow will be 4.16m;/sec. The Contractor shall take into account the likely septic nature of the total inlet flows and shall provide for suitable treatment to ensure the efficient operation of the downstream treatment processes.
- Flows up to 2.06 m^3/sec shall receive primary treatment in the form of primary sedimentation. Flow in excess of 2.06 m^3/sec shall be diverted to storm holding tanks.
- Primary settled wastewater flows up to 1.83 m^3/sec shall receive secondary biological treatment. Flow in excess of 1.83 m^3/sec shall be diverted to the storm holding tanks.
- The storm holding tanks shall provide for a minimum storage volume of 13940 m^3. Stormwater shall be returned to the treatment process upstream of primary sedimentation.
- Works return liquors shall be treated in addition to the flows described above.

7.3 Preliminary Treatment

7.3.1 Screening

The screens shall have apertures not exceeding 5 mm in either direction. The design velocity through the apertures shall not exceed 1.2 m/s.

The screens shall be equipped with an automatic cleaning system to prevent blockage. The screen cleaning system shall be operated intermittently and shall be controlled by both an adjustable timed cycle and a pre-set difference in head across the screen.

The screens and screening handling equipment shall be selected from suppliers with a proven track record for this application.

A minimum of two screens (one duty one standby) shall be provided. Each screen shall have the capacity to handle maximum flow. Each screen shall be automatically brought into operation, as required. A means of isolating each screen with penstocks capable of manual operation shall be provided.

An emergency bypass channel (or other similar type facility) capable of transferring the full flow shall be provided. This by-pass channel shall be isolated by a penstock which shall also act as an emergency overflow weir. The Contractor shall specify the design headloss before an overflow occurs. The bypass channel shall be equipped with a manually raked bar screen with a bar spacing of 10 mm.

Screenings shall be macerated, washed and compacted, or equivalent, to achieve a minimum dry solids content of 30%. The compacted screenings shall be free of faecal matter. The Contractor shall specify the guaranteed level of organic content in the screenings. In order to minimise nuisance, the screenings shall be bagged. Handling and collection of the screenings shall be conducted inside the screening building. The screenings handling plant shall be capable of treating the peak screenings loads, which may occur following a storm. The Contractor shall demonstrate that this has been taken into account in the design of the screenings handling system.

The used washwater shall be returned to the main wastewater stream for treatment.

Transport and disposal of screenings shall be the responsibility of the Contractor.

All screen headworks shall be enclosed and vented. The extracted air shall be provided with odour treatment. The screenings handling route shall be covered and the air from beneath the covers shall be vented to the odour treatment plant. Suitable materials shall be used to resist corrosion.

Screenings shall be removed from the Site in sealed containers designed to prevent release of odours or liquid to the environment along the route to the ultimate disposal location.

Provision shall be made for storage of empty containers/bags inside the building.

7.3.2 Grit removal

All the Local Flows shall be provided with grit removal. The grit separators shall be located in the screenings building downstream of the screens. The grit separators shall be capable of removing at least 95% of particles with a specific gravity of 2.65 g/cm^3 and with a diameter of 0.2 mm and greater.

Hydrodynamic circular grit separators or conventional cross-flow type separators are preferred. Aerated grit separators may also be used provided that a successful performance for grit removal efficiency and ability to remove the accumulated grit from the bottom of the separators can be demonstrated.

Grit removed by the separator shall be washed. The washing system shall be designed to achieve an organic matter content less than 10% of the dry solids content measured on a w/w basis. The wash water from grit washing shall be returned to the main inlet flow.

Grit separation, grit handling and collection shall be carried out inside the screenings building. The units shall be covered and the extracted air shall be directed to the odour treatment plant.

Transport and disposal of grit shall be the responsibility of the Contractor and the facilities shall be designed to prevent release of odour and liquid to the environment.

Provision shall be made for storage of empty containers within the building.

7.4 Septicity Treatment

All flows arriving at the plant are likely to be septic and the Contractor shall provide suitable treatment in order to minimise operational problems in the primary sedimentation tanks and primary sludge treatment.

If pre-aeration is proposed at least two pre-aeration tanks shall be provided. The tanks shall be designed for a minimum retention time of 20 min at the maximum design flow rate. There shall be provision for isolating one tank for maintenance.

Blowers shall be sized to provide a minimum air requirement of 0.6 m^3 of air per m^3 of wastewater. A minimum of two duty and one standby blowers shall be provided. The blowers may be housed within the screen house/pre-aeration house building.

The tanks shall be covered and the headspace shall be vented or extracted to the odour treatment system.

Any proposals submitted by the Contractor for septicity control shall consider the possibility for oils, fats and grease being separated in any pre-aeration process. The Contractor's proposed system shall be designed to prevent the accumulation of any materials separated from the main flow in pre-aeration tanks.

7.5 Storm Water Treatment

The Works shall include for the storage of stormwater in holding tanks with a minimum total capacity of 13,940 m^3.

The Works are to be designed such that the storm tanks shall be filled in sequence from the base without any cascades in order to avoid odour nuisance. Once one tank is full, the next in sequence shall be filled. Overflow to the outfall shall take place only when all tanks are full. The arrangement of the pipework around the storm tanks shall be flexible so that any tank can be isolated for maintenance. All storm tanks shall be fitted with scum baffles.

The storm tanks shall be equipped with the ultrasonic level monitoring and control system to inhibit operation of the storm return pumps when the tanks are empty. The rate of water level variations shall be continuously recorded and analysed in conjunction with the flow measurement to the secondary stage to ensure that a premature overflow to the storm tanks does not occur.

The Contractor's design shall provide for the return of stormwater to the main flows upstream of the primary settlement tanks as soon as the flow arriving at the treatment plant has reduced below the maximum design flow to secondary treatment. The settled sludge can be returned to the primary sludge treatment stream, provided the storm tank is equipped with a sludge removal system. The flow rate of the combined incoming wastewater and storm water return shall not exceed the pre-set maximum flow to the secondary treatment plant.

The flows from the storm tanks shall be returned downstream of the 3xDWF overflow. At least two duty and one standby storm return pumps shall be provided.

The Contractor shall ensure that the operation of the storm water treatment system and the return of the storm tanks contents does not cause odour nuisance. Automatic washing facilities shall be provided in order to ensure that, after the tanks are drained, all exposed surfaces are cleaned and that no residual sludge remains in the tanks. Final effluent may be used as wash water.

7.6 Primary Treatment

Primary treatment in the form of primary sedimentation shall be provided for flows up to the design flow stated in Table 5.3. The Contractor shall state the percentage reduction in total suspended solids and BOD at the design loading rates.

Primary sedimentation tanks shall be circular or other configuration below a circular cover to comply with planning permission.

Tanks shall have a minimum straight wall height of 3.5 m as measured from the top water level to the top of the base and shall provide a minimum retention period of two hours at max. flow conditions.

The inlet pipe shall discharge within a stilling box or diffusion mechanism located at the

centre of the tank. Where stilling boxes are used these shall occupy a minimum liquid surface area 10% of the liquid surface area of the tank. The Contractor's design shall include for a means of removing scum from the stilling box.

Settlement tanks shall be fitted with floor scrapers to direct settled sludge to a central collection hopper. Rotating bridge scrapers shall be used for all tanks with diameters greater than 20 metres. Floor scrapers shall be hinged from a fixed support frame. Trailing scrapers fixed directly to the bridge will not be permitted. The travel speed of the rotating bridge shall not exceed 2.5 m/minute at the periphery wall.

Each settlement tank is to be fitted with a scum removal system. The system shall be designed to minimise the volume of liquid discharged with the scum whilst providing efficient removal of the scum.

Automatic weir channel cleaning systems shall be provided to all tanks.

All primary sedimentation tanks shall be covered to provide for efficient odour containment and extraction to an odour treatment plant. Where covers are to be constructed above the bridge (such as is shown on the Planning Drawings) adequate height shall be provided under the cover to allow for personnel access at all points on the bridge. These type of covers shall extend a minimum of 1.0 m beyond the periphery wall and a minimum of two access doors shall be provided equidistant around each tank. Alternative designs which do not provide for personnel access below the cover shall be constructed with removable panels, such that the whole of the tank surface can be accessed for maintenance and inspection. Alternative designs must provide the same level of performance, in terms of odour abatement and treatment, to the system shown on the planning drawings during all operations including maintenance.

Automatic desludging systems shall be provided for each sedimentation tank. This shall consist of a programmable variable timed operation of desludging pumps.

Desludging pumps shall be positive displacement type pumps (hydraulic power pack pumps are acceptable). A minimum 50% standby will be required of total desludging pump capacity. Sludge withdrawal via an bellmouth system is not acceptable. Desludging pumps shall be directly connected to the sludge collection hoppers.

If lamella-type separators are proposed the spacing between the plates shall not be less than 80 mm and the slope of the plates shall not be less than 55°. A means of automatic cleaning of the lamella plates shall be provided and scum removed system shall also be provided.

7.7 Secondary Treatment

Secondary biological treatment shall be provided for flows up to the design flow stated in Table 5.3. Biological treatment systems shall be designed to achieve a treated effluent standard in accordance with the requirements stated in Table 6.1 of Section 6 of this specification. The treatment process shall be capable of treating the range of flows expected from the date of commissioning of the plant up to the design flow.

The secondary treatment process must fit within the envelope of the area identified for this process in the planning documents. Planning considerations as outlined in Volume 2 of this Specification will apply.

The secondary treatment process shall be designed so as to be easily expandable to cater for

future increases in loading and/or retrofitting of nutrient reduction facilities (nitrogen and phosphorus). The Contractor shall indicate on drawings the facilities necessary to provide for a future increase of 15% of the design load to achieve the discharge standards in Table 6.1. He shall also submit a second layout showing the required expansion of the plant, to provide for the current design loading to meet a total nitrogen standard of 10 mg/l, and a third layout showing the required expansion necessary to provide for the current design load to meet both a total nitrogen standard of 10 mg/l and a total phosphorus standard of 1 mg/l expressed as an annual mean.

The secondary treatment process shall be designed to maximise energy efficiency. Controls shall be put in place to operate the aeration system in a way which matches the air input to the process requirements

The secondary treatment process shall be designed to maximise energy efficiency. Controls shall be put in place to operate the aeration system in a way which matches the air input to the process requirements.

7.7.1 Activated Sludge Process

Activated sludge systems shall be designed to maximise the settleability of the mixed liquor in downstream clarifiers. Plug flow type systems are the preferred option but consideration will be given to other systems. Selector tanks shall be provided in all cases and systems shall be designed to achieve a Stirred Specific Sludge Volume Index less than 120 ml/g at a mixed liquor suspended solids concentration of 3.5 g/l.

A minimum sludge age of 5 days shall be maintained at a temperature of 10°C and the system shall be designed for a mixed liquor temperature range of 10° – 20°C.

Dead spots shall be eliminated by providing baffle walls and fillets to corners of tanks where necessary.

A minimum freeboard of 0.75 m shall be provided in all aeration tanks.

Aeration systems shall be capable of maintaining a dissolved oxygen concentration of 2.0 mg/.l throughout the full volume of the aeration tank at all times.

Comment [P J4]: Addendum 1. A1.4

Suitable arrangements shall be provided for draining aeration tanks.

The inlet and outlet channels and/or pipework shall be designed to permit any of the individual aeration tanks to be taken out of service.

The reactors shall be designed so that the accumulation of biological foam is prevented. Nevertheless facilities shall be provided for the control of foam at the surface of the aeration tanks. The minimum requirements for such facilities shall be a bunded hard standing area for containers of anti-foam complete with dosing pumps and pipelines to deliver anti-foam or water through spray nozzles to all of the aeration tanks. The anti-foam system shall also provide for a water spray.

7.7.2 Secondary Settlement Tanks

Secondary settlement tanks shall be circular. The design of the tanks shall be based on either of the following design methods:

Solids Flux:

The method to be used in design shall be the modified Water Research Centre (WRc) method described in IAWQ Scientific and Technical Report No. 6, 1997 (Ekama *et.al.* ISBN 1 900222 03 5), using safety factor of at least 0.8 in determination of the critical solids flux. The Contractor shall state the value of the stirred specific sludge volume index measured at a MLSS concentration of 3.5 g/l ($SSV_{3.5}$) used in the design. The design $SSVI_{3.5}$ shall not be lower than 120 ml/g.

If the design $SSVI_{3.5}$ of 120 ml/g is used, the design critical solids flux shall not exceed 4.8 kg $SS/m^2/h$ and the design critical underflow rate shall not be less than 0.65 m/h. The Contractor may allow for solids accumulation in the sedimentation tanks. In this case, calculations on predictions of sludge accumulation shall be included in the Tender Proposals. No more than 20% of the biomass (dry solids) in the aeration tanks shall be allowed to accumulate in the clarifiers.

The applied solid flux, G and underflow rate, U are defined as follows:

$$G = 10^3 (Q + Q_r)MLSS/A \qquad kgSS/m^2/h$$

$$U = Q_r/A \qquad m/h$$

Where:

Q and Q_r – maximum flow rate of sewage and underflow rate, respectively (m^3/h)
MLSS – concentration of suspended solids in the mixed liquor (mg/l)
A – plan area of the clarifiers (m^2).

Upward Flow Velocity:

The upward flow velocity shall not exceed 0.9 $m^3/m^2/hr$ with all tanks in operation and 1.2 $m^3/m^2/hr$ with one tank out of service for maintenance. The minimum hydraulic retention time shall be two hours and the maximum solids loading rate shall not exceed 75 $kg/m^2/d$.

In all cases the following shall apply:

- Settlement tanks shall incorporate rotating bridge scrapers and scum removal systems
- Scum removed from the surface of the tanks shall not be returned with the return sludge.
- The inlet pipe shall discharge within a stilling box or diffusion mechanism located at the centre of the tank. Where stilling boxes are used these shall occupy a minimum liquid surface area of 10% of the liquid surface area of the tank. The Contractor's design shall include for a means of removing scum from the stilling box.
- Sludge return pumps shall be capable of returning flows in the range not narrower than 0.5 to 1.5 times the average inlet flow or within the range 0.3 to 0.7 $m^3/m^2/h$ as an underflow rate where the solids flux design method is adopted.
- The side wall depth of the settlement tanks shall not be less than 4.0 m.

7.7.3 Sequencing Batch Reactors

Where sequencing batch reactors are proposed reactors shall be arranged in at least two independent sets of SBRs working in parallel and shall operate such that a constant discharge to the outfall pipeline is achieved for the majority of time each day.

The operation of each SBR shall be timed to provide a minimum settling time of 60 minutes.

The minimum distance between the low water level and the top of sludge blanket level shall be 1.0 metres.

Moving weir decanters shall be provided which function under a controlled (but variable) constant lowering rate. These systems shall be designed to prevent solids entering the decanting device during the aeration phase. Fixed subsurface devices will not be permitted.

SBRs shall be fitted with scum removal systems to prevent surface scums and floatables from exiting with the treated effluent.

7.7.4 Other Biological Treatment Processes

Where biological treatment processes, other than conventional activated sludge, are proposed the Contractor shall submit full specifications for all elements of the design for the approval of the Employer. Planning considerations as outlined in Volume 2 of this Specification shall apply.

7.8 Aeration Systems

Aeration systems shall be designed to maximise oxygen transfer and to react to the changing oxygen demands in biological treatment systems. Consideration should be given to the separation of aeration and mixing mechanisms in aeration tanks where appropriate to maximise energy efficiency. Tapered aeration in plug flow systems shall be provided. Combinations of aeration systems will be permitted in plug flow or modular designs. the Contractor shall state the turndown ratio of blowers and any other proposed aeration devices.

Aeration systems which incorporate blowers shall comprise at least 3 blowers. Blowers shall be capable of delivering maximum air requirements with the largest single unit out of service.

Duty blowers, diffusers and piping shall be capable of delivering at least 150 per cent of the air requirements based on the maximum design loading. The maximum air flow in pipework shall not exceed 15 m/sec.

Provision of a system for condensate draining and flushing of the air system is required. Pressure tappings shall be provided to monitor pressure drop for each air valve.

Where fine bubble diffused air (FBDA) systems are proposed membrane type diffusers shall be utilised. Ceramic diffusers are not permitted. The Contractor shall state the following:

- minimum and maximum capacity of the diffusers at the operating liquid depth
- number of diffusers in aeration zones

Jet aeration systems shall be designed to provide a minimum liquid recirculation rate capable of pumping the total volume of a reactor in 90 minutes. Manual back flushing systems shall be provided for all jet aeration systems.

The Contractor shall provide full details on the performance characteristics of proposed aeration devices. The details required shall include:

- standard oxygen transfer rates (kg O_2/h) at the chosen reactor depth carried out in accordance with 'A Standard for the Measurement of Oxygen Transfer in Clean Water' as published by the American Society of Civil Engineers (ASCE) or other equivalent European or internationally recognised standard procedure.
- Alpha factor assumed for wastewater at various stages in the process for plug flow or modular designs
- The overall standard oxygen transfer efficiency (%)
- The standard aeration efficiency (kgO_2/kWh)

The Contractor's design shall be such that it is feasible to carry out performance testing of the aeration system on a full scale section of the plant in accordance with the requirements of other Volumes of this Specification.

7.9 Sludge Handling and Treatment

7.9.1 Primary Sludges

Primary sludges from the primary sedimentation tanks shall be prethickened prior to treatment. Thickening/consolidation tanks shall be designed such that when operating in series with the sedimentation tanks the thickened sludge shall have a minimum dry solids content of 6%.

Tanks shall be covered and the air extracted for treatment. The solids loading rate for thickening consolidation tanks shall not exceed 110 kg/m^2/d for primary sludges. The sidewall depth from the effluent weir shall not be less than 4 m.

Where picket fences are fitted to tanks, the peripheral speed of the picket fence shall not exceed 3m/min. Spacing of tines shall not exceed 400 mm.

Thickening/consolidation tanks shall be fitted with sludge blanket detection system. Tanks shall be designed to provide a minimum hydraulic retention time of 1 day at maximum daily sludge flow rates.

Batch consolidation tanks shall be fitted with a monitoring system to ensure sludge removed for the tank meets the 6% dry solids requirement and minimises solids in the decant.

The Contractor's design for primary sludge thickening shall consider the possibilities for flotation occurring in the thickening tanks due to the nature and composition of the wastewater. Mechanical systems will be acceptable for primary sludge thickening subject to the requirements of planning.

7.9.2 Secondary Sludges

Sludges produced in secondary biological treatment processes shall be thickened to a minimum dry solids content of 5% by gravity belt thickeners or flotation systems prior to digestion.

The Contractor shall provide full details of his proposed systems for thickening secondary sludges including details of energy requirements, chemicals usage, and service life of major components (i.e. filter belt cloths, etc.). Co-thickening with primary sludges is not

acceptable.

7.9.3 Sludge Storage

The mechanical thickening and dewatering plants, and associated pumps shall be arranged in at least two duty parallel streams and at least one additional stream of the same size as each of the duty streams. The duty streams shall be sized to handle at least the average daily sludge quantities over not more than 20 hours per day. The additional stream shall be used to treat the peak loads and serve as a standby during the average loading.

Polyelectrolyte solution preparation and dosing systems shall be provided for all mechanical devices used for sludge thickening and dewatering. Duty and standby dosing units shall be provided.

Sludge storage facilities shall be provided for the following:

- Thickened primary sludges and secondary sludges
- Digested sludges.

Sludge storage facilities are intended for emergency use only to provide for maintenance or breakdowns of mechanical thickening, dewatering or drying plant items.

The Contractor shall provide sufficient storage for 3 days production of thickened primary and secondary sludges at maximum design loading. Storage shall be located in building block 18, or at the location of other tankage shown on the planning drawings which are not required for the design. Sludge storage facilities shall be covered and the headspace extracted to the odour treatment plant.

The design shall provide for 5 days available storage of digested sludge at all times based on the maximum design throughput of the sludge digestion plant. Sludge storage facilities shall be located in building block 18, or at the location of other tankage shown on the planning drawings which are not required for the design. The required available sludge storage capacity is emergency storage capacity and is in addition to the storage capacity required for the normal operation.

7.9.4 Sludge Dewatering

The mechanical thickening and dewatering plants, and associated pumps shall be arranged in at least two duty parallel streams and at least one additional stream of the same size as each of the duty streams. The duty streams shall be sized to handle at least the average daily sludge quantities over not more than 20 hours per day. The additional stream shall be used to treat the peak loads and serve as a standby during average loading.

Polyelectrolyte solution preparation and dosing systems shall be provided for all mechanical devices used for sludge thickening and dewatering. Duty and standby dosing units shall be provided.

Digested sludges shall be dewatered prior to treatment in a thermal drying process. The dewatering system shall be designed to maximise the efficiency of the thermal drying process. The minimum acceptable dry solids content prior to drying shall be 23%.

Comment [P J5]: Addendum 1 A1 6

Dewatering systems shall be fully enclosed within buildings.

Automatic systems shall be provided to monitor filtrate/centrate quality.

Where belt presses are proposed filtrate or treated effluent shall be used for belt washing except during start-up.

Where centrifuges are proposed controls shall be put in place to adjust the differential speed of the bowl and conveyor.

The conveyancing system used to transport the dewatered sludge to the drying process shall be fully enclosed. The design shall incorporate a means of purging this conveyancing system during downtime on the dewatering plant.

The dewatering plant shall include for a separate emergency conveyancing systems to convey dewatered sludge to 40 tonne articulated trucks for off-site disposal. This conveyancing system shall provide a movable discharge chute to utilise the full volume of the transport trucks.

7.9.5 Sludge digestion

The thickened primary and secondary biological sludges shall be combined and mixed in the thickened sludge holding tank from where the sludge shall be pumped to the anaerobic digesters. The Contractor shall provide information on the mixing intensity in the thickened sludge tank.

Only one stage digestion is required. The Contractor shall specify the percentage of solids destroyed during digestion. The rate of feed of sludge to the digesters shall be such that the sludge retention time is never less than 14 days.

The contents of the digesters shall be mixed. The Contractor shall specify the method of mixing and mixing intensity. The Employer may request that the mixing intensity in any of the digesters be tested using the lithium tracer method, as outlined in Volume 2, Section 7. The mixing shall be such that the concentration of the lithium is less than C_{90} within 30 minutes of adding the lithium. The definition of C_{90} is as follows:

$$(C_{90} - C_b) = 0.9\,(C_{ST} - C_b) \qquad \text{Equation 7.3}$$

where;

C_b is the background concentration of lithium in the sludge
C_{ST} is the (pseudo) steady state concentration of lithium occurring at long times.

The digesters shall be equipped with an automatic temperature control system. In each digester, at least two temperature sensors shall be installed. External heat exchangers shall be utilised. The Contractor shall specify the heat transfer capacity of the proposed heat exchangers. The heat exchangers shall incorporate arrangements for the clearance of sludge blockages and drainage of water. The exchangers shall be supplied complete with all control and isolating valves and shall be provided with the temperature sensors for inlet/outlet sludge and water. The by-pass shall also be provided.

The average daily temperature of the sludge in the digesters shall not be outside the range 35±0.5°C. The instantaneous temperature shall be continuously in the range 35±2°C.

During the digestion a minimum reduction of volatile solids entering the digesters of 38%

shall be achieved in order to fulfil the vector attraction reduction requirement for the Class A sludge.

The biogas generated during digestion shall be directed to the gas holder and utilised at the dryer plant. The low grade heat generated at the dryer shall be utilised at the digestion plant to heat the sludge. Under normal operation there may be no need to flare any of the biogas, however a flare stack shall be provided for emergency. Drainage for condensate shall be provided at all low points in all biogas pipelines. All necessary safety devices shall be provided.

The sludge from the digesters shall gravitate to the digested sludge holding tanks equipped with mixing facilities.

7.9.6 Thermal Drying

Dryer:

The sludge drying plant shall deliver a product of uniform quality at least equal to that defined in Section 6.3. The design shall also take into consideration the final product bulk density in order to minimise the frequency of sludge vehicle movements.

The sludge drying plant shall be compatible in all respects with the upstream sludge treatment processes and associated equipment and shall be capable of processing the maximum dewatered sludge cake production.

The Contractor shall provide fully enclosed sludge transfer systems throughout the sludge drying plant from dewatered sludge storage silo to the bagging plant and bag handling system. An alternative discharge for dried sludge shall be provided for the loading of 40 tonne articulated lorries outside of the building.

The sludge drying scheme specified below is a preferred system. Alternative systems can be offered which also meet the intent of the Specifications.

One sludge dryer shall be provided, rated at a minimum of 125% of the maximum daily sludge solids throughput and at all sludge dry solids concentrations of the dewatered sludge. The sludge drying plant shall be operated for not less than 8,000 hours/year and under normal conditions shall operate for 24 hours/day. Plant designs shall include appropriate plant engineering techniques to ensure that this utilisation can be guaranteed. Operation and process performance shall not be adversely affected by the "sticky phase" of the drying process.

Sweep gas circulating through the dryer shall form part of a closed loop, indirectly heated in a heat exchanger by the exhaust from gas burners, gas turbines or a CHP system, with a bleed-off to a condenser to control moisture content. The sweep gas circuit shall be maintained at a pressure below ambient at all times to obviate odour emissions.

Comment [RNH6]: Page: 19
This paragraph has been moved down.

Dryers producing a granule shall have adequate dried sludge recirculation equipment and mixing systems for feed sludge and dried sludge. Feed sludge and recirculated dried sludge buffer storage for at least 2 hours production at full capacity shall be provided. The mixing systems shall be situated as close to the dryer feed port as possible.

All dust, under- and over-sized particles in the final product shall be returned to the dryer feed unless a product pelletiser is used.

Dust filtration shall be incorporated into the sweep gas circulation loop. The Contractor shall allow for provision of new filter element bags at the end of the maintenance period. Pneumatic pulsing or other proven method of filter cleaning shall be used.

The sweep gas circuit shall incorporate a bleed-off to direct contact spray condensers or indirect condensers to remove moisture. Non-condensable gas from the condensers shall be used as combustion air in the gas combustion units for odour control purposes.

The temperature, oxygen content and carbon monoxide content shall be monitored in the sweep gas system, dryer inlet and outlet, and product recirculation streams. The Contractor shall install duty and standby transducers for monitoring the above parameters.

The sludge dryer shall be totally enclosed and fully insulated. No exposed, unguarded surface shall have a temperature in excess of 50°C. Adequate cooling shall be provided to ensure that the dried sludge leaving the main dryer loop is maintained at a temperature below 50°C.

Dryer Heating Equipment:

Heat for sludge drying shall be provided by the combustion of biogas supplemented as necessary with natural gas. If a gas turbine and/or CHP system is proposed, the dryer shall utilise heat from the exhaust gases of the turbine/CHP system and a biogas/natural gas burner shall be provided as a standby heat supply during maintenance periods of the turbine or CHP combustion unit.

If a gas turbine/CHP system is proposed, this shall be sized to provide, as a minimum, the heat required for sludge drying from the turbine exhaust while burning biogas supplemented as necessary with natural gas. The power generated shall be utilised to reduce the quantity of power required to be imported at the Works.

The Contractor shall install all necessary pressure regulation, pressure boosting and gas purification equipment as necessary as well as gas feed lines from the sludge digestion plant to ensure satisfactory burner operation and compliance with stack emission requirements. The Contractor shall allow for biogas with up to 5,000 ppm hydrogen sulphide content.

The Contractor shall include automatic changeover between biogas and natural gas during operation, i.e. without operator intervention and without stopping the dewatering/drying processes. The total fuel consumption shall be included in the guarantees.

Dryer Cooling System:

The Contractor shall provide all necessary plant for product and sweep gas cooling. If final effluent is used as the cooling medium, the Contractor shall ensure that the volumetric flow rate and hydraulic head required can be accommodated. Potable water shall be used only for filling/top-up of heat exchanger circuits and for emergency systems.

Sources of heat which cannot be used for sludge drying shall be used for maintaining the temperature of the anaerobic digesters and thereby making more biogas available for use in sludge drying and, if proposed, power generation.

The Contractor shall design all cooling systems such that the following conditions can be met:

(a) Rapid cooling of dryer and associated plant following emergency shutdown;

(b) Rapid cooling of partially dried sludge in system following emergency shutdown.

The Contractor shall assume that the maximum ambient air temperature on the Site shall be 45°C for design purposes.

Dried Sludge Cooling:

The Contractor shall provide a dried sludge cooler and final product handling equipment. The cooler shall reduce the final product solids temperature to below 50°C. The cooling liquid pressure and product temperature shall be monitored at the cooling element and alarms annunciated to SCADA. Pneumatic final product handling systems will not be permitted.

Dried Sludge Storage:

Following product cooling, the dried sludge shall be stored in a dried sludge storage silo. A minimum of 24 hours storage capacity at maximum throughput shall be provided in the silo. During normal operation, the silo shall discharge to the bagging plant but when necessary the silo shall discharge directly to 40 tonne articulated lorries outside of the building. Additional storage for at least 12 hour sludge production shall be provided outside of the building for the bagged dried sludge.

Duty and standby dehumidifying plant shall be installed to maintain low humidity in the Silo. Continuous monitoring of methane and carbon dioxide concentrations shall be provided and on detection of adverse conditions an inert gas purge shall be initiated.

Final Product Bagging:

A dried sludge bagging system shall be installed with the capacity to bag the design weekly output from the sludge dryer over an 8 hour daily shift during 5 days per week. The dried product shall be bagged in 1 m^3 bulk bags using an automatically controlled discharge from the dried sludge storage silo.

Odour Control:

All process, transfer and storage equipment shall be subject to odour control. During periods of dryer shutdown the odours from the sludge drying plant shall be exhausted to the main treatment plant odour control system.

7.9.7 Solids Disposal

The Contractor is responsible for the transportation and disposal of all screenings, grit and sludge generated by his proposed systems. The disposal of such waste materials shall be carried out in accordance with the requirements of the Waste Management Act 1996 and Implementary Regulations and in accordance with any permits or licences obtained by the Contractor under the Act.

7.9.8 Future Imported Sludges

The Contractor shall demonstrate how his design can be modified to provide for the possible future importation of sludges to the plant. The Contractor shall submit with his Tender Proposals, details and a layout plan which provides for the importation of a total of 2.4 tds/day of thickened primary and secondary sludges with a typical dry solids content of 4% - 6%. The Contractor's details and layout shall provide as a minimum for the following:

- Reception plant incorporating facilities for two road tankers to discharge simultaneously

including washdown areas, duty/standby 5 mm screens, day tanks and conveyancing system.

- Expansions and/or modification to sludge treatment plant to cater for the additional sludge volumes

- Details of the effect on any other aspects of the Works arising from the additional sludge including upgrading of Plant, upsizing of facilities and increased operatioin and maintenance activities.

It should be noted that the inclusion of such facilities would be subject to a separate planning approval and, as such, the current planning conditions do not apply to this item.

7.10 Return Liquors

Liquors generated during sludge treatment shall be returned for treatment in such a manner that any adverse effect of shock loads on treatment process is avoided.

Wastewater from the chemical odour treatment plant shall be stored and mixed and shall be gradually discharged to treatment provided their pH is within the range 6.5 to 8.5.

7.11 Ventilation and Odour Treatment

The treatment buildings shall be ventilated and the air scrubbed to prevent odour nuisance. Where practical, the Contractor shall cover individual treatment units and ventilate the head space, passing the air to a scrubbing system.

7.11.1 Ventilation

The design of the ventilation system shall ensure that air pressures inside the buildings are negative with the lowest values under the treatment unit covers. Electrical control rooms and switch rooms shall be provided with mechanical ventilation and where appropriate air conditioning systems which maintain the rooms at positive pressure with respect to process areas. Any accesses from the process areas to electrical rooms shall be by means of a double door system which will act as an airlock. The design shall also prevent surface condensation which may otherwise cause corrosion.

Each blower stage in the ventilation system shall be supported by a standby, with automatic starting at failure of a duty machine.

To limit power consumption and minimise the risk of noise nuisance, the velocity of the air through the ventilation ducting shall not exceed 12 m/s.

The ducting shall be manufactured from suitably resistant material. Galvanised steel will not be acceptable.

The Contractor shall specify the assumed air change rates for buildings and process units. The rates shall be sufficiently high so that the risk of corrosion is minimised.

Mechanical ventilation of buildings shall meet the following requirements:

• Switch, control rooms	Minimum 2 air changes per hour and a max temperature rise of 2°C
• Offices	Minimum 2 air changes per hour
• Storage areas	Minimum 2 air changes per hour
• Preliminary treatment building	Minimum 2 air changes per hour and max H_2S concentration of 50 ppb
• Blower house	Minimum 2 air changes per hour
• Sludge building	Minimum 2 air changes per hour
• Workshops	Minimum 8 air changes per hour

The following air change rates for the process units (under covers) shall be employed:

• Screens and grit separators	Minimum 8 air changes per hour
• Pre-aeration tanks	Negative pressure to be maintained, air extraction rate equal to aeration rate plus minimum 4 air changes (based on head space)
• Primary sedimentation tanks	Min 2 air changes per hour
• Gravity thickeners	Min 6 air changes per hour
• Tanks with variable water level	Min 2 air changes per hour on an empty tank or min 100%, max 150% of the maximum tank fill rate, whichever is greater

7.11.2 Odour treatment

External Odour Levels:

The plant shall be designed to ensure that the odour release is minimised. Cascading flows shall be avoided and cleaning systems for sumps and chambers shall be provided.

The odour scrubbing equipment shall be designed so that, during operation of the Plant, the treated air discharged from the ventilation stack shall not increase the short-term average TON (as measured using the procedure developed by CEN TC264 Working Group 2) by more than 5 TON, at any receptor position and anywhere on the boundary of the Site.

The Contractor shall conduct an odour dispersion study for the proposed design. The study shall provide the information on maximum allowable emission rates (OU/s) that may be discharged in the air from the stack while complying with the guarantee. The results of the study shall be submitted with the Tender.

The following criteria shall be used in the dispersion modelling:

- The meteorological data shall be obtained from the Meteorological Office and comprise hourly-average values for the most recent period of 5 years or more.

- The short-term TONs at the receptor positions shall be assumed to be a factor of ten greater than the hourly-averages predicted by the dispersion model. It follows that the maximum allowable hourly-average TONs at the receptor positions shall be a factor of ten less than the guaranteed short-term average values.

- The modelling shall take account of the presence of the Site buildings, the topography of the Site and surrounding area and the proximity of the coast.

- The maximum elevation of the stack top shall comply with the planning permission requirements.

The maximum allowable odour emission rate, E (OU/s) in the stack shall be converted to a short-term hydrogen sulphide concentration, C_s (ppb), in the stack gas using the following formula:

$$C_s = C_t \frac{E}{U K}$$ Equation 7.4

where: C_t - the threshold concentration of hydrogen sulphide, which shall be 0.5 ppb
U - the flow rate of the air from the stack (m^3/s)
and K - the ratio of the total TON of the stack air to the TON contributed by the H_2S in the stack air.

The value of K will depend on factors such as the composition of the source odour and the design of the scrubbing equipment. A value of 5 shall be assumed unless the Contractor can justify an alternative value acceptable to the Employer's Representative.

The short-term concentrations of hydrogen sulphide in the stack gas shall be automatically and continuously monitored and periodically recorded. The upper 98 percentile value of these readings shall be less than the value of C_s calculated from Equation 7.4.

Internal Odour Level:

The concentration of hydrogen sulphide and carbon monoxide in the air inside buildings within the boundary of the Site may be measured by the Employer at any time using hand-held instruments. The concentration of hydrogen sulphide shall comply with the guarantees. The concentration of carbon monoxide shall comply with Health and Safety regulations.

Buildings shall be ventilated to provide a safe working environment. Plant shall be selected to suit the zoned area. Units may have sealed covers in order to reduce the volumes of air to be deodorised if this offers the most efficient and economic solution.

At all times the odour standards and occupational exposure levels shall not be contravened.

Odour Treatment Plant:

Odour control facilities shall be provided for buildings, tanks and process plant where required to minimise toxicity, hazardous conditions and odour nuisance.

The Contractor shall propose the most economic system to achieve the specified duty.

The ventilation stack shall be installed and fitted with duty/standby ventilation fans and ancillary ductwork. Isolation dampers shall be provided to allow either of the fans to be maintained.

A blow down system shall be incorporated.

Air extracted from the buildings and tanks may contain concentrations of flammable gases and fans shall be of spark-proof design to prevent explosions.

Tanks and sumps shall be fitted with one way inlet vents.

All ductwork shall be designed to be laid with falls and be complete with valves situated at low points to enable condensation to be drained. Ductwork should generally fall back to the extraction point to ensure that condensed water returns to the tanks from which odour is being extracted. The ductwork shall be designed to ensure that the total number of drain points is minimised.

The ductwork installations shall be designed to avoid trappings of fumes or gases in dead ends and prevent the collection of condensation which may be formed internally at any point in the ductwork and which cannot be drained through drain valves located at accessible positions.

Ductwork shall be supplied with connections for instrumentation and gauges as required.

Appropriate gas sampling points shall be supplied in ducting running from each major leg at a distance of not less than four duct widths from any bend. Ports for manual sampling shall have a minimum diameter of 30 mm. Removable plugs for each of the sampling ports shall be supplied.

All interconnecting ductwork shall be manufactured in GRP or other suitable plastic material. Particular attention shall be given to adequate and sufficient supporting of plastic ducting, together with accommodation of thermal expansion.

Hydrogen sulphide shall be monitored in the inlet and outlet ducting to the odour control plant. The gas monitor at the inlet shall be capable of measuring hydrogen sulphide in the range 0 to 50 ppm with a resolution of 0.5 ppm. The sensor in the outlet ducting shall measure within the range of 100 to 200 ppb with a resolution of 10 ppb. Sampling points for the gas monitoring equipment shall be designed to allow manual sampling and shall be located in straight legs of ducting not less than four duct widths from any bends.

In addition to the previous requirements, two hydrogen sulphide monitors shall be located at appropriate locations to monitor the free space air.

The hydrogen sulphide monitors shall provide a 4-20 mA signal for monitoring of the air for H_2S levels by the SCADA system via the local MCC PLC.

The Contractor shall provide an air flow meter to measure the air flow rate to the odour control plant and shall provide a 4-20 mA signal for connecting into the SCADA system via the local MCC PLC.

The materials used in the construction of the odour control systems shall be completely suitable for operation in the prevailing internal and external atmospheric conditions.

7.12 Chemical Handling Systems

All the chemical dosing solutions shall be prepared and dosed automatically. Dosing shall be related to the demand in order to minimise consumption of chemicals. Adequate mixing and dispersion of the chemicals in the medium shall be achieved.

Storage capacity for chemicals used at the plant shall be sufficient to enable the plant to be operated for one month at maximum throughput. All storage tanks for chemicals shall be bunded and any spillage shall be diverted to the return liquor stream.

Polymers shall be used for conditioning of sludges, which are thickened and dewatered using mechanical devices.

The polymer make-up system shall be suitable for the sludge type, specified sludge throughput and the type of the mechanical device. The systems shall comprise make-up units transfer pumps, polymer storage and dosing pumps operated on a duty/standby basis.

Potable water shall be used for initial dilution of the polymer. Treated final effluent may be used to prepare the final dosing solution.

The polymer make-up system shall be supplied complete with all necessary pipework, valves and instrumentation.

7.13 Final Effluent Washwater and Potable Water Distribution

The Contractor shall provide a pressurised washwater booster set to supply the final effluent to the final effluent washwater ring main. The system shall include, but not be limited to, duty/standby submersible pumps, pressure vessel and a dual filtration unit to allow replacement of one of the filter elements whilst the other element is operational. Automatically backwashed filters shall be provided. The used backwashwater shall be returned to the main wastewater treatment stream.

The Site shall also be provided with a separate booster set to supply potable water to the potable washwater ring main. This water shall be drawn, via a break tank, from the mains feed to the site. The break tank shall be included with the potable water booster set and shall have a Type A air gap in accordance with the Water Supply Bylaws.

The potable water booster set pumps shall be two (duty/standby) vertically mounted, multistage, centrifugal types with close coupled electric motors.

The booster sets pressure vessel shall be of steel construction fitted internally with a removable synthetic rubber bladder type diaphragm in accordance with the applicable British Standard. The vessel shall be fitted with a self sealing valve connection for charging the space between the wall of the vessel and diaphragm, with air to pre-charge the diaphragm to the pressure requirements of the system.

Pressure gauges, complete with isolation valves shall be provided and fitted to the delivery line and booster set pressure vessel.

Separate suction pipework shall be provided for each booster set pump complete with isolation valve, non-return valve and strainer.

Booster set pipework shall be of ABS and shall be complete with isolation valves, non-return valves, strainer etc.

Final effluent water and potable water shall be provided to all Plant and Materials requiring washing down or flushing and to polymer dosing plant.

The Contractor shall identify potential points of spillage and shall provide the hose points for washing down within buildings and areas where sludge or liquor spillage may occur.

7.14 Allowance for Future UV Facility

An area of 15m x 5m between the final settlement tanks and final treated effluent flow monitoring facilities is required to be allocated for retrofitting an Ultra Violet Treatment system if required in the future. Allowance for a head loss of 0.75m across the UV facility must be made in the design of the Wastewater Treatment Plant and Outfall.

8.0 FLOW MEASUREMENT, SAMPLING

8.1 General

The Contractor shall provide sufficient measuring devices and sampling equipment to comply with the planning drawings and for the proper operation and maintenance of the plant.

The minimum requirements for flow measurements and sampling during normal operation are shown in Volume3, Section 6. More detailed sampling and measuring may be required during the Performance Tests.

Flow measurement and sampling shall be provided for the following purposes:

- estimation of the incoming wastewater flow rate and pollutants load for payment purposes
- estimation of the quality and quantity of flows discharged to the outfall for compliance purposes
- estimation of operational loads onto the particular process units for process control and operation

The minimum requirements for flow measurements and sampling are listed in Table 8.1 and described in Section 6 of Volume 3.

Table 8.1

Location	Flow/Weight measurement	Sampling point
Flows from Little Island/Glounthaune, Glanmire/Riverstown and Courtstown	3	
Combined flows downstream of the pre-aeration tank, upstream of the storm overflow	3	3^{A}
Overflow from the storm tank	3	3^{A}
Flow to the secondary treatment plant	3	3^{A}
Final effluent	3	3^{A}
Return liquors	3	3
Surplus activated sludge	3	3
Combined thickened sludge to digesters	3	3
Dried sludge	$3^{(1)}$	3
Odour control plants outlet stacks		3
Odour at the site boundary & receptors		3

Note: $^{(1)}$ Refers to mass rather than volume
$^{(A)}$ Automatic sampling required.

8.2 Flow Measurement

Flow rates used for payment purposes shall be measured with open channel flumes with ultrasonic level devices, rather than electromagnetic flow meters. In other areas where electromagnetic flow meters are utilised, the Contractor shall ensure that the meters with the electronic fingerprint are used in order to enable calibration to be conducted on site.

Flow measurement carried out using flumes shall be designed, provided and calibrated in accordance with BS 3680 Part 4C.

After construction of the flume and installation of the ultrasonic head, the flow meter shall be calibrated in accordance with the manufacturer's instructions.

8.3 Sampling

For the sampling points which are directly connected to the process guarantees or payments, refridgerated automatic samplers shall be permanently installed. Final effluent automatic samplers shall be flow or time proportional. Any automatic samplers which are utilised for determination of the loads for payment purposes shall be capable of collecting flow proportional composite samples.

9.0 SERVICES

9.1 General

The Contractor shall liaise with the service authorities to determine what services can be made available to the Works and their reliability. The Contractor shall provide all services required for the Works allowing for an anticipated increase of 25% in the influent over and above the design values.

The Contractor shall advise the Employer's Representative in writing of all arrangements he makes with the Public or Private Utilities and provide copies of all correspondence between himself and the Utilities. He shall give the Employer's Representative adequate notice of all meetings he has with the utility representatives so that the Employer's Representative may attend. He shall minute all such meetings and provide the Employer's Representative with copies.

Procedures shall be developed to cater for planned maintenance and for emergency failure of services, such that the environmental standards are not compromised.

9.2 Potable Water

The route of the potable water supply shall follow the access road to the Site as shown on drawing number A5124-N-008.

The Water Supply Authority has indicated that a 150mm supply can be made available and that is the minimum size of supply that shall be provided. The Contractor shall provide a pressurised washwater booster set on the Site to supply the potable washwater ringmain.

The Contractor shall provide a potable water storage facility equivalent to at least one day's storage at maximum usage.

All costs including any capital charges or contributions and usage charges shall be met by the Contractor. The Contractor shall arrange for all bills to be to his account.

9.3 Natural Gas

The Contractor shall provide a Natural Gas supply to the Site as required, which shall be a minimum of 63mm diameter. The route to the treatment plant shall follow the access road as shown on drawing number A5124-N-008.

The natural gas supply and storage facilities shall be compatible with the Contractor's chosen methods of power supply and energy recovery systems.

9.4 Electricity Supply

The Contractor shall provide two electricity supplies to the treatment plant, which shall each consist of a minimum size of XPLE cable of 400mm^2. The route to the treatment plant shall follow the access road as shown on drawing number A5124-N-008.

The supplies shall be capable of auto-change over in the event of a power failure or one of the supplies.

9.5 Telephone Supply

The Contractor shall provide a suitable number and specification of telephone cables following the line of the access road shown on drawing A5124-N-008.

10.0 MECHANICAL, ELECTRICAL & INSTRUMENTATION, CONTROL & AUTOMATION WORKS

10.1 General

10.1.1 Hazardous Area Classification

The Contractor shall carry out a risk assessment of the possibility of the existence of potentially explosive atmospheres and determine the need for Hazardous Areas Zonal Classification.

All zonal classification shall be in accordance with National Rules for Electrical Installations in Potentially Explosive Atmospheres, Part 6.1, 1984.

Any electrical Plant or Materials shall conform with the Guide to the Selection of Electrical Apparatus for use in Potentially Explosive Atmospheres, Guide G6, 1986 published by the Electro Technical Council of Ireland and the following Statutory Instruments:-

European Communities (Electrical Equipment for use in Potentially Explosive Atmospheres) Regulations:

SI Nr. 61 of 1981
SI Nr. 244 of 1986 (Amendment)
SI Nr. 355 of 1958 (Amendment)

Plant shall be of an approved type and be rated as "Intrinsically Safe" or "Flameproof" as necessary.

10.1.2 Labels

All labels or signs relating to safety shall conform with BS 5378.

All Plant items shall to be fitted with a rating plate, which contains as a minimum, the manufacturer's name, the type reference, the serial number, the date of manufacture and the rating of the machine or Plant item.

All Plant items are to be fitted with a unique name plate bearing the individual plant reference for the Plant item, e.g. "Agitator Motor Nr. 4" In the case of removable Plant items, the name plate shall be fitted alongside the item.

In addition each item of Plant and equipment shall carry an Asset Nr. label which may be electronic to comply with the requirements of the Reliability Centred Maintenance System to be developed as described in Volume 3.

Name plates and rating plates shall be either Traffolyte (black letters on white label) or 316 Stainless Steel labels stamped with black lettering. The lettering shall be of a size suitable for the application, but shall not in any case be less than 6mm high. All labels shall be visible from an operator accessway.

Each switchboard, motor control centre, ICA panel, pump, valves, etc. and any other item of Plant and equipment shall be fitted with an identification label with letters not less than 12mm high. Additionally, each individual switch shall have an identification label at both

the back and front of the unit, where applicable. These labels shall carry the unambiguous switch name and number, in letters not less than 8mm high, which will denote the service or Plant items which they control.

Fuse or MCB sizes and circuit numbers must be clearly indicated adjacent to each device to facilitate identification and replacement.

Where more than one power supply is connected to a distribution board or plant item, clear indication of the danger must be given and the voltage between phases should also be made obvious.

All cables shall be clearly labelled so that their source, estimation, and function can be identified.

All labelling or types of labelling must be approved by the Employer's Representative before installation.

All pipework above ground shall be labelled with contents and flow direction. Pipework of diameter less than 50mm may have tags or clamped signs unless it is less than 15mm in length where labelling shall not be necessary.

All storage tanks shall be labelled with contents and volume. Letters shall be of a size suitable for the application but shall not be less than 100mm high labels shall be painted at 90 degree intervals at a suitable elevation.

10.1.3 Emergency Stop Equipment and Local Isolation

Local Control Stations

Each specific item of electrically powered rotating machinery shall be provided with local start and emergency stop pushbuttons. Where the drive has the capability to run in reverse, separate "Start forward" and "Start Reverse" buttons shall be provided. The pushbuttons shall be housed in the same enclosure, clearly labelled, adjacent to the relevant access point or machinery.

Where applicable, e.g. screen drive motors, the local control enclosure shall include pushbuttons for "inch forward" and "inch reverse" control.

Emergency Stop buttons shall be of the "Stay Put" type, twist or pull to release, to BS EN 418.

Local Isolation

Each specific item of electrically operated machinery shall be provided with a local isolator. Isolators shall be mounted in accessible locations adjacent to the motor, or for submersible pumps, adjacent to the entrance to the sump.

Local isolators shall have auxiliary contacts to trip and lock out the contactor when the isolator is open.

Local isolators shall be provided in all cases for valve or penstock actuators.

All local isolators shall be suitable for padlocking in both the "on" and "off" positions and shall not be provided for use as an emergency stop facility.

10.1.4 Noise

The Contractor shall design and construct the Works to ensure compliance with the recommendation of BS 5228.

With the maximum number of items of Plant running on load the sound pressure outside an envelope of 1m radius from any item of Plant shall not exceed 85 dB(A). Where Plant is installed in a separate room or enclosure the noise level outside a distance of 1m from the room or enclosure shall not exceed 80 dB(A).

The Contractor shall erect hazard warning notices indicating that ear defenders are to be worn at the entrances to all rooms or areas where the sound pressure level exceeds 80dB(A).

Sound pressure levels shall be measured in dB(A) using a calibrated sound meter meeting the requirements of BS EN 60651 (with a response speed set to slow).

Determination of sound power levels and mechanical vibration produced by gears shall be subject to BS 7676-1 and 2.

Ear defenders shall comply with BS EN 352-1 and ear plugs shall comply with BS EN 352-2.

10.1.5 Finishes

Finishes shall comply with the Employer's Requirements in Volume 6 and 7. Alternatively proprietary items such as instruments, motors and gearboxes that are readily available from commercial sources can be supplied with the manufacturer's finish provided evidence is supplied to the Employer's Representative's satisfaction, demonstrating its finish is suitable for the application.

All painting and protection works shall be carried out to BS 5493. Zinc or aluminium sprayed steel components shall be to BS EN 22063.

10.1.6 Security

The Contractor shall design a suitable security system.

All buildings, kiosks and enclosures shall have a security lock.

All buildings and enclosures shall be fitted with intruder alarms which shall cover window and door contacts, glass breakage detectors and PIR movement detectors. The alarm system for the Site shall be armed/disarmed via a kepal in the administration building. The alarm system for each building shall be capable of being controlled by zone selection.

The intruder alarm system shall be designed to BS 4737 and shall be means powered with battery backing. High risk Plant or Materials shall be additionally protected by lockable cabinets or other devices.

The alarm shall alarm locally (external audible alarm) and to SCADA where it shall be logged.

10.1.7 Energy Recovery

The wastewater treatment plant shall, where practical, be designed to recover, recycle, and/or re-process by-product energy arising from the treatment process.

Energy recovery systems shall be considered for all stages of the process, for all energy sources and for all buildings.

Each energy recovery system shall be selected for cost effective operation and the installed capital cost of the energy recovery plant should be recoverable over a period of seven years or less.

Consideration should be given to total thermal process cycles and the opportunities to re-use recovered thermal energy in the Treatment Works.

Consideration shall be given to the export of surplus energy or for the use of natural gas as a fuel during periods of high electricity tariffs, to the use of bio-gas, gas engines, turbines and CHP plants.

10.1.8 Emergency Power Supply

The Contractor shall provide either through a natural gas generator or diesel generator a source of power sufficient to operate the treatment plant's essential service during a complete power failure of the ESB supplies. The plant shall be capable of safe shut down of all non-essential services and of safe start-up upon restoration of power. The Contractor shall develop procedures and demonstrate how these would be carried out in a safe manner.

The Contractor shall research the reliability of the power supplies and the plant through which it is supplied to the Works and demonstrate that the emergency power source will work for the duration of a power supply shutdown such that the environmental standards are met.

10.1.9 Rules and Regulations

The Electrical and ICA installation 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 including Amendment A1, 1997
2. "Requirements for Earthing in Electrical Installations" of the Electricity Supply Board
3. The Factory (Electrical) Regulations 1972.
4. The Regulations of Local Authorities.
5. The Code of Practice for the Design, Selection and Erection of Low Voltage Switchgear Assemblies 1981.
6. National Rules for Electrical Installations in Potentially Explosive Atmospheres Part 6.1.
7. Guide to the Selection of Electrical Apparatus for use in Potentially Explosive Atmosphere G6, 1986.

11.0 ELECTRICAL DESIGN AND CONFIGURATION

11.1 General

11.1.1 Scope

This section describes the electrical Plant to be provided for the Works and specifies the particular requirements for the Plant not covered elsewhere in the specification.

The electrical Plant to be provided shall comprise all the necessary works for the completion of all main and ancillary installations, and shall include but not be limited to:

- The necessary power supplies to the Site to cater for the Plant installation, testing, commissioning, operation and maintenance.
- The necessary equipment and controls to interface with the power supply authority's supply and to transform this supply to meet the requirements of the plant and the power supply authority.
- The necessary equipment and controls to recover energy from the wastewater treatment plant process and to utilise this energy safely and effectively for the generation of process heat and electricity.
- The necessary generating equipment and controls to provide emergency power in the event of a total or partial power failure on the National Grid supply.
- The necessary power distribution equipment, including distribution boards, electrical protection, metering, earthing, cabling, and cable support systems for the plant.
- The necessary electric motors, valves and actuators to operate the mechanical equipment being installed at the plant.
- The necessary electrical starting equipment, isolating equipment, electrical protection, controls and interlocks for each plant item.
- The necessary indoor, outdoor and emergency lighting including all poles, brackets, fixings, etc. for the plant.
- The necessary site electrical services including sockets, space heating, ventilation, frost protection, etc.
- The necessary uninterruptable power systems.
- The necessary fire detection and alarm system.
- The necessary gas protection and alarm system.
- The necessary telecommunications system
- The necessary security system
- The construction phase electrical services
- The necessary Materials and accessories to provide a complete electrical installation

11.1.2 Electrical Power System Design

Existing ESB Power Supply at Little Island
The Electricity Supply Board (ESB) has two supply stations on Little Island. One, at the Cork City end of the island, is supplied at 110 KV and is used mainly to supply the nearby industries on the island.

The second station is at the Carrigrenan end of the island. It is fed at 38 KV and is used to feed the rural load in the area. The ESB has provisionally indicated that it would use this 38 KV station to supply the Works.

This existing station is supplied by two separate 38 KV lines, which feed into two 38 KV busbars, which can be coupled by means of an 'on-load' bus coupler. The station contains 38 KV/10 KV transformers which are connected to the 10 KV distribution busbars. These 10 KV busbars can also be coupled 'on load'. The Contractor shall establish that this 38 KV station is suitable in terms of design and overall reliability for the supply of the Works during the construction phase, and during the subsequent testing, commissioning, operation and maintenance phases of the Works.

Existing Power Supply to the Carrigrenan Site
The ESB has indicated that it has an existing 10 KV single phase supply to the Carrigrenan site area at present. This is used to feed a 15 KVA, 10 KV/400V pole mounted transformer.

The Contractor shall apply formally to the ESB for a construction site power supply and shall indicate the details of the proposed load at the time of application.

Construction Site Power Supply
The ESB envisage that it will have to upgrade approximately 1 km of 10 KV overhead line to provide the construction site supply and that a new pole mounted transformer would be required for a supply in the 100 – 200 KVA range.

In the 200 – 630 KVA range, the ESB have suggested that the transformer may not be pole mounted and is more likely to be located in a small transformer house on the ground.

Proposed Power Supply to Wastewater Treatment Plant
The Contractor shall tabulate the proposed electrical load for the Works and shall submit a detailed application to the ESB for the supply of this load.

Following preliminary discussions with the ESB they envisage that the permanent power supply to the Site would come from the existing 38 KV/10 KV station on Little Island. This station is approximately 1.5 km north of Carrigrenan.

The ESB anticipate that it would install two 5 mVA, 38 KV/10 KV transformers at its KV station, that two separate 10 KV outlets would be added to their 10 KV distribution system and that they would use 400 sq.mm XLPE cables in two separate supply sets between the 38 KV station and the wastewater treatment plant switchroom.

The Contractor shall ensure that the size of the transformers, busbars and cables used in the ESB supply are adequate for the load being supplied, and that they are installed in a manner to provide maximum security of supply and flexibility of operation.

The ESB has indicated that it would provide a power supply rated at 20 KV but which would be supplied and operated at 10 KV initially.

The proposed method of supply is termed a 'Dual Radial Supply' where the two separate 20/10 KV supplies feed onto two separate 20/10 KV busbars at the plant switchroom.

The Contractor shall determine whether this method of supply is adequate for the requirements of the Works, and conforms with the requirements of the ESB (or other supply authority) as specified in Volume 7, Appendix C.

The Contractor shall establish the Capital Cost Contribution required by the ESB for the provision of the necessary power supplies and shall clearly indicate this cost separately in

the Tender Proposals.

The Contractor shall ensure that the two incoming power supplies to the Site are adequately protected and metered by the ESB and shall provide the space required by the ESB in the switchroom of the treatment plant for the ESB meter cabinets.

11.1.3 Power Generation

The Contractor shall prepare all the necessary documentation, including design calculations and application forms to support an application for parallel operation of generators with the ESB and shall undertake all the necessary negotiations to acquire approval for synchronised site generation.

The Contractor shall ensure that the generators used on the Site are sized so that they provide reliable, trouble free, power predictably as required.

The generators shall be provided as a complete installation including the necessary electrical protection and synchronising equipment.

Reference should be made to Volume 7, Appendix C 'Requirements for Connection of Generators to ESB Distribution Network' Publication G10/94.

The protection provided should include:

Loss of Mains Protection
Frequency Modulation
Voltage Modulation
Neutral Voltage Displacement
Pole Slip Protection

A system analysis shall be provided by the Contractor to ensure that network instability does not result from the operation of the Site generators when synchronised with the ESB network.

The Contractor shall examine all the sources of power available when assessing the means of generating power and particular attention shall be paid to the use of biogas from the process. The Contractor shall show that he has considered the following options for generating power.

(a) biogas to natural gas
(b) natural gas
(c) diesel oil

The Contractor shall demonstrate that his proposed generating equipment will ensure that the necessary Plant and equipment can be supplied with power and controls in the event of a total mains power failure, coupled with the failure of an on-site generating set.

11.1.4 Electrical Power System Design

The Contractor shall compile a schedule of the electrical loads at the treatment plant. This schedule shall show the total connected load in each category, together with the calculated diversity factor, the probable load and the maximum demand likely to be experienced.

This information shall be submitted to the Employer's Representative for review. The Contractor shall design the electrical power system to suit the ratings and duty cycles of the Plant items and auxiliary systems which are to be installed.

The power distribution shall be designed to suit the following voltages:

MV = 10 KV initially, 20 KV later
LV = 400/230/110 Volt

The Contractor shall select the necessary voltage and current transformers together with suitable protection relays to protect the electrical plant and its distribution system.

This protection shall include thermal overload, short circuit, earth fault and single phasing as appropriate.

The electrical protection shall be graded so that indiscriminate tripping is prevented under faults or surge conditions.

The Contractor shall co-ordinate the Works electrical protection with the ESB system protection and shall submit to the Employer during the design a tabulation to demonstrate the protection settings to be employed and the appropriate discrimination curves for the complete power system.

11.1.5 Plant Ratings

All electrical Plant whether specified for indoor or outdoor mounting shall be rated for continuous operation at the maximum specified duty load, and at an ambient temperature not less than the maximum anticipated Site ambient temperature conditions.

Where Plant is installed in buildings subject to internal heat gain due to plant power losses the Plant shall be rated for maximum continuous operation at the maximum internal ambient temperature limited by the performance of the building ventilation systems, as detailed in the Specification.

The Contractor shall ensure that the electrical switchgear is rated at not less than the current ratings for maximum load conditions.

11.1.6 Power Factor Correction

The power system shall be designed to operate at a minimum power factor of 0.95 lagging at the point of supply with the ESB.

Care shall be taken to ensure that harmonic voltages are limited and the Contractor shall consult the ESB concerning the impedance of their supply network at the frequencies most liable to resonance.

The Power Factor Correction Equipment shall conform with the requirements specified in Volume 7.

11.1.7 Switchgear Plant General

Medium Voltage Switchgear
The medium voltage switchgear should be designed for operation at 20 KV but shall be connected initially at 10 KV. This is to allow for the conversion of the ESB supply system from 10 KV to 20 KV at a later date (not established).

The Contractor shall ensure that the MV switchgear is designed to accept the ESB power supplies and to distribute the 10 KV/20 KV power to best advantage on the Site, when taking into account the location of the 'on-site' generation, and the various power demands, around the Site.

The MV switchgear shall meet the requirements specified in Volume 7, Section 5.0.

The Contractor shall ensure that the MV switchgear is rated for the fault levels likely to be encountered on the Site, and the system protection installed.

The Contractor shall ensure that circuit breakers on the MV system are interchangeable where this is possible and logical.

The MV switchgear panels shall be suitable for extension at both ends.

An ammeter and kilowatt hour meter shall be fitted to each outgoing circuit breaker panel and the kilowatt hour meter must be capable of delivering energy pulses to a SCADA station.

A kilowatt hour meter shall be fitted to each of the two incoming ESB supplies and these shall be used to verify the ESB power consumption figures. Energy pulses from these two kWhr meters shall be suitable for use by a remote SCADA station.

Each circuit breaker shall be complete with manual and motor charged electrical release, spring closing mechanisms.

The spring motor charging release and the shunt trip mechanisms shall be DC operated from a dedicated substation switchgear battery complete with its own monitoring and charging units. The battery monitoring unit shall be linked to the SCADA system.

The motor wound spring mechanisms shall automatically recharge after each operational cycle.

Each MV switchgear panel shall be complete with the necessary voltage and currents transformers, protection relays instrumentation, circuit breaker controls and indicator lamps.

The Contractor shall ensure that the protection of the MV switchgear is graded to match the ESB circuit breaker protection.

The Contractor shall ensure that the continuity of supply to the Works is optimised and the Contractor shall provide all the necessary protection and interlocking system to achieve this objective.

Low Voltage (LV) Distribution and Motor Control Switchgear

Low Voltage (LV) distribution and motor control switchgear shall be of the totally enclosed metal clad pattern and shall comply fully with the relevant clauses of Volume 7 Section 12.

All LV switchgear shall be designed for indoor floor standing installation and shall be in accordance with IEC 439. All switchboards shall be designed to have busbar and primary conductor assemblies certified for a short circuit strength of 50 KA for 3 seconds.

The LV switchgear shall be designed specifically to suit the plant requirements. Each switchgear unit shall incorporate an incoming 400 volt circuit breaker designed to protect the switchgear unit.

The number of LV switchgear units shall be decided by the Contractor based on the design loading of the plant, the physical location of Plant items and the sources of normal and emergency power that is appropriate to each Plant item.

The Contractor shall ensure that each item of Plant is provided with an adequate power supply, is equipped with the necessary local and remote control gear and is protected in an appropriate manner.

The following features shall be incorporated into the LV distribution and motor control switchgear where appropriate.

(a) Provision for an incoming supply
(b) A motor starter compartment for each motor
(c) Individual compartments for the common control
(d) Individual compartments for the PLC and VCA sections
(e) 400/230 volt, and 110 volt distribution
(f) Tool and hand lamp supplies
(g) Telemetry marshalling compartment
(h) Drawings compartment

Each incoming feeder shall be equipped with a voltmeter, an ammeter and a kilowatt hour meter.

The Contractor shall select the starting equipment appropriate to each drive motor and shall ensure that starting sequences are programmed to minimise disruption of the power supplies and maximise Plant availability. The starters shall be in accordance with Section 12 of Volume 7.

A KWhr meter, with pulsed output, shall be installed on the motor outlet to each motor where the rating exceeds 30 kw.

When designing the low voltage distribution assemblies the Contractor shall ensure that they are dimensionally suitable for delivery and installation on Site.

The Contractor shall ensure that provision is included in the low voltage switchgear to interface with the necessary on-site generators and this provision shall include all the necessary control gear, protection and interlocking to enable the 'on-site' generators to synchronise and run in parallel with the ESB system generators.

The necessary volt free contacts and analogue signals shall be provided by the Contractor on each panel for interfacing with the SCADA system.

These shall include:

Motor Run/Stopped
Motor Failed
Motor Selected to OFF
Motor Selected to MANUAL
Motor Selected to AUTO

The LV switchgear shall also include all the necessary voltage transformers, current transformers and miscellaneous control equipment to provide a complete unit.

11.1.8 Switchgear Batteries

The Contractor shall provide all batteries necessary for the complete operation of all high voltage switchgear protection and tripping circuits. Separate batteries shall be provided for each substation or plant control switchgear installation.

Each battery shall be rated at 110V DC.

Batteries shall be provided for the following duties:

(a) Circuit breaker motor charging spring closing mechanisms
(b) Switchgear protection and auxiliary control relay circuits
(c) Shunt trip circuits
(d) Switchboard indicating lamp and alarm circuits.

Each battery unit shall incorporate battery cells and duplicate chargers housed in a single panel compartment.

Supplies for switchgear auxiliary loads energised permanently during normal operation shall not prejudice tripping duty under any operating condition.

The battery systems, shall incorporate self regulating battery charging plant and failure of either charger or battery output shall initiate an alarm in the associated monitoring system.

11.1.9 Remote Control Stations

Remote control stations shall be located adjacent to all rotating Plant and equipment, etc. (vent fans and small dosage pumps are excluded). These control stations shall incorporate a motor 'start' push button, an 'emergency stop' push button and a padlockable isolating switch.

The motor 'start' push-button shall only operate when the starter Local-off-Remote switch is set to the 'Remote' position.

Emergency stop push-buttons shall be provided for all motor drives, adjacent to each motor or drive. The emergency stop push-button shall over-ride all other motor drive controls to ensure immediate motor drive shut down or prevent the drive from running.

11.1.10 Power Transformers

The Contractor shall assess the power requirements of the Works and the requirement to generate and distribute power on the Site. The Contractor shall design a power distribution system to meet these power requirements. The design shall incorporate the necessary power transformers to transform power from 10 KV – 20 kV/400 volt. Where possible, the size of power transformers should be the same to allow for interchangeability, in a modular form of design.

The Contractor shall decide on what type of transformers are used and he shall ensure that these are adequately housed and located.

The Contractor shall ensure that the transformers are rated for continuous load operation and full plant load conditions including, where applicable, future loads, at maximum Site ambient climatic conditions. The transformer voltage ratios are at 'no-load'.

The transformers should be designed to operate at 10 KV initially for a period of some years, after which they will be required to operate at 20 KV. The transformers shall conform with the specification included in Volume 7, Section 6 for either oil filled or dry type transformers.

The transformers shall be located indoors and the Contractor shall ensure that all the appropriate precautions are taken in the housing of the transformers.

Each transformer shall be complete with fittings and the appropriate protection shall be provided to suit the transformer size and type.

11.2 Cabling and Earthing

11.2.1 General Cabling

This section covers the supply and installation of the necessary cabling and earthing systems not covered elsewhere in the Employer's Requirements.

The Contractor shall supply, install, terminate, test, commission and identify all control, protection and instrumentation cabling systems necessary for the operation of the Works.

HV cables, forming part of the dual supply to the works shall be buried and separated both outside and within the Site by at least 2.5m to reduce the possibility of physical damage causing a complete power failure to the Works.

The Contractor shall design the cabling installations in accordance with the Employer's Requirements and shall provide all other additional cables necessitated by his particular arrangement of Plant installations.

The Contractor shall provide for the consideration of the Employer's Representative, detailed schematic and block diagrams, together with schedules of all cables he proposes to install for power, control and instrumentation systems. The schedules shall include the following information:

(a) Type of cable
(b) Size of conductor

(c) Number of cores
(d) Voltage grade
(e) Cable Gland
(f) Cable Identification Reference Number
(g) Cable Source
(h) Cable Destination

11.2.2 Types of Cables

The following types of cables shall be provided:

a) MV Power Circuits

XLPE/SWA/PVC/, 20000/35000V grade

b) LV Power Circuits

For conductor sizes above 10 mm^2 XLPE/SWA/PVC, 600/1000V grade.
For conductor sizes 10 mm^2 or less, PVC/SWA/PVC and PVC/PVC, 600/1000V grade.

c) Auxiliary Control and Protection Circuits

PVC/SWA/PVC and PVC/PVC, 600/1000V grade

d) Control and Instrument Circuits

All control monitoring and instrumentation shall have individually twisted pairs, a collective screen, PVC/SWA/PVC or polyethylene insulated construction, a minimum conductor size of 1/1.13 mm dia and 400 V grade.

e) Data Highway

Optical fibre cables shall be used throughout the data highway interconnecting each PLC with the SCADA system master-stations.

11.2.3 Cable Sizes

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.

The short time fault current ratings of all power cables shall match the maximum fault ratings of the associated switchgear plant and protection systems.

The Contractor shall determine by site investigation the values of:

soil temperatures
soil thermal resistivity

With the exception of special cables for analogue signal and measuring circuits, the minimum core size for auxiliary power and control cables shall be 1.5 mm^2.

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

11.2.4 Cable Segregation

Power systems operating at different voltages and control, protection and instrument circuits for separate units of Plant shall be run in separate cables.

On internal cable installations adequate spacing shall be maintained between all power cables to minimise de-rating due to proximity.

A minimum 300 mm spacing shall be maintained between all power and control cables and between MV and LV power circuits.

Analogue and DC control signals must not be run in the same cables. A minimum 600 mm spacing shall be maintained between both analogue and DC control cables and all other cable systems.

On external cable routes a minimum 300 mm spacing shall be maintained between all power and control cables.

11.2.5 Cabling Within Buildings

Cable installations within buildings shall be run in the ducts or trenches provided, or installed on or suspended from structural walls or ceilings. Cables in general building areas shall be installed on heavy duty, hot dipped galvanised steel tray. Cut edges of galvanised tray shall be liberally treated with a zinc paint.

In all locations of the works affected by wastewater effluent or chemicals creating a chemically corrosive condition, cable tray systems shall be of extruded glass reinforced ultra violet and corrosion resistant polyester (GRP) pattern, of approved type and manufacture.

For fixing cable trays in trenches, cable galleries, etc. galvanised steel channel inserts shall be embedded into the concrete, spaced at centres not exceeding 2000 mm. Civil structures utilised to support cable tray systems shall be designed to withstand the additional loading.

11.2.6 External Cabling

The cable routes shall also form the general cable casements which shall be used for the Plant auxiliary control and monitoring system cable installations.

The Contractor shall plan and arrange the external cabling to maintain segregation of cabling systems in accordance with the requirements of Volume 7 of these documents. Separation between cable systems and all other underground services shall not be less than 1300 mm in all directions unless otherwise agreed by the Employer's Representative.

External cables shall be contained within ducts unless specifically agreed with the Employer's Representative in advance.

In ducted section of cable routes the specified segregation between power and control cables shall be maintained throughout the ducted section.

Buried cables shall be installed with cover depths to the top of the protective tiles of 600 mm for control, monitoring and LV cables; and 1300 mm for MV cables.

11.2.7 Earthing

The Contractor shall provide and install a complete earthing system in accordance with the requirements of Volume 7 of these documents.

The system shall be designed to meet the following requirements:

a) under normal and abnormal operating conditions, there shall be no danger to persons in any place to which they have access;
b) the maximum current from any point of fault shall be conducted back to the electricity system neutral without giving rise to dangerous potential gradients either in the ground or between pieces of apparatus and a person who could be in simultaneous contact;
c) the passage of fault current shall not result in any thermal or mechanical damage to the system.

The Contractor shall satisfy the ESB that the earthing arrangements on the electrical installation are compatible with their system requirements.

Earth tape and conductors installed in areas subject to chemical corrosion shall be sheathed with green/yellow PVC

11.2.8 Lightning Protection

A lightning protection system shall be installed in accordance with BS 6651 and the requirements of Volume 7 Section 9.

11.3 Building and Site Services

11.3.1 Plant to be Provided

This section describes the building and Site services required at the Works and specifies particular requirements not covered elsewhere in the specification.

These Site services shall include but not be limited to:

a) Distribution boards, conduit and wiring to provide a complete and adequate electrical services installation for the Works, including Plant buildings and service areas.

b) building services for all buildings incorporated in the Work comprising:
   i) Interior lighting for all Plant and associated buildings
   ii) Small power socket outlets and heating services for all Plant and associated buildings.
   iii) External lighting for each building
   iv) Ventilation for each building

c) Site Services comprising:
   i) Site roadway lighting
   ii) area floodlighting
   iii) access lighting

iv) portable Site dewatering pump outlet sockets

d) Portable extra low voltage equipment
e) Intruder Alarm(s)
f) Site Surveillance CCTV
g) Secure access system
h) Fire detection Alarm System
i) Gas Detection System
j) Telecommunication system
k) Frost Protection

Materials employed and work carried out shall be in accordance with the requirements of Volume 7 of these documents.

11.3.2 Building Services Electrical Power Supplies

The power supplies for all building and Site services shall be provided from the building services switchboards or otherwise shall be derived from distribution boards which, as far as practicable, shall form an integral part of the main LV distribution and Plant control switchboards.

Sub-distribution boards not forming part of LV switchboards shall be complete with outgoing miniature circuit breakers for connection to the services and other equipment detailed in this section.

At least two spare ways for each type and size of circuit breaker in the distribution boards shall be included.

11.3.3 Socket Outlets

These shall be correctly earthed and protected by residual current devices.

At least one 220 V single phase socket shall be provided in each room and in any case shall be within 15 m of any internal part of a building.

At least one 400 V three phase socket shall be provided in each Plant area for maintenance purposes.

11.3.4 Heating

The Contractor shall provide for the supply and installation of suitable electric heaters for all Site offices, and control rooms and shall detail the proposed heating with the Tender. The heating shall be designed to maintain a room temperature of 20°C when the outdoor temperature is O°C.

11.3.5 Ventilation of Offices

Ventilation shall be provided to maintain a temperature of 22°C in all personnel areas, offices, messrooms and the control room when the outdoor temperature is 28°C.

11.3.6 Lighting Design

Building lighting installations shall be designed in accordance with international standards as detailed in Volume 7.

The building internal lighting design shall take into consideration:

a) the operating environment;
b) the type and style of architectural finish;
c) the activities to be performed in the areas concerned;
d) access for maintenance;
e) operating life.

Lighting circuits shall be supplied from the small power and lighting distribution boards incorporating manually reset miniature circuit breakers. For large areas or buildings, separate distribution boards may be located to serve discrete areas.

Switching shall be convenient to doors and entrances, multi-way switching being provided where areas have more than one entrance.

For large areas, lighting shall be contactor controlled. Contactors shall where practical be incorporated within the respective distribution boards.

In areas housing rotating machinery, lighting shall be arranged on multi-phase circuits to prevent stroboscopic effects.

The arrangement of circuits shall be such as to provide balanced loading of the phases.

The Contractor shall prepare detailed layout and installation drawings to show the location of the distribution boards, conduit routes, lighting and other fittings, etc. for consideration by the Employer's Representative, together with illumination level design calculations to support and confirm the proposals.

Except in any building where ceiling or wall finishes permit conduit to be concealed the installation shall be carried out in surface run galvanised conduit. All lighting switches, socket outlets, etc. shall be metal-clad surface mounting type.

11.3.7 Standby Generator Lighting and Small Power Installation

The equipment to be provided under this section shall include but not be limited to the following items, together with conduit and wiring connecting all fittings to their respective distribution boards:

Distribution
Essential lighting fittings
Emergency lighting
UPS for SCADA system PLC
Power supplies for fire protection equipment
Power supplies battery charger
Any other equipment necessary during mains power supply failure to maintain compliance with environmental performance criteria.

11.3.8 Buildings' Emergency Lighting

Emergency lighting shall be provided for all buildings and shall comprise exit and escape route luminaries to facilitate the safe evacuation of personnel from all buildings and structures in the event of power failure.

Emergency lighting shall also be provided in any area where work may be required during such a power failure, e.g. starting of standby generators or other essential plant control operations.

The emergency exit lighting luminaries shall be Type E bulkhead fluorescent, non-maintained type, incorporating self-contained battery/charger/inverter modules.

Emergency luminaries located above or adjacent to escape doors shall be supplied with RUNNING MAN labels.

The emergency luminaries shall be directly connected to the respective area main lighting circuits, to cover both total power and sub-circuit failures.

Emergency lighting circuits shall incorporate test switches to simulate failure of the normal supply. Test switches shall be situated in a position within the area covered by the lighting system to be tested and shall be suitably identified. Switches situated in positions accessible to unauthorised persons shall be of the tamper-proof, key operated type. All such switches shall be operated by a common key and the Contractor shall supply two keys for each switch installed.

11.3.9 Site Road Lighting

Road lighting systems shall be provided to illuminate all site roadways within the treatment plant area.

The lighting systems shall comprise column mounted luminaires in accordance with Volume 7, Section 17.3.

The lanterns shall incorporate high pressure sodium vapour lamps. Lanterns shall be of the side entry inclined overhanging pattern with integral lamp control gear, weatherproof body, and low glare cut-off hood.

The columns shall be sited 2 m from the road kerb edge with extended brackets to locate the lanterns at the kerb.

The columns shall be 8.00 m high with a 2 m outreach arm.

The road lighting shall be fed on independent radial TP&N buried cable circuits fed and controlled from a road lighting switchboard.

Each circuit shall be contactor switched, controlled by a photo-cell switching circuit and manual-auto control selector switch. The contactor, time switch and manual control switch for each area shall be incorporated in the LV road lighting distribution switchboard. Photo-cells, shall be wall mounted on the south face of the building from where road lighting is controlled.

11.3.10 Site Area Lighting

Site area lighting installations shall provide an overall minimum service illuminance of not less than 100 lux at locations where plant operation and emergency maintenance can occur, and shall be provided as shown on Drg. Nr. PATP 26.

Area flood lighting shall be fed from service distribution boards incorporated in the respective plant or ancillary switchgear buildings. Area lighting shall be manually controlled form each respective building and shall be capable of being switched on by a security intruder signal.

11.3.11 Extra Low Voltage Portable Equipment

The Contractor shall provide for each building one set of extra low voltage equipment comprising the following:

1 nr. gripper type handlamp with wire cage 25V 40 W bayonet cap rough service lamp complete with 15 m of 3-core tough rubber sheathed cable and plug of the same type as fitted to 25V socket outlets.

1 nr. 500W, 120V, 50Hz weatherproof portable floodlight complete with stand and 15 m of 3-core tough rubber sheathed cable and plug for 100V centre tapped earth socket outlet complying with IEC 209 and colour coded.

1 nr. 750 VA minimum, triple wound earthed screen step down transformer with 220V, 50Hz single phase primary and two secondary windings one at 110V, 50Hz with centre point earthed of 600 VA capacity and the other 25V, 50Hz, 150 VA capacity. Each winding to be complete with fuses in each lead and housed in a weatherproof enclosure complete with carrying handle. The primary shall be fitted with 2 m of tough rubber sheathed 3-core cable fitted with plug to IEC 309 of the resilient type. Each secondary shall be connected to two integral weatherproof sockets mounted on the enclosure exterior and shall comply with IEC 309 and be colour coded.

2 nr. 25 m extension cables, one for 110V and one for 25V fitted with plugs and sockets of the weatherproof type complying with IEC309. Each lead shall be coiled on a self-contained carrier.

11.3.12 Fire Detection and Alarm

Fire protection and automatic detection and alarm systems shall be provided in all Plant buildings throughout the Works in accordance with IS 3218, 1989 or equivalent.

The fire detection and alarm systems shall comply with the following:

a) A fire detection system shall be provided in each building comprising automatic fire detectors and manual break glass actuators.

b) In multiple room or Plant area buildings the automatic and manual alarm actuators shall be installed in zoned circuits covering each specific room or area.

c) The automatic fire detectors shall operate on rate of temperature rise and fixed maximum temperature characteristics; the maximum temperature alarm actuating at 20°C above peak design internal ambient. Each detector shall incorporate a pilot lamp operation indicator.

d) Automatic heat and smoke detectors shall be ceiling mounting arranged to cover general building areas and specific Plant locations.

e) The manual break-glass actuators shall be wall mounted, located at building entrances, general walkways and corridors and in other areas such that no location in a building is greater than 20 m from an actuator.

f) Alarm/detection installations in ancillary Plant buildings may be installed as zoned alarm circuits from the fire detection systems of associated adjacent main plant building.

g) All detector and alarm circuits shall operate on a normally closed fail-safe circuit principle.

h) Each fire detection system shall operate at 12 V DC or 24 V DC from a single control panel which shall be located at a location subject to the consideration of Employer's Representative. The control panels shall be of the totally enclosed metal clad pattern each complete with integral battery/charger equipment. The control panels shall each incorporate alarm and status indicators together with circuit test facilities to give visual alarm indication of:

i) Actuation of each alarm circuit and zoned protected area
ii) Input power system – Healthy/Failed
iii) Battery/charger output – Healthy/Failed

i) Operation of any fire detector or manual alarm actuator shall operate audible alarm(s) located internally and externally on each building.

j) Alarm system operation together with the operation of a control panel integral equipment fault circuit shall also be annunciated on the SCADA system.

k) All component equipment in the fire alarm installations shall comply with a specification which has been considered by Employer's Representative. All cable and wiring systems for the building alarm and detection circuits shall be in 400V MICC cable with PVC oversheath. All cable terminations for detector and manual actuators shall be in galvanised circular conduit boxes.

l) Alarm circuits between each plant building and the Central Control Panel shall be by dedicated PVC/SWA/PVC control cables.

The fire detection and alarm system shall meet the requirements of Volume 7.

11.3.13 Gas Detection System

Gas detection systems shall be incorporated into those areas of the Works where explosive and toxic atmospheres might occur. These shall include, but not be limited to, the following areas:

a) sludge treatment
b) sludge thickening and dewatering
c) sludge wells
d) gas storage units
e) enclosed pump wells
f) sludge pump rooms

The Plant to be provided shall be in accordance with the requirements of Volume 7 of these documents. In addition to any local annunciation the alarms generated shall be displayed on the SCADA system which shall initiate a high extract purge and detection system.

11.3.14 Telecommunications

The Contractor shall supply a telecommunication system for the treatment plant. Telephone handsets shall be provided within all buildings.

Telephone cables for routes external to buildings shall be multi-pair polythene insulated, 0.9 mm dia. copper conductor, petroleum jelly filled, collectively screened with aluminium tape and copper drain wire, polythene inner sheath, galvanised steel wire armoured and PVC sheath overall. All cores shall be colour coded. All cable interconnections shall be made in termination boxes which shall be installed within the buildings. Underground joint boxes shall not be used. All cables shall incorporate at least 15% spare cores and all cores including spares shall be terminated.

Telephone distribution cables wholly within buildings to junction boxes and outlet points shall be similar but unarmoured, and with conductor diameter not less than 0.5 mm.

Each telephone handset shall be wired using a 2 pair twisted cable terminated at a telephone outlet point equipped with a faceplate and wiring terminals. All main cable and extension outlet boxes shall incorporate moulded plastic screw fixed termination assemblies. Cable core terminations shall be crimped on spade end pattern or wire wrapped.

Telephone cabling within buildings shall be in galvanised steel conduit. The Contractor shall provide the necessary telemetry outstation and equipment to handle analogue and digital signals and communicate with a remote station.

11.3.15 Security System

The Contractor shall provide all the necessary Site security systems to detect intruders and raise alarms on Site and at a remote site. The security system shall be in accordance with Volume 7, Section 23.

11.3.17 Miscellaneous Materials and Accessories

The Contractor shall be responsible for the supply and installation of all miscellaneous Materials and accessories necessary to provide a complete electrical installation to conform with the Specification.

12.0 INSTRUMENTATION, CONTROL & AUTOMATION (ICA) EQUIPMENT

12.1 Drawings and Information to be Provided

The Contractor shall provide drawings and information for this Contract in accordance with the time period specified in Volume 2 – Employer's Requirements – Design Build Works, which shall include:-

- Functional Design Specification
- As Built Drawings
- Drawings for Review
- Final Documentation and Manuals

12.2 Plant to be Provided

The Plant to be provided in this section shall comprise all Instrumentation, Control and Automation equipment associated with the new Treatment Works as detailed in Volume 8 – Instrument, Control and Automation (ICA) Specification and in accordance with the relevant sections of the General Electrical Specification in Volume 7 of these documents.

The Plant to be provided for the Works shall include, but not be limited to, the following:-

(a) ICA panels complete with all accessories
(b) flow monitoring equipment for all main process streams including wastewater, stormwater and sludge treatment plant.
(c) dissolved Oxygen (DO) monitoring equipment
(d) level monitoring equipment
(e) turbidity monitoring equipment
(f) pH monitoring equipment
(g) composite sampling equipment.

In addition, the Contractor shall provide all other monitoring equipment required for the full functional and safe operation and maintenance of the Works.

The Contractor shall provide a portable "engineer's" computer complete with PLC programming software and copies of all PLC programmes. This shall, also, include all cables required to interface the computer with the PLCs so that modifications to PLC programmes can be undertaken.

All PLCs and monitoring equipment shall operate at 230V, 50Hz and shall be supplied from a UPS such that monitoring of all plant conditions is maintained during a mains power supply failure.

PLCs shall be from one manufacturer and of a common model type.

All Plant and equipment and products containing electronics must carry a CE mark to prove its compliance with the EU Directive 89/336/EEC.

12.3 Control Room ICA Panels

12.3.1 General

All ICA panels shall be indoor pattern located within the respective Plant buildings or in civil structural housings which shall be provided adjacent to outdoor treatment plant.

Each local Plant MCC shall have an associated ICA panel which shall be manufactured in accordance with the Engineering specification. It shall include, but not be limited to, the following equipment and facilities:-

(a) Local PLC, key-pad and display unit
(b) UPS System
(c) Relays as required to interpose PLC I/O with plant control equipment.
(d) Alarm annunciator panel to give local indication of those failures not indicated elsewhere on the ICA panel or corresponding MCC. The alarm system repeat contacts shall not be used for alarm inputs to the SCADA system. SCADA inputs shall be discrete.
(e) Pushbuttons, signal lamps, selector switches and indicating instruments and all other necessary plant for the automatic or manual control of Plant.
(f) Monitoring instrumentation as required for the effective operation and maintenance of the Works.

For the pumps, blowers, valves and penstocks the controls, signal lamps, switches and indicators shall be mounted on the respective panel as a group for each item of Plant.

In all cases where a mimic display, duty selection or setpoint adjustment is called for on the PLC system, then this facility shall also be provided on the SCADA.

12.4 ICA Panels

ICA panels shall be located within control rooms as free standing panels or be incorporated into MCC's as an integral part of the panel suite. They shall comprise, but not be limited to, the following main items of equipment:-

(a) PLC system for the control and monitoring of pumps and associated rotating plant and equipment.

By means of an associated PLC keypad an operator shall have the facility to select a variety of mimics for presentation on the PLC display unit with the added facility of modifying control setpoints. These mimics shall include:-

i) Simplified displays of rotating plant and auxiliary equipment, with status, set-point, flow and level indications displays of boilers, dryers, blowers, pumps and associated plant, with status, set-point and variable value indication.
ii)A display of the duty for each pump or rotating plant item, with the facility, by use of the PLC keypad, to manually select duty; or to select auto-duty rotation such that the duty of each rotating Plant item is automatically changed after a preset time has elapsed.

(b) UPS in accordance with Volumes 7 and 8 of these documents. The UPS shall be supplied from an Auxiliary Switchboard. In the event of UPS failure, or if the UPS is taken out of operation for servicing, then an alternative supply shall be provided from an associated motor control centre.

(c) Alarm annunciator in accordance with Volume 8 of these documents. It shall include those failure indications not displayed at the local MCCs, these generally shall include level monitor failure, high level, primary protection alarms, DO, SS monitor failure, flow monitor failure, temperature failure etc.

(d) Process monitoring equipment shall include:

i) Dissolved Oxygen monitors
The 4-20mA output from these DO monitors shall be transmitted to the PLC to provide control and process monitoring on the SCADA system.

ii) Pitot tube & DP Cells, flow measurement.
Located within the air pipelines the 4-20mA outputs shall be transmitted to the PLC to provide control functions.

iii) Ultrasonic flow monitoring.
The 4-20mA output from each flow monitor shall be transmitted to the PLC to provide process monitoring on the SCADA system.

iv) Electromagnetic flow monitoring
The 4-20mA output from each flow monitor shall be transmitted to the PLC to provide process monitoring on the SCADA system.

v) Mass flow meters to monitor gas flow.
The 4-20mA outputs from these flow monitors shall be transmitted to the PLC to provide plant control and process monitoring on the SCADA system.

vi) Temperature monitors.
The 4-20mA outputs from these temperature monitors shall be transmitted to the PLC to provide plant control and process monitoring on the SCADA system.

vii) Position switches, or linear position transmitters.
The digital, or 4-20mA, outputs from these devices shall be transmitted to the PLC to provide process monitoring on the SCADA system.

viii) Ultrasonic level monitors
Located within sumps, chambers and tanks. The 4-20mA output from each level monitor shall be transmitted to the PLC to provide a control function. Hard wired detection status shall be provided to the PLC.

ix) Electrodes or float switches
For sumps, chambers and tanks, high level alarm annunciation.

x) Presure gauges, switches, sensors and transducers associated with Plant operation and monitoring.

xi) All other instrumentation required for the full and safe functional operation of the Works.

12.5 MV / LV Substation PLCs

A PLC shall be located within the new MV/LV substation. The PLC shall collect all those signals associated with the MV/LV distribution switchgear generators and transformers for monitoring and display on the SCADA system. The PLC shall operate from a 230V, 50Hz supply fed from an associated UPS with a second supply available from the local distribution board in the event of a UPS failure.

12.6 Surge Protection Devices for Electronic Equipment

All electronic equipment installed shall be protected from electrical transients arising from;-

i) atmospheric lightning
ii) electrical switching events
iii) electronic equipment

To achieve this effective protective devices shall be installed on:-

i) mains power supplies
ii) data communication and signal lines to limit tansient voltages to a level where they can have no detrimental effect.

The Contractor shall provide a detailed schedule of the equipment with calculations to the Employer's Representative for review.

12.7 Plant Control System

12.7.1 Works to be Included

The Works included in this section shall comprise the design, manufacture, supply, installation, of the Plant Control System.

This section details the main systems and Plant together with the proposed methods of control of the Plant installations, and shall be read in conjunction with the mechanical and electrical Plant, and measuring equipment sections of the Specification.

In addition to the supply and installation of the Plant Control Systems, the Contractor shall also be responsible for testing and commissioning as detailed elsewhere in this Specification. As an integral part of the commissioning procedure the Contractor shall ensure, and demonstrate to the Employer's Representative, that all the monitoring, instrumentation and control systems are adjusted to achieve optimum control of the treatment plant process and/or Plant operation and that all control systems are correctly interfaced and operating as a fully integral system.

The Plant Control System and main items of Plant to be supplied shall include:-

a) Supervisory, Control and Data Acquisition system (SCADA) for the treatment plant
b) Control and indication at each location based on a Programmable Logic Controller (PLC)
c) Back-up power supplies for each PLC

All power and control cabling associated with the above Plant shall comply with the relevant clauses of the General Electrical Specification in Volume 7 of these documents.

12.7.2 Treatment Works Operating Philosophy

The monitoring and control systems shall provide for the automatic operation for the process Plant, pumping Plant and their associated support and subsidiary Plant installations, with minimum operator intervention.

12.7.3 Site Operation

The treatment plant shall be supervised by a SCADA system master station located in the administration buildings at the Treatment Works.

Within each Plant area, the individual Plant installations shall be controlled by PLCs located within their respective local control panels. These PLCs shall communicate with the SCADA system master station using communications systems as detailed in Volume 8. The local PLC system shall monitor the operation and carry out interactive control functions between the Plant and installations within its sphere of operation. Any process safety or plant critical alarms/trips or controls shall be hardwired between Plant installations. Each

local PLC system shall incorporate a man machine interface (MMI) unit complete with a key pad for re-setting local parameters and setpoints, a visual display unit for viewing Plant status, parameters and setpoints and an input terminal for the "engineer's" laptop computer.

Under abnormal operating conditions, or a control system failure, each Plant installation shall be capable of being switched to manual control from local control panels and associated motor control and Plant switchboards.

The local PLC systems shall pass all the Plant information to the SCADA system master station. The SCADA system master station shall not directly control the Plant, but shall have the ability to select modes of operation, ie duty rotation of pumps, when the Plant is under automatic control of the local PLC system.

Automatic control sequences shall continue to operate under automatic control except when manually selected to "local", "off" or "plant" on the control panel.

A PLC shall be located in those areas where no control function is required. These shall only transfer data between the Plant and the SCADA.

A SCADA masterstation shall operate autonomously with the ability to monitor the complete Works in the event of the other masterstation being off-line (out of operation). On re-starting the off-line masterstation it shall update its internal memories by retrieving the current data from the on-line (operational) masterstation.

All Plant input/outputs shall be indicated at the local PLC system MMI unit. These signals shall subsequently be transmitted to the control rooms for processing, display and storage by the masterstation computer system.

A programme development system shall be provided which shall be capable of amending the system configuration and control database to incorporate future expansion to the Works and also to take advantage of future technological developments which may take place in the field of wastewater treatment applications software.

Where a dedicated PLC control system is incorporated in a Plant control panel then the PLC equipment shall utilise the same protocol/language as the SCADA system. However, if the Contractor proposes to use individual Plant control systems with a different protocol/language than valid user certificates for the control panel to SCADA system protocol conversion shall be submitted to the Employer's Representative for consideration.

The facility to adjust the operational parameters on any item of Plant shall be available at the PLC and remotely at each master-station.

A PLC System shall comprise a PLC, front panel mounted keypad and display unit necessary for the control and monitoring of the plant for which that control panel is responsible. The direct control of plant from the motor control switchboards shall be manual only.

The PLCs shall scan all associated I/O for transmission to the masterstations. Automatic control sequences for the plant shall be carried out within the local PLC control system; but under abnormal operating conditions, or a control system failure, the plant shall be switched to manual control from the relevant local control panel(s) or motor control switchboard.

An inverter/battery UPS power system shall be installed in accordance with Volume 7 –

General Electrical Specification and Volume 8 – ICA Specification to maintain each PLC system under a mains failure condition.

12.8 Interface with Atlantic Pond Pumping Station

The Ballinure Header Chamber and the two local pumping stations deliver wastewater to the Works and in order to avoid problems of flooding at times when the treatment plant is unable to accept incoming flows, the facility is required to send an interlock signal to these three locations to prevent them from operating subject to a protocol agreed with the Employer's Representative.

12.9 SCADA System

12.9.1 General

A computer based SCADA system shall be provided to operate in conjunction with the PLC based control system by providing a man-machine interface at a central location within the Works which can view and (to some extent) control the PLCs which run the Works. The Contractor shall supply, install, test, and commission all necessary hardware, software and associated peripheral devices which will form part of the SCADA system. The SCADA system shall be generally as indicated by this Specification.

Normal operation of the wastewater treatment system will be fully automatic and the SCADA equipment will be used to carry out functions such as mode control, set point adjustment, data logging and archiving at the same time as allowing one or more operators to monitor the system. The SCADA system functionality shall permit full access to all features for any part of the Site from all operator workstations.

12.9.2 SCADA System Functions

The SCADA system shall carry out or assist the following actions:

- Indicate status of all main or important drives;
- Indicate status of all actuated valves, bellmouths and actuators;
- Display the status of devices in graphical format (ie running, stopped, fault etc);
- Display all analogue values measured by instruments;
- Annunciate alarms associated with the area of the Plant concerned including details of the time the alarm occurred;
- Carry out totalisation of flows;
- Provide facilities for the operator to:
  - acknowledge alarms;
  - view a journal of unacknowledged alarms;
  - view a journal of acknowledged and unacknowledged alarms;
  - display and select the duty drive of duty/standby drive pairs;
  - adjust and Display process set points.
- Carry out real time and historic trending of analogue values;
- Carry out data archiving of all analogue values;
- Prepare daily, weekly, monthly and annual reports;
- Display a total running hours log of main or important drives.

12.9.3 SCADA System Hardware

The Contractor shall provide the following hardware for the SCADA system:-

- 2 nr. operators terminals complete with monitors, keyboards, pointing devices etc. One of the computers shall be the "server" and the second computer shall be a "client".
- 1 nr. demonstration monitors to demonstrate the operation of the treatment plant for visitors. This shall be a 42 inch plasma type.
- 1 nr. standard serial interface dot matrix type printer.
- 1 nr. standard parallel interface colour ink jet printer
- Data back-up system comprising of 1 Nr. CD-ROM writing unit (WROM).

12.9.4 Furniture

The Contractor shall provide desks and furniture to house the computers, printers, UPS and associated peripherals and equipment.

In adition the Contractor shall provide 2 nr. operators chairs.

12.9.5 SCADA System Software

The Contractor shall provide a proprietary software package for the SCADA system which has a proven track record in the European wastewater industry. Using this software the Contractor shall provide a fully programmed and configured system which shall include the following system functions:-

- Clear language menus for operator interface
- Password access for features on operator's panel.
- Help facility for functions and alarms etc
- Alarm annunciation and printing etc
- Status monitoring of Plant via volt free contacts
- Analogue signal monitoring of Plant and instrument parameters
- User programmable software to allow operators to construct programmes for plant control.
- Integrated control utilising proportional, integral and derivative control techniques
- Auto power up of plant after a power failure.
- Logging of status or value of system points at regular time intervals or change of state and storing of this information/data
- Data analysis and report preparation utilising proprietary spread sheet packages.

12.10 Effluent Quality Monitoring

In order that the performance of the Works may be effectively monitored, inlet and outlet wastewater and also sludge from various process areas are required to be analysed by on site instrumentation.

12.11 Instrumentation

Instruments shall be provided to measure all variables as shown on the P&I Diagram for the Works. Instruments shall be of an approved type from a major international manufacturer and be supplied with manufacturers calibration certificate and a Year 2000 Compliance Certificate.

Instrument types include the following:-

- Electromagnetic flowmeters
- Ultrasonic level devices
- Float switches and level sensors
- Hydrostatic level measurement
- Pressure measurement transducers
- Pressure gauges and switches
- Turbidity measurement
- PH measurement
- Composite samplers
- Analytical instruments
- Signal Conditioners

12.12 Testing and Commissioning

Equipment shall not be delivered to Site unless an inspection has been carried out or waived in writing by the Employer's Representative. Tests should be organised to represent the installed condition as closely as possible and shall include the following:-

a) Factory Acceptance Tests (FATs)

These tests shall provide documented evidence that system under test meets the functional and performance requirements of the FDS (Functional Design Specification).

b) Site Acceptance Tests (SATs)

These tests shall encompass the normal modes of operation and failure modes and demonstrate correct functionality of the system in accordance with the Specification. The tests shall be fully documented.

c) Commissioning

Commissioning shall be carried out on complete Design-Build Works where every item of equipment shall be individually tested and then collectively to form an integrated system.

13.0 TREATED EFFLUENT OUTFALL

13.1 General

13.1.1 Scope

This section gives all the mandatory requirements relating to the design of the outfall. Any offer that does not comply with this section in every respect is non compliant and will be treated as a qualified offer.

13.1.2 Drawings.

The Tender Invitation drawings are included in Volume 9.

13.1.3 Available Information.

In addition to the published sources (Admiralty tide tables, Charts, DoE Offshore design Code for wind / wave data etc.), the following information is available:-

(a) Boreholes logs, cores, samples, testing and analyses carried out by Norwest Holst in 1999 on behalf of the Employer. The factual report on this investigation was contained in Volume 10 of the Tender Documents.

(b) Bathymetric survey at 1:2500 scale dated 25.01.99 carried out by Norwest Holst in 1999 on behalf of the Employer. The factual report on this investigation was contained in Volume 10 of the Tender Documents.

(c) Geophysical survey carried out by Norwest Holst in 1999 on behalf of the Employer. The factual report on this investigation was contained in Volume 10 of the Tender Documents.

(d) Current meter measurements at the diffuser and 3 points in Lough Mahon, referred to in the Foreshore Licence Application which was included in Volume 12 of the Tender Documents.

(e) Three dimensional numerical flow model currents in Lough Mahon and the channels and inlets between the site and the open ocean. These were primarily designed to examine the water quality but sediment dispersion was also modelled and the current vectors are given. These are referred in the Foreshore Licence Application which was included in Volume 12 of the Tender Documents.

(f) Limited dredging records and bathymetric data for the navigation channel in Lough Mahon, supplied by the Port of Cork Company. This information will be made available to the Contractor.

Further information from the Port of Cork Company or other sources shall be researched by the Contractor.

The Contractor shall review all this information and may use it as a basis for his design.

The Employer does not warrant the accuracy or sufficiency of this data and errors in the information shall not relieve the Contractor of any of his responsibilities and duties under the Contract.

13.1.4 Design responsibility

The Contractor shall be responsible for the design, construction, commissioning, operation and maintenance of the outfall.

This responsibility shall include:-

(a) Hydraulic design of the outfall and diffuser.
(b) Compliance with the licences and consents, obtained by the Employer or with variations to these consents, as necessary for the Contractor's design or construction methods.
(c) Selection and detailed specification of the Materials, for every component of the outfall and diffuser.
(d) Structural design of the outfall and diffuser covering both the temporary and permanent load cases for the Permanent Works
(e) The design of the temporary works including the side slopes of the dredged trench and the stresses in the Permanent Works during installation, to ensure that these do not impair the function or durability of the finished work.
(f) Demonstrating that the outfall operates in the required manner.

13.2 Marine Licences, Permits and Permissions

13.2.1 General

The Licences, Permits, Permissions and Agreements outlined below have been obtained by the Employer and the Contractor shall comply with them or any variations or amendments to them that may be subsequently approved by the issuing authority. All other licences, permits, permissions and agreements shall be obtained by the Contractor.

13.2.2 Tenders

Tenders shall include a design, specification and method statement that complies with the Licences etc in every respect.

13.2.3 Contractor Proposed Alternatives

If the Contractor wishes to propose a design, specification or method of construction which does not comply with the terms of one or more of the licences etc or the premise on which they were obtained, the Contractor shall notify the Employer's Representative as soon as he becomes aware of this fact, clearly identifying the source of conflict.

The Employer's Representative shall consider the Contractor's proposals but shall be under no obligation to authorise any application to vary the terms of a Licence etc and may determine that the Contractor must comply, without the Licence.

Where the Licence, etc can only be obtained in the name of the Employer, the Employer's Representative may give his consent to allow the Contractor to develop his proposals and apply for a revision or amendment to the relevant licence on behalf of the Employer. This shall be carried out at the Contractor's risk and the Employer will accept no responsibility for any consequences of pursuing an amendment, nor will he be obliged to assist the Contractor with his application.

Where the Licence etc can be obtained in the Contractor's name the Contractor may, with the Consent of the Employer's Representative apply for a new or revised licence etc. The Contractor shall bear all risks for the consequences of his application.

The Employer's Representative may withdraw his consent if, in his opinion the programme for completion of the Works will suffer or if the Employer will be affected in any way to his detriment.

Nothing in the foregoing shall relieve the Contractor of his obligations under the Contract.

13.2.4 The Foreshore Licence

The Foreshore Licence, issued by the Department of the Marine and Natural Resources covers the final effluent outfall, the Lough Mahon Siphons Contract and the two tunnel crossings near the City Centre. The Licence and the section of the application that applies to the final effluent outfall was included in Volume 12 of the Tender Documents. The full application is available for inspection during the Tender Period.

The Foreshore Licence covers all works below mean high water spring tide and permits the locating of the outfall , the construction of the temporary and permanent works and the discharge of effluent from the outfall, in accordance with the details submitted in the application.

With respect to this Contract the Licence does not specify an area for temporary stockpiling of excavated material. The Contractor shall apply to the Department of Marine and Natural Resources for approval, under the Licence, of his proposals.

The Licence does not cover the dredging of suitable bedding, backfill or cover materials.

13.2.5 The Dumping At Sea Licence

The Dumping at Sea Licence will be issued by the Department of the Marine and Natural Resources and permits the disposal of surplus unsuitable material excavated from the outfall trench and from the navigation channel as required by the Port of Cork, in accordance with the terms of the Licence.

The co-ordinates of the marine dump site associated with the dumping at Sea Licence are as follows:-

51°43.00' N	8°10.18' W
51°43.00' N	8°09.00' W
51°44.50' N	8°09.00' W
51°44.50' N	8°10.18' W

Comment [PJ7]: Addendum 7: A7.4 (folows changed to follows)

13.2.6 The Port of Cork Requirements

The Contractor shall comply with the requirements of the Port of Cork Company and local Fishing Committees, these are reproduced in section 41 of Volume 5.

13.2.7 The Planning Permission

The Contractor shall comply with the planning permission from An Bord Pleanála as amended by the design shown on drawing no 4797-N126-C dated Feb 99.

13.2.8 Mandatory Requirements.

The following requirements are mandatory and cannot be the subject of an alternative or licence amendment:-

(a) The horizontal alignment of the outfall, as defined in Table 13.1.
(b) The horizontal alignment of the diffuser, as defined in Table 13.1.
(c) From Chainage 260 metres to Chainage 620 metres, as defined on Drawing A4797N-126-C, the cover to the outfall shall not be less than 2.3 metres.
(d) Backfill and armour that will comply with the planning consent Drawing A4797-N-126-C.
(e) From Chainage 260 metres to Chainage 780 metres, as defined on Drawing A4797 N-126-C, the outfall shall be laid in a trench not less than 16.4 metres wide and armoured with a layer of stone not less than 1m thick.
(f) The effluent shall be diluted with not less than 20 times its volume of ambient water at the sea surface at mean low water spring tides, with the maximum effluent discharge and zero ambient current.
(g) The diffuser shall not have less than 5 ports, equally spaced along the 63.8 m length of the diffuser. The calculated discharge through the ports shall be equal at mean sea level [MSL] at maximum flow.
(h) The design life shall a be a minimum of 60 years.

13.2.9 Coordinates.

The coordinates of the outfall and diffuser, as approved in the planning consent are:-

Table 13.1 Horizontal Alignment of Outfall

Point	North	East
Landfall - shore end of works covered by this section	177032	70507
Junction of outfall with diffuser section	176746	69736
Seaward end of diffuser - terminal port	176683	69726

Comment [P J8]: Addendum 3: A3.4

13.3 The Employer's Design

13.3.1 Status of the Employer's Design

The Employer has carried out a conceptual design; compliance with this design will not relieve the Contractor of any of his responsibilities or duties for design and compliance with the licences and consents.

Nevertheless the Contractor shall review the Employer's design and provide the conclusions of this review. Calculations are included as Appendix D to this volume.

With respect to hydraulic capacity it should be noted that the outfall pipe and diffuser design, set out in Appendix D "Employer's 1998 Treated Effluent Outfall Conceptual

Comment [P J9]: Addendum A3.2 (wording modified to allow addendum to be added to Clause 13.3)

Comment [P J10]:

Comment [P J11]:

Design" was based on a Total Design Flow of 3.85m^3/sec through the outfall and diffuser, which was the flow envisaged at that time. Subsequent to the wastewater survey of 1998, the design flow was increased to 4.16m^3/sec. The design included in Appendix D is an indicative design only and the Contractor will be required to design the outfall and diffuser to standards which shall conform with Clause 14.7 of the Employer's Requirements in this Volume 4 and to standards no less favourable than that set out in the indicative design included in Appendix D. Modification to the outfall design and changes to the diameters of the outfall or diffuser pipes may be required. These changes of diameters will not render the design "non compliant". The Employer would, however, have to notify the Department of the Marine and Natural Resources of any changes to pipe diameters, if they occurred.

13.3.2 The Employer's Design Criteria

In addition to the mandatory requirements given above the Employer's design criteria include:-

(a) Outfall internal diameter 1400 mm.

(b) Diffuser comprising 18 vertical ports at 3 m centres alternating with 18 horizontal ports at 3 m centres.

(c) Pipe invert through the diffuser section 12.7 m below O. D.

Note the pipe invert is 0.5 metres above the sea bed, at the diffuser position.

13.4 Design Criteria

13.4.1 Scope

In addition to compliance with the licences and consents as defined at 13.2 above, the Contractor's design shall comply with the requirements set out in this section .

13.4.2 Design Codes, references and text books

Where a relevant design code or text book that is applicable exists (e.g. The Det Norske Veritas Rules for Submarine Pipeline Systems, D o E - Design of Offshore Structures etc.) it shall be used. Where no design code exists, the reference used shall be stated.

Copies of all design codes not referred to in this document and of all papers used shall be included in the first submittal in which they are used or attached as appendices to the calculation books.

The Contractor shall also include a list of the key text books (e.g. Roarkes Formulas For Stress and Strain, Lambe and Whitman Soil Mechanics, Tables for the hydraulic design of pipes, Sewers and channels - HR Wallingford & Barr) in his design submittal.

13.4.3 Overall hydraulic design

The outfall and diffuser shall be designed to discharge all the effluent from the Works against a tidal level with a 1:50 year return period.

A basis for the design, which will be deemed to satisfy this requirement is set out in Table 13.2.

Table 13.2 Hydraulic Design Basis

Parameter / Method		Notes
Max. Flow Rate	4.16 m^3/sec (min)	Full influent to the Works + process additions or as modified by lag though the Works or the provision of a holding tank
K value for mature pipe (slimed),	3 mm	To be increased if treatment by lime dosing is used or may be reduced if good evidence for the removal of slime by shear is presented
Friction head loss Calculation		Colebrook White Formula.
Form and Manifold losses		D. S. Miller "Internal Flow Systems" BHRA
Non return valve losses		As determined by valve supplier, based on physical test.
Upstream head	Highest permissable level at the works	From Contractor's design calculations
Downstream Head	HAT +)Δ H	HAT from the British Admiralty tide tables or local predictions.)Δ may be taken as 0.025

13.4.4 Saline intrusion and purge

As far as physically possible the outfall and diffuser shall be designed to remain full of effluent at all times.

The fitting of "Tideflex" valves manufactured by the Red Valve Co of Carnegie, Pa, U.S.A. or approved equivalent, to all the ports will be deemed to satisfy this requirement.

If fitted, non return valves shall be designed to resist a back pressure equal to the maximum rise in sea level that could occur in any 12 hour period (i.e. around 5 metres)

If non return valves are not fitted, the outfall and the diffuser shall be designed and operated so that:-

(a) the smallest peak daily flow (i.e. the minimum possible peak dry weather flow at commissioning) is sufficient to purge sea water from the outfall.

(b) the least densimetric Froude number at any port is not less than 1 (one) at the minimum night time dry weather flow, when the plant is commissioned.

(c) the flow, as defined at [a] above, shall be sufficient to remove settled sediment from the outfall and all parts of the manifold. It shall be assumed that this sediment may be derived from either the works or the sea or both.

13.4.5 Manifold

The manifold shall be designed so that the flow though any port, (in m^3 / sec) is between 0.9 and 1.1 * (4.1 / total number of ports) when the sea is at MEAN SEA LEVEL [MSL] with a density of 1.025 and the flow through the works is a maximum.

The variables to be included in the calculation are, internal diameters of the main and branch pipes, port diameters, non return valve losses (at part flow), line to branch geometry (losses).

The manifold shall be tapered to ensure that all ports discharge at the average dry weather flow rate.

13.4.6 Initial dilution.

The initial dilution shall be determined for the peak flow at mean high water springs MHWS, MLWS and MSL using any internationally accepted buoyant plume model.

The current CORMIX and RSB models of the US EPA are acceptable.

Compliance with 13.1.3 [e], shall be demonstrated.

13.4.7 Security, future dredging and accidental load cases

The Contractor shall adopt design parameters and materials to assure the integrity of the diffuser until 60 years after the issue of the Taking-Over Certificate. If, during the Operations and Maintenance Works, any part of the outfall or any part of the diffuser are damaged, he shall reinstate the outfall and /or diffuser so that neither the performance nor

the design life are impaired. The outfall and diffuser shall be covered by an indemnity from the Contractor or covered by insurance throughout the full Operations and Maintenance Works period.

The risk assessment and calculations shall be based on the following assumptions:-

(a) The channel may be dredged to -13.2 m OD MH (approx 10.62 m CD) at any time during the design life.

Comment [MSOffice12]: (J C in PJH Office)Addendum A6.1

(b) The limits of this future dredging will be as shown on drawing no A5124-N006-A.

(c) The new channels may be used with vessels of up to 12 metres draft, when fully laden.

(d) The types of vessel, with this draft (12 m), will include bulk carriers (tankers), LNG / LPG carriers and container ships.

Load cases to be considered & provided for in the design shall include:-

(i) Direct hit by anchor dropped on the diffuser.

(ii) Anchor cable dragged over the diffuser.

(iii) Vessel straddling over the outfall / diffuser.

(iv) Scour caused by wash from the propellers of vessels turning in the proposed swinging basin.

(v) Over dredging / dredging outside the channel limits, either to form or maintain the channel.

(vi) Over Dredging / dredging outside limits, either to form or maintain the specified pocket for the diffuser.

The risk assessment and resulting design / indemnity / insurance policy, shall be presented with the design submittals.

Comment [PJ13]: Addendum 7: D7.13

13.4.8 Durability, materials design life

Save for parts that can be replaced regularly as maintenance (e.g. "Tideflex" non return valves and impressed current cathodic protection systems) the components of the outfall shall be made from Materials that should give a life of more than 60 years with the end of the useful life after 100 years. For example, cover to steel reinfocement and coatings to steel tube should be selected to give a life of 60 years before corrosion commences. Thereafter corrosion allowance and redundancy in the design should allow a further life of several decades.

Standards which will be deemed to satisfy this general requirement are set out in Table 13.3:-

Table 13.3 Material Standards

Material and Application	Life
Solid wall polyethylene in pipes exposed to effluent internally and buried externally or enclosed in steel or concrete.	Indefinite (compliant) if the normal in service stress is below the 500 year creep stress and it can be shown that there is no risk of fast fracture under any combination of combined applied

Material and Application	Life
	and temperature stress.
Solid wall polyethylene in pipes exposed to flowing sea water (i.e. in the water column)	Nil, in the absence of evidence that there will be no attack by marine borers (not allowed).
Reinforced concrete in pipe surround, pipe linings and piles / support to the diffuser	Compliant provided the crack widths are less than 0.2 mm (BS 8110) and all other criteria as required under the tables headed "intended for a working life of at least 100 years" in draft standard prEN 206 "Concrete, Performance, production and conformity" or if issued the final version of this document.
Mortar lining to steel pipes.	25 mm thick to AWWA C203 or 205 with 1:1 sand : cementitious material by weight. Cementitious material 70% opc 30% pfa or equal.
Other lining materials	Acceptable subject to corrosion allowance from the end of the proven coating life to 100 years.
Steel exposed to sea water / steel coated with a paint system + sacrificial anode cathodic protection.	Compliant with zero corrosion at 60 years in accord with DNV rules 1981 or 1996 or equivalent standard
Steel with no effective coating + impressed current cathodic protection.	Compliant with cathodic protection designed to DNV rules or other international standard.
Tin bronzes (i.e. zinc free) & Monel metal not in electrical contact with any steel part.	Compliant
High performance plastics (e.g. nylon 66) for nozzles, bolts etc.	Compliant
Stainless steel and other alloy which resist corrosion by the formation of a stable oxide layer.	Generally not acceptable.

13.4.9 Access for cleaning

No provision for emptying the line is required.

The Contractor shall ensure that the capacity of the outfall and diffuser is not less than assumed in the design calculations for 20 years after commissioning. After 20 years he shall demonstrate that the k value is not greater than assumed in the design calculations.

Access points for cleaning shall be provided, as the Contractor deems necessary, to enable him to comply with this obligation.

13.4.10 Load Cases

Load cases shall include all the identifiable temporary and permanent conditions and possible combinations of these conditions.

13.4.11 Stresses in pipe materials

Steel components shall not be stressed to more than the yield stress under any condition.

Steel tube shall not buckle if subjected to any identifaible load case. The DNV rules may be used to demonstrate compliance with this criterion.

Acceptable design philosophies and the related design assumptions are included in Table 13.4.-

Table 13.4 Permitted Pipe Stresses

Pipe type	Design assumptions	Permitted stresses.
Steel tube, wrap and non structural weight coat, plastic lining and corrosion allowance internally	All ring bending and longitudinal stress taken in the steel tube. Weight coat assumed to be cracked to the NA at all times.	In steel tube not more than:- • 85% F_y during installation. • 66% F_y normal in service to 60 years • 100% F_y normal in service after 100 years. • 100% F_y for accidental load cases with a probability of occurrence of less than 0.02 in any year.
As last but with mortar lining	As last	As last, but normal in service not exceeding 180 N / mm^2
Steel tube with structural concrete surround and mortar lining	All ring bending taken in the concrete. Long. stress taken in the steel tube.	As last but cracks in concrete calculated in accordance with BS 8110 less than 0.2 mm in service.

Plastic pipe shall be solid wall extruded polyethylene designation PE 100.

It shall comply with the requirements of the draft code EN 12201 part 1, 2 and 3 where these are applicable.

Design and installation shall be in accordance with the Water Research Centre "Polyethylene manual: 2nd edition 1994.

The combined stresses due to temperature, ring bending + internal pressure at low tide with a discharge of maximum flow shall be calculated. This stress shall not cause failure at 500 (five hundred) years based on extrapolation of the manufacturer's test data from a test over not less than 1000 hours carried out with the specimen at 20 deg Centigrade.

13.4.12 Joints

Joints that are equal in strength, stiffness and durability to the remainder of the line and have been fully inspected before the pipeline enters the water are acceptable. Joints that satisfy this criterion include:-

[a] Butt welds in steel tubes inspected by radiography with pipe wrap made good and holiday tested, concrete surround formed and either fully (14 day) cured or sealed in a temporary steel casing / formwork, lining made good and inspected to the same standard as the lining to the pipe sections.

[b] Fusion welds in plastic pipe either:

CONTENTS

PREAMBLE

The complete set of documents for this contract consists of two volumes and the contract drawings. The Preliminary Safety & Health Plan is issued for information purposes only.

Volume 1 Instructions to Tenderers and
Conditions of Contract (Doc. Nr. A4634-N-S-02)

Volume 2 **Specification and Schedule of Prices**
(Doc. Nr. A4634-M-S-01).

Contract Drawings

Preliminary Safety and Health Plan (Doc. Nr. A4634-N-H-01)

SECTION 1.0

SPECIFICATION

SECTION 1.1

GENERAL SPECIFICATION

1.1 GENERAL ARRANGEMENT

1.1.1 Scope of Work

The scope of the contract provides for the supply and installation of pumps, associated pipework and related electrical equipment for the proposed new pumping station at Atlantic Pond, Cork. The pumping station will be constructed as part of a separate Civil Works Contract. The scope of the Pumping Contract will include for the following:-

(i) 4 Nr. storm (SWF) pumps.
(ii) 4 Nr. main foul (DWF) pumps.
(iii) 2 Nr. Minimum flow foul pumps.
(iv) 5 Nr. sump pumps.
(v) Suction and delivery pipework.
(vi) Reflux and isolation valves.
(vii) Pump starters.
(viii) Power and control cables from starters to pumps.
(ix) High and low level control.
(x) Surge protection equipment

1.1.2 Drawings

The scope of the works is set out in the following drawings:-

Drawing Nr.	Title
A4634-M001	General Layout of Pumps and Suction Pipework.
A4634-M002	General Layout Pressure Pipework, Plans & Sections.
A4634-C009	Sectional Plan at -3.75m and Typical Sections.
A4634-C010	Sectional Plans at -12.27m, -10.90m and -6.75m.
A4634-C019	River Outfall Plan and Longitudinal Section.
A4634-N003	Pumping Station Process and Instrumentation Diagram.
A4634-A004	Floor Plan of Pump Station Building.
A4634-A005	Cross-section of Pump Station Building.
A4634-E001	Overall Single Line Diagram.
A4634-E011	Electrical Services Layout at Ground Fl. & Sump levels, & 3D Sectional view of Pump Station for Pumping Contract.

1.1.3 Pumping Station Layout

The layout of the pumping station will be as shown on the general arrangement drawings. The main pumps will be located in a central circular dry well, with the wet wells located around the outside of the sump. Valves on the delivery pipework will be located in valve chambers situated directly over the wet wells or on the risers from the pumps.

Rotating bar screens with a 100mm spacing will be located upstream of the pump sump inlet and will provide protection to the pumps from large debris.

The pump sump will be divided into four sumps, 2 Nr. foul sumps and 2 Nr. storm sumps. Each half of the pump station, i.e., 1 Nr. foul sump and 1 Nr. storm sump will be capable of handling the full design flow of the pumping station. Two main foul pumps, capacity 1,225 l/s each at maximum head and one minimum flow foul sump, capacity 100 l/s at maximum head shall pump from each foul sump. Two storm pumps, capacity 2,500 l/s each at maximum head, shall pump from each storm sump.

The minimum flow foul pumps are required in order to maintain continuous flow in the rising mains during periods of minimum flow into the pumping station, so that air injection for septicity control can be operated continuously. When flows into the pumping station exceed the capacity of the minimum flow foul pumps, then the main foul pumps will take over the pump duty.

Flows of up to 2,450 l/s entering the pumping station will be handled by the foul pumps. Flows in excess of 2,450 l/s, up to a maximum flow of 7,450 l/s will overflow from the foul sump through 6mm fine screens into the storm sump. In the situation where all four storm pumps are available for use, and flows into the pumping station warrant it, all four pumps will be used to pump storm flows to the river.

In general, all four sumps will be available for use with a duty/standby pump arrangement in each sump. When any sump is out of use, e.g., for maintenance reasons, then all flows will be diverted to the other half of the pumping station.

1.1.4 Pumping Requirements

The specific pumping requirements are set out in Section 1.2. In general, the DWF pumps will pump a total maximum flow of 2,450 l/s (6.22 x DWF) through twin 1,100mm diameter cement lined ductile iron rising mains to a proposed header chamber at Mahon, Cork, for onward delivery to a proposed wastewater treatment plant. The storm pumps will discharge a total flow of 5,000 l/s (12.7 x DWF) through a 1,800mm diameter outfall to the adjacent River Lee.

1.1.5 Other Contracts

It is envisaged that there will be four main contracts let for the construction of Atlantic Pond Pumping Station. These contracts will be for the following scopes of work:-

1. Civil and building works.
2. Pumps and pipework.
3. High tension electrics.
4. Low tension electrics and SCADA.

No Contractor shall have exclusive access to any area on site during the course of the construction. It will be a requirement of each contract that the Contractor shall co-ordinate his activities with the other

Contractors on site. At a minimum, the Contractor should allow for separate visits to site for suction pipework installation, pump installation and electrics. See also Sections 1.1.11 below.

1.1.6 Hydraulic Scale Model Testing

A hydraulic scale model of Atlantic Pond Pumping Station has been constructed as part of a separate contract. Hydraulic modelling has been carried out as part of the contract to determine the optimum layout and configuration of pump sumps and suction pipework and to provide guidance on the pump start/stop control levels. The Report on the Hydraulic Scale Model Testing has been included in Appendix A.

1.1.7 Surge Protection

Surge protection for the rising mains, in the form of a surge vessel, will be required to protect the rising mains from excessive positive and negative pressures. The following are the anticipated requirements for surge protection:-

- Total vessel volume $80m^3$
- Steady state pumping pressure $33.5m^3$
- Internal air volume at SSPP $30m^3$
- Volume of water retained in vessel on downsurge $5.6m^3$
- Maximum surge pressure vessel will experience on line 40m
- Minimum surge pressure vessel will experience on line -1m
- Vessel inlet diameter 600mm

The Tenderer will be required to confirm the requirements for surge protection. The supply and installation of the surge protection equipment will form part of the scope of the Pumping Contract. The pipework from the surge vessel to the rising mains will form part of the Civil Works Contract.

Duplicate vessels shall be provided with a combined volume equal to the total required volume, in order to allow inspection and maintenance of one vessel while the second vessel remains in operation.

1.1.8 Project Supervisor for the Construction Stage

It is envisaged that the Civil Works Contractor will be appointed as Project Supervisor for the Construction Stage in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 1995, The Preliminary Safety and Health Plan has been included with the contract documents for the information of tenderers.

1.1.9 Hazardous Area Classification

The hazardous area classification is in accordance with IS EN 60079-10 Electrical Apparatus for Explosive Gas Atmospheres Part 10 : Classification of Hazardous Areas and is set out as follows:-

Area	Classification
Pump Sumps	Zone 1
Inlet chamber	Zone 1
Valve chamber	Zone 2
Dry Well	Zone 2
All other areas	Non-hazardous

1.1.10 YEAR 2000 COMPLIANCE

All equipment supplied must be fully Year 2000 compliant, where applicable, as defined below:-

The following definition of Year 2000 Conformity is based upon the British Standard Institute's DISC PD 2000-1.

"Year 2000 Conformity" shall mean that neither performance nor functionality of the Computer System is affected by dates prior to, during and/or after the Year 2000. In particular:

Rule 1 No value for current date will cause any interruption in operation of the Computer system.

Rule 2. Date based functionality and performance of the Computer System must behave consistently for dates prior to, during and/or after the year 2000.

Rule 3 In all interfaces and data storage of the Computer system the century in any date must be specified either explicitly or by unambiguous algorithms or inferencing rules.

Rule 4. The year 2000 must be recognised as a leap year by the Computer system.

"Computer system" shall mean any computer, data processing equipment media or part thereof, or system of data storage and retrieval, or communications system, network, protocol or part thereof, or storage device, microchip, integrated circuit, real-time clock system or similar device or any computer software (including but not limited to application software, operating systems, runtime environments or compilers), firmware or microcode.

1.1.11 Extended Maintenance Period

It is envisaged that Atlantic Pond Pumping Station will not be fully commissioned and brought into use until approximately 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 should ensure that all guarantees for plant and equipment should 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 items has been included in the Schedule of Prices to be priced by the Contractor.

SECTION 1.2

PUMP SPECIFICATION

1.2 PUMP SPECIFICATION

1.2.1 Foul Pumps

The foul pumps shall be submersible type pumps, suitable for operation in a dry installation and capable of handling raw sewage and passing solids of up to 100mm diameter. The minimum flow pumps shall each be capable of pumping flows of 100 l/s under maximum head conditions. These pumps will be used during periods of minimum flow (approximately 0.5 x DWF) into the pumping station. When flows exceed this flow, the main foul pumps shall take over the pumping duties. Each main foul pump shall be capable of pumping 1,225 l/s under maximum head conditions.

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

Minimum Flow Foul Pumps

Nr. of duty pumps	2 Nr.
Pump capacity (at maximum head)	100 l/s
Sump invert level	-11.77 mOD
Header chamber outlet level (vertical riser)	20.00 mOD
Estimated maximum TWL at header chamber	20.00 mOD
Pump start level (1)	-10.5 mOD
Pump stop level (1)	-10.8 mOD
Nr. of rising mains	2 Nr.
Length of rising mains	2,060m
Diameter of rising mains	1.1m
Estimated head loss in rising mains at full flow	2.0m

Main Foul Pumps

Nr. of duty pumps	2 Nr.
Nr. of standby pumps	2 Nr.
Pump capacity (at maximum head)	1,225 l/s
Sump invert level	-11.77 mOD
Header chamber outlet level (vertical riser)	20.00 mOD
Estimated maximum TWL at header chamber	21.30 mOD
Pump start level (1)	-7.0 mOD
Pump stop level (1)	-8.5 mOD
Nr. of rising mains	2 Nr.
Length of rising mains	2,060m
Diameter of rising mains	1.1m
Estimated head loss in rising mains at full flow	6.7 mOD

Note:

(1) Pump start/stop levels are dependent on pump selection.

1.2.2 Storm Pumps

The storm pumps shall be submersible type pumps, suitable for operation in a dry installation and capable of pumping screened municipal waste water.

The storm pumps will be required to pump flows in excess of 2,450 l/s arriving at the pump station, up to a maximum flow of 7,450 l/s (i.e., 2 Nr. storm pumps to pump a total of 5,000 l/s under maximum head conditions) through a steel outfall pipeline to the adjacent River Lee, where flows will be discharged through a diffuser. It is anticipated that there will be extensive periods when the pumps will not be in use. Accordingly, the Tenderers should set out the routine maintenance requirements necessary because of the extensive idle periods for the pumps.

It should be noted when all the storm pumps are available and flows entering the pumping station exceed 7,450 l/s, then the standby storm pumps will be used to assist the duty pumps so that up to 10,000 l/s (10 m^3/s) could be pumped to the river by the four storm pumps.

The storm pumps performance will be based on the following data:-

Nr. of duty pumps	2 Nr.
Nr. of standby (assist [1]) pumps	2 Nr.
Pump capacity (at maximum head)	2,500 l/s
Sump invert level	-11.77m OD
Discharge level (hydraulic head)	1.5 mOD
Maximum tide level	3.0 mOD
Pump start level [2]	-5.0 mOD
Pump stop level [2]	-6.5 mOD
Length of outfall	160m
Diameter of outfall	1.8m
Length of Diffuser	76 m
Diameter of Diffuser (varies)	1.35 - 0.45 m
Estimated head loss in rising mains and outfall (at full flow)	6.0m

Notes:

(1) Standby pumps will be used to assist the duty pumps when flows entering the pump station are in excess of 7,450 l/s.

(2) Pump start/stop levels are dependent on pump selection.

1.2.3 Sump Pumps

Five (5 Nr.) Sump Pumps shall be supplied and installed by the Pumping Contractor. All five sump pumps shall be submersible pumps installed in wet sumps. One pump shall be installed in a sump in each of the four wet wells and one pump shall be installed in a sump in the dry well.

The pumps will be based on the following data:-

1. Foul wet well sump pump:

Nr. of pumps	2 Nr.
Capacity of each pump	25 l/s
Maximum static head	8m
Rising main diameter	100mm
Rising main length	10m
Solid passage size	80mm

2. Storm wet well sump pump:

Nr. of pumps	2 Nr.
Capacity of each pump	10 l/s
Maximum static head	8m
Rising main diameter	100mm
Rising main length	10m

3. Dry well sump pump:

Nr. of pumps	1 Nr.
Capacity of pump	5 l/s
Maximum static head	8m
Rising main diameter	100mm
Rising main length	10m

1.2.4 Pump Construction

All pumps shall be fixed submersible sewage pumps suitable for pumping sewage and wastewater containing solids and fibres and capable of delivering the required flows against the stated heads. The pump rotational speed for the storm pumps and the foul pumps shall not exceed 750 rpm.

Major pump components shall be grey cast iron, with smooth surfaces free of blow hole and other irregularities. All exposed nuts and bolts shall be made of Grade 304 stainless steel. The interior and exterior shall be sprayed with an PVC epoxy primer and the exterior finished with a chloric rubber coating. All wear surfaces shall be coated with a high abrasion resistant polyurethane lining.

All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o'rings. Fittings shall be such that sealing is accomplished by metal to metal contact between

machined surfaces. This will result in controlled compression of nitrile o'rings without the requirement of a specific torque limit. No secondary sealing compounds, gaskets, elliptical o'rings, grease or other devices shall be used.

The volute casing of the storm pumps and the foul pumps shall have removable hatches for inspection of the impellers. Pump inlets and outlets shall have flanges drilled to NP 16 for direct connection to the suction and discharge pipework.

1.2.5 Impeller

The impeller shall be manufactured from high chrome, wear resistant cast iron, dynamically and hydraulically balanced, single suction, non-clogging, with grit repelling ridges. The impeller shall be locked to the impeller shaft and shall isolate the shaft iron from the pumped fluid.

1.2.6 Motor

The motors shall be a squirrel-cage induction, shell type design, housed in an air-filled, watertight chamber, with Class "F" rated insulation. (The wire and phase insulation shall be Class "H" and the slot and sleeve insulation shall be Class "F"). The motors shall be suitable for a 400V supply.

The motors shall be designed for continuous duty, capable of sustaining a minimum of 6 starts per hour for the dry well submersible pumps and a minimum of 15 starts per hour for the sump pumps. Rotor bars and short circuit rings shall be made of aluminium. High efficiency motors shall be provided for the 6 Nr. foul pumps.

The temperature rise of the motor shall not be in excess of the specified standard for Class "B" insulating materials, when operating continuously under load. The junction chamber, containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal (o'ring).

Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board. The motor stator shall be shrink fitted into the pump housing and shall not require bolts to hold it in place with axial and radial movement. The combined service factor (combined effect in voltage, frequency, specific gravity, etc.) shall be 1.10 or greater. The motor shall have a voltage tolerance of plus or minus 10% and a frequency tolerance of plus 5%.

The motor shall have watertight integrity to a depth of 20 metres.

1.2.7 Cooling System

Each unit shall be provided with an adequately designed cooling system. Except for the sump pumps, 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 ports shall be non-clogging. Provision for external cooling and flushing shall also be provided. Thermal sensors shall be provided to monitor stator temperatures. The stator shall be equipped with three (normally closed) thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with external motor overload protection and wired to the control panel.

1.2.8 Wear Rings

A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear rings shall consist of a stationary ring fitted to the volute inlet and a rotating wear ring which is shrink fitted to the impeller hub. The stationary wear rings shall be made from bronze or gun metal and the rotating weir ring shall be made from stainless steel.

1.2.9 Mechanical Seals

Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir. Lapped seal faces must be hydrodynamically lubricated at a constant rate. The lower seal unit, between the pump end oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationery tungsten-carbide ring and one positively driven rotating carbon ring.

Each interface shall be held in contact by its own self-aligning spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable.

Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal, shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication.

1.2.10 Cable Seal

The cable entry water seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the

entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder. The cable entry junction chamber and motor shall be separated by a sealed stator lead sealing gland or terminal board, which shall isolate the motor interior from foreign material and moisture gaining access through the pump top.

The sealing gland shall include integral double ended copper terminal studs, each end with double locknuts for terminating the power supply and signal cables on one side and motor lead and instrument cables on the other side.

Epoxy silicones, or other secondary sealing systems shall not be considered acceptable.

1.2.11 Bearings

The bearings shall be designed such that the life rating shall not be less than 100,000 hours. Bearings shall be permanently grease lubricated. The pump shaft shall rotate on two permanently lubricated bearings. The upper bearing shall be a single row deep groove bearing and the lower bearing, a two row angular contact ball bearing.

1.2.12 Guide Bars and Brackets

Two guide bars suitable in size, diameter, wall thickness and spacing for the pumpset shall be provided for guiding each of the wet well sump pump units in raising and lowering. The guide bars shall be installed truly vertical and parallel and shall not support any portion of the weight of the pump. The lower guide bar holders shall be integral with the discharge elbow. The top of the guide bars shall be faxed to the wet well wall or edge of the pump access ope. Guide rope or single bars are not acceptable.

The pump unit shall be guided on the bars by a guide bracket which shall be an integral part of the pump. The use of one guide, guide ropes or the requirement of personnel in the wet well when connecting the pump will be unacceptable.

All guide bars, brackets and fittings shall be constructed from low carbon steel galvanised to BS 729. It is envisaged that the pump pedestal units will be bolted to the floor of the relevant sump. The fixing arrangement shall be to the approval of the Engineer. Details of the pedestal and its installation arrangements shall be supplied with the tender.

1.2.13 Lifting Chain and Fittings

Each of the wet well sump pumps shall be fitted with hot dipped galvanised alloy steel link lifting chain to BS 3114, Grade 80, capable of lifting the pump and motor. The necessary fittings shall be provided. The chain shall be connected to the lifting bracket with a hot dipped galvanised alloy steel ring or shackle to BS 3551 and connected to the top of the sump with a stainless steel anchor bracket.

1.2.14 Painting

All pumps shall be factory coated with an epoxy primer and two coats of chloric rubber finish. The Contractor shall include for touching up with primer and a full top coat on site.

1.2.15 Submissions

Each tender shall be accompanied by the following information:-

(i) Full description of the pumps.
(ii) Head plotted against delivery.
(iii) Overall efficiency of the pumps and motors.
(iv) Speeds of the pumps and motors.
(v) HP of the motors.
(vi) Efficiency plotted against delivery.
(vii) HP plotted against delivery.
(viii) NPSH plotted against delivery.
(ix) Pedestal arrangement.
(x) Power cable arrangement.
(xi) Completed specification sheet (Section 4).

1.2.16 Testing

Tenders shall include for witness testing of all pumps prior to shipment from the factory. Commissioning on site shall include confirmation of the testing carried out at the factory. Tests shall be required to prove head against delivery, power, efficiency and speeds.

1.2.17 Pump Controls

The standard operational control of the pumps shall be by means of ultrasonic level measurement linked to PLC, all of which shall be provided as part of another contract. The Tenderer shall therefore provide terminals in his starter panel for taking the start/stop signals from another panel. The Tenderer shall also provide output terminals to take the signals from the pumps to the SCADA system.

In addition to the ultrasonic level measurement, hydrostatic level sensors in each of the four sumps shall provide low level protection to the pumps and also provide a high level signal for pump start and alarm in case of failure of the measurement system. The hydrostatic level control system shall be provided as part of the Pumping Contract

and it shall be hard-wired to the pump control panel. (Refer to Section 1.3.5).

Motor monitoring shall include for leakage in the stator, stator winding temperature, oil condition monitor and motor vibration.

1.2.18 Spares

The following spares shall be supplied as part of the contract:-

- 1 Nr. Minimum flow pump (100 l/sec)
- 1 Nr. impeller for each pump type

The Tenderer shall submit a full list of all recommended spares for the equipment installed by him in Section 3.0 of this document. The cost of these spares shall also be submitted.

SECTION 1.3

ELECTRICAL SPECIFICATION

1.3.1 General Requirements

1.3.1.1 This section contains the specification for the electrical works to be carried out by the Pumping Contractor.

1.3.1.2 The Electrical works to be carried out under the pumping contract are briefly described hereunder:-

- Supply, installation and commissioning of motor control equipment for
  4 Nr. Main foul pumps
  2 Nr. Minimum flow foul pumps
  4 Nr. Storm pumps
  5 Nr. Sump Drain Pumps.
- Supply installation and commissioning of power and control cabling from the motor control panels to the motors.
- Supply and installation of cable ladder in the dry well.
- Supply, installation and commissioning of dry run protection low level sensors in each sump, including cabling to the motor control panels.

1.3.1.3 Work By Others:

The motor starter and cabling for the dry well drain pump will be supplied and installed by the LT Electrical Contractor. The cable transits and main cable tray runs in the valve chamber will be provided by the LT Electrical Contractor. The pumping Contractor shall allow for final PVC tray drops to the 5 sump drain motors and the 4 sump level sensors instrument from the main tray runs. Final drops shall be in 100mm PVC cable tray.

1.3.1.4 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 1.3.1.15).

IS 273	Cables with PVC or XLPE insulation 600/1000V with or without SWA.
BS 31	Specification Steel Conduit and fittings for electrical wiring.
BS 731	Flexible steel conduit for cable protection.
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 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 Assemblies.

1.3.1.5 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.

1.3.1.6 Training:

The Contractor shall hand over to the staff appointed by the Client, Five 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.

The Contractor will be obliged to undertake training of staff as set down below:

(a) During Commissioning:

At the discretion of the Client, one or more employees will be assigned to assist in or observe the commissioning of the plant. The Contractor shall ensure that such employees are given such explanations as they require and answer all their questions relating to plant operation, control set points, alarms, interlocks, etc.

(b) Classroom Training:

The Contractor shall prepare classroom type lectures for various categories of staff to explain the underlying principles and modus operandi of their installation - separate lectures are required for maintenance staff to explain any particular requirements for plant maintenance, and for management, to give them a thorough understanding of the plant operation and capabilities.

1.3.1.7 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.

1.3.1.8 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.

1.3.1.9 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.

1.3.1.10 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.

1.3.1.11 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.

1.3.1.12 Supply of Equipment:

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

1.3.1.13 Temporaries, Compliance with National Regulations:

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

1.3.1.14 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.

1.3.1.15 Equivalence of Standards:

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.

1.3.2 Motor Control Centres

1.3.2.1 Scope:

This specification shall govern the design, materials, fabrication, test and inspection of Pumping Contract Low Voltage Motor Control Centres to be installed for Cork Corporation at Atlantic Pond Pumping Station, Cork, Ireland.

Approval of manufacturer's drawings shall not relieve the Contractor of the responsibility of compliance with all requirements of this specification.

The equipment described in this Specification shall be suitable for continuous duty at the specified ratings, under the specified ambient conditions for twenty four hours a day, 365 days a year.

The scope of work includes supply installation and commissioning of the following motor control panels:-

Panel	Description
SSP1	Sump 1 Foul Pump P1 Soft Start Panel
SSP2	Sump 1 Foul Pump P2 Soft Start Panel
SSP5	Sump 1 Storm Pump P5 Soft Start Panel
SSP6	Sump 1 Storm Pump P6 Soft Start Panel
SSP8	Sump 2 Foul Pump P8 Soft Start Panel
SSP9	Sump 2 Foul Pump P9 Soft Start Panel
SSP12	Sump 2 Storm Pump P12 Soft Start Panel
SSP13	Sump 2 Storm Pump P13 Soft Start Panel
MCC-4	Sump 1 Minimum Flow Pump P3 Soft Start and Drain Pumps P4 and P7 DOL starters MCC
MCC-5	Sump 2 Minimum Flow Pump P 10 Soft Start and Drain Pumps P11 and P14 DOL starters MCC.

1.3.2.2 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 (refer also to Clause 1.3.1.15).

IEC 51	Electrical Indicating Instruments.
IEC 185	Specification for Current Transformers.
ET 201	Code of Practice for the Design, Selection and Erection of Low Voltage Switchgear published by the ETCI.
IEC 439	Specification for Low Voltage Switchgear and Control Gear Assemblies.
IEC 947	Specification for Low Voltage Switchgear and Control Gear.
BS 6231	Specification for PVC Insulated Cables for Switchgear and Control Gear wiring.

1.3.2.3 Environmental And Service Conditions:

The equipment shall be suitable for operation in an indoor switchroom. The environmental data is as follows:-

Ambient Temperature	:	Min. -5°C, Max. +40°C
Relative Humidity	:	30 - 95%
Location	:	Coastal Area
Altitude	:	Less than 1000m

1.3.2.4 Electrical Data:

The Motor Control Centres (MCC'S) shall be supplied from main power distribution centres via multicore XLPE/SWA/PVC cables, as indicated on the single line diagrams.

The following electrical demands shall be met:-

Rated Voltage	:	600 VAC
Operating Voltage	:	400 VAC
Frequency	:	50 Hz
Phase	:	3 Phase & Neutral
Symetrical Short Circuit Current	:	50 kA isec.
Rated Current	:	Refer to SLD
Impulse Withstand Voltage	:	12 kV

1.3.2.5 Switchgear:

1.3.2.5.1 Structural and Mechanical Requirements

Switchgear shall be type tested, free-standing cubicle type, suitable for floor fixing, and of the dead front type. MCC's shall be arranged in a back to wall formation and the design shall be such that the MCC's can be completely inspected, maintained, repaired and cabled from the front, with no rear access required.

The MCC's shall generally meet the requirements of IEC 439, Form 4.

The total enclosure, along with individual panels, cubicles and compartments, shall be designed and constructed to prevent the passage of flame or gases from one section to another.

The total enclosure shall be dust-proof and damp-proof to IP54 (IEC 529).

The switchgear bus shall be braced to withstand, without damage, fault currents that are at least equal to the fault current rating of the main circuit breakers.

Switchgear assemblies shall be self-ventilated.

The switchgear shall be designed and manufactured to facilitate inspection, cleaning, repair and maintenance. Switchgear shall also be designed to ensure absolute safety during operation, inspection and maintenance.

All equipment shall operate without undue vibration.

Similar parts shall be interchangeable wherever possible.

Each MCC shall be provided with 25% spare cubicle space for future fit out.

Each panel shall be provided with an incoming isolator. Isolating mechanism shall be designed for minimum operating effort and time. These isolating mechanisms shall be suitable for operation by a single operator and shall be located on the front panels of the MCC. Isolating mechanisms shall be padlockable in the 'off' position.

All doors providing access to control circuitry or to the rear of instruments and relays shall be key locked.

Bolted type removable covers shall be fitted to the busbar chamber, giving access to busbars in each cubicle. Warning labels shall be fitted to both covers and chamber.

MCC shall be mounted on a heavy duty metal plynth, a minimum of 150mm high.

1.3.2.5.2 Cable Terminations

MCC's shall be complete with the necessary cable termination facilities. Undrilled gland plates will be required for all power and control cable terminations.

Cable gland plates and terminals shall be located to allow sufficient space and access for each cable termination. Cable sizes and types shall be as noted on the single line diagrams. Particular attention shall be given to the space and bending radii required for large copper cables.

Cable supports shall be provided for cabling where the weight of the cable would create an undue strain on the cable termination, or gland plate.

Incoming power supply cables shall be top entry and shall be installed and terminated by the LT Electrical Contractor. Outgoing power and control cables to field equipment shall be bottom exit. The pumping contractor shall provide ample space for glanding and terminating of both top and bottom entry cables.

Each MCC shall be provided with 25% spare terminal space for future fit-out.

1.3.2.5.3 Circuit Breakers

Circuit breakers shall conform to IEC 947-2, Category P2 and shall be ASTA certified for 50 kA fault breaking and 105 kA fault making. Air circuit breakers shall be from the ABB Sace Emax range, or equal to approval. Moulded case circuit breakers shall be from the ABB Isomax S2S/S3H range (or equal to approval) with thermo magnetic releases.

Circuit breaker continuous ratings shall be as specified on the single line diagrams. Ratings stated are those when installed and working under the specified service conditions. Ratings shall not be dependant upon the use of cooling fans.

Circuit breakers shall be capable of making on to the peak asymmetrical fault current specified without damage or danger. Circuit breakers shall also be capable of latching on to this fault current. When the peak asymmetrical current is not specified, it shall be taken to be 2.55 times the interrupting symmetrical R.M.S. current.

Circuit breakers shall be capable of interrupting the fault current specified, without damage or danger.

Switchgear shall have the short-time rating specified and shall be capable of withstanding the dynamic stresses associated with peak asymmetrical make duty. Switchgear shall also be capable of carrying

the through-fault interrupting symmetrical R.M.S. current for the short time noted in the IEC Standards specified.

Circuit breakers shall be fixed pattern manually operated. The operating mechanism shall be of the stored energy type

1.3.2.5.4 Busbars

The continuous current rating of busbars shall be sized by the pumping contractor. Neutral busbars shall be fully rated.

Busbars shall be solidly braced to withstand a through fault current of 50 kA for one second, without sustaining mechanical damage.

Busbars shall be manufactured from hard drawn high conductivity copper.

Busbars shall be the same size throughout the length of the switchgear.

Main busbars shall be air insulated. Droppers and connectors shall be suitably sheathed.

Nuts and bolts used for main busbar connections shall be suitably protected to prevent corrosion.

The busbars shall be mounted in a completely self-contained chamber to Form 4 construction.

1.3.2.5.5 Earthing

All metallic, non-current carrying parts shall be bonded to an electrically continuous copper earth bar, which shall run the entire length of the switchboard.

The main earth bar shall be sized to withstand a bolted earth fault for a duration equal to the longest short-time rating of any equipment item contained in the switchboard.

The main earth bar shall preferably be located at the rear of the switchboard, and earth straps shall be provided from the main bar to each unit cable box position. These earth straps shall be connected to incoming and outgoing earthing cables. Gland plates shall be bonded to the earth bar.

The main earth bar shall have provisions at each end for connection to the sub-station earthing system.

All doors shall be bonded to the switchboard structure by means of a flexible copper connection, arranged so that the connection cannot be trapped as the door is closed or opened.

1.3.2.5.6 Secondary Wiring

All internal wiring shall be carried out with stranded copper conductor cables of not less than 1.5 sq. mm cross-section area having fire and moisture resistant 600/1,000-volt Grade PVC insulation to BS 6231. Flexible cables shall be used for wiring equipment on doors and shall be arranged so that it is impossible for wiring to be trapped by door movement. Internal wiring shall be neatly arranged in looms of 25 cables or less, wrapped with flexible PVC coil for protection and firmly clamped at both ends to prevent movement at terminations. Wiring shall be positioned and routed so as to minimise the possibility of mechanical damage.

All wiring shall be terminated with approved type terminals which shall have a permanent, easily readable numbering system of identification utilising slip-on plastic markers. All terminals shall be numbered, and where a cable terminates with a different number to that of the cable, the cable shall have a double number. The number next to the cable end shall correspond to the terminal number.

Terminal blocks shall be arranged and positioned to afford easy access for carrying out external cable terminations, testing, inspection and maintenance.

Not more than two wires shall be connected to any one terminal. Links shall be provided when more than two connections are required at one point.

Circuits and terminals operating at different voltages and/or performing different functions shall be segregated. Grouped stud type terminals shall be provided with transparent plastic covers.

Internal wiring passing between sections shall be adequately protected against mechanical damage. Where wiring passes through main busbar sections, it shall be installed in a segregated wireway such that it is possible to replace or install a new cable without de-energising the main busbar compartment.

Control circuits deriving power from bus wiring through the switchboard shall be individually fused for each unit.

The following colour codes shall be used to identify wiring:-

Power:	Phase 1	Brown	Control:-110V AC	Live Grey
	Phase 2	Red	Neutral	Purple
	Phase 3	Yellow	24Vdc	White
	Neutral	Blue	+	Black
	Earth	Green/Yellow		

1.3.2.5.7 Current Transformers

The switchgear manufacturer shall be responsible for selecting the current ratio, accuracy, saturation factor, class and rating of current transformers. The switchgear manufacturer shall ensure that current transformers meet the requirements of equipment connected to them.

The secondary side of current transformers shall be earthed on one side through a removable link. Where current transformers are connected in star, the star point shall be earthed through a removable link at one point only.

Shorting links shall be provided at the outgoing terminals where protective circuit wiring leaves the switchboard.

The markings on the current transformer terminals shall comply with the IEC standards listed and shall clearly indicate the polarity of the windings.

All current transformers shall be capable of carrying, without injurious heating or mechanical damage, a current equivalent to the short circuit rating of the switchboard for the short time rating of the panel in which they are mounted.

The switchgear manufacturer shall provide excitation curves for all current transformers he supplies.

1.3.2.6 Motor Starters:

1.3.2.6.1 General Requirements

Starters shall be suitable for starting constant speed, squirrel cage induction motors as follows:-

- Up to 30 KW Direct on line
- 30KW up to 75 KW Star Delta
- 75 KW and over Soft Start Unit.

Each starter shall be provided with out-going terminals to accommodate a remote stop/start push-button station.

Each starter shall be provided with a 24 volt interface relay and hand-off-auto switch to permit remote control by PLC in the auto position.

Indication lamps / pilot lights shall be provided to the following colour coding:-

Start / On	-	Green
Stop / Off	-	Red
Trip / Failure	-	Amber

Two normally open and two normally closed volt-free auxiliary contacts shall be provided to permit remote indication of starter status to the PLC system.

Two sets of out-going control wiring terminals shall be provided for each starter to permit drive interlocking. These shall be wired into each control circuit immediately after the overload tripping contact and shall be linked out at the terminal block when required.

Form 4 cubicle construction shall be provided for all motor starters.

Automatic start controls for motors shall be designed so that, in the event of a power failure, the motor will automatically restart on restoration of power. This facility will permit automatic operation of the unmanned pumping station in the "auto" position.

MCC's shall be provided with lamp test facility

Anti-condensation heaters shall be provided for each starter enclosure to give an output of 10 walls/sq.m. They shall be thermostatically controlled and shall be 230 Volt single phase with Auto-Off selector. The supply to these heaters is to be switched off with the main isolator.

Starter units shall be provided with outgoing terminals for connection of a remote lock-off stop mounted adjacent to the motor. Following operation of the emergency lock-off stop, the starter shall lock out until it is reset at the starter panel, i.e., the motor should not restart on release of the lock-off stop.

Control voltage shall be 110V AC, with one pole earthed. The 110 supply shall be provided by a suitably sized control transformer, with 50% spare capacity.

1.3.2.6.2 DOL Starters

DOL Starters shall consist of a combined motor rated MCB / thermal overload relay, backed up by fuses if necessary for fault rating and with anti-single phase protection and a contactor. Starters shall have full type 2 co-ordination in accordance with IEC 947 Part 4.

The MCB / thermal overload shall be electrically reset from a push-button projecting through the compartment door.

Two normally open and two normally closed volt free auxiliary contacts shall be provided for each MCB / thermal overload unit. Contacts shall be wired to terminals.

The combined MCB / thermal overload shall be provided with a facility to padlock in the off position. Alternatively, a padlockable isolator shall be provided ahead of the MCB / thermal overload.

1.3.2.6.3 Soft Starter Units

The soft starter controls for each of the main pumps shall be housed in a separate enclosure.

Soft starter units shall comply fully with the requirements of IEC 947. The soft starters shall be suitable for 400V, 3 Phase, 50 Hz supply and shall have the following programmable features to enable selection of the optimum set points during commissioning.

Initial voltage	10 - 60%
Ramp time during start	1 - 240 sec.
Step down voltage	100 - 30%
Ramp time during stop	0 - 240 sec.
Current limit at start	1 - 5 x FLC
Overload level	60 - 120%

The following other features shall be provided on each soft start unit :-

- Full function electronic overload relay c/w
  - thermal overload
  - single phase/asymetry protection
  - Thermister protection
  - Earth leakage protection
- Phase selectable digital display of motor current (door mounted)
- Keypad for parameter adjustment (door mounted)
- Control inputs for start/stop
- Energy saving function
- Kick start
- Thermistor trip input
- Signal relays for - Running / Fault / Overload
- RS 485 communications port
- 4-20mA signal for remote monitoring of motor current on the SCADA system

The soft starters shall be Control Techniques, Type SFE2 or equal to approval.

Each soft start unit shall be fitted in an IP54 enclosure and equipped with a door interlocked isolator, which shall be lockable in the "off" position. The following shall be provided on the front of the enclosure.

- Start Lamp (Blue)
- Run Lamp (Green)
- Stop Lamp (Red)
- Trip Lamp (Soft Start) (Yellow)
- Trip Lamp (Thermistor) (Yellow)
- Fault Lamp (Orange)
- Local / Off / Remote Control Switch
- Start Pushbutton
- Stop Pushbutton
- Digital Ammeter/Phase selector switch
- Digital Voltmeter/Phase selector switch
- Hours Run Meter
- Emergency Lock Stop
- Reset Pushbutton
- Lamp Test Facility

The low low sump level relays shall be hardwired into the control circuit immediately after the electronic overload tripping contact and shall prevent the pumps running dry.

The pump motor starter winding thermal switches shall be interlocked with the starter to provide protection against overheating.

The following motor parameters shall be monitored and status indication shall be provided and displayed with warning lamps on the panels:-

- Stator winding over temperature.
- Stator housing leakage.
- Lower bearing temperature.
- Oil condition monitor.
- Motor vibration.

1.3.2.7 Labels

All equipment items mounted on the face of switchgear and control panels shall be provided with labels denoting their function.

A main label shall be affixed in a prominent position on the switchboard, giving the following information:-

A. Manufacturer's name.
B. PURCHASER's name.
C. Switchboard designation and tag number.
D. System voltage, phases, wires.
E. System frequency.
F. System fault level.
G. Busbar rating.
I. Feeder Designation and Tag number

Circuit breakers shall be fitted with a label providing the following information:-

A. Current rating.
B. Voltage rating.
C. Interrupting rating at correct voltage (symmetrical R.M.S. current).
D. Make rating (asymmetrical peak current).
E. Short time rating.
F. Serial number.
G. Closing voltage.
H. Tripping voltage.

All control relays shall be identified with the designation noted on the wiring diagrams to facilitate identification of their function. The device tag numbers and designations detailed on the single line diagram shall be used on all switchgear manufacturer's drawings.

All units shall be identified at the back and front of the switchboard, with the unit designation shown on the single line diagrams.

All current transformers shall be provided with identification labels showing the information specified in the applicable IEC Standards.

Labels for panel instruments and devices shall have black lettering engraved on a white background, the lettering having a minimum height of 5mm. Labels and fixing screws shall be of corrosion - resistant material.

Each MCC shall have a label permanently fixed to the incomer cubicle with the following notice:-

Colour Code System:-

Brown	=	Phase 1
Red	=	Phase 2
Yellow	=	Phase 3
Blue	=	Neutral
Green / Yellow	=	Earth

A single line schematic diagram shall be painted on the front of the MCC to clearly indicate the busbar distribution within the panel.

1.3.2.8 Finish

The finish for switchgear cabinets shall be subject to the Engineer's approval. Details of paint finish shall be provided with the tender.

Enough of the finished coat paint shall be shipped with the switchgear to repair any damage to the protective coating after erection.

1.3.2.9 Tools And Accessories

The switchgear manufacturer's shall provide a full compliment of standard switchgear accessories required for operation, maintenance and testing of the equipment.

All tools and accessories shall be listed and individually priced within the tender.

A sturdy container shall be provided for storage of tools and accessories. The container shall be secured with a suitable type lock.

1.3.2.10 Spares

The tender shall include for commissioning spares in this tender.

The tenderer shall submit with his tender a separate quotation for the supply of five year's operational spares as recommended by the

switchgear manufacturer. The quotation shall include a full description of the spares offered, complete with the manufacturer's part number.

1.3.2.11 Testing And Certificates

The tenderer shall provide, with his quotation, copies of certificates to prove that the design of the equipment and components have been successfully tested by a recognised international testing authority at the required operating and short circuit duty. Certificates shall be provided for each type and each rating of the equipment offered.

The following tests shall be conducted on each unit at the manufacturer's works and shall be witnessed by the PURCHASER's representatives. A test report showing all values shall be signed and released by the switchgear manufacturer.

A. High Voltage.

B. Insulation Resistance.

C. Primary and secondary injection and relay operation.

D. Operational check of all circuit breakers, motor starters, control circuits, relays, etc., including a check on pull-in and drop-off voltages.

E. Full interlocking check, including withdrawal and isolation features.

F. Functional check of all control and tripping devices and circuitry.

G. Phasing and wiring continuity check.

H. Check on earthing facilities.

I. Functional check of automatic changeover controls and interlocks.

1.3.2.12 Shipping

Each MCC shall be suitably packed and shipped as one complete unit. Each MCC shall be provided with lifting facilities to enable offloading at the site.

1.3.2.13 Offloading, Installation And Commissioning

The offloading, installation and commissioning of the MCC's shall be carried out by the Pumping Contractor in conjunction with the Switchgear Manufacturer.

The Pumping Contractor shall provide the services of a switchgear manufacturer's factory based Engineer to supervise the offloading, installation and commissioning works at the site.

The Switchgear Manufacturer's Engineer shall be present at all times during work on the MCC's and shall instruct the Pumping Contractor in the correct procedures for all such work.

The complete and satisfactory set up and commissioning of the MCC's and associated protection relays and accessories shall be the sole responsibility of the Pumping Contractor. Selection of relay curves and set points shall be agreed with the Purchaser's Engineer at time of commissioning.

Testing detailed in Clause 1.3.2 shall be repeated at the site and shall be witnessed by the Purchaser's representative.

The Pumping Contractor shall provide the services of a switchgear manufacturer's specialist engineer to provide instruction to the Purchaser's staff in both the operation and maintenance of the equipment at the time of installation as set out above.
The duration of the services outlined shall be agreed prior to contract award. For tender purposes the Pumping Contractor shall allow a period of two days exclusive of time required for the installation and commissioning work.

Details of the rates applicable for extension of the specialist Engineer's services shall be provided with tender.

1.3.2.14 Data And Drawings

The Tenderer shall provide drawings and data in accordance with the Instructions to Tenderers and the following list of requested documents:-

1.3.3 Cabling

The Contractor shall supply and install all power and control cabling between the starters and the field equipment.

Power and control cables for the dry well installed pumps shall be PVC or XLPE insulated, PVC sheathed, steel wire armoured and PVC sheathed overall (XLPE or PVC/SWA/PVC) and shall comply in all respects with IS 273/ BS 6346 or equal and shall be 600/1000 Volt grade.

The cables shall be installed in accordance with the manufacturer's instructions and standard manufacturer's glands, terminations and other accessories shall be used. Cable glands shall be flameproof type EIWF and shall conform to BS 6121.

The conductors shall be of standard annealed high conductivity copper, complying with the latest relevant BS shaped and pre-spiralled for minimum overall size.

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

1.3.4 Galvanised Cable Ladder Installation

The Electrical Contractor shall include for the complete galvanised cable ladder installation as shown on the drawings and as specified herein, and shall include for all supports. Galvanised ladder shall be used in the dry well area only. The Contractor shall co-ordinate the cable ladder routes with the pipework and HVAC ductwork.

The cable ladder shall be of heavy duty type, with rolled-in vertical flange and designed to support a load of 85 kg/m at 2 m fixing centres.

The ladder will be fabricated from galvanised sheet steel with 72 mm flange complete with a separate galvanised lid with 21 mm side flange.

Only manufacturer's fish plates, bends etc. shall be used.

Galvanised cable ladder shall be as manufactured by Messrs. Mecafablon or Rico supplied respectively by Westgate Engineering Ltd., and Ellickson Engineering Ltd. or equal to approval.

Cable ladder supports shall be formed from R.H.S. Box Section and shall not exceed a spacing of 1.5 metre centres, and fixed to wall or beams by means of 2 No. 8 mm bolts, nuts and spring washers. The cable ladder shall in turn be bolted to the box cross members by 2 No. 6 mm Mushroom head bolts, nuts and washers, care being taken to ensure that the head of the bolts are uppermost in cable ladder.

Where the cable ladder is run between building columns, purpose made stand-off brackets shall be used between columns so that the cable tray

maintains a straight line. This bracket shall be fixed to the wall by means of 2 No. 8 mm rawlbolts, nuts and spring washers as previously described.

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

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

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.

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.

1.3.5 PVC Cable Tray Installation

The Electrical Contractor shall include for the complete PVC cable tray installation as required and as specified herein, and shall include for all supports. PVC cable tray shall be used exclusively in the wet well and valve chamber areas. The Contractor shall submit proposed tray routes for Engineer's approval.

Cable trays shall be rigid PVC to BS 4678 and have wide flanged edges. It shall have an ignitability characteristic "P" in accordance with BS 476, Part 5.

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.

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

Cable trays and racks 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 or racks shall be carried without undue sagging. Reference shall be made to manufacturer's recommendations regarding spacing of support brackets etc.

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.

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

Lidding shall be provided on all trays.

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

The tray will be sufficiently sized to allow adequate space for 1 No. only full layer of cables, with sufficient space for ventilation and 20% spare capacity. Where tray widths greater than 600 mm are used, two or more adequately sized cable tray runs will be allowed for.

All supports will be fixed horizontally at 1.5 metres centres unless particularly heavy runs require closer spacing. The allowable deflection under load shall be in accordance with BS 499: 1959.

1.3.6 **Low Level Interlocks**

1.3.6.1 The Pumping Contractor shall install dry run protection for the pumps. High level switch contacts shall operate in the event of failure of the PLC to control the pumps.

A hydrostatic sensor shall be installed in each sump to detect the wastewater level and remote transmitter/controller and alarm relays shall be configured to trip and start the pumps at the specified levels. The transmitters and relays shall be installed in the dry well area at ground floor level (Safe Area).

1.3.6.2 The level sensors shall be as follows or equal to approval:-

Manufacturer:	Endress & Hauser
Model:	Deltapilot S
Type:	DB52-BM 10 BC 13C G3 0

1.3.6.3 The controllers shall be as follows or equal to approval:

Manufacturer:	Endress & Hauser
Model:	Prolevel FMB 662
Type:	FMB 662 R 1 B 2 A

SECTION 1.4

PIPEWORK AND VALVE SPECIFICATION

1.4 PIPEWORK AND VALVES

1.4.1 Pipework

The contract shall include for the supply and provision of all pipework between the sumps and the last flange inside the substructure perimeter, as shown on Drg. Nr. A4634-M001.

All pipework shall be bitumen coated, sulphate resistant cement lined ductile iron, to BS 4772: 1998 and shall be the produce of an approved manufacturer.

Pipework shall be flanged to a national EC Standard, which shall be stated. Pipework and flanges will be to PN 16 rating. Flanges shall be machined. Gaskets shall cover the full face of the flange and shall be pierced to take bolts. The dimensions of gaskets shall comply with BS 4865: Part 1. Gaskets shall be manufactured from material complying with the provisions of BS 2494 for Type W rings. Nuts and bolts shall be grade 304 stainless steel.

Pipework shall terminate in the valve chamber, with flanged ended pieces. Where pipework passes through walls, puddle collars capable of fully anchoring the pipework against static and dynamic thrusts shall be fitted to the pipework. Details of pipework supports shall be set out in the working drawings to be submitted after acceptance of the tender.

In accordance with the above standards, each pipe and fitting shall have cast, stamped or indelibly painted on it the following appropriate marks:-

(a) Manufacturer's name, initials or identification mark.
(b) Nominal size.
(c) Class designation.
(d) The number of the relevant standard.
(e) The length of the pipe, if non-standard.
(f) Angle of bends, in degrees.

A manufacturer's signed certificate shall be supplied, stating that the pipes or fittings comply in all aspects with the provisions approved Standards.

1.4.2 Valves

Each pump shall have a separate reflux valve and sluice valve on the delivery pipework, as shown on the layout drawing. In addition, each of the pumps installed in the dry well shall have a sluice valve on the suction pipework to provide for isolation of the pump to allow for inspection, maintenance or removal. All sluice valves over 300mm diameter shall be geared for ease of operating manually.

In addition to hand wheels, electric actuators are required to all the 300mm, 500mm and 800mm diameter valves. These are to be

supplied and fitted by the Pumping Contractor. The MCC's, cabling and controls for the valves shall be supplied and installed by the LT Electrical Contractor. Commissioning shall be carried out by the Pumping Contractor, assisted by the LT Electrical Contractor.

The valves shall be of single approved manufacture and shall have gunmetal faces or equal approved and shall be self-cleaning.

All sluice valves shall be wedge gate valves complying with BS 5163 or equal approved. With the approval of the Engineer end types not included in the adopted Standard may be used. Valve components shall be manufactured from the basic materials detailed in the Standard.

Valves shall be rated at 16 bar nominal pressure which shall be the maximum permissible working pressure at 20°C. They shall be tested in accordance with the Standard and the manufacturer's testing certificate for each valve used in the works shall be produced.

Valves shall be operated by means of a geared handwheel or a motorised actuator as called up on the drawings. Handwheels shall be marked close or shut with an arrow to indicate the direction of closure.

Valves shall be of the metal seating type unless elsewhere specified to be resilient seated.

All valves shall be painted with a fusion bonded polymeric anti-corrosion coating, 250 microns thick, to WIS 452-01 Class C.

Each valve shall be clearly marked on the body with the following information:-

(a) Nominal size (i.e. DN...)
(b) Nominal pressure rating (i.e. PN...)
(c) Material designation
(d) Type of seat, i.e., metal or resilient
(e) Manufacturer's name or trade mark
(f) The number of the Standard adapted
(g) Identification number.

1.4.3 Reflux Valves

Reflux valves shall comply with BS 5153 or equal and shall be the product of an approved manufacturer. They shall have body cover and disc of best grey cast iron, with gunmetal seats and disc facing rings. All trunnions shall be bronze or stainless steel and have gunmetal or bronze bushes. Where non-slam reflex valves are specified, they shall be designed to close without slamming, when rapid reflux occurs. Valves shall be tested to the same pressure as those specified for sluice valves and shall have flanged ends drilled to BS 4504 or approved equal.

1.4.4 Testing

All pipelines shall be tested before being brought into service. The test shall be a hydrostatic test performed by filling the pipe with water and raising the pressure to the selected test pressure. The Contractor shall supply all necessary water pumps, gauges, jacks, struts and all apparatus necessary for carrying out the tests. He shall provide for transmitting the unsupported end thrusts to solid ground and ensure that the anchorage of bends is complete. The pipes shall be tested in such lengths and at such times as the Engineer may direct. Testing shall not be permitted against a closed valve and these shall be in fully open position and sealed with blank flanges. The test period shall be for one hour or as directed by the Engineer.

Calculations for the proposed pipework shall be submitted for approval before installation. These calculations shall include:-

- Internal pipe pressures
- Thrust forces at bends
- Surge pressures

All pipework shall be tested to a test pressure which shall not be less than the greater of the following:-

(i) The maximum sustained operating pressure plus 5 bar.

(ii) The maximum static pressure plus 5 bar.

(iii) The sum of the maximum sustained operating pressure, or the maximum static pressure, and the maximum calculated surge pressure.

SECTION 2.0

SCHEDULE OF PRICES

PUMPING CONTRACT FOR ATLANTIC POND PUMPING STATION

SCHEDULE OF PRICES

	Item	Amount IR£
1.0	**Preliminaries**	
1.1	Provide for all insurances as required under the Contract.	
1.2	Provide for all packing, transport, freight, cranage and carting of materials, including unloading, storage on site, securing, protection, etc.	
1.3	Provide for meeting all the requirements of safety under the Safety, Health & Welfare at Work (Construction) Regulations, 1995, the Safety Health & Welfare at Work (General) Regulations and the Factories Act.	
1.4	Provide for co-ordinating work on site with other contractors.	
1.5	Provide for mobilisation of site facilities, including accommodation, power, water, telephones, etc.	
1.6	Provide for maintenance of site facilities for the duration of the Contract, including accommodation, power, water, telephones, etc.	
1.7	Provide for all temporary works required for the installation on site, including construction plant, temporary power supply, small tools, task lighting for the completion of the Contract.	
1.8	Provide for all necessary cranes and lifting equipment for the completion of the Contract.	
1.9	Provide for all ladders and scaffolding for the completion of the Contract.	
1.10	Provide for mobilisation of Contractor's Management Supervision and Staff.	
1.11	Provide for Contractor's Management supervision and staff salaries, expenses and overheads for the completion of the Contract, including attendances at site meetings.	
		IR£

1.12 Provide for carrying out the works in accordance with the terms and requirements of the Specification.

1.13 Provide for provision of programmes, reports, etc., as specified.

1.14 Provide for QC Procedures and Testing, as per the Specification.

1.15 Provide for all consumables.

1.16 Provide for all shop fabrication working/drawings and sketches.

1.17 Provide for 5 Nr. bound copies of operation and maintenance manuals, including completed installation drawings and single line diagrams, as specified.

1.18 Provide for commissioning and 30 days operation of the pumping plant.

1.19 Provide for full instruction of the Employer's staff in the operation of the pumping plant during the above 30 day period.

1.20 Provide for all costs in relation to site cleanliness and maintenance.

1.21 Provide for all costs for complying with the Tender Documents.

Form of Tender

Form of Agreement

Form of Repayment Bond

Instructions to Tenderer

Conditions of Contract

Special Conditions

Specifications

Information to be provided by the Tenderer

IR£

1.22 Provide for spares as set out in the Specification, Clause 1.2.18.

1.23	Provisional Sum to be expended in whole or in part by the Engineer for additional spares.	20,000
1.24	Provisional Sum to be expended in whole or in part by the Engineer for tools.	5,000
1.25	Provide for special defects liability period of 48 months as per Section 1.1.11 of the Specification.	
1.26	The Contractor shall enter a rate per month for each additional month by which the special defects liability period is extended. Rate only: £ _____ per month	
1.27	Provide for extension of all manufacturers guarantees for plant and equipment by a period of 36 months.	
1.28	Provide for routine maintenance of the pumping plant and motor control equipment as described in Section 1.1.11 of the Specification. Rate per year: £ _____ for 4 years =	
1.29	Provide for other costs of any kind which are not specifically scheduled above and/or which have not been allowed for elsewhere in the Schedule of Prices. (The Contractor is required to list all items allowed for in this lump sum in the space provided below). _____ _____ _____ _____ _____	

Total
(Forward to Summary)

Schedule Of Prices

	Item	Amount IR£
2.0	**Pumps**	
2.1	Supply and install 4 Nr. storm pumps, capacity 2.5 m^3/sec. each, under maximum head conditions.	
2.2	Supply and install 4 Nr. main foul pumps, capacity 1.225 m^3/sec. each, under maximum head conditions.	
2.3	Supply and install 2 Nr. minimum flow foul pumps, capacity 100 l/s each, under maximum head conditions.	
2.4	Supply and install 2 Nr. sump pumps, capacity 25 l/s each, including guide rails, lifting chains, etc..	
2.5	Supply and install 2 Nr. sump pumps, capacity 10 l/s each, including guide rails, lifting chains, etc.	
2.6	Supply and install 1 Nr. sump pump, capacity 5 l/s.	
2.7	Supply 1 Nr. minimum flow foul pump, capacity 100 l/s as a spare pump.	
2.8	Provide for painting pumps on site as described in the Specification.	
2.9	Supply and install pump pedestal anchorages (to be built-in by the Civil Works Contractor).	
2.10	Provide for witnessing factory tests of all pumps.	
2.11	Provide for completion tests as described in the Specification.	
2.12	Provide for surge analysis for surge protection for the pumps, pipework, rising mains and fittings.	
2.13	Provide for surge protection equipment for the pumps, pipework, rising mains and fittings.	
	Total (Forward to Summary)	

SCHEDULE OF PRICES

	Item	Amount IR£
3.0	**Pipework, Fittings and Valves**	
3.1	Supply and install all 100mm diameter ductile iron pipework and fittings, in accordance with the Specification and as shown on Drg. Nr. A4634-M001.	
3.2	Ditto as Item Nr. 3.1, but 200mm diameter.	
3.3	Ditto as Item Nr. 3.1, but 300mm diameter.	
3.4	Ditto as Item Nr. 3.1, but 500mm diameter.	
3.5	Ditto as Item Nr. 3.1, but 800mm diameter.	
3.6	Ditto as Item Nr. 3.1, but 1100mm diameter.	
3.7	Provide for 5 Nr. 100mm diameter non-return valves as per the Specification.	
3.8	Ditto as Item Nr. 3.7 but 2 Nr. 200mm diameter.	
3.9	Ditto as Item Nr. 3.7, but 4 Nr. 500mm diameter.	
3.10	Ditto as Item Nr. 3.7, but 4 Nr. 800mm diameter.	
3.11	Provide for 5 Nr. 100mm diameter sluice valves as per the Specification.	
3.12	Ditto as Item Nr. 3.11, but 4 Nr. 200mm diameter.	
3.13	Ditto as Item Nr. 3.11, but 2 Nr. 300mm diameter.	
3.14	Ditto as Item Nr. 3.11, but 8 Nr. 500mm diameter.	
3.15	Ditto as Item Nr. 3.11, but 8 Nr. 800mm diameter.	
3.16	Provide for pressure testing all pipework as required by the Specification, including calculations.	
3.17	Provide for motorised actuators on 2 Nr. 300mm dia. sluice valves as per the Specification.	
	IR£	
3.18	Provide for 8 Nr. motorised actuators on the 500mm dia. sluice valves as an optional extra.	

3.19 Provide for 8 Nr. motorised actuators on the 800mm dia. sluice valves as an optional extra.

Total
(Forward to Summary)

SCHEDULE OF PRICES

	Item	Amount IR£
4.	**Electrics**	
4.	Supply of 4 Nr. soft starters for storm pumps as specified.	
4.	Supply 4 Nr. soft starters for the main foul pumps as specified.	
4.	Supply MCC 4 comprising the soft starter for the minimum flow foul pump and DOL starters for the sump drain pumps for side 1 of the pumping station as specified.	
4.4	Supply MCC 5 comprising the soft starter for the minimum flow foul pump and DOL starters for side 2 of the pumping station as specified.	
4.5	Provide for witnessed Factory Acceptance Testing of all pump starter panels at the manufacturers works as specified.	
4.6	Deliver, offload, install, test and commission the motor control panels at the work site as specified.	
4.7	Supply, install, terminate and test all power cabling from motors to starters.	
4.8	Supply, install, terminate and test all instruments and control cabling from starters to field equipment.	
4.9	Supply and install cable racks and cable trays as specified.	
4.10	Provide for commissioning the entire pumping plant electrical installation.	
	Total (Forward to Summary)	

SCHEDULE OF PRICES

	Item	Amount IR£
5.0	**Daywork Labour Schedule**	
	The Contractor to allow for the following:-	
5.1	Foreman	
	50 hrs. @ T x 1	
	25 hrs. @ T x 1½	
	25 hrs. @ T x 2	
5.2	Chargehand	
	200 hrs. @ T x 1	
	100 hrs. @ T x 1½	
	50 hrs. @ T x 2	
5.3	Electrician/Tradesman	
	200 hrs. @ T x 1	
	100 hrs. @ T x 1½	
	50 hrs. @ T x 2	
5.4	Apprentice Electrician	
	100 hrs. @ T x 1	
	50 hrs. @ T x 1½	
	25 hrs. @ T x 2	
5.5	Starter Equipment Specialist Engineer	
	50 hrs. @ T x 1	
	25 hrs. @ T x 1½	
	25 hrs. @ T x 2	
	Total (Forward to Summary)	

Note: The rates stated above should be the Contractor's fully inclusive rates for the operatives and include for all insurances, expenses, site allowances, tool money, subsidence and percentage additions which are applicable.

SCHEDULE OF PRICES

SUMMARY

	Description	Amount IR£
Section 1	Preliminaries	
Section 2	Pumps	
Section 3	Pipework, Valves and Fittings	
Section 4	Electrics	
Section 5	Daywork Schedule	
	Contingency	50,000
	Sub-Total	
	Add VAT @ ___%	
	Sub-Total	
	Allow for Bond	

The Contractor shall obtain from an approved Company or Society, a Guarantee Bond for the due and proper completion of the works within the time limit in the contract and shall pay all premiums and fees required for same, including the cost of the Solicitor.

Total Amount to Form of Tender

SECTION 3

LIST OF RECOMMENDED SPARES

LIST OF PROPOSED SPARES

The Tenderer shall list below the recommended spares to be held by the Purchaser, together with the cost of supplying same.

Item	Amount IR£

TOTAL

SECTION 4

PUMP SPECIFICATION SHEETS

STORM PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• •Load 75%	• •Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE
29. MAX. TORQUE/RATED TORQUE

MAIN FOUL PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• •Load 75%	• •Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE:
29. MAX. TORQUE/RATED TORQUE:

MINIMUM FLOW FOUL PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• •Load 75%	• •Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE:
29. MAX. TORQUE/RATED TORQUE:

FOUL WET WELL SUMP PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• Load 75%	• Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE:
29. MAX. TORQUE/RATED TORQUE:

STORM WET WELL SUMP PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• •Load 75%	• •Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE
29. MAX. TORQUE/RATED TORQUE

DRY WELL SUMP PUMP

1. MOTOR IDENTIFICATION:
2. RATED VOLTAGE:
3. NR. OF PHASES:
4. FREQUENCY:
5. POLES:
6. RATED MOTOR INPUT POWER:
7. RATED MOTOR INPUT POWER:
8. RATED SPEED:
9. RATED CURRENT:
10. STATOR VARIANT:

		Full Load 100%	• •Load 75%	• •Load 50%
Output Power	KW			
Input Power	KW			
Efficiency	%			
Current	A			
Power Factor (Uncorrected)				
Torque	Nm			
Speed				

11. STARTING TORQUE:
12. MAX. TORQUE:
13. ROTOR INERTIA:
14. NO LOAD CURRENT:
15. NO LOAD POWER FACTOR
16. STARTING CURRENT:(DOL)

17. STARTING POWER FACTOR:
18. LOCKED ROTOR CURRENT:
19. LOCKED MOTOR POWER FACTOR:
20. SPEED AT MAX TORQUE:
21. STATOR RESISTANCE:
22. IRON LOSSES:
23. STRAY LOSSES:
24. FRICTION LOSSES:
25. PULL UP TORQUE:
26. MAX. OUTPUT POWER FOR Y/D STARTING:
27. STARTING CURRENT/RATED CURRENT:
28. STARTING TORQUE/RATED TORQUE:
29. MAX. TORQUE/RATED TORQUE:

APPENDIX A

HYDRAULIC SCALE MODEL REPORT

(53 Pages)

CORK CORPORATION

CORK MAIN DRAINAGE SCHEME – PHASE 2

ATLANTIC POND AND TRAMORE VALLEY RISING MAINS

CONTRACT DOCUMENTS

for

MECHANICAL/ELECTRICAL SUB-CONTRACT

RONAYNE'S COURT PUMPING STATION

BESBOROUGH PUMPING STATION

VOLUME 2

SPECIFICATION

Mr. Kevin M. Terry, BE, M.SC, MPA, C.ENG., FIEI
Director of Services & City Engineer
Cork Corporation
City Hall
Cork

E. G. Pettit & Company
Consulting Engineers & Architects
Springville House
Blackrock Road
Cork.

Job Nr. A5088 **December 2001**

REVISION CONTROL TABLE

APPLICABLE FROM 10.12.01

User Is Responsible For Checking The Revision Status Of This Document

Rev. Nr	Description of Changes	Prepared by	Checked by	Approved by	Date
A	Issued for Tender	G. Sim	KC	GOS	December 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. A5088-N-S-04

Volume 2: Specification
Section A – Scope of Works
Section B – Scope of Supply, Installation and Commissioning
Document Nr. A5088-N-S-05-A

Volume 3: Schedule of Prices
Document Nr. A5088-N-S-06

Contract Drawings

Preliminary Safety & Health Plan
Document Nr. A5088-N-H-01
(Ref. Volume 2, Section A, Clause 4.0)

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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 pumps, associated controls, electrics, pipework, fittings and ancillaries in the proposed Besborough Pumping Station and existing Ronayne's Court Pumping Station.

The Civil Works will be constructed by others under the Cork Main Drainage Scheme – Phase 2 Contract.

Under the Civil Works Contract, a twin 1100mm diameter ductile iron rising main will be laid along the former Passage Railway Line between Atlantic Pond Pumping Station and the Mahon Technology Estate Road. Similarly a twin 700mm diameter ductile iron, rising main will be laid along the disused Railway Line between the existing Ronayne Court Pumping Station and existing pipework at the Mahon Technology Estate Road. A 350mm diameter rising main is to be constructed from the proposed Besborough Pumping Station, through the grounds of the Besborough Convent and along the former Passage Railway Line, to connect to existing pipework at the Mahon Technology Estate Road. A 450mm diameter rising main will be constructed from the existing Ring Mahon Pumping Station along Ring Mahon Road to connect to a section of 450mm diameter rising mains to be constructed by others.

2.0 SCOPE OF CONTRACT

2.1 This Contract provides for the supply, installation, testing and commissioning of mechanical and electrical equipment in 1 nr. new and 1 nr. existing reinforced concrete structure, 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 36 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/Electrical Contractor. The concrete structure for the Besborough Pumping Station 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, Atlantic Pond and Tramore Valley Rising Mains (Doc. Nr. A5088-N-H-01-B) 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 20.0 "Compliance with Safety & Health Requirements" in Section B.

5.0 FLOWS

5.1 Besborough Pumping Station

The total design inflow to the pump station is 126 l/s. there are a total of 3 identical pumps which operate on a 1 Nr. duty, 1 Nr. Assist and 1 Nr. Standby basis. With the duty and assist pump operating simultaneously the flow to be forwarded is 126 l/s (6 DWF). With the duty pump operating in isolation, the flow to be forwarded is 84 l/s (4 DWF).

5.2 Ronayne's Court Pumping Station

This existing pump station receives flows ranging from 72 to 860 l/s. the total design flow of this pump station is 1144 l/s (8DWF). The existing 4 pumps, presently pumping to a header chamber adjacent to the pump station, are to be replaced by 4 new pumps. These 4 new pumps will initially, for a period of approximately 2 years, continue to pump to this existing header chamber. Thereafter they will be required to pump to a new header manhole located at a distance of 1712m away from the pump station. Each of the twin rising mains is to be served by 2 Nr. pumps. The pumps operate on a duty and assist basis on each rising main. The flow to be forwarded along each rising main with both pumps operating simultaneously is 572 l/s (4DWF). The flow to be forwarded along each rising main when pump is operating is 321.7 l/s (2.25 DWF). These flows apply for both the initial and ultimate conditions – see Section B Clause 2.1.1.