BALTIC HUB T5 OFFSHORE WIND TERMINAL PROJECT

Technical Volume 2

Part 2.1 Employer's Requirements
Section 4- Landside Utilities and Services

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Baltic Hub

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4 LANDSIDE UTILITIES

4.1 GENERAL

4.1.1 INTRODUCTION

This section of the Employer's Requirements outlines the requirements for utilities and mechanical services required to support the safe and efficient operation of the T5 Offshore Wind Supply Base Terminal (OWSB). This Employer's Requirements outlines the Contractor's responsibilities for the design, manufacture, supply, works testing, painting, site installation, testing and commissioning, together with the supply of Operations and Maintenance manuals and the supervision, labour and plant provision in connection with all the elements of work herein.

The Contractor shall read all of the Employer's Requirements, tender drawings, room data sheets and the Employer's Standard Employer's Requirements to fully appreciate and understand the requirements and services to be provided as detailed within this Employer's Requirements, the drawings and room data spreadsheets.

The works are generally enclosed within the boundary as detailed on the drawings. However, the contractor shall carry out the necessary works outside the boundary to integrate / connect into existing mechanical and electrical services and ducts systems from T3 to enable the works to be completed and provide a fully operational mechanical and electrical system within terminal T5.

Following the Employer's Requirements for particular sections of the Works, the General requirements in respect of civil works are included which are to be read in conjunction with the particular Employer's Requirements as appropriate.

It shall be noted that notwithstanding any descriptions given in the following sections the Contractor shall allow for all clearance, excavation, removal and disposal off site of any material encountered that the Contractor considers necessary for his chosen design.

For the avoidance of doubt, "any material" means any material of any nature whatsoever (whether the same be naturally occurring or manmade) which may be encountered during or otherwise affect the execution of the Works including (without limitation) polluted materials, mud, silt, sand, clay, rock, boulders, corestones, vessel, car or other wrecks, chains, anchors, cables, existing structures and services, bombs or shells.

4.2 ELECTRICAL POWER AND DISTRIBUTION

4.2.1 INTRODUCTION

This Section of the Employer's Requirements outlines the requirements for electrical and mechanical services required to support the safe and efficient operation of the T5 OWSB terminal. This Section also outlines the Contractor's responsibilities for design, manufacture, supply, works testing, painting, site installation, testing and commissioning, together with the supply of operation & maintenance manuals, and the supervision, labour and Contractor's Equipment provisions in connection with all the elements of work herein.

The works are generally within the Site boundary as shown on the Layout Drawings. However, the Contractor shall carry out works as necessary outside the boundaries in order to integrate/connect into existing mechanical and electrical services and duct systems on the present Terminal and on Port Authority land where necessary, to enable the works to be completed and to provide a fully operational electrical system within the new Terminal. The Contractor shall request the Employer gives temporary possession of areas required by him to carry out any works required which are not within the Site at least 21 days before the works are programmed to commence.

4.2.2 WORK SCOPE

The scope of the electrical works includes design of the power distribution system required for the new T5 OWSB terminal. The electrical works include supply, installation, testing and commissioning of the MV and LV electrical distribution network for T5 OWSB terminal.
Adequate power supply for preassembly work, turbine preservation, lighting, containers, office, warehouse facilities, etc. shall be provided.

The scope of the Electrical Installation to be provided whether specifically mentioned herein or not will include as a minimum the following elements:

a) The scope of the electrical works includes design of the power distribution system required for the new T5 OWSB terminal. The electrical works include supply, installation, testing and commissioning of the MV and LV electrical distribution network for T5 OWSB terminal.

b) Adequate power supply for preassembly work, turbine preservation, tower packs lighting, containers, office, warehouse facilities, etc. shall be provided.

c) Detail electrical design solutions needs be agreed with ZMPG and the Employer

d) Connection and routing of 15kV High Voltage power supply from existing T3 substation and switch gear, to onsite MV distribution system housed in an modular MV receiving substation.

e) 15/0.69kV Modular Substations incorporating 15kV switchgear (in it's own dedicated accommodation) transformers, main 600V switchgear and all associated equipment and facilities power factor correction equipment

f) 15/0.4kV Modular Substations incorporating 15kV switchgear (in it's own dedicated accommodation) transformers, main 400V switchgear and all associated equipment and facilities power factor correction equipment.

g) 15/0.23kV Modular Substations incorporating 15kV switchgear (in it's own dedicated accommodation) transformers, main 230V switchgear and all associated equipment and facilities power factor correction equipment.

h) 690V 3P+PE supply to:

- 2 x tower testing equipment at the outbound quay area, via power outlets
- 1 nacelle HSBM blade mounting facility in the storage area.

Voltage variations shall be limited to +/- 5% and frequency variations to +/- 1%. Fault levels should be less than 150mVA.

i) Main 230V/ 400V power distribution equipment and cabling to:

- 12 tower pack points alongside the outbound quay via power outlets
- 30 Nacelle plug in points in the storage area via power outlets
- 2 x ERTs via power outlets
- Buildings
- High mast Lights
- Containerised power (Power container to tower frames)
- Dehumidifiers via power outlets
- Tools via power outlets
- Service Lift via power outlets
- Cable pull hat via power outlets
- Harbour test units via power outlets
- SST Charging points via power outlets

j) Specific and general purpose small power distribution equipment, supplies and cabling to fixed appliance outlets, electrical equipment and lighting installations.

k) Low voltage supplies for external area lighting including perimeter fence and port side.

l) Low voltage supplies in the buildings.

m) Fire detection and alarm system for buildings.

n) Telecommunication systems

o) Electrical cable duct system to serve the earthing, lighting towers, buildings etc for the power, data, telephone, security, fire fibre optic network systems.

p) Cableways and cable support systems for distribution systems.

q) Earthing, bonding and lightning protection.

r) Electrical installations to serve mechanical services and equipment.

s) Liaise with the Local Authorities and Supply Authorities

t) Testing and Commissioning of electrical installations and plant.

u) Labelling of all equipment

v) Design drawings and documentation.

w) 'As Built' drawings.

x) Operations and Maintenance Manuals.

y) Port Operations staff and Maintenance Staff training.

z) Submission of any design drawings/load schedules to the Local Authorities and/or Supply Authorities for approval.

All elements of work not specified directly in the Employer's Requirements and/or in other Contract Documents but necessary to execute the Employer's Requirements shall be considered as included in the Contractor's Scope of Works.

The Contractor shall obtain all required decisions, approvals, and opinions where necessary for his design.

The existing terminal shall operate continuously for the entire period of execution of the Works. All obstructions, disturbances, and exclusions of access to the existing terminal shall be agreed with the Engineer and the Employer 14 days prior to their commencement.

4.2.3 690V POWER SUPPLY

A 690V modular substation shall be provided on the Site via the buildings and service corridors as shown on the Tender Drawings.

The substation, associated switchgear and transformers shall comply with all significant aspects of the current relevant standards and regulations.

Electrical parameter requirements

- Mains voltage- 690V,
- 3-phase system, 3P+PE
- Frequency-50 Hz,
- Protection electric shock
- Resistance earthed.
- All Tower Frames and Nacelles shall have sufficient
- grounding for lightning protection. This is achieved when
- less than 10 Ohm resistance is measured between the
- component and the ground.

Contact protection requirements.

- Enclosures /insulation of active components,
- Partitions,
- Obstacles,
- Placing out of range

Protection in case of indirect contact:

- Earthing
- All Tower Frames and Nacelles shall have sufficient grounding for lightning protection. This is achieved when less than 10 Ohm resistance is measured between the component and the ground.

An electrical installation owned by Baltic Hub shall be designed behind the energy metering system described above. MV consumers will be supplied radially.

15kV is mainly used to supply and distribute power to site but all MV consumers are limited to 690V equipment on site such as the ones described in the Design Criteria and transformers which reduce the voltage of 15kV to 0.69kV, which ensure the distribution of electricity at the level of voltage required. The 690V MV consumers can be split into two areas of the T5 site are these are the nacelle storage and preassembly tower pack laydown areas.

All MV consumers will be powered by 0.69kV socket installed on an outlet post connected to the supply cables through connection pits equipped with junction boxes.

Voltage Reducing Transformers

MV/LV transformers, naturally cooled AN/AN, are required to be designed. Voltage gearing with no-load voltage regulation +/- 2x2.5% is required. Required temperature class min. F for transformer insulation. An emergency stop is to be provided in the transformer room to allow the voltage drop in the SN power bay. Unification transformers are to be designed by the Contractor.

Surge Protection

Surge arresters need to be installed in the SN 15kV bays. Surge arresters needs be connected with conductors to the earthing insulation.

4.2.4 230V / 400V POWER SUPPLY

Electrical parameters/requirements for low-voltage:

- Mains voltage - 0.4kV 3 phase 3P+N+PE
- Main voltage 0.23kV –1 phase N+PE
- System TN-C-S,
- Frequency - 50 Hz,
- Protection against electric shock
- All Nacelles must be connected to Earthing/Ground Protection System with maximum 10 Ohms resistance

Basic protection requirements:

- Insulation of active parts,
- Partitions and enclosures,
- Automatic switch off.

Supplementary protection requirements

- Differential current protections,
- Bonding, earthing installations.
- All Tower Frames and Nacelles shall have sufficient grounding for lightning protection. This is achieved when less than 10 Ohm resistance is measured between the component and the ground.

In general, the contractor shall analyse the protection settings along all electrical facilities currently installed at Baltic Hub and agree the final design and protection method with the Authorities. However, as a minimum the following should be considered.

In order to provide low-voltage power supply in each electrical building, transformer stations are to be provided together with the main low-voltage transformer switchgear. Low-voltage main switchgear shall have a self-switching system (SZR) to switch the power source in the event of a failure. Each main/transformer switchboard shall be equipped with a digital self-switching system (SZR) and planned power field switching (PPZ), operating in the event of a voltage failure on the switch rails to open the switch in the primary buy and close the backup or coupling switch. The system will include a residual voltage control member. It shall perform the following functions:

- SZR switching: synchronous (fast), quasi synchronous, slow.
- Switch between SZR cycle and surge voltage reduction.
- Any power declaration of the primary switchboard.
- Switching in PPZ and WBS cycle: synchronous (fast), quasi synchronous, and free.
- Equipped with measuring to control the voltage.
- The SZR system will be connected to the BMS system. The system will provide signaling with the current status of the PPZ/SZR system as well as enable the implementation of switches.

The main switchgear provides for the possibility to control all switches remotely from the BMS system and locally from the switchboard. In addition, for all switches in the main switchgear via the BMS system shall provide the following:

- signalling of the current state of outflow,
- signalling of the operations of breakers,
- measurement of basic parameters (current, power) for each circuit,
- implementation of basic commands: attach, disable, reset.

Surge Protection

Surge arresters must be installed in the SN 15kV fields. The stops must be connected with the suitable designed conductors to the GSU building. Type 1 + 2 surge protectors shall be used in low-voltage switchgear. Type 2 protectors will be used for building switchgear powered from the main switchgear.

4.2.5 POWER OUTLET POINTS

Most LV and MV power consumers on the T5 terminal as listed in Section 4.2.2 shall draw power through connection to outlet sockets via cables between the socket and the equipment drawing power. The equipment that will require connection to outlet points will be described in this section.

Nacelle Storage Area:

The nacelles storage area is envisaged to house up to 30 nacelles, 6(six) outlet post will be required with the following outlets on each outlet post:

- 5x 400V 16A 3Phase N+PE CEE Outlets IP67 (for connection into nacelle for heating, dehumidifier, light yaw box etc)
- 1x 400V 32A3 Phase N+PE CEE Outlet IP67 (For connection to ERT)

Outlets must be earthed to a maximum of 10 ohms

The Contractor shall design and install all power supply and routing to the outlet post positions indicatively shown on the tender drawings for the nacelle storage area.

The Contractor is not required to design, supply and install any of the outlet posts which will be provided by the final operator. However, the Contractor must ensure that the proper required power supply for each outlet post to supply the required power to each socket is designed and installed. The final connection of the power supply cables to the outlet equipment will be carried out by the operator but it is envisaged that the Contractor shall liaise and co-ordinate the power supply design and installation with the equipment suppliers to further refine and confirm his design for the power supply.

Preassembly Areas – Tower Foundations:

The preassembly area is to house up to 2 separate tower packs each containing up to 6 tower positions. Each tower position shall have access to one outlet post which will consist of the following outlets:

- 1x 230V 16A 1 Phase N+PE CEE Outlet IP67 (16A 230V Fuse and RCD (4 Pole) for dehumidifiers
- 1x 230V 16A 1 Phase N+PE CEE Outlet IP67 (16A 230V Fuse and RCD (4 Pole) for tower lights
- 1x 230V 16A 1 Phase N+PE CEE Outlet IP67 (16A 230V Fuse and RCD (4 Pole) for tools
- 1x 690V 16A 3 Phase N+PE CEE Outlets IP67 (16A 690V Fuse and RCD (4 Pole) for service lift
- 1x 400V 16A 3 Phase N+PE CEE Outlets IP67 (16A 400V Fuse and RCD (4 Pole) for Cable pull hat
- 1x 690V 16A 3 Phase N+PE CEE Outlets IP67 (16A 690V Fuse and RCD (4 Pole) for Harbour testing unit
- 1x 400V 32A 3 Phase N+PE CEE Outlets IP67 (32A 400V Fuse and RCD (4 Pole) for SST Charging

The Contractor shall design and install all power supply and routing to the outlet post positions indicatively shown on the tender drawings for the tower packs within the preassembly area.

The Contractor is not required to design, supply and install any of the outlet posts which will be provided by the final operator. However, the Contractor must ensure that the proper required power supply for each outlet post to supply the required power to each socket is designed and installed. The final connection of the power supply cables to the outlet equipment will be carried out by the operator but it is envisaged that the Contractor shall liaise and co-ordinate the power supply design and installation with the equipment suppliers to further refine and confirm his design for the power supply.

Earthing protection to the outlets are required up the maximum of 10ohms.

4.2.6 POWER AND LIGHTING INSTALLATIONS IN BUILDINGS

A separate switchgear for buildings will be required. The switchboard will supply installations associated with heating, air conditioning, ventilation, general purpose sockets and lighting. Ventilation, air conditioning systems will be monitored and most importantly also controlled by the BMS system.

The firefighting equipment will be supplied from a separate switchboard, powered before the main switchboard switches.

A guaranteed voltage switchgear is to be installed for each building. Telecommunications, teletechnical, monitoring, BMS and other systems will be supplied by the guaranteed voltage switchgear to ensure reliable control of the container terminal. The guaranteed power switchgear shall be powered from 2 sections of the main switchboard and in addition, in the event of failure of both sections, the power supply of the switchboard will be provided via UPS in a n+1 system with battery system ensuring that 100% of the receivers are supported for a period of 60 min. A switchboard shall be provided for the supply of computer circuit sockets in the area of the temporary work offices on site.

A separate guaranteed voltage system shall be provided for the auxiliary needs of the switchgear control circuits. The designed power supply shall be guaranteed with power supply from 2 sections of the main switchboard transformer, in addition, in case of failure of both sections, the power supply of the switchboard will be provided through an UPS with a battery system ensuring power for 240 mins.

For the low-voltage transformer switchgear, after installation and commissioning (after approximately 12 months), the operating measurements of the outward power consumed must be carried out and the levels of deformation of the higher harmonics should be verified and active filters needs be selected to compensate reactive power and to neutralize harmonic deformations.

Indoor lighting to the buildings shall be provided and designed in accordance with the requirements of PN-EN 12464-1.

In addition, emergency lighting with requirements in accordance with EN 1838 shall be designed for the building rooms.

In the buildings, cable routes shall be pulled and secured to cable trays and on cable ladders at vertical parts and in cable rooms. Cable connections with fixings ensuring the continuity of

energy supply for a period of not less than 90 minutes shall be used for the equipment involved in the fire extinguishing operations, “E90” cable systems with CNBOP certificate.

Cable passages through walls and ceilings that require fire separation shall be fire resistant. In addition, cable glands with a diameter of more than 4 cm through the walls and ceilings of an enclosed space for which the required fire resistance class is not less than EI 60/REI 60 and which are not components of fire separation shall have a fire resistance class (EI) of the walls and ceilings of that room.

For fire zones in buildings with a volume of less than 1000 m3 PWP(EPO) current fire switches are not required. In the case of a fire-fighting operation, the switch-off of electricity will be carried out on the basis of internal procedures by means of circuit breakers located in switchboards.

Lightning masts on the roof of the building are to be located and designed, brought down by ducts into the ground network through control connectors placed in boxes near the building. Each building will be equipped with potential equalization installations connected to the foundation grounding installation and to the external grounding installation with a minimum of 2 points.

4.2.7 EARTHING, BONDING AND LIGHTINING INSTALLATIONS

The Contractor shall provide a complete earthing, bonding and lightning protection system to serve the new terminal. The system shall be positively interconnected with the adjacent existing earthing facilities to ensure safe and functional performance particularly with respect to the elimination of any possibilities of potential differences existing between earthed components on the overall Site.

The necessity for any surge diverters or filtering Plant to protect installations or Plant they serve from the effects of surges arising from systems disturbances due to lightning, system switching, the presence on the system of heavy waveform-distorting loads or other naturally occurring or man-made causes, shall be assessed by the Contractor. The analysis shall be carried out in accordance with current standards and regulations, and the result of the analysis shall be provided by the Contractor to the approval of the Engineer. If the Engineer requires, the Contractor shall install all necessary surge diverters or filtering Plant.

Earth bonding shall be provided throughout the installations as required for safety and functional aspects of electrical systems, lightning protection of electrical and structural assets and safety of personnel. Earthing/bonding conductors shall be PVC insulated, flexibly stranded copper cable. The PVC shall be coloured green/yellow. Earthing connections shall be labelled to indicate their function with a disconnection warning.

Earthing shall be carried out in accordance with all relevant standards and regulations.

All Tower Frames and Nacelles shall have sufficient grounding for lightning protection. This is achieved when less than 10 Ohm resistance is measured between the component and the ground.

The buildings should have additional foundation grounding systems that will be connected to the T5 terminal grounding system.

Earthing provision for the future STS crane rails that will be installed on the T5 terminal shall be provided in the Contractor's design. Although the final STS rails and earthing is not required to be installed, the Contractor shall include in his design all provision and integration for ease of retrospective installation in the future such that no abortive works is required such as demolition of the quay wall capping beam and rail trenches and or modifications to be made on the quay wall etc.

4.2.8 CABLE ROUTING AND DUCTING

Cables in terminal T5 will be routed underground via cable ducts. On branching, changes of direction and every 100m, cable manholes are required. An underground ducting system will be built between the main electric building and the quay, allowing future supply cables to be supplied for the power supply of container ships (cold ironing).

The cable ducts needs to be installed according to the terminal layout. After pulling the cables, the ends of the ducts need to be sealed.

Installation of cable ducts into cable chambers and buildings should be done with prefabricated cable glands. The cable ducts must be connected tightly so that no water can enter. The inner diameter of the cable ducts shall be at least 1,5 times the outer diameter of the cable. When inserting several cables into the guard, the surface of the hole should not be less than three times the sum of the surfaces of the cables.

Each cable chamber will be enabled for manual pumping of rainwater. Each connection chamber for lifting equipment will be connected to the terminal sewerage system. Each connection chamber will be enabled for lighting, anti-condensation heating and pump to be pumped out in the event of an emergency flood.

Connections entered end exited from cable chambers should ensure the remaining connection points are sealed and are tight. Only certified proven system solutions are allowed. Sealings are not allowed to pass through the foundations with mounting foams, sealing, etc. Chamber openings should be adapted to the number and location of ducts. The cable access into buildings must be sealed against the penetration of water and gases. The entire cable routing system should be adjusted to the level of the target area. Cable chambers are to be designed with a minimum height of 2m.

Before proceeding with the design, it must be confirmed that the existing armament of the site is in accordance with the land use plan.

Although not required for the OWSB terminal all ducts required for the future container terminal shall be installed in accordance with the Building Permit if the future T5 container terminal service corridors are to be adopted by the Contractor. Contractor shall submit his design to the Engineer for approval.

For lighting circuits, a minimum of two ducts shall be designed for low-voltage power cables.

As a standard, a cable duct with a diameter of 160mm shall be used across the site for T5.

The Contractor shall produce drawings showing duct routes with cross sections indicating the numbers of ducts per route. The drawings showing the overall system of ducts shall be submitted to the Engineer for approval before construction commences.

4.2.9 OUTDOOR LIGHT INSTALLATIONS

For the illumination of the external areas of the terminal, LED-type luminaires are to be utilized, these are to be mounted on the top of masts or poles. The lighting masts will be installed on individually designed foundations. The internal areas of the terminal will be illuminated by mobile LED task lights provided by the final operator.

The Tender Drawings show the typical locations of the light masts, lighting poles to which cable ducts should run to. The spacing of the lighting poles and masts are to be designed by the Contractor to achieve the required levels of illuminance while ensuring the uniformity factor and the required glare level in accordance with the requirements of PN-EN 12464-2. In the area of the technical buildings, outdoor lighting fixtures will be installed on support structures on the roof of buildings.

The external lighting will be powered by ROZ external lighting switchgears located in main control buildings.

External lighting circuit is to be controlled by:

- Manually from the facade of the outdoor lighting switchboard
- Autonomous with astronomical clock device
- From BMS

For each external lighting circuit, a spare supply and control circuit is to be provided, "in a loop", which acts as a power reserve in the event of damage to the main circuit's power supply cable.

The BMS system is expected to confirm the outdoor lighting circuit status and confirm the presence of voltage in the ROZ switchboard.

For each lighting mast, external lighting pole, junction boxes equipped with a switch and individual protections are provided for each luminaire installed on the mast/pole.

Masts of 35m Height:

Basic requirements for masts:

- The lighting mast meets the wind requirements for zone II and the ice load according to the requirements of the applicable standards,
- The steel masts must be protected against corrosion in class C5-M (min. for 60 design life years),
- Luminaire Housing mounting height: ~34m and
- The masts must ensure the safe installation of luminaires and the operation of lighting and power installations, taking into account the increase of an additional 25% of lighting fixtures in the future,
- The preparation of the foundation must be adapted to the attachments of the masts,

- Auxiliary structures enabling the housings to be fixed,
- The design of the mast must ensure electrical continuity, a lightning needle and a grounding will be required to enable it to be connected to the grounding system and connected to the foundation ground,
- double inspection doors to be installed (teletechnics, lighting),
- possibility of installation of data processing equipment, video and wiring.
- Fixed service platform with hatch together with access ladder equipped with fall arrest protection system
- Inspection door for cables
- Foundation raised 1m above the surrounding ground level

Basic requirements for outdoor lighting fixtures

a) Luminaires on 35m masts

- Asymmetric floodlight with LED source
- Housing power approx. 1100W - 2000W
- Stream min. 110,000 lm
- Min IP66, min. IK08
- Colour Temperature of 3000k for all outer most perimeter luminaires facing towards the sea
- Color temperature: 4000K for all other luminaries facing towards the terminal land area
- Colour rendering index: Ra min 70
- The light efficiency of the housing to suit number of luminaires and design to meet the LUX level requirements,
- Rated power factor of at least 0.95
- Operating temperature: -30°C - +35°C
- Power supply with starting current max. 20A for 230V,
- Dali or DMX luminous flux adjustable
- Durability of mine sources 50,000 h
- Execution in the class of protection against corrosion environment min. C5-M
- Surge protection

4.2.10 CABLES

The Contractor shall be fully responsible for delivering cabling, Plant, terminations and other associated components in accordance with current standards and regulations. The category and quality of Plant deployed shall take due account of diversity, robustness of system, safety criticality, temperature and the requirements of guiding legislation and regulations.

The cables that supply the individual consumers should be selected from the taking into account the power demand, voltage drops, short circuit impedance, etc. and parameters that result from the standards.

4.3 SEWERAGE SYSTEMS

4.3.1 WORK SCOPE

Temporary foul drainage will be installed for the OWSB temporary offices, the foul water drainage will be limited to the area where the OWSB offices will be situated.

The total foul water discharge per head will need to be calculated and suitable foul water connections shall be provided and connected temporarily into the existing T1 waste-water network. The full wastewater network for the final T5 container terminal will not be constructed during the operation of the OWSB terminal operations, the indicative foul water network corridor to be considered by the Contractor is shown on Drawing PC1063-RHD-T5-ZZ-DR-EL-6002. The discharge of proposed flows into the existing T1 network is to be controlled as not to surcharge the system. The suitable location for discharge and the maximum available capacity available must be confirmed by the Contractor with the Employer. The design will comply with these requirements.

The head count for number of workers to be situated on the T5 terminal within the offices is set to be 100 people. Should the capacity of high pressure sewerage line connected to T1 and T2 be exceed, the Contractor must install waste water holding tanks on the site of the offices and buildings to discharge either back into the existing terminal sewerage system at the correct flow rate or emptied using waste water disposal trucks and services.

4.3.2 PUMPING STATIONS FOR DOMESTIC WASTE WATER

Pumping systems, if deemed necessary by the Contractor, supplied to the site shall be complete, i.e. they shall comprise the delivery of the following elements:

Basic pumping station components:

- concrete reservoir of the pumping station adapted for load class F900,
- inspection and assembly manhole suitable for F900 class loads
- submersible pumps of parameters such as KSB AMAREX N type or equivalent
- deflector at the inlet (AISI 304),
- coupling elbow (cast iron),
- ball check valves (cast iron),
- soft sealing shut-off valves (cast iron),
- discharge piping (AISI 304)
- pump guides (AISI 304)
- pump lowering and lifting chain (AISI 316),
- mounting kits (bolts, washers, nuts, anchors, etc.) (AISI 304)
- connection flanges (AISI 304),
- ventilation pipe (AISI 304),
- power and control cabinet,
- power and control cables,
- equalization connections of all metal parts,
- ladders (AISI 304),
- handrailing (AISI 304),
- technological platform (AISI 304) / plastic,

- hydrostatic probe with cable,

The drainage system used must be such as to allow the replacement of individual drainage elements without damaging adjacent components.

Pumps should be switched on automatically and be equipped with electronic alarm systems in case of exceeding the permitted levels or damage and should be integrated into the BMS. Device status control like pump operation, pump failure, other alarms (dry running, too high level of waste water), no power, maintenance shutdown, operating mode – manual/automatic etc., should be possible remotely via BMS system. Equipment and pipelines shall be protected against uplift pressure by groundwater by concrete cladding or in the case of wells, separators, settlers, chambers using thickened bottoms or ballast plates.

4.3.3 MINIMUM COVER TO PIPES

In order to provide protection from external loads, the minimum cover to pipe soffit levels should be:

a) Trafficked areas, 1.2m below finished pavement level;

b) Non-trafficked areas, 0.9m below finished pavement level;

Should the above criteria not be achievable then, a 150mm minimum of concrete surround to the pipe must be applied.

4.3.4 MATERIALS AND STRUCTURAL FORM

Drains and outlets installed shall generally be constructed using low corrosive materials as follows;

- Service connections 150mm diameter uPVC;
- Pipes from 200mm to 300mm diameter uPVC, or Vitrified Clay;

Manhole covers shall be load Class F900, cast iron and bolted.

4.3.5 MANHOLE DIAMETERS

Typical circular manholes sizes are listed below to suit specific pipe diameters. These should be used as guide for minimum size required when developing design.

Diameter of largest pipe in manhole (mm)	Internal diameter of manhole (mm)
Less than 375 =	1200
375 - 450 =	1350

Where site specific requirements apply, manhole sizes could be developed to suit the project needs. Consideration should be given to constructability, maintenance and access.

4.4 RAINWATER DRAINAGE SYSTEMS

4.4.1 WORKSCOPE

The surface water drainage for the OWSB shall be designed as an integral solution with the gravel paving of the OWSB surfacing, whereby the surfacing is considered as permeable allowing surface water to drain directly into the gravel bed. Where impermeable paving is used, the gradients and falls of the impermeable paving must be designed to channel surface run off back towards the permeable paving and drainage system designed in the rest of the terminal.

The drainage layer is at the pavement surface and becomes a ‘gravel bed’. In these situations, the gravel is designed to accept Sub-Surface Collector Drains deigned to accept 100 % of the rainfall falling directly on it plus any that is channelled into the gravel bed from surrounding impermeable/less permeable pavements.

To comply with the existing Environmental Decision the gravel surfacing medium must be ‘tanked’ with an impermeable geotextile membrane which will prevent the water collected in the gravel medium to enter into the sub-base and water course without first being filtered into collector pipes and an oily water interceptor.

The water collected in the gravel bed medium shall be channelled out of the outfalls designed in the main T5 Quay Walls via buried collector pipes.

No flooding or ponding is allowable of the surface of the terminal, collector pipes and depth of the gravel medium shall take this into consideration for saturation and permeability parameters.

The contractor shall design and construct a rainwater drainage system for terminal T5 whereby the rainfall runoff volumes generated within the T5 terminals’ footprint must be collected by suitably sized drainage networks which will convey the volumes for unrestricted discharge into the sea by outfalls located in the quay walls.

All drainage networks will be sized taking into consideration, appropriate catchments’ size, construction phasing of the terminals and the proposed terminal layout.

Drainage collectors shall be placed at the low spots across the terminals or at suitable intervals between collectors. Buried carrier drains will be placed in locations which allow for suitable access to be provided without interfering with the port’s operations.

Suitably sized separator tanks should be designed and installed to the upstream of the outfalls to intercept debris, oils and other light liquids prior to discharge. A penstock has to be installed behind the separator to seal the network in case of emergency (prevention against contamination of bay). To prevent the networks from being flooded by sea water during periods of high tides, a non-return valve will be installed upstream of the outfalls.
All sandtraps/oil separator’s chambers will be equipped with a system to signal:

- Too high level of petroleum substances
- Too high level of solid contaminants

- the flooding of the chamber with remote signaling integrated into the existing BMS system

Until a new terminal is built, no rainwater will be discharged into the sea by the installed outlets. Rainwater will be purified locally through settler wells located under street drains and with linear drainage and open channels and centrally using settlers and petroleum separators.

Each catchment area shall have a separate central cleaning system constructed of a swirl suspension separator integrated into a light liquid slat separator.

If required, a flow regulator will be installed in front of the cleaning system to limit the flow to the nominal flow of the cleaning system. Excess rainwater from the precipitation will be discharged by a bypass.

The cleaning system will be protected against the wash-out of accumulated contaminants and adapted to work under periodic sewer flooding conditions. Sand traps/oil separators will be designed in such a way that during maintenance works related to cleaning of the wells, the amount of contaminants necessary for pumping and utilization is as small as possible (protected against incoming water, chamber capacity as low as possible while ensuring the efficiency and performance of the separator at the level required by law).The cleaning system will be adapted to load class F900 and will allow full service, maintenance, replacement of the equipment through the inspection manhole. The cleaning system shall be equipped with an alarm system informing the maximum amount of contaminants to be collected integrated with BMS system.

Drainage outfalls shall be designed and installed in the locations indicated on the Tender Drawings. The Contractor should note that the outfall sizes and locations have been submitted along with the invert levels as part of the Building Permit. All out falls are to be protected by a flap gate and grating, resistant to sea conditions.

4.5 DRAINAGE PIPES AND CONNECTIONS

4.5.1 GRAVITY SEWER PIPES AND MANHOLES

The following minimum requirements are specified for the pipes and manholes.

- For pipes in the range between diameter De160mm to De300mm, PP tubes with circumferential stiffness min. SN10 class, cup joints, pipes with parameters such as WEhoTripla from UPONOR or equivalent.

- De400mm to De1200mm min. SN10 stiffness class, cup joints, pipes with parameters such as WEhoLite (PE) from UPONOR or equivalent.

- On the section from the rainwater treatment plant towards the outlet to the sea pressure pipes shall be of minimum welded connections De1200x71,1 (Di1057,8) PE100, SDR17 PN10 with parameters such as WEHOPipe from UPONOR or equivalent,

- Rail trench drainage pipelines shall be corrosion resistant.
- The use of pipes made of different Material shall be permissible, provided that parameters related to ring stiffness are maintained, with the exception of dual wall corrugates tubing.
- Inspection manholes should typically be reinforced precast elements of C40/50 concrete, joined with a seal, according to the standard PN-EN 1917. Cast iron covers to manholes shall be adapted to load class F900
- Assembly and earthworks – lines of the gravity and pressure system shall be laid according to requirements of the pipe system manufacturer, in a narrow excavation with formwork. Backfilling of the excavation – in layers, with precise compaction of particular layers (Ip=1.03).
- All technical infrastructure elements i.e. pipelines, wells, settling devices, separators, pumping equipment, inspection manholes, hydrant box drains, valve boxes must be adapted to load class F900.

4.5.2 MATERIALS AND STRUCTURAL FORM

Drains and outlets installed shall generally be constructed using low corrosive materials as follows;

- Service connections 150mm diameter uPVC;
- Pipes from 200mm to 300mm diameter uPVC, or GRP;
- Pipes 350mm to 1000mm diameter and larger Concrete, Twin Wall Structured PVC, or GRP;

Linear drainage channels located in areas designated for road traffic shall have integrated bilateral reinforced concrete strip and grate and formation strength shall be Class F=900kN.
Linear drainage channels located in areas not designated for road traffic shall have a grate and formation strength shall be Class D=400kN.
Manhole covers shall be load Class F900, cast iron and bolted.

4.5.3 MANHOLE DIAMETERS

Typical circular manholes sizes are listed below to suit specific pipe diameters. These should be used as guide for minimum size required when developing design.

Diameter of largest pipe in manhole (mm)	Internal diameter of manhole (mm)
Less than 375 =	1200
375 - 450 =	1350
500 - 700 =	1500
750 - 900 =	1800

Where site specific requirements apply, manhole sizes could be developed to suit the project needs. Consideration should be given to constructability, maintenance and access.

4.6 POTABLE WATER SYSTEM

4.6.1 WORKSCOPE

The contractor is to design and construct a potable water system for terminal T5 to supply drinking water to sanitary ware located in buildings and to alongside berth potable water points. The potable water supply shall be sourced from the existing Terminal's potable water network. The connection point is as shown on the Tender Drawings.

The distribution network serving the welfare facilities shall be of direct mains formation with branched off-take connections to each building.

The potable water system shall meet all health and safety requirements to maintain the required quality of water and prevent contamination, or any other detrimental effects, of the potable water supply in accordance with the relevant Design Codes and Regulations.

The total water demand for the future T5 terminal is estimated peak 22.32m^3/hr. Should the demands of the OWSB be greater than that of the T5 container terminal, a sperate network for the water supply may be required. The Contractor is to assess and verify this requirement.

4.6.2 ABOVE GROUND STORAGE TANKS

The Contractor shall assess whether the current designed potable water network is sufficient to satisfy the OSWB T5 water demand based on the information provided in terms of flow rate and capacity. If not, aboveground potable water storage tank(s) shall be installed, within the compound area, to ensure sufficient water is available to supply the T5 distribution network serving the quayside vessel bunkering points for a minimum of 24 hours and at least 7 days for all personal water consumption at the site welfare facilities, should the mains supply fail, or it is unable to deliver sufficient water during peak demand. The potable water storage tank shall provide Fluid Category 5 backflow prevention by means of an air gap, as per PN EN 1717, to prevent contamination of the incoming potable water mains supply.

4.6.3 CIRCULATION PUMPS

Circulation pumps will be required to maintain water quality and prevent bacteriological growth, such as legionella, forming within the distribution network.
The circulation pumps shall be supplied as a packaged pump set. The pumps shall comprise of an electric motor driven booster set arranged in a duty/assist/standby format complete with its own dedicated control panel.

The pumps will be sized according to the expected peak demand and pressure on the potable water system, other than for filling of the fire water storage tank.

4.6.4 DISTRIBUTION NETWORK

The potable water distribution network shall be a combination of both direct and ring mains with branched off-take connections that meets the applicable water pressure and capacity requirements. The distribution network shall use high-density polyethylene (HDPE) pipe with butt fusion connections and be suitably rated to withstand the working and associated test pressures.

Metallic elements such as valves, duck foot bends, etc. will be provided with a Denso wrap to ensure that they are suitably protected from the local environment and the soil.

Where required, individual pipework connections shall be provided to the new terminal buildings to serve the buildings' sanitary facilities.

To provide protection from external loads, the minimum cover to the top of the service pipes shall be 750mm below finished pavement/surfacing level. Detectable warning tape shall will be placed 150mm above buried pipework to assist with locating the water main during maintenance and for system expansion purposes.

Hydraulic calculations and modelling will be completed to size the distribution pipework. The potable water pipework system shall be designed based on the Hazen-Williams formulas. A roughness coefficient of 140 shall be used for HDPE pipe installations.

For the purposes of the design calculations, the flow velocities are set as 2.0 m/sec maximum and 0.3 m/sec minimum as per PN EN 805.

4.6.5 VALVE CHAMBERS

Strategically located isolation valves shall be provided to allow:

- The network's construction to be phased,
- Isolation of hydrant spurs,
- Servicing and maintenance of the individual items of equipment
- Isolation of sections of the ring main if required, without compromising the water supply to the berth and other terminal buildings.

Where possible, valves shall be installed within below ground valve chambers that provide access for maintenance and manual operation, otherwise direct burial gate valves with an extended spindle and road box shall be used. The covers and cover support frames shall be made of heavy type ductile cast iron (Class F900).
Isolation valves shall have suitable internal and external corrosion protection and be suitable for the conveyance of potable water without contamination.

4.6.6 WASHOUT CHAMBERS

Washout chambers shall be provided for flushing and draining the distribution network during construction and the subsequent testing, commissioning and operation of the system.

The washout facilities shall comprise of a reinforced concrete chamber containing a gate valve and interconnecting pipework to an adjacent sump.

During testing and commissioning a sump pump with flexible hose shall be placed within the side of chamber to be flooded when the gate valve is opened, so that the water can be pumped into a mobile bowser or the nearest storm water drainage channel.

The gate valve can be throttled to control the flow of water entering the chamber.

4.6.7 SUPPLY OF WATER TO SHIPS

In addition of providing drinking water to buildings, the Contractor shall design a separate potable water system to supply vessels along side T5 Outbound Quay Wall with potable water. The supply of drinking water abstraction points for ships will be carried out through the port water supply system.

Below ground wet type hydrants will be installed along the new berthing infrastructure of the T5 terminal for vessel bunkering. The potable water hydrants will be installed within a below ground chamber and come complete with an isolation valve, backflow preventer, and drain line discharging into a drainage system.

The maximum spacing between bunkering points shall be **100m** as per Port Authority requirements.

Circulation station should be equipped with alarming system communicated with ZMPG systems.

Distribution network and the whole remaining system elements should be protected against freezing.

Detailed design of the vessels water supply system should be agreed with ZMPG.

4.7 FIREFIGHTING WATER SYSTEM

4.7.1 WORKSCOPE

The scope of work for the firefighting system will include but is not limited to the design of the following:

- Primary connection to incoming water supply and / or connection(s) to the existing pipework,
- Firewater pump house (including pumps if required),
- New piped distribution network including.
    - Above and below ground pipework, bends, couplings, valves and fittings,
    - Hydrant chambers,
    - Valve chambers,
    - Washout chambers,
    - Connections to buildings,
    - Coordination with other services,
    - Any abandonment of the existing pipework if required,

- Fire hose cabinets and ancillary equipment (hose reels, extinguishers, valve keys, nozzles, branch pipe, etc).

4.7.2 BELOW GROUND HYDRANTS

Below ground wet type fire hydrants will be installed throughout the yard to serve the new berthing and container yard infrastructure of terminal T5 and come complete with an isolation valve installed within a below ground chamber.

The distance between hydrants will not normally exceed 150m. the typical hydrant layout and spacing for the Future T5 Container terminal is as shown on Tender Drawing. Please note that the spacing and hydrant types shall be assessed by the Contractor and the exact location and spacing to be tailored to the exact requirements of the T5 OWSB fire scenarios considered for design.

4.7.3 FIRE WATER PUMP FACILITY

Any firewater pump facility shall be supplied as a containerised firefighting pump station. The fire water pumps will be UL listed/FM approved and designed to meet the pressure and flow requirements of NFPA 20. Pumps maybe as per the following:

- Duty Fire Pump (Electrical Driven Motor)
- Standby Fire Pump (Diesel Driven Engine)
- Two Pressure Maintenance (Jockey) Pumps (Electrical Driven Motor)

Each pump shall come with its own dedicated control panel and shall be complete to the requirements of NFPA 20. The diesel driven pump will be tested weekly and fitted with a double-walled fuel tank designed and constructed in accordance with NFPA 20 to provide 8 hours of fuel.

4.7.4 EXISTING ABOVE GROUND STORAGE TANKS

Firewater is stored in two above ground storage tanks in T3 designed in accordance with NFPA 22 to ensure the availability of the water during maintenance and repair. The fire water storage tanks will be supplied with potable water from the site's incoming mains supply via the T1 potable water ring main and feed the fire water pumps installed within the containerised pump stations.

The two above ground fire water storage tanks is designed to hold a capacity of 4 hours at 100% of the fire water pump's rated flow of 227 m3/hr (1000 gpm) i.e. 908 m3 as per NFPA 307. A total storage capacity of 1,136 m3 (300,000 gal) is therefore required as per NFPA 22 (568 m3 / 150,000 gal per tank).

The storage tanks shall be provided with permanent connection to the incoming water supply. The water supply shall be capable of replenishing the required 1,136m^3 total fire water storage capacity in 8 hours, in accordance with NPFA 22.

4.7.5 BELOW GROUND HYDRANTS

Below ground wet type fire hydrants shall be installed throughout the yard to serve the new berthing and container yard infrastructure of terminal T5 and come complete with an isolation valve installed within a below ground chamber.
The distance between hydrants will not normally exceed 150m. The typical hydrant layout and spacing for the Future T5 Container terminal is as shown on Tender Drawing. Please note that the spacing and hydrant types shall be assessed by the Contractor and the exact location and spacing to be tailored to the exact requirements of the T5 OWSB fire scenarios considered for design.

4.7.6 VALVE CHAMBERS

Isolation valves should be located on each connections and crossings of the net and shall be provided to allow:

- The network's construction to be phased,
- Isolation of hydrant spurs,
- Servicing and maintenance of the individual items of equipment
- Isolation of sections of the ring main if required without compromising the water supply to the hydrants.

Where possible, underwriters laboratory and factory mutual listed valves shall be installed within below ground valve chambers providing access for maintenance and manual operation, otherwise direct burial gate valves with an extended spindle and road box shall be used. The covers and cover support frames shall be made of heavy type ductile cast iron (Class F900) if located in trafficked areas of the terminal.
Isolation valves shall have suitable internal and external corrosion protection from the conveyed firefighting medium and external environmental conditions.

4.7.7 DISTRIBUTION NETWORK

The firefighting distribution network shall be of ring main formation with branched hydrant connections that meets the applicable water pressure and capacity requirements. The distribution network shall use high-density polyethylene (HDPE pipe) with butt fusion connections and be suitably rated to withstand the working and associated test pressures. Where the pipework exposed and has potential to be in contact with flames or hazardous products, such as within open trenches or valve chambers, metallic pipe shall be used. Metallic elements such as valves, duck foot bends, etc. will be provided with Denso wrap to ensure that they are suitably protected from the local environment and soil.

Individual pipework connections shall be provided to the welfare/amenities buildings to serve the internal fire protection systems (automatic sprinklers, hose reels, deluge, etc.)
In order to provide protection from external loads, the minimum cover to the top of the service pipes shall be 750mm below finished pavement level. Detectable warning tape shall be placed 150mm above buried pipework to assist with locating the fire main during maintenance and for system expansion purposes.

Hydraulic calculations and modelling will be completed to size the distribution pipework. The water pipework system shall be designed based on the Hazen-Williams formulas. A roughness coefficient of 140 shall be used for HDPE pipe installations.

To comply with NFPA standards, a design velocity of 0.6 to 2.5 m/s is allowable within the pipework.

4.8 TELETECHNICAL INSTALLATIONS

4.8.1 WORKSCOPE

IT infrastructure is required to support the communication and safe operation of the terminal. This shall comprise of the following elements:

- Telecommunications internal and external to the site
- Computer network and data transfer on the site
- Fire detection and alarms
- Security systems
- CCTV and anti-intrusion measures
- Ducting, cabling and connection points for office telephones, IT network and UPS power points for a modern office environment.
- Provision of internet by means of fibre optic cabling with a minimum band width of 100 Mbit/s to all site offices.

IT infrastructure shall be provided to support visual, communication, data transfer, security, fire detection and alarm requirements.

4.8.2 TELETECHNICAL DUCTIING

For the purpose of bringing wiring to teletechnical equipment located on the quay and future T5 container terminal, the use of a common electrical and teletechnical ducts shall be used. In the main duct lines, separate ducts dedicated to teletechnical installations will be separated, to which electrical cables should not be drawn. Details of the main routes on the container terminal according to the design of the electrical industry. As a minimum 4 number fibre optic cable ducts shall be installed along the indicated routes as shown on the Tender Drawings. Empty duct pipes intended for teletechnical installations shall be blinded with polystyrene plugs.

The ducts and wiring input to buildings must be gas-sealed and waterproofed by dedicated sealing systems (e.g. HSI type, Jackmoon, etc or similar approved).

From the main electrical and teletechnical cable ducts, it is required to make approaches to poles with CCTV cameras, WiFi points, navigation system devices and other devices using suitable ducts.

4.8.3 CCTV INSTALLATIONS

The T5 terminal is to be covered by CCTV surveillance systems and are to be designed on 34-metre lighting masts, and along the waterfront. CCTV locations are to be designed by the Contractor in accordance with ISPS requirements. The system will be based on compatible devices with the existing installation on the terminal and will be integrated into it. To observe the camera image, the existing Terminal monitoring station will be used, which will retain its existing functionality.

4.8.4 INSTALLATION OF NAVIGATION SYSTEM

A navigation system is designed to monitor the speed of the ship's approach to the quay, the approach berthing speed of the vessel and the current of the water. The system will comply with the Regulation of the Minister of Transport and Maritime Affairs of 1 June 1998 on the technical conditions to be met by marine hydrotechnical structures and their location. The main components of the system will be laser sensors, environmental sensors and an information board. The designed System will be used for the safe mooring of ships by measuring the distance, speed, bow and stern angle in relation to the battleline and triggering alarms during the final berthing phase of the ship sideways/sideways. According to the findings of the design work, the system will support units over 100m in length and others whose freeboard will extend above the point of installation of the measuring laser.

Power must be brought to the connector boxes at the wave sensor and the laser LED display(s).

4.9 FUEL BUNKERING SYSTEM

4.9.1 WORKSCOPE

The Contractor shall design and construct a fuel bunkering system to provide facility for refuelling of vessels along the OWSB’s outbound berth. The system shall facilitate the ship-to-ship transfer of fuel via an underground pipeline running along the length of the quay with one offloading connection pit and two loading connection pits allowing simultaneously refuelling of up to two vessels.

The bunkering system will be supplied from a fuel barge using the vessel’s onboard pumps and the vessels will connect to the piped system via flexible hoses. It is not envisaged that any fixed aboveground equipment will be installed on the quay (i.e. loading arms) and it is assumed the vessels' cargo gear / derrick cranes will be used to handle hose lines.

The bunkering pits and associated equipment for both loading and offloading activities shall be located within recessed chambers, keeping the quay area clear when the bunkering system is not in use. The bunkering pits shall contain all couplings, valves, fittings and ancillaries to

enable safe ship-to-ship transfer of fuel between vessels, and metering to aid in accounting and billing.

Storage for hoses, spill kits and booms as well as means of transporting the hoses shall be made available within the site compound.

4.9.2 PIPEWORK, VALVES & FITTINGS

All pipework within the fuel bunkering system shall be carbon steel to API 5L Grade B (or equivalent to the approval of the Employer) and suitably rated to withstand the working and associated test pressures of the system.

Fully welded connections shall be used in directly buried sections of the network and flanged connections within the ship loading / offloading bunkering pits. All pipework, valves and fittings shall be externally coated to ISO 12944 / DIN 30670 for corrosion protection.

To provide protection from external loads and freezing, the pipework shall be buried to a depth of no less than 1200mm below finished pavement level in accordance with PN EN 14161 and 1400mm at crossings with the adjacent STS crane rail. Detectable warning tape shall be placed 150mm above buried pipework to assist with locating the fuel pipework during maintenance.

It is not intended that the fuel bunkering system be designed to allow for cleaning, maintenance and inspection by way of an intelligent pipeline inspection gauge (PIG) i.e. “pigging”. Instead, annual inspection and testing of the pipeline’s integrity shall be carried out by way of hydrostatic testing.

Hydraulic calculations and modelling shall be completed to size the fuel distribution pipework. For the purposes of the design calculations, a maximum flow velocity of 7 m/s (or the value of 0.5/d m/s where d = internal pipe diameter in meters, whichever is less) shall be permitted to prevent static electric charge build up in accordance with API 2003. A minimum flow velocity of 0.9 m/s shall be adopted to minimise accumulation of sediment or any other solids within the pipework.

Trace-heating and insulation shall be provided as required within the ship loading / offloading bunkering pits to prevent the fuel from gelling / waxing in freezing weather conditions (solidification of the fuel into a partially crystalline state).

4.9.3 SHIP OFFLOADING PIT

To facilitate offloading of fuel, the ship offloading connection pit will be equipped with the following:

- TODO dry break coupling for connecting the fuel barge hose line.
- Valves (isolation, non-return, drain, etc.)
- Instrumentation (pressure gauges etc.)
- Controls equipment mounted on a portable backplate enabling removal from the pit for the duration of the operation including (see Figure 4-1):

    - Emergency shutdown pushbutton with guard to prevent accidental activation.
    - General alarm beacon and sounder.
- Pendant remote with an emergency shutdown push button connected to a length of flexible coiled cable which for the duration of the fuel bunkering operation would be placed on the vessel to enable quicker reaction in case of emergency (alternatively, an ATEX rated portable radio with ESD facility may be considered).
- Remotely operated shut-off valve (ROSOV) to stop the flow of a fuel in the event of an emergency.
- Sump level switch and alarm.
- ATEX rated LED lighting and light switch.

All equipment shall be entirely enclosed within a recessed chamber keeping the quay area clear when the bunkering system is not in use. The covers and cover support frames shall be made of heavy-duty ductile iron (Class F900 to PN EN 124). Access covers above the hose coupling and pit access ladder shall be pneumatically assisted.

At the end of fuel bunkering activity, the fuel barge's hose line will be blown clear of fuel by the ship's pumps which will enable easier hose handling. Offloaded fuel will then be measured by tank gauging and checked against the Bills of Lading.

It is not intended that a permanent sump pump be installed within the ship offloading connection pit for drainage of water ingress into the chamber. Instead, a suction pipe from the sump to the underside of the pit access covers terminated with a suitable hose coupling (e.g. Bauer) shall be installed for connection to a portable suction pump or jet-vac tanker.

4.9.4 SHIP LOADING PITS

The fuel bunkering system shall be designed to enable up to two vessels to be refuelled simultaneously. As a result, there will be need for individual metering points within each ship loading connection pit.

An electronic pre-set delivery system shall be provided at each ship loading connection pit to enable initiating fuel loading transaction and enable monitoring of the key parameters. Upon completion of the export operation, a Bill of Lading will be produced by the control system (at agreed location – site compound, if possible).

To facilitate loading of fuel, the ship loading connection pits shall be equipped with the following:

- TODO dry break coupling for connecting the refuelling vessels' hose lines,
- Valves (isolation, drain, etc.)
- Instrumentation (pressure gauges etc.)
- Controls equipment mounted on a portable backplate enabling removal from the pit for the duration of the operation including (see Figure 4-1):
    - Electronic preset delivery system with general alphanumeric display showing key parameters i.e. pre-set export volume, loaded volume, left volume, flow rate, time to completion, general alarm etc.

- Emergency shutdown pushbutton with guard to prevent accidental activation.
- General alarm beacon and sounder.

- Pendant remote with an emergency shutdown push button connected to a length of flexible coiled cable which for the duration of the fuel bunkering operation would be placed on the vessel to enable quicker reaction in case of emergency (alternatively, an ATEX rated portable radio with ESD facility may be considered).
- Flow meter with pulse transmitter.
- Digitial electro-hydraulic flow control valve.
- Combination basket strainer and air eliminator.
- Sump level switch and alarm.
- ATEX rated LED lighting and light switch.

Figure 4-1 Typical Bunkering Point Control Equipment

All equipment shall be entirely enclosed within recessed chambers keeping the quay area clear when the bunkering system is not in use. The covers and cover support frames shall be made of heavy-duty ductile iron (Class F900 to PN EN 124). Access covers above the hose couplings and pit access ladders shall be pneumatically assisted.

For ease of connecting the bunkering hoses, a portable elbow connector (standpipe) shall be provided with TODO dry break couplings on either end and a compressed air hose connection. This shall enable the connection of the bunkering hoses to the ship loading connection pits in a horizontal position, and at the end of the bunkering operation, the compressed air connection will allow the hoses to be blown clear towards the bunkering vessel. For this task, a portable compressor will be used.

It is not intended that a permanent sump pump be installed within the ship loading connection pits for drainage of water ingress into the chambers. Instead, suction pipes from the sump to the underside of the pit access covers terminated with a suitable hose coupling (e.g. Bauer) shall be installed for connection to a portable suction pump or jet-vac tanker.

4.9.5 EMERGENCY SHUTDOWN SYSTEM

The Contractor shall undertake hazard and operability (HAZOP) study and safety integrity level (SIL) assessment to validate the functional safety requirements for the fuel bunkering system on which the system shall be designed.

An emergency shutdown (ESD) system shall be installed with inputs into the system being from emergency shutdown pushbuttons located at the ship loading / offloading connection pits and on the portable ESD pendant remotes on the vessels in addition to the pipe leak detection system.

The pushbuttons shall be stay put, pull, or twist and pull to release, yellow / red mushroom type with normally closed contact and protective collar to prevent accidental activation.

The pushbuttons shall be connected via remote I/O and relay to a main ESD system safety PLC. As minimum, activation of the pushbutton(s) shall cause the following: closure of the remotely operated shutoff valve (ROSOV) within the ship offloading connection pit, and activation of the local beacons and sounders at each pit.

The signal from the ESD pushbuttons shall also activate audible and visual alarms within the site compound to alert relevant personnel in the event to an emergency.

The Contractor shall undertake surge analysis to determine the ROSOV closure time to prevent unacceptable transient conditions in the pipework which may cause hose rupture or damage to the pipework, valves or fittings.

4.9.6 PIPE LEAK DETECTION SYSTEM

A fuel leak detection system shall be installed along the length of the buried pipeline. The leak detection system shall comprise of a fuel sensing cable (TraceTek TT5000-HS or equivalent) installed within a slotted conduit providing the cable mechanical protection while ensuring fuel is able to be detected. The fuel sensing cable shall be capable of detecting hydrocarbons (typical reaction time for marine gasoil is 60-120 minute) and shall not react or alarm when in contact with water.

On detection of a fuel leak, the sensing cable shall trigger an alarm on the leak detection system control panel and pinpoint the location of the leak in meters. Once the leak is rectified and contaminated materials removed, the slotted conduit shall allow for pulling of the full length of the faulty or contaminated cable and replacing with new.

The conduits shall terminate with cable pull boxes (Class F900 to PN EN 124) to allow jointing of subsequent lengths of cable and individual lengths to be replaced as required. The maximum length of cable between pull boxes shall be accordance with the manufacturers' recommendations (240m for the TraceTek TT5000-HS), however it is recommended to install cable pull boxes approximately every 150m, especially where the cable run is not straight, to minimise risk of damage due to pulling forces.

The fuel sensing cable shall be installed near the bottom of the pipeline where any leaks can reach the cable by natural gravity dispersion. In locations where the pipeline may become (temporarily) submerged under the water table, there is a risk that the fuel leak may float

towards the surface of the water and disperse, not reaching the cable and giving alarm or giving alarm with an unpredictable delay. In these cases, the pipeline and fuel sensing cable shall be overwrapped within a lining to enable timely detection. The lining purpose is not to completely contain the leak within, instead assist with directing potential leaks towards the sensing cable.

4.9.7 HAZARDOUS AREA CLASSIFICATION

In areas where dangerous quantities and concentrations of flammable gas, vapour or mist may arise, protective measures are to be applied to reduce the risk of explosions. The application of the international standard IEC 60079 along with relevant industry codes of practice provide a method to determine the hazardous area classification for areas where flammable goods are stored and used.

The Contractor shall be required to undertake and record a Hazardous Area Classification exercise on the design layout for the new fuel bunkering system. This record should be added to and amended, as appropriate, as this design progresses to detail design, and through the construction and operations phases. This record shall include a risk assessment as well as diagrams / drawings in accordance with IEC 60079.

Specification of equipment installed on site will be subject to location within the particular zones defined in Hazardous Area Classification drawing. All equipment located within the hazardous areas shall be suitably ATEX rated.

4.9.8 FIRE PROTECTION

Fire protection shall be provided by the external yard hydrant network (refer to Section 4.7). In the event of a fire, mobile foam monitors shall be deployed and attached to the hydrants to allow rapid deployment of foam extinguishing agent for fighting hydrocarbon fuel-based fires.

The monitors shall be trailer mounted and comprise of an onboard foam concentrate tank, lever-operated monitor, self-inducing nozzle, and an instantaneous hose connection for attaching to a local fire hydrant.