

ANNEXURE A

C3.1 EMPLOYER'S WORKS INFORMATION

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PART C3: SCOPE OF WORK

SECTION 1

1 DESCRIPTION OF THE WORKS

1.1 Executive overview

This contract is for the supply of a new caisson, complete with all ancillary systems as described in the detailed design drawings and the specifications contained herein, for Robinson Dry Dock, in the Port of Cape Town.

The Port of Cape Town's Ship Repair facilities is in dire need of new equipment, as the current equipment is subject to constant breakdowns and failures due to age and obsolete components. The caisson in particular is suffering due to degradation of the structure itself, resulting in the necessity to replace the vital part of Ship Repair's infrastructure.

TNPA has thus embarked on appointing a contractor to execute the designs that have been conducted in FEL3 stage by Lodemann Consultants and construct the caisson as per the design provided. The contractor appointed for this project shall be responsible for inductions, permitting, all SHERQ requirements as per the Employer's requirements, risk assessments by relevant authorities as determined by the Employer and Statutory Bodies, inspections and audits, planning, all Plant and Materials and Equipment required to undertake the complete scope of the works, access requirements for Plant and Materials and Equipment, certification of Equipment and vessels, fuels and lubricants and any other consumables, demolition and transportation to storage of existing materials and equipment, all diving work below water and on the water surface, underwater installation by diving, procurement, offloading, material and equipment handling, storage, fabrication, equipment and infrastructure refurbishment, testing, modifications, welding, bolting, production, corrosion protection, rigging, trial fitting, marking, packing, transportation, mechanical and civil and structural and electrical and control installations complete, electrical and control system hook-ups, terminations and wiring which include the supply of all cabling, punch listing, cold and hot commissioning, trial operation, handover and project management and any other requirements not specifically mentioned but required as per industry and engineering and construction legislation and requirements. On completion of the Works by the Contractor, to the Employers satisfaction and approval, the Contractor shall take full responsibility for the handover of the caisson, to the Employer for operations.

1.1.1 Background and Context

The Robinson Dry Dock at the Port of Cape Town has one steel caisson that when in working position, fits in a slot that has been formed into the dry dock side walls and floor. The caisson is a 'floating' type, which means that it is able to sink and float at different depths in the water using its on board systems, but it requires external interventions from either vessel i.e. tug boats and launchers or dry dock furniture i.e. capstans and bollards (located on the dry dock cope level) to maneuver it and stow it. Unlike driven caissons, it cannot be retracted into a stowing tunnel but needs to be docked along the quay when not in use and is fitted with compressible rubber inserts on periphery of its steel structure that fits inside the slot. The rubber inserts assemblies form what is referred to as the 'sealing faces'. When in position in the slot, the water pressure impinging the submerged surfaces of the caisson compress the rubber inserts against the exposed surfaces forming a seal and preventing water from entering the dry space of the dock.

The basic approximate mass and dimensions of the existing caisson are:

- 450 tons
- 21.4m length
- 7.7m width
- 11m height



Figure 1: Floating Caisson in operational position

Constrained maintenance of the Floating Caisson over the last 10 years has resulted in progressive structural capacity loss, due primarily to corrosive damage of its internal and external steelwork structure, equipment malfunction and failure as well as general deterioration and breakdown of systems. Thus, there currently exists an urgent requirement to replace the Floating Caisson as fast as possible.

The new caisson will be dimensionally similar to the existing do to the civil works constraints of the dry dock.

The construction of the Floating Caisson shall be in accordance with all “Vessel” regulations as stipulated by the various maritime authorities and classification societies due to the Caisson being classified as a “Vessel” in Maritime terms. All relevant statutory protocols shall apply.

Note: Only Contractors that are able to demonstrate sufficient recent experience in the construction and refurbishment of heavy industrial or maritime steel structures and mechanical and electrical and control systems shall be considered acceptable for executing the Works. The Contractor shall supply

sufficient experiential information and references with the tender to enable the Employer to determine their level of experience.

1.2 Employer's objectives

The Employer, Transnet National Ports Authority, requires the Works, comprising the complete rebuild of the entire Floating Caisson and all ancillary systems, at the Robinson dry dock, Port of Cape Town to be carried out. The Employer intends to appoint a Main Construction Contractor for the execution of the Works.

The Employer shall provide the Contractor with a complete pack of detail drawings, for all relevant engineering disciplines, which the Contractor shall construct the caisson to.

The primary objectives of the Employer are thus, to take ownership of a fully functional and operational caisson that is:

- in accordance with the detail design drawings, supplied to the Contractor by the Employer
- constructed in accordance with engineering best practice and the relevant Codes and Standards
- constructed at a location that is not one of TNPA's operational and ship building/repair facilities i.e.: Robinson dry dock, Sturrock dry dock or Synchrolift
- constructed in the quickest possible time
- constructed in a manner that results in minimal disruption to TNPA operations
- makes minimal or no use of TNPA resources to either construct or commission the caisson

Note: The dry dock precinct is classified as a heavy industrial, operational environment requiring the Works to be planned and executed in a manner which results in minimal operational disruption and this requirement is considered to be a primary concern of the Employer.

1.3 Work Breakdown Structure

It is envisaged that the scope of works can be subdivided into the following work packages: shall be broken down into the following work packages:

- S1 – Caisson Structure and Steelwork
- M1 – Bilge System
- E1 – Electrical Installations
- I1 – Control System Installations

The components of the works related to the individual packages are described below:

S1 WORK PACKAGE

- Caisson steel structure (frames, plating, stringers, webs etc.)
- Caisson trunks and hatches
- Caisson access ladders
- Sealing face and fender support steelwork
- Walkway vastrap/mentis grating, handrails and stanchions

M1 WORK PACKAGE

- Pumps
- Piping
- Pipe fittings
- Valves
- Mud boxes
- Flanges
- Bolt sets

- Pipe supports
- Sealing Face assemblies
- Corrosion protection system

E1 WORK PACKAGE

- Electrical panels (Motor Control Centre, Distribution board)
- Cables
- Control Devices (Isolators, switches, etc.)
- Light Luminaires
- Light poles
- Cable Rack
- Wireway – (Trunking, conduits, etc.)
- Generator

I1 WORK PACKAGE

- PLC/ Network
- Instruments
- Automated Valves actuators
- SCADA
- Cables
- Marshalling cabinet
- Racks and Panel

1.4 Location of Works

The new caisson is to be installed at the Robinson dry dock, Port of Cape Town, shown in the following diagram:

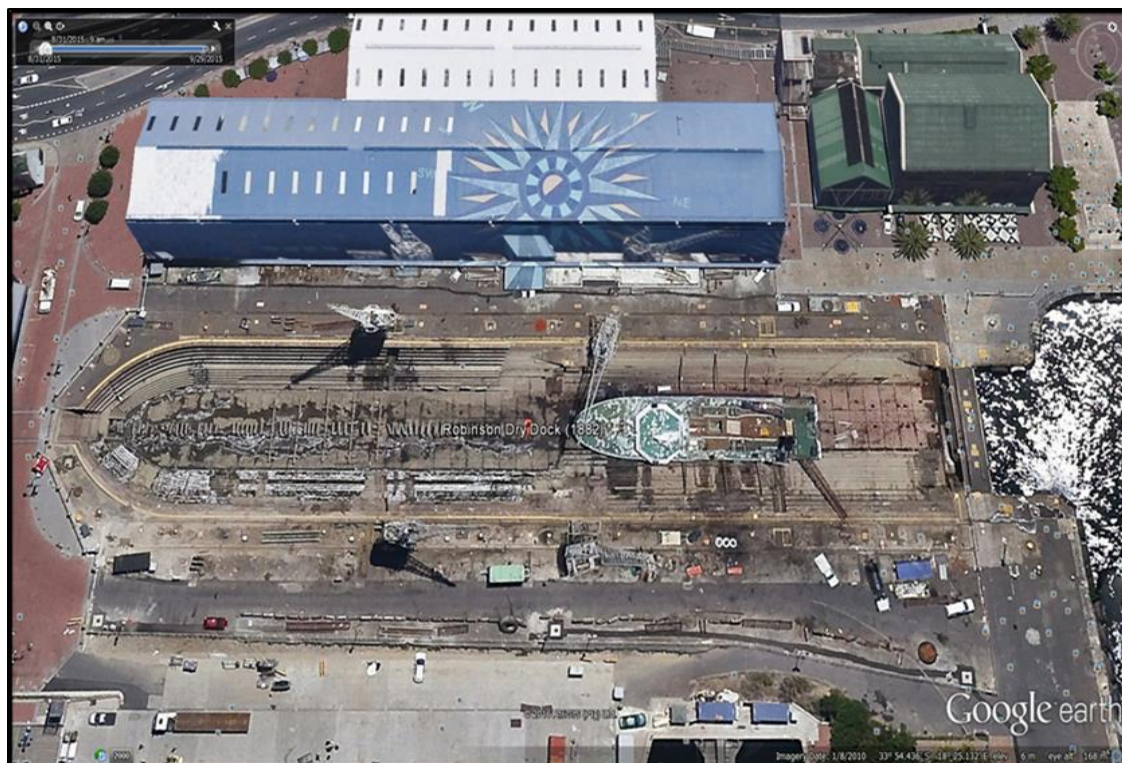


Figure 2: Google Earth image of the Robinson Dry Dock

However, it is not expected that the new caisson will be constructed at any of TNPA's ship building/repair facilities i.e. Robinson or Sturrock dry docks and the Synchrolift. It is an expectation of TNPA that the Contractor fabricates the entire Caisson complete including the installation of all ancillary systems and full corrosion protection application at another site specified by the Contractor and then, dependant on the Contractors construction site facilities, either launches and tows the caisson over water to the Robinson dry dock or delivers the caisson via the road network to the Synchrolift from where it will be launched and towed to the Robinson dry dock.

1.5 Site Conditions

- Altitude: At sea level
- Ambient temperature: 15-22 °C
- Relative humidity: Frequently 100%
- Air pollution heavily saline; industrial and locomotive fumes;
- General wind velocities: Up to 60 km/h
- Storm wind velocities: Up to 180 km/h

1.6 Tide Levels Used in the Designs

It shall be noted that the tide levels given below are referenced from the caisson slot baseline and are provided here for reference purposes only.

- Low Tide = 6.27m
- Mean Tide = 7.27m
- High Tide = 8.27m

1.7 Access to the Works

Access to the Robinson dry dock will be via existing public road networks, the main access situated along South Arm Road.

Access will be subject to the Transnet National Ports Authority security requirements and regulations. Due allowance must be made for any potential delays arising from vehicular congestion along South Arm Road.

1.8 Interpretation and terminology

The following abbreviations are used in this *Works Information*:

Abbreviation	Meaning given to the abbreviation
Codes and Standards	Means the design and construction codes and standards that are applicable to the Works
Guaranteed performance parameters	Means the performance parameters and values stipulated in the Guaranteed Performance Schedule contained herein that the Contractor warrants and guarantees to the Employer that the Plant will achieve when being operated
shall	Means that the requirement is mandatory
CA	Contract Administrator
CQA/QCM	Contractor's Quality Assurance/Quality Control Manager
CDR	Contractor Documentation Register

CDS	Contractor Documentation Schedule
QCP	Quality Control Plan
AIA	Approved Inspection Authority
CSHEO	Contractor's Safety Health and Environmental Officer
CHSMP	Contractor's Health and Safety Management Plan
CM	Construction Manager
PSIRM	Project Site Industrial Relations Manager
PSPM	Project Safety Program Manager
PSSM	Project Site Safety Manager
ProjM	Project Manager
ProjEM	Project Environmental Manager
ProjEO	Project Environmental Officer
QA	Quality Assurance
SANS	South African National Standards
SES	Standard Environmental Specification
SHERQ	Safety, Health, Environment, Risk and Quality

Where in these documents the words TNPA is used, read "TRANSNET NATIONAL PORTS AUTHORITY".

Where in these documents the words or expression "Engineer" or "engineer" is used, read "Project Manager" or "Supervisor" as the context requires.

1.9 Scope of Works Table

The table below describes the activities comprising the *Works* that must be completed by the Contractor to the total satisfaction of the Employer, enabling the Employer to formally acknowledge and accept the *Works* completion by issuing a Completion Certificate to the Contractor, approve the quality and workmanship of the *Works* and finally take ownership, via a formalised handover process, of the *Works*.

The individual items in the table below are described in reference to the detail engineering design drawings provided to the Contractor by the Employer. Thus, anything built/constructed by the Contractor concerning any of the engineering specific disciplines, shall be in accordance with the detail engineering design drawings provided to the Contractor by the Employer.

The **SCOPE OF WORKS** pertinent to the construction of the new Robinson dry dock caisson include; inductions, permitting, all SHERQ requirements as per the Employer's requirements, risk assessments by relevant authorities as determined by the Employer and Statutory Bodies, inspections and audits, planning, all Plant and Materials and Equipment required to undertake the complete scope of the works, access requirements for Plant and Materials and Equipment, certification of Equipment and vessels, fuels and lubricants and any other consumables, demolition and disposal of existing materials and equipment, all diving work below water and on the water surface, underwater installation by diving, procurement, offloading, material and equipment handling, storage, fabrication, equipment and infrastructure refurbishment, testing, modifications, welding, bolting, production, corrosion protection, rigging, trial fitting, marking, packing, transportation, mechanical and civil and structural and electrical and control installations complete, electrical and control system hook-ups, terminations and wiring which include the supply of all cabling, punch listing, cold and hot commissioning, trial operation, handover and project management and any other requirements not specifically mentioned but required as per industry and engineering and construction legislation and requirements relating to the following individual items captured in the table below:

Item	Description of the Works	Location
1	Construction of the new Floating Caisson steelwork structure complete including: control and access cabins, trunks, access ladders, vastrap/mentis installations, stanchions/handrails, doublers/brackets/gussets, temporary bracing steelwork and supports and 'strong backs'. Being a structure assembled by welding and bolting, the construction of the caisson is fully inclusive of all welding works and associated consumables for whichever welding derivative is stated as per the relevant drawings as well as all fixing and securing elements.	Contractors workshop/ Synchrolift

2	Electrical system complete	Contractors workshop/ Synchrolift
3	Control system complete	Contractors workshop/ Synchrolift
4	Ballasting system complete	Contractors workshop/ Synchrolift
5	Sealing Face assembly complete	Contractors workshop/ Synchrolift
6	Ventilation system complete	Contractors workshop/ Synchrolift
7	Demolition, disposal, recovery and careful handling of existing materials to designated location as prescribed by TNPA	Dry dock/ Synchrolift
8	All vents, vent piping, breather piping, sounding and instrumentation housing piping	Contractors workshop/ Synchrolift
9	Application, to all steel surfaces interior and exterior, of a 5year supplier guaranteed, AIA and Employer approved marine grade corrosion protection system and grit/water blasting and high pressure washing and cleaning	Contractors workshop/ Synchrolift
10	Zinc anodes	Contractors workshop/ Synchrolift
11	Inspection, quality control, site security, AIA approvals and monitoring, NDT testing, documentation, generation of quality and management packs/dossiers	Dry dock /Contractors workshop
12	All diving works associated with the handling, commissioning and handover of the caisson Pressure testing of all tanks and Commissioning Activities	Dry dock and Synchrolift

2 ENGINEERING AND DESIGN

2.1 Employer's Requirements

The Employer requires that the Contractor shall submit with its tender, a highly detailed technical description of the Plant and Works (in the form a design report) of sufficient detail that the Employer is able to determine the alignment of the Contractors offer in relation to the technical requirements contained herein.

The following main system technical descriptions and proposals, collectively forming the scope of works for the project shall be included, with tender (in design report format), as a minimum:

- Steel Structure
- Mechanical System
- Electrical System
- Controls System
- Ballasting
- Ventilation
- Corrosion protection
- Sealing faces
- Ancillaries

2.1.1 Summary of Requirements

A summary of the Employers requirements for the Plant and other Goods to be supplied by the Contractor and the execution of the Works is set out below, but is provided for introductory purposes only and is not exhaustive of the Employers requirements.

The Employer confirms that the Contractor has acknowledged, by its tender submission, that all necessary and required Plant, Equipment and Personnel to

properly perform the Contractors obligations under the Contract have been understood by the Contractor and shall be inclusive of:

- Project management of the execution of the Works and the design and supply of other Goods including planning, scheduling and reporting to the Employer
- The implementation of QCP's to demonstrate compliance with the requirements of the Contract
- Construction site surveys as required
- Ensuring that the completed Works shall comply with the Codes and Standards and any other applicable statutory requirements
- Selection of suitable materials (where not already specified herein)
- Procurement of the Goods
- Detailed design (if required) by relevant professionals including a Professional Naval Architect (including fabrication drawings), purchase, fabrication, manufacture, supply, installation, testing, commissioning and trial operation of all Plant and Goods required to meet the Employers Requirements for the Project
- Design of the Works (if required)
- Supply and installation of the Floating Caisson and all ancillaries
- Supply and installation of all piping, pipe supports, pipe fittings, mud boxes and valves
- Workshop and offsite inspection and testing
- Preparation and protection of exposed Plant and structural surfaces in compliance with the relevant Codes and Standards
- Packing, marking and protection for shipping / transport of the Goods
- Procurement, transportation and transfer supervision of the Goods
- Scaffolding
- Lifting equipment for erection
- All structural, mechanical, piping, pipe fittings, valves, sand blasting and complete corrosion protection, electrical and instrumentation required for the Works
- Supply of all signed-off (by professional engineers) design calculations, design criteria, static and dynamic loadings pertinent to the Works and

associated and surrounding structures that have been signed off by a Professional Naval Architect (non-negotiable) (if designs are required)

- Construction, erection, assembly, installation and supervision of the Works
- Specialist installation and installation supervision
- All specialised tools necessary for the installation of the Plant and its operation and maintenance
- Name plates and name plate data
- Site inspection and testing
- Removal and disposal, as approved by the Employer, of all scrap and rubble generated by the Contractor with the site to a demarcated area on the site
- Supply of Commissioning and Operating spares
- All documentation for statutory and regulatory compliance, project controls, training and the operation and maintenance of the Works
- Supply of all the Contractors documentation including all designs, drawings, “as-built” drawings, operation and maintenance manuals in sufficient detail to enable the Employer to maintain and repair the plant together with all test certificates and a detailed, priced recommended Operating Spares list
- All tests on completion and results
- Training of the Employers staff

2.2 Part of the Works which the Contractor is to Design

The Contractor is to design the following parts of the works:

- Scaffolding – The Contractor is responsible in his design for the overall integration of the design of the Works with the design of the Employer as stated in Employer’s design above. Additionally, the Contractor shall be solely responsible for the design of any temporary Works required to execute the scope of works.

2.3 Work Excluded from the Contractors Scope of Work

The following are excluded from the Contractors scope:

- Works associated with future expansions
- Permanent diversion of existing services within the site

2.4 Design and Engineering Criteria

The Contractor shall study, prior to the commencement of its design of the Works, verify for itself, the requisite design criteria, calculations and information, data and designs supplied to it, in order to ensure that the Plant and other Goods and the Works specified and provided by the Contractor shall result in the Plant and other Goods and the Works meeting the purposes and intent of the Works.

In regard to the Plant and other Goods to be supplied by the Contractor it shall be the responsibility of the Contractor to ensure that the Plant and other Goods chosen are suitable to meet the requirements of the project.

The Contractor shall either concur with the basic descriptions, specifications and requirements provided as the Employers preference or submit alternatives for consideration. The acceptance of the descriptions, specifications and requirements contained herein shall not relieve the Contractor of its responsibilities in terms of the design and engineering performance of the Plant and other Goods to be fit for their purposes.

Any design, supply and installation requirements stated herein for the Floating Caisson shall be supplied by the Contractor. The Contractor shall be liable for the entire Works and supply of Plant and other Goods. The supply of the Plant and all its components should not be of lesser quality than those stated herein. The size, quality and operating parameters of the Plant and Goods supplied by the Contractor shall not be less than those specified herein.

The preparation of the Contractor's Documents for the Works shall be the responsibility of the Contractor. The Contractor shall ensure that its execution and completion of the Works comply with the Laws in the Country, the

documents forming the Contracts and good engineering and construction practices, methods, equipment and procedures usually employed in engineering, design, procurement, construction, operation and maintenance.

2.5 Guaranteed Performance Requirements

The Employer expects the Contactor shall supply the performance confirmation documentation (in the form of General Arrangement drawings, specifications, data and performance sheets, maintenance plans, operating manuals etc.) of its offer for the caisson with its tender submission.

If different to those contained herein, the Employer shall evaluate the performance capabilities of the specified material, Plant and Equipment and these shall comprise part of the evaluation criteria for Contract award. On award, the selected performance criteria shall be added to the final agreed Contract and the Contractor shall be liable for said performance of specified material, Plant and Equipment.

2.6 Applicable Codes and Standards

A caisson is classified as a “Vessel” in Maritime terms, hence all relevant statutory protocols apply. The following Codes and Standards are applicable for the design marine structures, including caissons/sea locks:

- BS 6349-3:2013 Maritime Works – Part 3: Code of practice for the design of shipyards and sea locks;
- Lloyd’s Register Rules and Regulations – Rules and Regulations for the Construction and Classification of Floating Docks, July 2003;
- Lloyd’s Register Rules and Regulations – Rules and Regulations for the Classification of Ships, July 2014;
- Lloyd’s Register Rules and Regulations – Rules for the Manufacture, Testing and Certification of Materials, July 2014.
- ISO 9001: Quality systems — Model for quality assurance in design development production installation servicing.
- Latest revisions of SANS 32 and 719

- Latest revisions of SANS 1461; Galvanizing
- Code of Practice for Steel Construction SANS 1200
- SANS 10162-1:2011 Part 1, Limit-states design of hot rolled steelwork
- EN-10025-2:2004 Hot Rolled Products of Structural Steels
- EN1991-1-1:2002: Eurocode 1: Actions on Structures
- EN1993-1-1:2005: Eurocode 3: Design of Steel Structures
- EN1993-1-8:2002: Design of Steel Structures: Design of Joints
- BS 6349-3:2013 Maritime works - Part 3: Code of practice for the design of shipyards and sea locks.
- AWS – D 1.1 – 2010 Structural Welding Code of Practice
- SANS 10142 -1 - Code of Practice for the wiring of premises.
- SANS IEC 60614 (1) - General requirements of conduits.
- SANS 61035 - Installation of Conduit Fittings.
- SANS IEC 61084 - Electrical Installation Ducting & Trunking Systems.
- SANS 1507 & 1574 - PVC Insulated Single Core Voltage Conductors.
- SANS 1464 and IEC 598-1 - Mounting & Positioning of Luminaries.
- SANS 10114 - Code of Practice for Artificial Interior Lighting.
- SANS 1973/61439 - Distribution Boards.
- SANS 1973-1 - Low voltage switchgear & control gear.
- SANS 10313 - Code of Practice for the Protection of Structures against Lightning.
- Occupational Health & Safety Act 85 of 1993.
- The Local Authority by-laws and any special requirements for the district concerned.
- Local Fire Regulations.
- Lighting of Work Places - Part 1: INDOOR, ISO 8995-3:2006

BS 6349 gives recommendations and guidance on the design of shipyard waterfront layouts, dry docks, piers, quays, slipways, shipbuilding berths, shiplifts, floating docks, sea locks, hydrolifts, dock and lock gates, mechanical and electrical services distribution and control systems. In particular, BS 6349-

3 covers the design criteria which are specific to caissons/sea locks. Lloyd's Register Rules and Regulations set appropriate standards for the design, construction and lifetime maintenance of vessels and maritime structures. In particular, Lloyd's Register Rules and Regulations detail the structural and piping design requirements for general vessels such as scantlings, welding procedure, bilge and ballast piping systems.

The applicable Sections of Lloyd's Register Rules and Regulations are:

- The Part 2 Chapter 1, General Construction – Hull of Rules and Regulations for the Construction and Classification of Floating Docks, July 2003
- Part 3 and Part 4 of Rules and Regulations for the Classification of Ships, July 2014
- Part 3 Chapter 10, Welding and Structural Details of Rules and Regulations for the Classification of Ships, July 2014
- Part 2 Chapter 1 Section 8, Welding of Rules and Regulations for the Construction and Classification of Floating Docks, July 2003
- Part 5 Chapter 12, Piping Design Requirements of Rules and Regulations for the Classification of Ships, July 2014
- Part 5 Chapter 13, Ship Piping Systems of Rules and Regulations for the Classification of Ships, July 2014

2.7 Transnet General Specifications

The following "Transnet General Specifications" are applicable:

Hydraulic Equipment	EEAM-Q-002
Structural Steelwork	EEAM-Q-006
Compressed Air Systems	EEAM-Q-007
Steel Wire Ropes	EEAM-Q-003
Quality Management	EEAM-Q-009
Reinforced concrete	EEAM-Q-010
Maintenance of cranes and hoists	EEAM-Q-011

General electrical equipment	EEAM-Q-012
Motors and generators	EEAM-Q-014
MV switchgear	EEAM-Q-017
Lighting	EEAM-Q-018
Tests on electrical equipment	EEAM-Q-020
Gears, shafts, bearings, brakes	EEAM-Q-004
Corrosion Protection	EEAM-Q-008

2.8 Technical Specifications

2.8.1 General

The caisson is a fully welded steel structure that spends the majority of its operational life in the sea. It is a floating structure and in respect of maritime legislation, is classified as a **Vessel**.

The caisson seals off the entrance to the dry dock preventing sea water from entering the dock's dry space. With the dock closed off, ships can be repaired inside the dry dock.

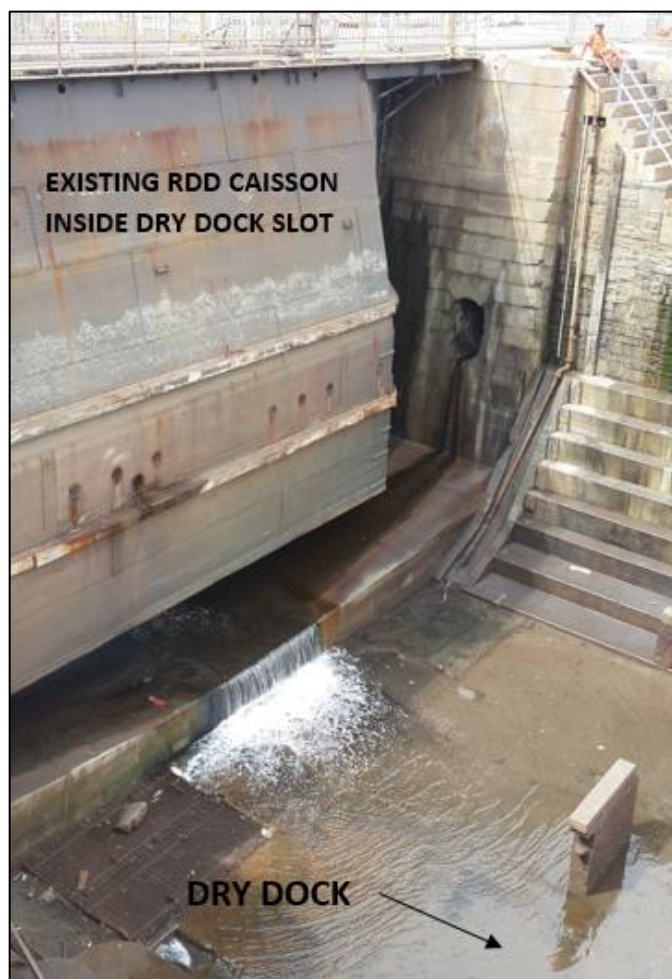


Figure 3: Caisson sealing off the dry dock

Two types of caisson exist:

- Sliding – slides on rollers with sliding motion being effected via a winching system attached to the caisson
- Floating – only has the ability to be raised or lowered in the water, but must be moved by external equipment like tug boats or capstans

The new RDD caisson is a floating type. Internally, it is comprised of dry spaces i.e. spaces which are isolated from seawater ingress by sealed bulkheads, and wet spaces i.e. various sealed tanks. The steel structure is modular, comprising of rigid steel frames. Each frame maintains structural continuity by being joined together through a combination of webs and stringers, thus forming the rigid frame of the caisson.

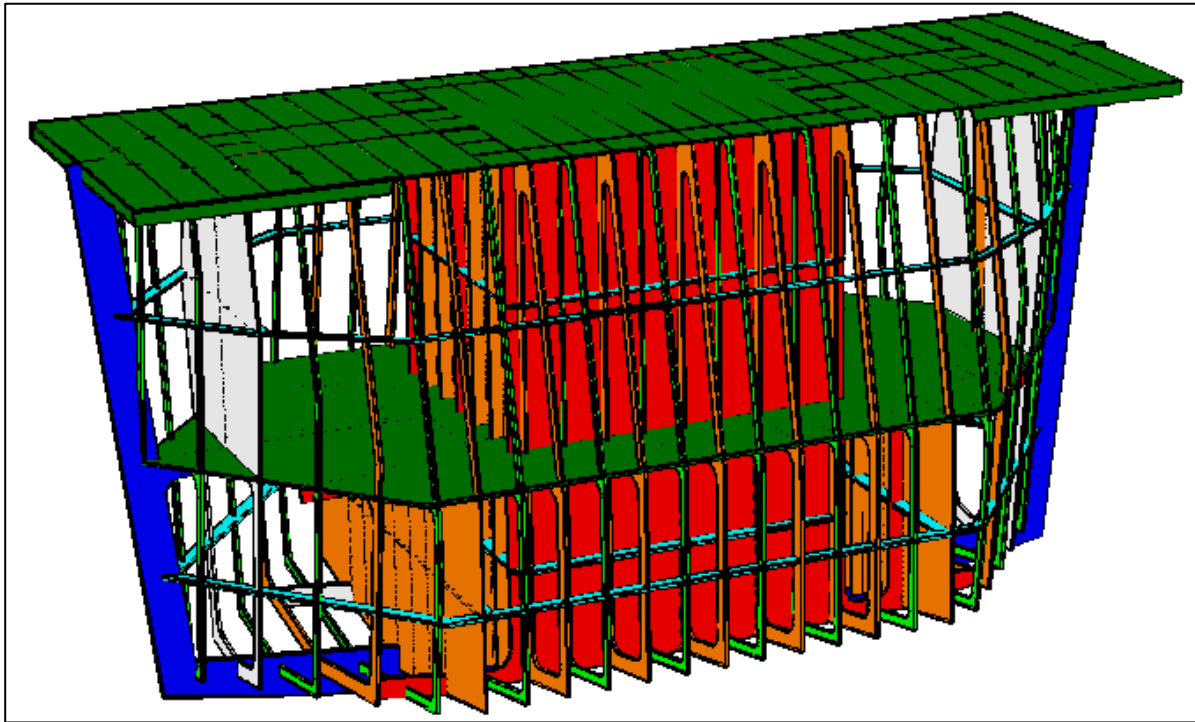


Figure 4: 3-D model of caisson showing internal frame structure

The caisson steel frame structure is covered by sheet steel of various thickness as determined by the water pressure exerted on it. A combination of sealed and isolatable tanks along with a pumping system control the floating and sinking action of the caisson. The tanks are designated as follows:

- Trim Tidal Tank – 2off
- Tidal Tank – 1off
- Ballast Tank – 2off
- Sinking Tank – 1 off

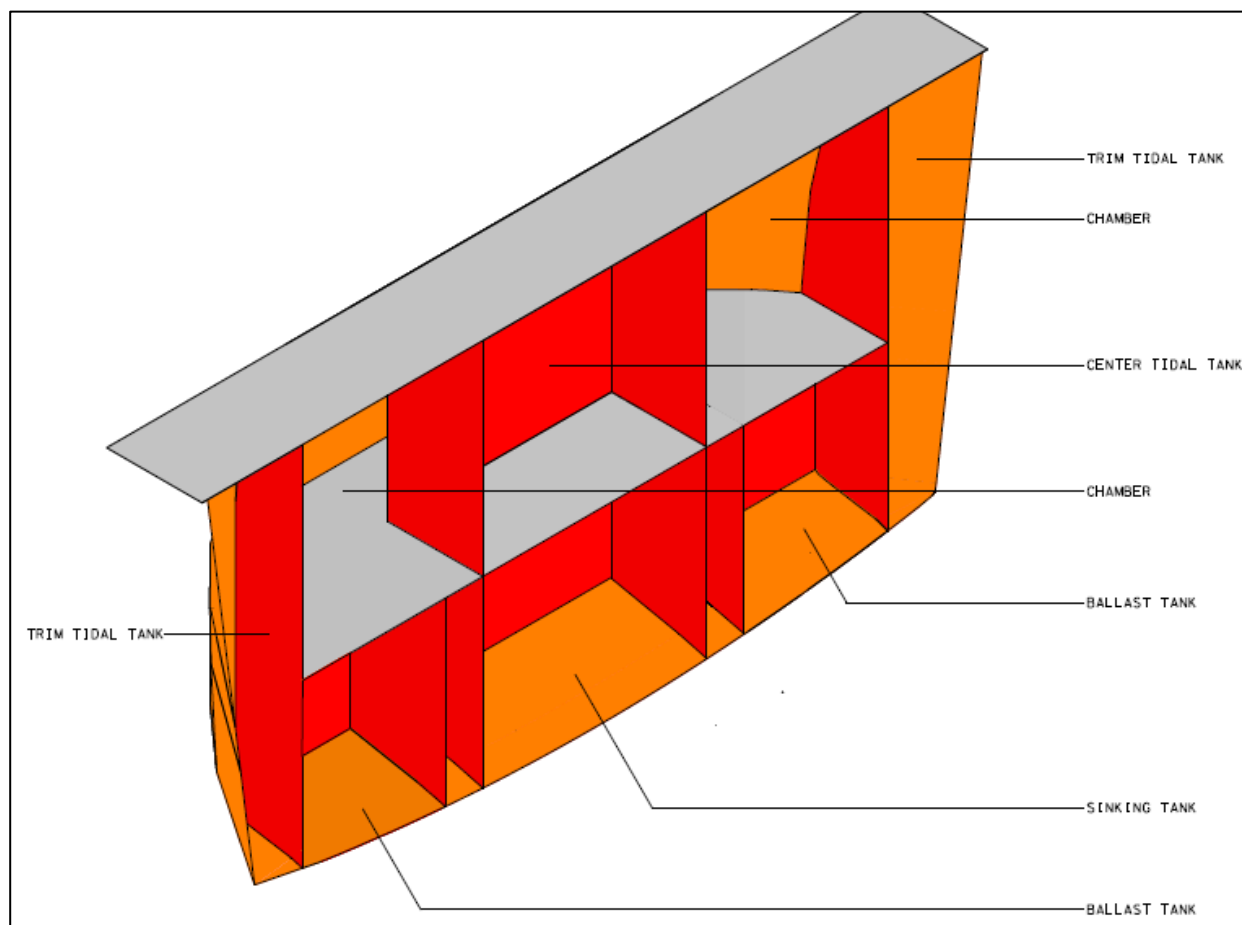


Figure 5: Caisson internal tank layout

When the caisson is 'in position' it is aligned inside its slot or groove which has been shaped into the vertical side walls and floor of the dry dock. To get into its slot position; tug boats, capstans or a combination of both are used to push, pull and manoeuvre the caisson from its stowed location on the quayside into its slot. Once in the slot, an automatic seawater pumping and circulation system (called the bilge system), located on-board the caisson, transfers seawater as required between its internal tanks. This transfer of water between the tanks of the caisson causes the sinking and floating action of the caisson as a result of mass addition, removal or transfer that consequentially alters the vessels buoyancy.

The caisson is split along its width by a single deck plate. The dry space above the deck is called the 'Airchamber' and houses the caisson bilge system as well as most of the caissons electrical and control installations. Below the deck plate, another dry space, much smaller than the Airchamber, is provided mainly for accessing the tanks in this area.

The caisson is provided with a walkway platform at the uppermost elevation that is designed to serve as a pedestrian walkway and thoroughfare for patrons of the Victoria and Alfred Waterfront precinct. The walkway shall be cordoned off into three zones as follows:

- A centre operations island that is inaccessible to the public
- Two walkways either side of the centre operations island for pedestrians

The centre operations island encloses the access hatches from where the caisson internal structure is accessed. The hatches lead into square cross-section, steel box shape trunks, into which the stainless steel access ladders are mounted. The internal caisson space is accessed by climbing down the access ladders. The ladders are also used when climbing out of the caisson.

A basic ventilation system comprising forced draft and extraction air fans and ducting has been incorporated into the design of the caisson. Inlet air is extracted from the outside of the caisson and internally extracted air discharged to the outside of the caisson through suitably positioned vents positioned towards the upper extremities of the caisson. The purpose of the ventilation system is to ensure that a fresh supply of air is prevalent inside the caisson and that any potentially contaminated air can be extracted from inside the caisson and expelled to the atmosphere.

Portable fire extinguishers shall be installed at designated locations inside the caisson to aid the extinguishing of any fires that may arise inside the caisson while there is human occupancy inside. Smoke detectors are also located inside the caisson dry space which will trigger a siren and alarm in case of a fire when the caisson is unoccupied.

Electrical installations on-board the caisson comprise mainly of power supply provisions to pump drives and automated valve actuator connections, power supply points for maintenance and lighting inside the caisson. A multi-core flexible rubber cable will draw power from the nearest shore based electrical kiosk to supply the caisson. This cable will terminate on a power distribution board located in the vicinity of the access hatch on the walkway level of the caisson. From this distribution panel, another flexible cable will be installed to

terminate on the main power distribution board located inside the caisson airchamber. All power cables to equipment shall be powered from the main board inside the caisson.

A control system has been designed to control the caisson bilge system which is mainly associated with sinking and floating the caisson when it is in position in its slot. Additionally, the control system shall also control the ventilation system and fire detection system. However, for redundancy, all control systems are manually over-ridable. The control system shall be Supervisory Control and Data Acquisition (SCADA) based system. SCADA refers to a control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management, but uses other peripheral devices such as Programmable Logic Controller (PLC) and discrete PID controllers to interface with the process plant or machinery. The key attribute of a SCADA system is its ability to perform a supervisory operation over a variety of other proprietary devices. A main control station comprising a desktop computer and push-button station shall be housed in a pre-fab type moveable container that is positioned on the quayside to provide a direct line of site of the caisson and dry dock for operational purposes. In addition to this control station, a mimic board shall be installed on the caisson walkway deck to provide control functionality aboard the caisson.

The caisson is fitted with Greenheart timber along its sealing edges. When it has been sunk into position in its slot, the difference in hydrostatic pressure between the sea level and the level inside the dry dock results in an actuation force which forces the wood against the slot face edges, preventing ingress of water into the dry dock.

2.8.2 Structural Steelwork and Welding Consumable Material Specification

The following Material Specification for all structural steel plate, sections and bilge piping, vent, breather and sounding piping are applicable:

- Structural steel plate and sections – S355JR+AR

Note, the brand of consumable has been specified for information purposes only. The Contractor is under no contractual obligation to procure the brand of consumable mentioned, but any consumable procured by the Contractor shall

not be less, in respect of its performance and features than the consumable specified. The following Welding Consumable Specifications are applicable:

- Electrodes: BOEHLER E7018L
- MIG Wire: BOEHLER SG2 / BOEHLER EMK 6
- Flux Core: BOEHLER TI 46-FD

2.8.3 Bilge System

The Bilge system is a mechanical pumping system designed to transfer and circulate sea water from the exterior of the caisson and between the various caisson tanks. The Bilge system purpose is to automate and execute the sinking and floating activities of the caisson. It is comprised of the following components:

- Pumps
- Piping
- Pipe fittings
- Electrically actuated valves
- Mud boxes
- Flanges
- Pipe supports
- Bolt sets and gaskets

Following construction of the new caisson, it shall be launched into the water from the Synchrolift facility within the Port of Cape Town.



Figure 6: Synchrolift facility at the Port of Cape Town



Figure 7: Existing Caisson on the Synchronlift

Once in the water, the caisson ballast tanks, which are a sub-system of the bilge system, will be filled. The caisson will then float at its design draft and will be towed by tug boats to the Robinson Dry Dock. Using a combination of dockside furniture and the tugs, the caisson will be manoeuvred into its slot while still floating at its design draft. Once in the slot, the automated activities of sinking the caisson into the slot will be undertaken using the bilge system. A basic description of the dock opening/caisson sinking process and the logic that the bilge system will execute is presented below:

Caisson Sinking

1. Prior of moving the caisson into the dock slot:
 - Check that the air chamber is dry.
 - Check that the sinking tank is empty and its inlet valves are closed.
 - Check that the tidal tank valves are opened.
 - Check that the ballast tank valves are closed.
 - Check that the ballast tank soundings are at the correct levels.
2. Move caisson to allocated dock position. Port facing dockside, starboard facing seaward side.
 - Ensure caisson is aligned in the dock slot.
 - Ensure mooring ropes are slack.
3. Check that the caisson heel and trim are within the acceptable limits.
4. Open the seaward side (port side) tidal tank valves.
5. Open the sinking tank inlet valves to sink the caisson.
6. Monitor heel and trim.
7. Close the sinking tank inlet valves once the tank is 100% full.
8. Allow 5mins for the tidal tanks to fill sufficiently.
9. Check tidal tank levels. Same as current tide.
10. Check sinking tank level (100% full).
11. Empty dock.
12. Constantly Monitor:
 - Sinking tank level
 - Tidal tank levels
 - Ballast tank levels

Caisson Floating

1. Prior of flooding the dock:

- Check that the air chamber is dry.
- Check that the sinking tank inlet valves are closed.
- Check that the sinking tank level is 100% full.
- Check that the dockside (starboard) tidal tank valves are closed.
- Check that the seaward side (port) tidal tank valves are opened.
- Check that the ballast tank valves are closed.
- Check that the ballast tank soundings are at the correct levels.
- Ensure mooring ropes are slack.

2. Start filling the dock.

3. Open dockside (starboard) tidal tank valves when dock water level is equal to sea/tide level.

4. Open the overboard outlet valves.

5. Start the centrifugal pumps to empty the sinking tank. Caisson will raise and sea water level in the tidal tanks will drop.

6. Monitor heel and trim.

7. Check that the sinking tank is empty.

8. Stop the centrifugal pumps.

9. Close the overboard outlet valves.

10. Move caisson out from the dock to its stowed position.

11. Close all tidal tank valves.

The following equipment specifications are relevant:

PUMP DATA SHEET	
DESCRIPTION	BILGE PUMP
Pump Type:	Self-Priming, Back Pull-Out, Centrifugal c/w Integral Air Release Valve
Quantity:	2
Manufacturer:	SPX FLOW JOHNSON PUMP
Model No.:	JP CH150-315
Flow Rate:	250m ³ /hr
Head:	12m
Speed of Rotation:	960rpm
NPSH _{AVAIL}	2.2m
Direct Driven	YES
Common Baseplate Supplied	YES
Shaft Seal	Tungsten Carbide
Motor Type:	IP65, Premium Efficiency, AC
Manufacturer:	WEG/SEW
Supply Voltage:	400V
Rated Power:	15kW

GLOBE VALVE DATA SHEET	
DESCRIPTION	BILGE SYSTEM ISOLATION VALVES FOR DISCHARGE AND SUCTION LINES
Valve Type:	Globe Valve
Spindle	Rising
Hand wheel	Non-rising
Flanges	Integral cast on valve body
Sizes	150NB and 250NB
Pressure Rating	PN10
Materials of Construction	Nickel Aluminum Bronze (NiAlBr) to ASTM B148
Flange Dimensions	ANSI B16.5
Face to Face	ANSI B16.10
Wall Thickness	ANSI B16.34

NON-RETURN VALVE DATA SHEET	
DESCRIPTION	BILGE SYSTEM CHECK VALVES FOR DISCHARGE LINES
Valve Type:	Wafer Check Valve
Actuation	Dual plate, spring assisted
Flanges	None
Sizes	150NB and 250NB
Pressure Rating	PN10
Materials of Construction	Nickel Aluminum Bronze (NiAlBr) to ASTM B148
Face to Face	ANSI B16.10
Wall Thickness	ANSI B16.34

MUD BOX DATA SHEET	
DESCRIPTION	BILGE SYSTEM STRAINERS FOR PUMP SUCTION LINES
Mud Box Type	Straight Pattern
Flanges	ANSI B16.5
Sizes	250NB
Pressure Rating	PN10
Materials of Construction (body)	Nickel Aluminum Bronze (NiAlBr) to ASTM B148
Materials of Construction (basket)	316L Stainless Steel
Code of Manufacture	DIN 87151E
Basket Mesh Aperture	8mm
Features	Supplied with integral drain plug

PIPING DATA SHEET	
DESCRIPTION	BILGE SYSTEM PIPING
Material	316L

Flanges	ANSI B16.5
Sizes	150-250NB
Pressure Rating	PN10
Code of Manufacture	ASTM A312
Welded/Seamless	Seamless
Features	Welded and Seamless Cold Drawn, Annealed and Pickled

2.8.4 Sealing Face

The caisson seals of the entrance to the dry dock. It is floated into its slot and then sunk into position. Water trapped inside the dry dock is then pumped out leaving the dock dry.

When in its lowest position in its slot, sealing surfaces on the caisson make contact with the slot seal faces and the hydrostatic pressure on the seaward facing side of the caisson pushes the caisson and slot contact faces together. The sealing faces on the caisson are made of a shaped hardwood called Greenheart timber.

GREENHEART TIMBER DATA SHEET	
DESCRIPTION	GREENHEART TIMBER FOR CAISSON SEALING FACES
Material (common name)	Greenheart timber
Material (scientific name)	Chlorocardium rodiei (syn. Ocotea rodiei)
Average dry weight	1010kg/m ³
Janka Hardness	11.26kN
Modulus of Rupture	185.5MPa
Elastic Modulus	24.64GPa
Crushing Strength	91.7MPa
Colour/Appearance	Pale olive green colour with darker streaks
Grain/Texture	Grain tends to be straight to interlocked, with a fine to medium grain, and good natural lustre

Rot Resistance	Greenheart is rated as very durable, and is also resistant to most insect attacks. It's also considered to be one of the best-suited woods for use in marine environments, and has good weathering characteristics.
Workability	Generally, somewhat difficult to work on account of its density, with a moderate to high blunting effect on cutters. Sections with interlocked grain should be machined with care to avoid grain tear out. Gluing can be difficult in some pieces, and precautions for gluing tropical species should be followed.

The steel structure of the caisson is fitted with a retaining frame fabricated from steel. The cross section of the retaining frame is shaped to suit the Greenheart timber profile.



Figure 8: Yellow outline showing existing sealing face installation

The Contractor is required to do the following to the timber:

- Mark and cut and shape the timber to the final required dimensions as per final design
- Verify all final dimensions and gain signoff from the Engineer
- Ensure straightness and trueness of all cut edges, faces and dimensions
- Mark and drill holes in the wood for securing bolt installation
- Cut a slot in 1 face of the Caisson for mounting of the rubber seal strip

- Cut any additional slots required for merging the wood with the steel retaining members

The Contractor shall supply the following:

- All fixing and securing elements
- Rubber seal strips
- Hessian seal cloth or similar
- Marine grade bitumen sealant or similar
- Any other plant or material not specifically mentioned but required for the installation of the timber

The basic installation procedure for the wood sections shall be as follows:

- One section of wood installed at a time
- Thoroughly clean and degrease the metal surface on which the wood is to be mounted
- Apply a layer of 5mm thick bitumen sealant
- Apply the hessian cloth onto the bitumen and press over the surface to remove trapped air
- Three layers of bitumen and hessian should be applied
- The last layer should be bitumen sealant
- Press on the wood section onto the bitumen layer
- Secure the wood section

All wood sections are to be installed in the manner prescribed with the Contractor ensuring that all wood sections are straight, true and level. The Contractor shall produce a QCP for the wood installation and the QCP shall be signed off by the Contractor and included in the Contractors code data book submission

Before installation of the timber sections into the retaining frame, the frame to timber mating surface is covered in a waterproof adhesive and sealant

combination. The mating timber edges are also covered in the adhesive before being inserted into the retaining structure. The timber steel assembly is held together and in place by a combination of long threaded studs secured by nut and washer assemblies.

2.8.5 Caisson Gate Groove

The scope of works includes the remediation of the sealing faces of the dry dock civil infrastructure used to ensure effective sealing of the caisson gate. The scope includes following aspects:

- Assessment of concrete condition to determine the extent and severity of deterioration for caisson groove
- Proposed methodology to execute repairs of (concrete and granite) deterioration, inclusive of cost related to the methodology
- All testing procedures (Compression test on concrete cores, pull-out test, rebound hammer, ultrasonic pulse velocity, combined NDT methods and material bonding test methods etc.)
- Provision of laboratory reports and results of testing conducted
- Compliance with the Health and Safety requirements and environmental of TNPA and all contractors on site

The scope for the remedial works has not been determined as yet, and thus an allowance will be made for this to be conducted during executed to assess the extent of the repairs required. Post this assessment, the contractor shall mobilise his team to procure, supply and deliver all material required for the remedial works to site, and conduct the repairs accordingly.

2.8.6 Ventilation

The caisson is fitted with a forced draught and extract air ventilation system, the purpose of the system being to ensure a fresh air supply to the interior dry spaces of the caisson. Provision has also been made for continuous air exchange between the outside environment and the caisson internal structure via the use of suitably sized natural air vent pipes venting the caisson tanks and dry spaces. The forced air system extracts outside air through suitably positioned intake, grillage protected vents and passed this air through the intake air ducting, through the intake, inline tube fan, which discharges the air through an attenuator into the caisson internal dry space. Simultaneously, air is extracted from the dry spaces through extract air ducts, through the extract

inline tube fan, which discharges through an attenuator to the outside of the caisson. All ducting is sized to handle the required air volumes while minimising system backpressure. The ducts are fabricated from 3mm galvanised steel plate to the required cross-sectional diameter to accommodate the volumetric air-flow.

Supply and Extract Air Fans

Tube fans, or inline duct fans as they are sometimes referred to, are used mainly for moving small to medium air volumes through duct runs with relatively high resistance's. Ideal for industrial applications, this air mover offers both high flow and backpressure performance. Typical installations include applications where air is to be moved from one point to another or where the fan distributes air to one or more areas via branch ducting. Diameters vary from 100mm to 315mm and with inlet and identical sized discharge spigots to suit all standard flexible ducting. Air volumes of up to 513 l/sec and static pressures of up to 646 Pa are possible with these fans. The complete assembly is housed within a zinc coated corrosion resistant sheet metal casing and painted with a silver enamel finish. The units come complete with a mounting brackets. A PVC terminal box is mounted on the outside of the fan making the electrical connection to a 220-volt power supply, a simple task. A legend sticker is fixed to the lid of the terminal box providing all technical data for the unit. The IP65 motor is an external rotor type which is mounted inside the backward bladed impeller assembly and incorporates built in thermal overload protection. Fans are speed controllable when coupled to a suitable sized speed regulator but for this application, a single speed setting based on flow and backpressure is required. Silencers, or attenuators are compatible with these fans and required by the caisson system.

TUBE FAN DATA SHEET	
DESCRIPTION	DUCT INLINE TUBE FAN FOR FORCED AND EXTRACT AIR
Fan Type	Inline Tube fan
Brand	Luft
Model	OX200B
Power	140W
Current	0.65A
Maximum Pressure	541Pa
Maximum Volume	245l/s

Attenuators

Circular silencers are designed primarily for tube or in-line fan types which have inlet and outlet diameters of between 100mm and 450mm. They are an effective and economic solution for sound attenuation in circular duct systems from 100 mm to 315mm diameter. Suitable attenuation characteristics are achieved with circular attenuators without imposing undue system resistance. Pressure losses are little more than those which would occur over a comparable section of straight duct. The attenuator consists of a tubular liner manufactured from galvanised mesh. The liner is enclosed by a thick layer of mineral wool sound absorbing material. Casing and end plates are formed from galvanised sheet steel. The attenuators shall have a 30minute fire rating.

2.8.7 Electrical System Specification

2.8.7.1 General

The *Contractor* will be responsible for the supply, delivery, installation, testing, commissioning and handing over in proper working condition of the complete new electrical installation, as specified in detail in these documents. Also included in the scope is the supply of as-built drawings, operating and maintenance manuals and on-site training of the *Employer's* staff.

The existing Caisson is fed from 2x63A, 400V supply from TNPA kiosk. The existing electrical installation feeding the caisson is in poor state. Existing electrical installations shall be decommissioned and stripped when the new caisson is on site and fully operational.

The Scope of Work shall include the supply of all necessary required Equipment and *Contractor's* Personnel to properly perform the *Contractor's* obligations under the Contract, including:

- Construction Site surveys (dimensional, layout, checking etc.);

- ensuring that the completed Works shall comply with the Codes and Standards and any applicable statutory requirements;
- selection of suitable Plant and Materials (where not already specified herein);
- offloading of Plant and Materials at Site;
- safety equipment (guards, notices, etc.;
- construction, erection and the supervision of the Works;
- specialist installation and installation supervision;
- removal and disposal, as approved by the Employer, of all scrap and rubble generated by the Contractor within the Site to a demarcated area on the Site;

2.8.7.2 Generator Plant Scope of Work

- (a) The Standard for Uniformity in Construction Procurement published in terms of the Construction Industry Development Board (CIDB) Act, 2000 (Act no. 38 of 2000), the Standardized Construction Procurement Documents for Engineering and Construction Works as issued by the CIDB and any other relevant documentation pertaining thereto must be studied and all principles in this regard must be applied to all procurement documentation, practices and procedures.
- (b) The *Contractor*, under this contract, shall supply, install and commission a new emergency generating plant to provide emergency power to the RDD Caisson in Robinson Dry Dock at the Port of Cape Town.
- (c) It is a specific requirement of this enquiry that the successful contractor must have permanent premises situated in a suitable geographic location in order to provide a standby response of two hours maximum to the Dry Dock Port of Cape Town.
- (d) Tenderers are to note that typical basic standard offers by their suppliers will not be acceptable. All offers must be fully in accordance with the specifications in these tender documents inclusive of all extra items specified.

The scope of work is to procure, manufacture, supply, store, assemble, deliver, install, test and commission, guarantee and maintain for first 12 months a new 160 kVA 3 phase, 400V, 50 Hz emergency generator plant at the RDD Caisson, which will enable the plant to provide a reliable system of emergency power should the normal mains power supply fail at the Dry Dock Port of Cape Town main supply. The generator shall have a guarantee of 12 months or 1200 hours, whichever comes first from the hand over date. During that first 12 months' contractor shall provide free spare parts caused by contractor's quality of product. Contractor shall carry out service 4 time during the year as per the scheduled attached on annexure of the document.

The complete diesel generator installation shall comply with the requirements of the Transnet National Port Authority General Technical Specification for emergency generator plant and the additional requirements in this section of the document.

The generator contractor will be responsible for the complete diesel generator installation and associated equipment and power and communication cabling between the generator set and the AMF panel, the set is to include the metal clad insulation of the complete exhaust pipe and silencer system within the enclosure and the supply, oil resistant hose pipes and a funnel. The fuel line from the fuel tank must be fitted with a fuse link operated shut-off valve. Fuse link to be mounted above the plant in the event of a fire. The drain from the radiator and oil sump must be extended to outside the base frame. The exhaust pipe must discharge horizontally and be fitted with a mesh at the end to prevent entry of small birds.

It is the generator contractor's responsibility to ensure that the container manufacturer / supplier provides adequate ventilation within the enclosure for the efficient operation of the plant at full load condition.

Adequate electrical protective devices must be provided to shut the engine down before any permanent damage can result to the generator equipment. Refer to 'Alarm and Protection Equipment' clause in the General Technical Specification. The following equipment must also be provided:

A low level cut out probe in the diesel day tank to prevent the engine running dry, in addition to the low-level alarm probe.

A low-level cut-out probe near the top of the radiator to provide engine cut-out in the event of low coolant or a water leak.

In general, the essential outgoing circuits will be the:

The supply to the kiosk / electrical board on the essential side of the electrical board.

The electrical contractor shall provide the cabling and connections from the TNPA meter panel to the kiosk, to the generator, the Kiosk 2-Caisson and to the Caisson electrical installations.

Part of this contract is to provide:

- A 12-month guarantee of all new diesel generator plant from the date of hand over to the employer.
- A daytime emergency call out service with a response time of 2 hours during the first year.
- A three-monthly maintenance inspection including a 30 minute on-load run test and checking the battery charging system and replacing the fuel filters.
- A full annual service of the generator plant and replacement of the battery at the end of the 12-month guarantee period.

2.8.7.2.1 Guarantee

A guarantee period of 12 months shall apply to all new plant and equipment supplied and installed under this contract. The guarantee period shall commence from the practical completion date.

For details refer to the clause Guarantee in the General Technical Specification.

2.8.7.2.2 Maintenance

Maintenance of the specified systems, services and / or parts of equipment and infrastructure shall all be referred to as "Maintenance of an Installation". Maintenance of all completed installations shall ensure reliable functioning and optimum service life thereof. Maintenance responsibilities for each installation including all units and components as specified shall commence after practical completion of the installation and shall leave the Contractor with a functional installation to maintain for 24 months and guarantee for 12 months.

Maintenance of an installation shall be performed in accordance with the Technical Specifications, the Operating and Maintenance Manuals (where applicable) and the Maintenance Control Plan.

2.8.7.2.3 Drawings

Final position of the generator set shall be decided on site by the generator specialist and the engineer.

2.8.7.2.4 Engine Instruments

Refer to clause Panel Equipment in the General Technical Specification for equipment to be provided.

2.8.7.2.5 Battery Charging System

This shall include the engine alternator and regulator (12V or 24V system). Refer to the General Technical Specification for the battery specification details.

2.8.7.2.6 Electrical Reticulation

Electrical reticulation work under this contract will involve the installation of the new AMF panel and interconnecting of the power and control cabling and earthing between the generator set, alternator and the AMF panel. Also included under this scope of work is the separate earthing to ground of the generator set and the AMF panel. An emergency stop button shall be fitted on the outside of the enclosure. Wiring between this stop button and the AMF panel shall be undertaken by the generator contractor.

The electrical contractor will install and terminate the out-going cables from the AMF panel to the TNPA electrical board and / or as per drawings.

Cabling between the alternator and the AMF panel shall be suitably rated for the full load rating of the alternator and shall be suitably supported on stainless steel Gr316L cable tray.

All new electrical installation work shall comply with the SANS 10142-1.

After completion of the work, a compliance certificate for the new electrical installation work for the generator and AMF panel shall be issued to the Engineer.

2.8.7.2.7 AMF Panel

The diesel engine must be started automatically when the mains power fails.

The AMF panel must be mounted on the base frame of the engine or alternatively mounted at the end of the set and be visible through a window in the enclosure door.

A 250 amp TP 20 kA MCCB shall be provided as the main switch for the incoming supply from the TNPA supply source. A separate main generator circuit breaker rated for the FLC of the alternator, to protect the alternator against short circuit and overload is to be mounted in the AMF panel. The electrical / mechanical change over switch / contactors shall be mounted in the AMF panel. A by-pass switch for maintenance is also to be provided.

In addition, there shall be a cable to the main distribution board to an essential supply side to feed essential busbar which shall have circuit breakers feeding other distribution boards. Refer to the single line diagram for detailed drawing.

The AMF panel shall be fully equipped (including battery charger) and wired as detailed in the standard specification. An approved generator controller unit shall be used – Levato RGAM 20 only (this is to standardise the controls at Transnet).

In addition to the power cabling a 2,5 mm² 7 core armoured (control) cable and a 4 mm² 4 core armoured cable (for battery charger) will be required. The AMF panel shall also incorporate a red alarm indicator with audible electronic siren and reset button which must be clearly visible through the window in the door. A remote panel to be provided under this scope of works shall consist of a red indicator lamp for a general generator alarm (labelled GENERATOR ALARM)

The remote panel is to be handed over to the main Contractor.

2.8.7.2.8 Fuel/Water Separator

The diesel generator set shall be provided with a Duvalco fuel separator/filter unit.

The fuel filter unit and replacement filters are available from DUVALCO AFRICA or similar in South Africa.

Tenderers shall allow for the separator / filter to be installed in the fuel line from the tank to the diesel engine. The unit shall be positioned above the engine drip tray. The separator shall be manufactured to the following specifications and shall preferably be supplied by DUVALCO AFRICA.

The filter cartridge must be changed every 3 months even if the diesel engine does not run. Tenderers must allow for the cost of replacing the cartridges in their service rates.

2.8.7.2.9 Specification

The diesel / water separators:

- Shall be manufactured from die-cast aluminium.
- Shall be Robust Double Epoxy powder coated.
- Shall have a 10 micron filter cartridge with mechanical shut off, for overwhelming by water.
- Shall have a flow rate of ± 4 litres per minute.
- Shall have an Inlet / Outlet port.
- All parts shall be corrosion resistant and float shall be solid.
- Approximate measurement of unit shall be, Height - ± 325 mm, Width - ± 99 mm, Depth ± 125 mm.
- Shall be 4 Bar pressure tested.
- Shall have a ± 300 millilitre per minute water dump – differential head pressure dumping.
- Shall have a 2mm dump valve aperture.

Operation

- No visual inspections i.e. automatic water dumping.
- No electrical circuits required.
- Complete water separation.

2.8.7.2.10 Fuel

Fuel supplied and used in the diesel engine shall be commercially obtainable automotive diesel fuel to SANS 342.

The new generator set shall be provided with a full tank of diesel fuel. The fuel shall be pumped into the day tank for use during testing and commissioning.

2.8.7.2.11 Enclosures

The generating plant must be provided with a canopy enclosure for weather proofing the plant and equipment and also for sound attenuation. The canopy shall be purpose made and designed by the diesel engine supplier. The canopy shall be made of the epoxy powder painted 3CR12 steel with welded hinged doors for access to the plant for servicing. The doors are to have a rod with double latching similar to container locks. H3 Viro locks. The canopy is to have a single point lifting facility. Lift points shall be provided in the base frame of the gen set for lifting the plant.

2.8.7.2.12 Annual Service

At the end of the guarantee period a full annual service shall be undertaken in accordance with the following table. Should this service schedule not include all the requirements deemed necessary by the manufacturers of the relevant generator sets, then the contractor is to ensure that the omitted schedule maintenance items are included and that the annual service is in accordance with the manufacturer specifications.

Should the engine use for less than 400 hours in the twelve-month period, the schedule below must be used:

The preventive maintenance operations must be applied at the interval (hours or months) which occurs first.

To ensure consistency in tendering, tenderers shall allow in the priced bill of quantities for 3 inspections and the replacement of filters and a full annual service at the end of the guarantee period.

A = 3 Monthly inspection / service and initial training of operators

B = Every 400 hours or 12 months

A	B	Operation
<input type="checkbox"/>	<input type="checkbox"/>	Check the amount of coolant
<input type="checkbox"/>	<input type="checkbox"/>	Check the level of the lubricating oil
<input type="checkbox"/>	<input type="checkbox"/>	Check the restriction indicators for the air filters and, when necessary, renew the filter elements.
<input type="checkbox"/>	<input type="checkbox"/>	Start and run the engine with 30% load (minimum), until normal temperature of operation is reached. Engine must run for a minimum of 1 hour.
<input type="checkbox"/>	<input type="checkbox"/>	Drain the water / sediment from the primary fuel filter.
<input type="checkbox"/>	<input type="checkbox"/>	Check the condition and the tension of all drive belts.
<input type="checkbox"/>	<input type="checkbox"/>	Check the specific gravity and the pH value of the coolant.
<input type="checkbox"/>	<input type="checkbox"/>	Renew the lubricating Oil
<input type="checkbox"/>	<input type="checkbox"/>	Renew the canisters of the lubricating oil filter
<input type="checkbox"/>	<input type="checkbox"/>	Renew the canister of the main fuel filter
<input type="checkbox"/>	<input type="checkbox"/>	Clean the primary fuel filter
<input type="checkbox"/>	<input type="checkbox"/>	Ensure that the mounting nuts for the turbochargers are tightened securely.
<input type="checkbox"/>	<input type="checkbox"/>	Check the timing of the fuel injection pump
<input type="checkbox"/>	<input type="checkbox"/>	Check that the drive coupling bolts of the fuel injection pump are tightened to 120Nm (88lbf ft)
<input type="checkbox"/>	<input type="checkbox"/>	Ensure that the fuel injectors are checked and corrected or renewed, if necessary *
<input type="checkbox"/>	<input type="checkbox"/>	Ensure that the tappet clearances are checked and adjusted, if necessary *

In addition to the operations listed above, the following must be included in the 12-month annual service.

- Drain and flush the coolant system and renew the coolant mixture.
- The operation of the turbochargers be checked and repaired, if necessary, by a competent person.
- Check that the air charge cooler and the radiator are clean and free from debris
- The operation of the alternator be checked and repaired, if necessary, by a competent person.
- Check the battery charging system and adjust the charging rate if necessary.
- Install a new heavy-duty battery each 12-month interval.

2.8.7.2.13 Quarterly Maintenance Inspections

A quarterly maintenance inspection is required every 3 months throughout the guarantee period for the plant providing emergency power. A quarterly maintenance schedule is attached which must be photocopied and completed by the service Contractor. The engine must be started by simulating a mains failure and run for at least 30 minutes.

The price for the quarterly inspections shall include all necessary costs such as travelling, labour, tools, cleaning materials, replacing fuel filter cartridges etc. Contractors are advised to assess the rising costs and price these services accordingly, as these costs are fixed and no additional escalation on rates will be permitted.

2.8.7.2.14 Monthly Maintenance Services

A monthly maintenance service will not be required for the generator set unless otherwise recommended by the diesel generator set manufacturer. This

generator in not a **base load set** that would run continuously day and night to provide electricity.

2.8.7.2.15 Emergency Call Outs

Should a breakdown occur during the 12-month free maintenance period, the contractor is expected to visit site within two hours of receiving written notification from Transnet Agent. Any faulty electrical or mechanical equipment shall be replaced at the contractor's cost under the guarantee.

Reimbursement (including travelling) will not be made for call outs to faults on new equipment installed under guarantee unless it can be proven wilful damage or negligence by the Employer's operating staff.

2.8.7.2.16 Servicing

All parts and components shall be approved and in accordance with the manufacturer's spare parts' list. Generic or similar parts not approved by the manufacturer of the plant may not be used.

2.8.7.2.17 Documentation

Refer to Item 18 of the General Technical Specification: **INSTRUCTION MANUALS**. The same clause also specifies the requirement for wall mounted drawings in plant rooms which are to be provided for in the enclosure of the new generator set.

Four copies of an A4 size hard covered spiral binder with 12 coloured plastic fly sheets suitable to contain the following information shall be provided for the new generator and handed to the Engineer:

- 1) Cover page with title of contract and file numbers
- 2) Contractors details – name, address, contact names and phone/cell numbers
- 3) Consultants details as above

- 4) Hand over certificates – compliance forms, practical completion forms
- 5) AMF panel routine test certificates from supplier – refer SANS 1973 and a schedule of all controller programmed settings
- 6) Site instructions
- 7) Technical data sheets with supplier's names and model numbers – radiator level probes, battery charger unit, generator controller, plug-in relay types and replaceable filter cartridges.
- 8) As built drawings of AMF panel and genset
- 9) Operating and maintenance manuals
- 10) List of all consumables with make and type number – oil, filters etc.

2.8.7.2.18 Log Book

An A4 size hard covered service log book on a chain shall be provided in a metal envelope in the door. The log book shall be chained to the inside of the enclosure. The log book is to be filled in each time anyone opens the doors to the enclosure after the set is commissioned. A full detail of servicing and repairs is to be recorded in the book with the run hour reading.

2.8.7.2.19 Cleaning / Clearing

Cleaning during maintenance service refers to the high pressure hosing of the engine. Removal and disposal of any oil or diesel in the drip tray.

All mechanical and electrical equipment must be cleaned of dust and oil. The electrical switchboard must be blown out of dust with an air blower.

Clearing refers to the removal of all unauthorised items stored within the canopy to ensure fire safety and compliance with the OHS Act. The enclosure may not be used as a store room.

2.8.7.2.20 Signage

Mandatory signs to SABS shall be installed inside the enclosure – first aid, resuscitation, fire, etc. All other signage shall be approved by the Transnet Agent (Consultant) before purchasing.

A sign as indicated in clause 11 of the General Technical Specification must be installed inside the enclosure at the electrical indication/control panel.

In addition to the mandatory OHS signs, a plastic laminated schedule shall be mounted inside the enclosure with the contractor's name and contact details together with the name of the Transnet service/maintenance manager and his/her contact details.

A plastic laminated schematic wiring diagram of the electrical control system must also be mounted inside the electrical enclosure.

Two signs shall be installed outside on the door. One at high level with the words "GENERATOR PLANT" and the other with the words "UNAUTHORISED ACCESS NOT PERMITTED"

The generator set plant and the control panel shall also be provided with a unique alpha numeric label identifying the plant for the TNPA e.g. TNPA – 005.

All signs must be fixed with non-corrodible screws.

2.8.7.2.21 Commissioning

The diesel generator set and AMF panel is to be tested in the supplier's workshop prior to dispatching to site. Tests in the workshop shall include a load test with a dummy load, equivalent to the full output of the particular alternator and in the presence of the Transnet Agent (Consultant). Temperature rise tests shall also be taken within the enclosure during the load tests.

2.8.7.2.22 Training

The contractor shall ensure that the relevant Transnet personnel (at least two persons) are fully versed with the operation, starting procedure and monthly maintenance requirements of the generator sets. The names and signatures of the trained officials indicated on the handover certificate shall be forwarded to Transnet Agent (*Project Manager / Engineer*).

2.8.7.2.23 Electrical Competent Person & Identification

The Contractor must have in his permanent employ a person deemed to be electrically competent. Such a person must be in possession of a valid and current certificate certifying he/she is an Installation Electrician. This person will accept a permit to work on behalf of the Contractor associated with system outages. It is a requirement that the above person be resident on the site whenever installation work is being carried out. Work on site shall at all times be supervised by a designated responsible person appointed in writing in terms of the OHS Act No. 85 of 1993.

Whilst on site all staff and labourers employed by the generator contractor shall wear distinctively marked clothing bearing the name of the mechanical contractors or his identification logo.

2.8.7.2.24 Visits to Site

Tenderers are advised to visit the site and acquaint themselves with the existing installation, working, site and access conditions. A compulsory site visit will be held as per the details noted in the Tender Notice.

No claims whatsoever shall be entertained due to lack of knowledge of the site conditions.

2.8.7.2.25 Attendance on Principal Contractor

It is a requirement that the generator contractor liaise closely with the Principal contractor on all aspects of the generator plant installation. The generator contractor will be required to attend regular (2 weekly) site meetings with the Principal Contractor.

2.8.7.2.26 Indemnity

In carrying out his obligation as the Mandatory to the Employer for this Contract in terms of Section 37(2) of the Occupational Health & Safety Act No. 85 of 1993, the Contractor ensures that he complies with the Act when providing the Works or using plant, materials or equipment. The Contractor indemnifies the Employer and the Engineer and their representatives against loss and damage to property, death of, or injury to, a person and claims, proceedings, compensation and costs arising from the Contractor's transgression of the Act, except to the extent that the Employer caused the transgression.

2.8.7.2.27 Quality Control

The Contractor shall specify to what standards the equipment will be Manufactured i.e. ISO, EN, IEC, CENELEC.

The Contractor shall supply all necessary compliance certificates, handover documents, drawings,

2.8.7.2.28 Safety Arrangements And Procedural Compliance With The Occupational Health And Safety Act (Act 85 Of 1993) And Applicable Regulations.

- The Contractor shall accept his obligation to complying fully with the Act and applicable Regulations and with Transnet safety requirements.
- The Contractor shall provide a written Health and Safety plan, the file shall be approved before starting with the work
- The Contractor shall keep a safety file at all times.

- The Contractor shall keep a site diary and instruction book.
- The Contractor shall attend Transnet National Ports Authorities safety induction training before starting with the work.

2.8.7.2.29 Environmental Responsibility.

- The Contractor shall separate hazardous or non-hazardous waste and where practical, waste for recycling prior to disposing thereof.
- The Contractor also undertakes to minimize the amount of waste generated or released, whether it is hazardous or non-hazardous waste, as far as possible to reduce the impact on the Environment.

The Contractor undertakes to dispose of all waste generated, albeit hazardous or non-hazardous waste in a responsible manner and submit proof of all disposal documents to the Project Engineer

2.8.7.3 Generator Plant Technical Specification

2.8.7.3.1 General

This is a typical standard specification that covers the supply, delivery, complete installation and testing on site in full working order and the guarantee of new diesel generator plant as detailed below.

Brochures with full technical particulars, performance curves and illustrations of the equipment offered must be submitted with the tender. Contractors may quote their standard equipment, complying as close as possible with the specification, but any deviations from the specifications must be fully detailed.

The schedules following this specification must be completed by the Contractor in all respects.

The Employer reserves the right to accept any portion of any tender and does not bind itself to accept the lowest or any offer.

2.8.7.3.2 Requirements

The diesel engine alternator set shall be robust in construction, of the heavy duty, industrial engine type with speed not exceeding 1500 RPM and shall comply with SANS 8528. The set shall be fully automatic, i.e. it shall start when any one phase of the main supply fails, and shall shut down when the normal supply is re-established. The set shall be capable of delivering the specific output continuously under the site conditions, without overheating. Maximum ambient temperature can be assumed to be 40° C and the maximum ambient humidity at lowest temperature to be 80 %. The altitude is between below 1 m above sea level. The engine shall be capable of delivering 110% of the specified output for one hour in any period of 12 hours consecutive running, in accordance with BS 5514.

Full particulars, including detailed descriptions, illustrations and curves, with engine performance (output of engine against speed for both intermittent and continuous operation) and fuel consumption curves shall be submitted with the tender.

The enclosure, 3CR12 with minimum of 2,0mm thickness and the engine and alternator shall be mounted as a complete set on a common steel base which shall incorporate anti-vibration dampers. The set must be placed on a level concrete floor. A drip tray, large enough to catch a drip from any part of the engine and water discharged from the fuel / water separator filter, must be fitted under the engine. All diesel engines must be fitted with a charging alternator for charging the battery.

2.8.7.3.3 Voltage and Output

The output shall be rated to suit the specified, kVA, power factor and voltage ratings as shown on the specification schedule. The engine size shall not exceed the specified ratings by more than 25%. Contractor to complete the attached schedule and return it with the BOQ for evaluation.

2.8.7.3.4 Enclosures

The generator plant must be provided with a weatherproof, sound attenuated enclosure to protect the plant. The canopy shall be purpose made and designed by the diesel engine supplier. The container shall be made of epoxy powder painted 3CR12 steel with welded hinged doors for access to the plant for servicing. The doors are to have a rod with double latching similar to container locks. Outdoor plastic / brass Viro padlocks which are keyed alike are to be fitted on each door. The container is to have a single point lifting facility. Lift points shall be provided in the base frame of the generator set for lifting the plant. A waterproof stop button in vandal proof box must be provided on the outside of the container.

The inside of the container must be insulated with fire retardant acoustic lining to provide sound attenuation. The sound level must not exceed 65 dB(a) at 7 m from the enclosure.

2.8.7.3.5 Concrete Base

The outdoor generator plant shall be installed on a reinforced concrete plinth, which must be raised above ground line to prevent water ingress and corrosion. A concrete base shall be cast in situ for each generator plant. The base shall be made of reinforced concrete at least 350mm thick and overlap the plant by 500mm all round. The plinth must protrude 150mm above ground line. The concrete shall have strength of 30MPa after 28 days. It is essential that the base is level. The edges of the base shall be tapered for neatness. Concrete bases shall be cast in position at least 28 days prior to installation of the plant. The base frame of the plant must be bolted / bracketed to the concrete base. Provision must be made in the base for the cable entry and the main earth wire connection. A molthoid strip shall be placed between the concrete base and the generator plant. The generator floor shall withstand a maximum weight of 5 tons. Any designs required for this plinth shall be made by the Contractor and must be approved by a Professional Registered Engineer / Professional Registered Technologist where applicable.

2.8.7.3.6 Diesel Engine

Diesel engines shall be manufactured in accordance with BS 5514. The engine must be of the solid injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the specified site conditions. **The engine shall be de-rated for the site conditions.** Unless otherwise indicated, the starting period from either automatic or manual switching-on until the taking over by the generating set, in one step, of a load equal to the specified site electrical output shall not exceed **15 seconds**. This must be guaranteed by the Tenderer. The engine shall be easily started from cold, without the use of any special ignition devices, under summer as well as winter conditions, against full load. Water cooled engines shall be fitted with immersion heaters. Turbo charged engines will only be accepted if the Tenderer submits a written guarantee that the engine can deliver full load within the specified period. Emissions from the exhaust shall be kept to a minimum and shall be given at the time of tender.

A remote drain for draining the sump oil and water from the radiator must be extended to the outside of the base frame.

2.8.7.3.7 Battery

The set must be supplied with a fully charged **heavy duty, industrial**, maintenance free lead-acid/calcium type battery, complete with the necessary electrolyte. Batteries shall be of the DELTEC or as approved by the Engineer and shall not be less than 120 Ah rating. The battery will be of sufficient capacity to provide ample starting torque for the engine, which could require up to six consecutive starts. However the battery capacity shall not be less than that recommended by the diesel plant manufacturer.

The battery shall be mounted on a painted non corrodible, battery shelf secured to the base frame. Rubber insertion shall be installed at the bottom of the shelf. The terminals of the battery shall be sprayed red and green with a terminal spray protector.

Where plant is installed indoors within a plant room, a complete set of distilled water bottles, funnel, hydrometer, etc. will be provided in a glass case fixed on to the plant room wall to maintain and test the battery.

2.8.7.3.8 Cooling

Air cooled or water cooled engines shall be acceptable. To prevent excessive running temperatures on water cooled engines, an engine-mounted, tropicalised, pressurised radiator with blower-type fan shall be provided to maintain safe operation at 43°C ambient temperature. The radiator shall be designed for an ambient air temperature of 50° C. Total air flow restriction to and from the radiator shall not exceed 0,12 kPa. The Contractor shall provide duct work with flexible connecting section between radiator and discharge louvre frame. Radiators must be dosed with anti-freeze and a suitable corrosion inhibitor. A low level probe shall be mounted near the top of the radiator to alarm with visual indicator and shut-down the plant. Should the radiator be too narrow to accommodate the probe, then the probe shall be installed in an enclosed cylinder with extension pipe fixed to the radiator. The probe shall be of the Electromech AC DC Dynamics LS 103-3 or similar make.

An audible alarm and visual trip system shall be provided on the control panel to indicate that excessive temperatures have been reached.

2.8.7.3.9 Lubrication

The main bearings and other important moving parts in the engine shall be lubricated by a forced feed system. An audible alarm and visual trip system shall be provided on the A.M.F. panel to operate the stop solenoid in the event of low oil pressure.

2.8.7.3.10 Fuel Pump

A manual fuel pump must be permanently connected to the fuel tank to enable refuelling from 220 litre drums. The fuel injection equipment must be suitable for operation with all commercial brands of diesel fuel. Second pump shall be electronically connected to the external tank.

2.8.7.3.11 Fuel Tank

The generator shall have its own diesel tank that shall run for 12 hours at full load. There will be an additional external 220l tank nearby the site.

Fuel will be delivered in 220 litre drums and the *Contractor* will provide a suitable hand pump and all necessary oil resistant hose pipes to enable the transfer of fuel to be carried out on site with the minimum amount of skill.

All fuel pipes shall be steel (but not galvanised) with appropriate bends to provide an expansion facility and flexible connections with armoured covering for vibration isolation at the engine. Copper shall only be used from the primary filter to the engine pump.

2.8.7.3.12 Fuel / Water Separator

A fuel / water separator unit with automatic water dump feature shall be installed in the fuel line from the tank to the diesel engine and shall be mounted above the engine drip tray. The unit shall be of the Duvalco Mk3 DSF type with 10 micron filter cartridge and have a flow rate of +/- 4 litres/min. supplied by *Duvalco Africa*.

2.8.7.3.13 Governor

The speed of the engine shall be controlled accurately by a mechanical governor complying with class A1 to BS 5514 such that when full load is suddenly switched off the temporary increase in speed will not exceed 10% above 1500 rpm. The permanent speed variation shall not exceed 2½% of the nominal engine speed. Manual adjustment must be provided on the engine to adjust the normal speed setting.

Engines delivering an output 80 KVA shall be provided with an electronic governor where the engine is electronic.

2.8.7.3.14 Flywheel

A suitable flywheel must be fitted that is large enough to prevent any visible flicker in the lights. The cyclic irregularity of the set must be within the limits specified in BS 5514. The fly wheel must be covered/enclosed.

2.8.7.3.15 Silencer and Exhaust System

The complete exhaust system shall be made of stainless steel.

A residential exhaust silencer (to 65 dB (A)), muffler companion flanges, and flexible stainless steel (suitable for coastal conditions) bellows-type exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Canopied generator set should be sound attenuated to achieve a sound level of less than 65 dB(A) at 7 metres from the plant. The exhaust pipe shall be secured by flanges both sides of the wall of the plant room at the point of exit and shall extend 0,5m above the room gutters and must be fitted with a weather flap. Exhaust pipes through canopy walls must be flanged where it penetrates the canopy wall to permit ease of removal of the canopy. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine. The exhaust pipe and silencer must be lagged inside the generator room to reduce heat and noise transmission.

The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth, due to thermal expansion, be imposed on the engine penetration. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

The muffler and all indoor exhaust piping shall be lagged by the installing Contractor to maintain a surface temperature not to exceed 150°F (65.5°C). The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting. Insulation between the manifold and silencer shall be double 25mm layers of FIBREFAX and the silencer and piping to the outer wall insulated using 50mm thick wire backed INSULWOOL of at least 80kg density. The insulation shall be cladded under tension and riveted with 3mm stainless steel rivets. The cladding shall be 0,7 mm thick 430 stainless steel.

2.8.7.3.16 Alternator

Alternators shall be manufactured in accordance with BS 5000. Unless otherwise specified, the alternator shall be of the self excited brushless type enclosed in a ventilated drip-proof housing, and must be capable of supplying

the specified kVA continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and stator windings having 'Class H' insulation.

The alternator shall be capable of delivering an output of 110% of the specified output, for 1 hour in any period of 12 hours consecutive running.

The alternator windings will be suitably impregnated and tropicalised to withstand the specified climatic conditions. Alternators shall be of the low harmonic type. An alternator heater will not be required. Contractors are to list the number of similar installations operating in similar climatic conditions. The preferred makes of alternators are Stamford, Leroy Somer, Mecc Alte and Marelli in order of preference.

2.8.7.3.17 Regulation

Since the alternator set could be installed in an area where maintenance staffs are not readily available it is essential to offer regulating equipment which is simple and robust in construction. Complicated equipment requiring specialised knowledge will not be considered.

The alternator shall be self regulated and the voltage regulation limits shall not exceed $\pm 1\%$ of the nominal specified voltage, under all load conditions and at the specified power factor, while the engine speed "droop" variations between no load and full load shall not exceed $4\frac{1}{2}\%$.

2.8.7.3.18 Performance

The excitation system shall be designed to promote rapid voltage recovery following the sudden application of full load. The voltage shall recover to within $2\frac{1}{2}\%$ of the steady state within 300 milli-seconds following the application of full load and the transient voltage dip shall not exceed 15%.

2.8.7.3.19 Coupling

The engine and alternator must be directly coupled with a high class quality flexible coupling which is designed to cope with the most severe torque changes, due to instantaneous load changes in the alternator from no load to full load. The flexible coupling shall be of the HOLSET type or equal and similar.

2.8.7.3.20 Computer Power Supply

The Contractor shall ensure that the output has low harmonic distortion and voltage regulation of less than 4%.

2.8.7.3.21 Automatic Mains Failure Panel

The panel will incorporate all of the specified control and protection equipment required to operate and protect the alternator. The preferred AMF panel is a Reid & Associate-AMF 120 Mk3 control unit or the Generator Control cc. with LAVATO RGAM12/24 generator controller or equal and approved. Control units must be supported by GSM and have modem support with auto-call function for e-mail or SMS sending. It is important that the equipment used in the control panel has a history of use in RSA and that parts are readily available off the shelf.

The visual and audible alarms, battery-charging unit and mains failure sensing relays will also be incorporated in the panel. All instruments are to be flush mounted.

Where solid-state equipment is used for control circuits etc, these shall be of the printed circuit board design, which can be easily unplugged and replaced with standard replacement cards in the event of failure, testing etc. Spares of these PCB cards etc must be available at all times from the supplier of the emergency equipment.

The *Project Manager / Engineer* must approve the panel manufacturer's detailed working drawings of the assembly before any fabrication commences. Any other construction or type of assembly proposed as an alternative to that specified must have the approval of the *Project Manager / Engineer* in writing.

The drawings will detail all dimensions of busbars, connections, electrical component make, type and rating.

Positions and layout of busbars, earth bars and gland plates will be shown in front and side elevation drawings.

All panel and equipment shall to be designed in accordance with SABS IEC 60439-1 and SANS 1973-1-2 and shall be suitable for operation on supply voltages of 230/400 Volts, 50 Hz, AC.

Panels designed for plant within plant rooms shall generally be of a floor standing cubicle type assembly, suitable for top and bottom cable entries. Schematic drawings will show the specific requirements applicable to each assembly.

Panels designed for plant within a container or canopy shall be mounted on the base frame of the plant and provided with vibration isolation from the generator set.

The entire assembly shall be of strong and rigid construction with suitable folded 3CR12 stainless steel frame work, totally enclosed by means of removable 3CR12 stainless steel covers and hinged 3CR12 stainless steel doors where required. The entire assembly shall be manufactured from 3CR12 sheeting of a minimum 2mm thick.

The overall outside dimensions of the assembly shall be suitable for easy handling of the switchgear as indicated on the drawings. The height of the assembly shall generally not exceed 2 100mm above floor level.

All removable covers shall be secured in position by means of patent screw locking devices approved by the *Project Manager / Engineer*. All panels shall be suitably braced to ensure rigidity.

The enclosures shall be designed to accommodate the electrical distribution and control equipment shown on the diagrams and comply with all the constructional requirements of this specification.

The panel will be fitted with a lockable door having a suitable gasket incorporated in the frame to ensure that the arrangement is in accordance with the required degree of protection. The sealing strips and gaskets shall be made of durable, non-hardening rubber, neoprene or other synthetic material, suitably fixed to the door or frame to ensure that the seal does not become dislodged during normal operation and use.

Identification labels in accordance with the specification will be screwed to the front of each door on the panel. The label will describe the purpose of the equipment contained within each compartment.

All hinges and door handles shall be of the bolted-on type and shall be manufactured from non-ferrous materials or stainless steel, suitably finished and treated against corrosion by an electro-plating process. All hinges are to be of the lift-off type and samples shall be submitted to the Representative/Agent (Consultant) for approval.

Hinges and door locks shall be of Barker and Nelson, Zeuss, Yale or equivalent quality to ensure satisfactory operation and a pleasant appearance, and where possible the lock and door catch shall consist of one combination unit.

Door latching and de-latching operations shall be smooth and quick, whilst ensuring proper compression of the sealing gaskets.

The repeated opening and closing of the hinged doors and the operations of the door locks and catches shall not cause chipping or scratching of the painted surfaces or any other blemishes to the finished panels.

Each lock shall have two keys, and where more than one locked panel is specified the locks shall be in one master series. All keys, plus one master key, shall be handed to the Department for which a receipt shall be obtained. One

master key shall, in addition, be handed to the Representative/Agent (Consultant).

All keys submitted by the Contractor shall be suitably tagged with the panel designation and location.

Bolts, nuts and washers used throughout the panel shall be of stainless steel with the exception of busbar bolts, nuts and lock-washers which shall be of stainless high tensile steel or high tensile phosphor bronze material.

All screws, bolts, door locks, etc must not be in direct contact with painted surfaces, to avoid sticking or damage to the paintwork.

The 3CR12 panel shall be epoxy powder coated Red (Colour VEP 2002).

This inside of the cabinet door shall be fitted with a suitable holder for the schematic control diagrams, schedules of equipment of the method of operation specification.

All busbars shall comply with the requirements laid down in SANS 1195. The completed busbar system shall be a standard modular system and shall have been tested to SABS approval and a certificate shall be made available confirming the full busbar technical description, current rating and fault rating together with full details of the test results. Busbars shall be rigidly supported by means of approved insulated busbar clamps to prevent damage resulting from the specified short circuit conditions,

Solid high conductivity copper busbars shall be rigidly mounted in the top section of the switchpanel. The busbars must be rated for the continuous full load current, as stated, at a current density not exceeding 1,60 Amps per mm².

If a relaxation of SANS 1973 is agreed to permit the drilling of holes, the cross-sectional area as measured is to be reduced by the area of the holes.

The busbars shall run along the entire length of the assembly up to 76mm from either end, and the incoming collector bars shall be fitted directly below the main circuit breaker or incoming HRC fuse unit.

Sufficient space must be allowed for the connection of all the incoming cables as specified. All busbars shall be identified in the phase colours red, white and blue.

The busbars shall be arranged horizontally with the longer side of the cross-sections in the vertical plane and one behind the other in the horizontal plane at 90mm centres.

All connections and extensions to busbars shall be effected by means of high tensile phosphor bronze nuts, bolts and washers or cadmium plated, high tensile steel bolts and nuts which shall also be provided for future extensions. The minimum diameter of any hole will be 10 mm.

A solid copper earth bar shall be provided inside each assembly at the back and along the entire length, at a height of approximately 500mm above floor level, or 200 mm above the gland plates. A bar is to be provided at the top of the assembly where top entries exist and this shall be solidly connected to the bottom earth bar.

The bar will be supported on robust spacers and will have a minimum clearance of 40mm to the sheet steel panel.

The earth bar shall have a cross-section of not less than 40mm X 6mm and shall be drilled with the requisite number of holes for the individual connection of all cable ECC and other earth conductors.

High tensile phosphor bronze or cadmium plated nuts, bolts and lock washers shall be provided through the earth bar at each earthing position and at least 5 additional holes will be provided for future connections, each being fitted with nuts and bolts as above.

The earthing positions shall be evenly spaced along the length of the earth bar and the bar must be clearly identified as the earth.

2.8.7.3.22 Alternator Protection

Small alternators shall be protected by a triple pole MCB or air circuit breaker with instantaneous short circuit trips and adjustable thermal overload protection of the correct characteristics which shall be provided on the front of the panel. The settings of this unit will ensure that the alternator is adequately protected against all short circuit conditions. Alternatively, on small alternators, fuse protection may be used in conjunction with a phase failure monitor.

Larger alternators shall be protected by an adjustable electronic circuit breaker.

2.8.7.3.23 Parallel Operation

Should parallel operation with other sets or any supply network be specified, it must be possible to synchronise such machines without creating any undue shock or fluctuating conditions.

2.8.7.3.24 Alarm and Protection Equipment

Alarm relays with re-set push buttons are required to give visible and audible alarm signals to protect the plant by shutting it down before any permanent damage results. The visual indication will remain uncanceled until the problem causing the trip has been returned to normal.

The protection required will be:

- OVERLOAD
- TEMPERATURE HIGH
- LOW OIL PRESSURE
- OVER SPEED

- UNDERSPEED
- START FAILURE
- LOW WATER LEVEL
- In addition, one DIESEL FUEL LOW level alarm and indication as well as one BATTERY/CHARGER FAILURE alarm and indication must be provided which does not trip the engine. Provision must be made for both these items to be remotely alarmed.
- FUEL TANK EMPTY – to trip the engine before the fuel runs out completely so as to avoid bleeding the engine on refuelling. The lights and associated push buttons will be engraved accordingly.

One common hooter (Klaxon type SY2/725) and red flashing light is required to be mounted on the outside wall of the plant room with the alarm cancel button mounted on the control panel. The alarm system must be supplied from the starting battery.

Provision is also to be made for remote alarm indication and remote cancellation in the charge office.

A remote alarm panel shall be supplied and installed in the charge office with a connecting 2,5mm² 4 core pvc/swa/pvc cable from the generator control panel. The remote alarm panel shall incorporate a mains on and generator on and not in auto indicators, a low fuel, low battery, start fail, and genset fault indicators and relays as well as an electronic sounder (with low sound level) and a silence button. The silence button shall not switch off the pilot lights – pilot lights can only be switched off when the fault has been cleared at the generator panel.

9.1. Start and Stop Delay Timers

Where connected to a rural supply system with auto-reclosing protection, an adjustable timer (0-180 sec) will be fitted to prevent starting as a result of transient faults. The engine control system is also to be fitted with an adjustable timer (0-3 minutes and set on 1 minute) which will keep the engine running on load for a pre-set time after the mains power has been restored to normal. An additional timer (0-10 minutes and set on 8 minutes) will keep the engine operating on no load for its 'run-down' period. It shall be possible for the set to take load again without adverse effects.

2.8.7.3.25 Operation Selector

A four-position selector switch is to be provided on the AMF panel to select the mode of operation, which could be – ‘Auto’, ‘Manual’, ‘Test’ and ‘Off’.

With the selector in the ‘Auto’ position, the set is to automatically start and stop, according to the mains supply condition.

In the ‘Test’ position the engine shall be capable of being manually started and stopped without the alternator picking up any electrical load, to ensure that starting equipment, battery etc. are in operational condition. This routine will be repeated every week and a logbook recording this fact must be provided in the plant room.

With the selector in the ‘Manual’ position, the set must pick up the electrical load when started but it must not be possible for this supply to be paralleled with authorities supply. A change over relay/contactors is therefore to be provided in the main distribution board.

In the ‘Off’ position the set shall be completely isolated and cannot be started manually or automatically. This setting will be used for maintenance of the machine only.

2.8.7.3.26 Battery Charging

The AMF panel is to include a fully automatic battery-charging unit to keep the battery at its optimum condition at all times. The preferred charger unit is the LAVATO model BCE or equal and approved. The system shall ensure that the batteries are not overcharged by being permanently connected to the charging system. The charging current must reduce to 30% when the battery voltage is above 50%. The charging circuit must be able to inhibit:

A short circuit at the battery charger terminals

Inverse battery polarity

Low battery charge ($< 0.2 U_c$)

The output current of the charger shall not be less than 3 amps at 12 volts.

An alarm relay output will be required.

Fuse protection must be provided on the input supply and on the battery output.

An ammeter and voltmeter suitably scaled to indicate the trickle charging supply will be flush mounted in the front panel. The voltmeter will operate by depressing a spring loaded push button and will not remain in the circuit continuously.

2.8.7.3.27 Panel Equipment

The following items of equipment will be fitted to the panel:

- One flush mounted 72mm x 72mm PCI voltmeter scaled to the specified voltage to read all phase-neutral voltages.
- One 7 way voltmeter selector switch to suit item 7.7.1 above.
- One 72mm x 72mm frequency meter showing alternator frequency.
- One run hour meter with cyclometer counter showing the actual running hours of the engine.
- 3 - 2 amp HRC fuses for the voltmeter circuit, including spare fuses.
- 3 - 72mm x 72mm maximum demand indicating ammeters scaled to the specified maximum load current, complete with current transformer, to indicate the current in each phase of the alternator.
- One phase rotation indicator.
- One suitable rated main isolating switch to isolate the complete board.
- One adjustable type triple pole MCB or air circuit breaker rated to protect the alternator.
- One four-position selector switch as specified.
- One emergency stop push button behind a hinged cover.

- Two push buttons (green and red) marked 'Start' and 'Stop' for test operation.
- One complete battery charger with instrumentation to be operated from the mains supply.
- One alternator charge indicator with 30-amp deflection.
- One start-delay timer.
- One stop-delay timer.
- Relays and reset push buttons for engine protection with spare lamps.
- One lube oil pressure gauge and relay with shutdown for low pressure.
- One low fuel level relay device and spare lamps.
- One fuel tank empty cut-out relay and spare lamps.
- One low water level relay device and spare lamps.
- One battery/charger relay device and spare lamps
- One 12 Volt DC. Hooter/alarm with protection fuses, cancellation button, etc. and terminals for the operation of a remote alarm.
- One push button for manual start operation.
- One set of terminals and all interconnecting wiring including earth connections.
- One on-load by-pass switch in separate cubicle as specified.
- One spring-reserve seasonal time switch or photocell.
- Surge arrestors for all 3 phases and the neutral.
- Any other equipment necessary for the correct and safe operation of the installation.

2.8.7.3.28 Marking

All instruments, lights, push buttons etc. are to be provided and will be marked with Trafalite engraved labels, screwed to the panel. The lettering shall be 6mm high. All labels will be in English and any other Official Language as directed by the Representative/Agent (Consultant).

All engine instruments shall have clear markings on the faceplates, indicating the normal operating zone(s). Maximum and minimum allowable values/limits and danger zone(s).

The base frame or other suitable location shall be marked with the recommended oil type to be used in the engine.

2.8.7.3.29 Change Over System

The main switchboard shall be divided into two sections for 'mains supply' and 'mains/emergency generator supply'. Two specified three pole contactors rated for AC3 operation or two motorised circuit breakers shall be incorporated in the switchboard to facilitate the automatic changeover of supplies, but they shall be electrically and mechanically interlocked to prevent the generator from running in parallel with the mains supply.

An engraved plastic danger notice is to be prominently fixed on the switchboard stating that "This switchboard can be automatically energised from the emergency generating set."

2.8.7.3.30 By-pass Switch

The main switchboard must be equipped with a manually operated on-load by-pass switch, which shall connect the incoming mains to the automatic control gear or directly to the outgoing feeder. In the latter position, the automatic control gear, including the main contractors, shall be isolated for maintenance purposes. A triple pole on-load isolator is to be provided to isolate the mains. It shall not be possible to start the engine except with the selector switch in the "Test" position.

It is required that this by-pass switch and mains isolator be mounted away from the automatic control gear in a separate compartment either on one side or in the lower portion of the switchboard and that the switches are operated from the front of the cubicle.

2.8.7.3.31 Earthing & Lightning Protection System

The system shall comply with the relevant requirements of the following specifications.

- SANS 10313 : Protection of structures against lightning
- SANS 10199 : Design and installation of earth electrodes
- SANS 1063 : Earth Rods and Couplers

Only SABS approved earth rods and couplers bearing the SABS mark must be used.

2.8.7.3.32 Earthing

The neutral of the system and the alternator must be solidly earthed. The Contractor shall provide a 400 x 50 x 6mm thick copper bar fixed to the plant room wall on two insulators rated at 500V. The earth mat shall consist of 70mm² bare standard copper conductor and 4 or more 1500mm long x 16mm diameter earth spikes to achieve a maximum resistance of 10 OHMS. The earth mat shall be spaced 4 metres from the plant room. Two 70mm² insulated copper conductors shall connect the diagonal ends of the earth mat and earth bar within the plant room.

2.8.7.3.33 Lightning Protection

Aluminium roof conductor shall be installed on the roof and bonded to a down conductor and then connected to the 1500mm long earth spike via 70mm² insulated copper conductor. Bi-Metallic connectors are to be made at all aluminium and copper connections. The lightning protection and earthing system shall be bonded to ensure that they are at the same potential

Suitable surge arresters must be installed on each phase and the neutral in the AMF control panel and connected to the earth bar.

2.8.7.3.34 Warning Notices

A non-corrodible and non-deteriorating engraved warning notice will be wall mounted in a conspicuous position reading:

“Danger: This engine will start without notice. Turn selector switch to ‘Off’ position before working on plant. (Do not forget to reset)”.

In addition all statutory notices required by the Occupational Health and Safety Act No. 85 of 1993, for the handling and generation of electrical equipment.

2.8.7.3.35 Inspection and Testing

General

Because of the number of Contracts and the need for the project to function as a co-ordinated whole, particular emphasis will be paid to testing. No test will be recognised unless it is documented in a previously agreed format. The test procedure shall ensure that every combination of switches and events is tested for correct functioning and each such combination is recorded in a test sheet and checked off.

No plant or equipment may be energised until testing is complete and the results accepted by the Representative/Agent (Consultant).

The Contractor shall supply all test equipment and consumables.

The Contractor shall conduct tests at the following stages. The Representative/Agent (Consultant) shall be advised of the tests one week in advance of the test dates.

- a) At manufacturer's work before equipment is released to site.
- b) During installation where testing is necessary
- c) Before final connections are made
- d) After installation is complete

After the tests are complete the Contractor shall compile and submit a report to the Representative/Agent (Consultant). After submission of the test report the Representative/Agent (Consultant) may call for all or some of the tests to be repeated in his presence. Should any test be unsatisfactory at this time the Representative/Agent (Consultant) reserves the right to have his reasonable abortive costs deducted from the contract sum.

Inspections during Manufacture

The Representative/Agent (Consultant) or his representative shall have access at all reasonable times to any works where materials are being manufactured for the purpose to the contract and shall be at liberty to inspect the manufacture at any stage and to witness the carrying out of the specified tests. Every reasonable facility and assistance shall be provided by the Contractor and/or his supplier for the purpose of such inspection by the Representative/Agent (Consultant) or his representative. The Representative/Agent's (Consultant) may reject at any stage of manufacture any material which does not comply with the specification or such modifications thereof as have been agreed by the Representative/Agent (Consultant).

Factory Testing

It shall be the responsibility of the Contractor to carry out such factory tests as are practicable to ensure that all plant, equipment and components supplied under this Contract comply fully with the relevant specifications and can function as intended. Dummy load tests of the alternators full rated output shall be carried out in the suppliers workshops prior to the plant being despatched to site.

Inspection on Arrival at Site

On delivery direct to the erection position or to the storage area, the plant and equipment shall be inspected by the Representative/Agent (Consultant) and the

Contractor or his agent. The Representative/Agent (Consultant) shall be at liberty to carry out any tests he may deem fit before acceptance.

Payment for delivery to site shall not be made until the relevant items of plant and equipment have been inspected and accepted by the Representative/Agent (Consultant).

Repairs to Damage

Damage or defects of any kind, which become apparent on inspection or delivery, shall be repaired by the supplier of such items to the satisfaction of the Representative/Agent (Consultant) immediately upon detection. Where damage is such that, in the opinion of the Representative/Agent (Consultant), satisfactory repairs are not practicable, the damaged articles shall be replaced at no cost to the Department which shall accept no responsibility for any loss or damage which may be suffered as a result of delays in obtaining the necessary replacements.

Testing After Installation

On completion of the installation of all plant and equipment the Contractor will be required to make appropriate arrangements and supply any instruments or apparatus etc. necessary for the testing of all plant and equipment supplied by the Contractor. Testing shall be in the presence of the Representative/Agent's (Consultant's) representative in order to demonstrate compliance with the requirements or the specification.

All load resistance equipment and instruments including fuel oil will be provided by the Contractor and test reports in duplicate for both series of tests will be submitted to the Representative/Agent (Consultant) within 7 days of such tests.

Site tests must include function tests of all operating systems and protection devices.

Insulation Testing

Before starting the generator set after installation, test the insulation resistance of the alternator windings. The automatic voltage regulator (AVR) must be

disconnected and the rotating diodes either shorted out with temporary links or disconnected. Any control wiring must also be disconnected.

A 500-volt Megger or similar instrument should be used. Disconnect any earthing conductor connected between neutral and earth and megger an output terminal to earth. The insulation resistance should exceed 5 meg ohm to earth. Should the insulation resistance be less than 5 meg ohm, the winding must be dried out.

2.8.7.3.36 Commissioning

Commissioning shall proceed in accordance with a previously agreed procedure which shall be documented and which shall form the basis of the commissioning report.

During commissioning the operating parameters of each piece of equipment and each device shall be established and recorded at no-load, average and full load conditions.

The final set of points of all adjustable devices shall be recorded.

The Contractor will be required to make appropriate arrangements, and supply the necessary instruments and apparatus, etc., for the testing of all plant and equipment, in the presence of the Representative/Agent's (Consultant's) representative in order to demonstrate compliance with the requirements of the specification.

The Representative/Agent (Consultant) may require valid calibration certificates to be submitted to cover any meters, gauges, or other instruments used in the tests and may, if considered necessary, arrange for the use of additional meters or other instruments in order to establish the degree of accuracy of the tests.

The Contractor shall be responsible for performing all tests on completion and shall provide the services of an approved Commissioning *Project Manager / Engineer* and all necessary skilled and unskilled labour, as well as the required tools and test equipment. The *Project Manager / Engineer* shall approve the procedure for carrying out the tests on completion and shall witness all tests and

shall approve any adjustments or modifications necessary to achieve satisfactory operation.

The *Project Manager / Engineer* shall also witness and approve the tests for demonstrating the plants ability to meet the specified duty. Should the *Contractor* fail to provide the necessary staff to undertake the tests on completion timeously or efficiently, the *Project Manager / Engineer* may, in order to meet the programme for start-up, make arrangements to have the outstanding duties undertaken by others for the *Contractor's* account.

2.8.7.3.37 Load Balancing

It is important to ensure that a balanced load is presented to the generator set. If loading in one phase is substantially higher than the other phases, it will cause overheating in the alternator windings, imbalance in the phase to phase output voltage and possible damage to the sensitive 3 phase equipment connected to the system. Ensure that no individual phase current exceeds the current rating of the generator set. For connection to an existing distribution system, it may be necessary to reorganise the distribution system to ensure these loading factors are met.

2.8.7.3.38 Safety Precautions

Protection of Persons and Plant

Due cognisance shall be taken of the need to provide adequate protection of persons and plant, from accidents arising or likely to arise from whatever source. To this end, all units of plant which may possibly be subject to damage or become a source of danger to human life either in itself or by virtue of its operation shall be adequately protected as laid down in the Occupational Health and Safety Act No. 85 of 1993.

Appointment of Responsible Person

- (a) The Contractor shall cause all work to be carried out under the general supervision of a responsible person appointed by the Contractor in writing in accordance with the provisions of the General Safety Regulation R.11. Supervision of any work; made in terms of the Occupational Health and Safety Act No. 85 of 1993.

- (b) A copy of the letter of appointment and of the appointee's written acceptance thereof, shall be lodged with the Representative/Agent (Consultant).
- (c) Work on site shall not commence until the documents referred to in sub-clause (b) have been received by the Representative/Agent (Consultant).
- (d) Due cognisance shall be taken by the Contractor of Regulation 5 "Work in Confined Spaces", of the O.H.S.A. Regulations and further to this no clearance certificates shall be given by this Department.

Precautions shall be taken to avoid safety and health hazards to workmen. The Contractor shall be responsible for supplying protective clothing etc. for use of the workmen.

2.8.7.3.39 Defects Liability Period

The Contractor shall be responsible for the initial routine maintenance and provision of all lubricants, etc., until such time as the plant and equipment is capable of fulfilling its specified operational duties.

Once the plant and equipment has been successfully commissioned and accepted, the Contractor's staff will undertake the routine maintenance of the plant and equipment for a period of 24 months in accordance with operating procedures and routine maintenance requirements to be furnished by the Contractor prior to acceptance.

The Defects Liability Period shall commence concurrent with the guarantee period.

All cost of servicing and maintenance during this period is to be included in the tender price.

Under the agreement the Contractor will arrange for qualified maintenance staff to visit the plant once every three months and shall, in the presence of the Officer –in-Charge:

- Enter into the log book the date of the visit, the tests carried out, adjustments made and any further notes concerning the condition of the plant and its operation. Also log the hour meter reading.
- Lubricate, grease all moving parts and check and clean all items of equipment as specified in the quarterly maintenance schedule addendum "A" and in accordance with the manufacturer's instructions. Replace all fuel filter cartridges.
- The plant to be tested for automatic starting by simulating a mains failure, and run on maximum possible load for at least half an hour. During this test all mechanical and electrical equipment will be checked for correct operation. All trip alarms and change over relays will be tested for correct operation. All necessary adjustments will be made and recorded in the log book.

Should the Contractor find **any** item which may require replacing due to fair wear and tear or any item which has become unserviceable for the same reason, he will immediately report this matter and submit a quotation in writing to the Representative/Agent (Consultant), detailing the cost of such repair.

The Contractor will advise when it becomes necessary to decarbonise the engine and will indicate the cost of this service.

After the expiry of the 12-month guarantee/defects liability period the Contractor will be required to maintain the generator sets and associated equipment for a further 2 year period.

2.8.7.3.40 Guarantee

The Contractor shall guarantee all plant, equipment and fittings supplied by him and installed under this contract for a period of twelve months. The guarantee shall include any latent defects in the plant, equipment, fittings and installation thereof and any labour or other costs inherent in repairing any defects and ensuring that the plant, equipment and fittings remain free of defects and in good working order to the satisfaction of the Representative/Agent (Consultant).

This guarantee shall not be applicable to existing plant and equipment previously installed by others.

Fair wear and tear shall not be considered as requiring any action by the Contractor under the requirements of the contractual guarantee.

Inspection of the plant shall be made by the Contractor in the presence of the Representative/Agent (Consultant), at suitable intervals, to confirm that the plant is operating in a satisfactory manner.

Provision, as required, shall be made in the contract rates, or elsewhere, for any additional costs incurred in providing this contractual guarantee.

2.8.7.3.41 Training and Instruction

On completion of the installation on site, the Contractor will be required to instruct the Staff member-in-Charge in the safe and satisfactory operation of the plant and will ensure that he/she is fully conversant with the equipment.

2.8.7.3.42 INSTRUCTION MANUALS

Three (3) copies of the operating and maintenance manuals shall be provided on delivery of the plant and equipment. These shall come in the form of plastic covered ring files with the following information indelibly printed on their covers.

OPERATING AND MAINTENANCE INSTRUCTIONS FOR THE

GENERATOR SET AT:

Transnet National Ports Authority RDD CAISSON

SUPPLIED BY

(Name, address, telephone and fax number of Contractor).

Each page, pamphlet, booklet, diagram, drawing etc. shall be separately bound into the manuals in a clear plastic pocket. Each pocket shall be numbered and indexed.

The first page of each set of manuals shall be an index which shall include a list of the numbers and descriptions of all drawings and pamphlets included in the set and also a list of the Representative/Agent (Consultant)'s drawings relating to the relevant sections of the Contract.

The instructions shall include the following:

- (a) A list of spares, tools and testing equipment supplied under the Contract.
- (b) A list of spare parts and testing equipment which are not supplied under the Contract but which may be required for future major overhaul and/or testing of electrical plant and equipment.
- (c) For (a) and (b) above for spares, tools and testing equipment the Suppliers' names, addresses, telephone numbers, fax numbers and costs must be listed.
- (d) List of "Name Plate Data" giving full particulars of serial numbers and other descriptive data pertaining to the plant and equipment installed.
- (e) List of points requiring lubrication, stating for each point the type and grade of lubricant recommended and full details as to quantity, timing and renewing of lubrication. Before typing the manuals, the Contractor shall contact the Representative/Agent (Consultant) to obtain the name and brand of lubricants generally in use by the Representative/Agent (Consultant) and, wherever possible, suitable grades of lubricant of that particular brand shall be nominated by the Contractor in the manuals.
- (f) Particulars of bearings, contacts and other moving parts with instructions relating to any special attention which may be required.
- (g) Precautions to be taken in starting, running and stopping the plant or equipment by remote or manual control.
- (h) Routine tests which the Contractor/Supplier(s) would suggest be carried out.

All information mentioned above shall be cross-referenced to the drawings.

Additionally, the manuals shall provide the following information which shall also be cross-referenced to the drawings:

- All technical and other information, in English, concerning the equipment.
- Equipment layout drawings.
- Power single line diagrams.
- Control schematic diagrams.
- Narrative description of the control circuit operation.
- Fault finding routines.
- Routine maintenance instructions, procedures and frequencies.
- Equipment and component specification sheets.
- List of equipment and components including manufacturer, catalogue number and suppliers address, fax and telephone numbers.
- Instrument data sheets
- Cable block diagram
- Cable schedules
- Termination schedules
- Issue a certificate of compliance for electrical installations signed off by a currently registered Installation Electrician.

Copies of all computer generated drawings compatible with Autocad version 2002 shall be submitted to the Department on a Compact Disk.

Further one (1) set of drawings relevant to a particular generator and a hard covered A4 size log book shall be placed in a weatherproof glass fibre enclosure adjacent to the generator. This enclosure shall be electric orange in colour, be sized to accommodate drawings folded to A4 format, be labelled "Electrical Drawings" and shall have provision for fitting a standard padlock.

2.8.7.4 LV Scope of Work

The existing low voltage (LV) board and isolators feeding the existing Caisson shall be redundant. One new 5-pin isolators rated IP66, 250A, 400V, 3phase + neutral + earth at 50Hz shall be installed on Caisson. Two kiosks from both side of the Dry Dock shall have a 120mm²-4core flexi-cable with 95mm² earth conductor terminations for the Caisson. The head of the 5-pin isolator shall be terminated on the movable cable. Female head of the isolator shall be fixed on the Caisson. From the Isolators, a 1x120mm²-4-core flexi-cable with a 95mm² single insulated core earth copper cable shall feed the MCC in the Caisson. The cables shall be trailing above ground. New Motor Control Centre (MCC) shall be installed tested and commissioned as per specified on electrical documentation. There will be new LED luminaires, control devices such as occupancy sensor, light switch, switched socket outlet, start / stop control, stainless steel cable racks and welding sockets to be installed in the inside the Caisson. New cable tray, trunking and any other required wire ways shall be installed. New energy efficiency pump motors with new motor control system and new cabling to be installed as per drawings. Earthing and bonding shall be provided including clean earth for control and instrumentation.

The entire electrical supply shall be fed from the existing generator.

All equipment offered shall comply with the Specific Requirements, Standard Specifications, SABS and other standards as detailed in the specifications.

The *Contractor* is to note that the entire installation is classified as a Class II Division 2 installation and the minimum rating is to be IP65. All equipment used is to comply with all relevant SANS standard.

The electrical work includes, but is not restricted to the following:

- Strip all existing electrical installation to the Caisson and inside the Caisson including decommissioning of cables and hand them to the TNPA for disposal.

- Decommissioning of existing electrical equipment inside the existing caisson and disconnecting of cable and handing them over to the client.
- The supply, delivery, installation, connections and testing of any material and equipment associated with the electrical supply connections to the Caisson equipment
- The supply, testing and inspection at the manufacturer's premises, installation, connection, testing and commissioning of new Motor control centre (MCC), distribution boards and switchgear
- Supply, delivery, installation and connection of all power and lighting, distribution, cabling, conductors i.e. socket outlets, light switches, isolators, etc.
- Supply, installation and connection of all circuit wire ways, cable trays, cable ladders, conduit, draw and outlet boxes and sleeves as per the drawings
- Supply, delivery and installation of earthing and bonding
- Supply, delivery, installation of control panel of the motors,
- Supply, delivery, installation and connection of all circuit wiring, cables and conductors;
- Provide labelling on MCCs, distribution boards and equipment and cover plates as per specification;
- Supply, delivery, installation and connection of all luminaries including correct lamps for the fittings,
- Supply, delivery, installation and connection testing and commission of backup 160kVA 400V generator set complete with earthing
- Connection of electrical power to all mechanical equipment/motors and systems.
- Supply, installation, connection and testing of an earthing system for MCC and at the LV distribution boards including providing clean earth for future instrumentation;
- Supply, delivery, installation of earthing and bonding for all metal equipment's, including providing clean earthing for instrumentation
- Excavations for all cable trenches, compaction, backfill and making good of existing surfaces.

- Cutting of existing floor trenching and re-instate for cable laying,
- Supply, delivery, design, test and commissioning of the instrumentation and control system for the entire pumping systems
- Co-ordination with the TNPA electricians / Artisans for power on and off at the main feeder, etc;
- Testing of all new installations in accordance with the latest requirements of SANS 10142, the Electrical Contracting Board of South Africa and the issue of a certificate of compliance test report for the electrical installation in the buildings.
- Any other work deemed necessary by the *Engineer* for the completion of the project.

2.8.7.5 New Isolators

The Contractor shall install 5-pin isolators rate IP66 marine graded that shall be mounted next to the caisson as indicated on the drawing. These isolators shall be the supply point of the Caisson. The 5-pin isolators shall have female and male outlets.

2.8.7.6 Redundant Equipment

The *Contractor* shall be responsible for disconnecting and removing redundant electrical equipment and cables handed over to the TNPA.

2.8.7.7 Electrical Supply

2.8.7.7.1 General Supply

The supply comes from newly refurbished / new essential section main distribution board from TNPA substation. The cable shall feed a kiosk as indicated on the drawings. The kiosk shall feed the caisson which a backup generator incorporated the essential board. There shall be one cable to the caisson and only one supply shall feed the caisson at a time. The new 5-pin isolators shall feed the MCC in the Caisson with 1x120mm²-4 core copper flex

cable for marine application and a 95m² single core copper insulated flex cable for earthing.

The Low Voltage supply to the Caisson shall be below 192A, 3-phase+N+E (400V) AC at 50Hz.

Temporally LV supply shall be made available during construction for other services such as lighting, small and welding points, etc. These shall form part of the *Contractors'* scope and contract.

Cables from inland isolator to the caisson shall be laid on a trench with sleeves as shown on the drawing.

Supply comes from newly refurbished / new essential section main distribution board from TNPA substation. The cable shall feed an isolator as indicated on the drawings. There shall be two (2) point of supply for the Caisson. There shall be one cable to the caisson and only one supply shall feed the caisson at a time. The new 5-pin isolators shall feed the MCC in the Caisson with 1x70mm²-4 core copper flex cable for marine application and a 50mm² single core copper insulated flex cable for earthing.

The Low Voltage supply to the Caisson shall be 160A, 3-phase+N+E (400V) AC at 50Hz.

Temporally LV supply shall be made available during construction for other services such as lighting, small and welding points, etc. These shall form part of the *Contractors'* scope and contract.

Cables from inland isolator to the caisson shall be laid on a trench with sleeves as shown on the drawing.

2.8.7.8 Back-up Supply

The backup supply shall come from 160kVA, 400V generator set located next to the inland control room. The *Contractor* under this contract is responsible for

all installation from the kiosk to the caisson electrical installation. Since there are two (2) points of supply for the Caisson, the backup supply shall come from once side of the dock.

Refer to a detailed generator specification attached with this document for more generator details.

2.8.7.9 Installation of Equipment

The Contractor shall be responsible for the installation of all equipment supplied by him/her under the contract.

2.8.7.9.1 General

All electrical equipment supplied under this contract shall be designed to perform effectively under the full range of conditions of temperature, pressure and voltage regulation prevailing.

The equipment shall also be capable of withstanding the highly corrosive and sea effects of a moist saline atmosphere. All enclosures of electrical equipment and indoor electrical equipment shall have a minimum degree of protection of IP 66 and all equipment shall be able to withstand the vibrations present on the structures. Junction boxes shall be of the bottom gland-entry type only.

2.8.7.9.2 Electrical Equipment

All equipment and fittings supplied and installed under this contract, shall be in accordance with the standard and project specifications of this document. All distribution boards and motor control centre shall be manufactured as per SANS 1973. All motor control centres and equipment shall be designed and manufactured in accordance with SANS 1973/60439. The equipment shall conform to SANS 60947 Parts 1 -7, unless otherwise stated, and shall be suitable for operation on supply voltages of 230/400 Volts, plus neutral and earth, 50 Hz, AC. MCC and DB shall be 3CR12 or as specified on the drawing.

2.8.7.9.3 LV Switchgear

All LV installation work shall be carried out strictly in accordance with SANS 10142-1 and as per Lloyd's standard regulation.

The *Contractor* working on the 400V system and equipment must be deemed competent electrician and authorised to work on LV switchgears by the Department of Labour with particular regard to safety rules, systems operating regulations, underground mains cabling and substation maintenance.

2.8.7.9.4 Motor Ratings and Details

The following table is an indicative list of all motors to be installed and is for preliminary assistance only. It is the Contractor's responsibility to advise the switchboard manufacturer of any changes in motor ratings.

<i>Equipment/ Motor</i>	<i>Power (kW)</i>	<i>Voltage</i>	<i>Control/ Starting</i>	<i>Power Factor</i>	<i>Source Supply</i>
<i>Motor 1 – 2</i>	15	400V	DOL	0.81	MCC
<i>Actuators 1-36</i>	3,52	230V	DOL	0.79	MCC1
<i>Actuators 37-40</i>	1,7	230V	DOL	0.79	MCC1
<i>Ventilation Fans 1-2</i>	0,65	400V	DOL	0.79	MCC1

2.8.7.9.5 General Requirements

The *Contractor* shall ensure that each starter panel incorporates the following:

- 1 No. Running indication light (green)
- 1 No. Stopped indication light (red)
- 1 No. Tripped indication light (amber)
- 1 No. Power on indication light (white)
- 1 No. Selector switch - Local/Remote/Off
- 1 No. Start button (green)
- 1 No. Stop button (red)
- 1 No. Digital meter
- 1.No. Multi-meter (Amperes, voltage, hertz, etc.)
- Suitably rated controls for motor heating.
- RTD's sensors protection for windings and bearings

Note: All material / equipment must be marine graded.

Refer to the drawings for a typical wiring diagram for Drive starters.

- All supply circuit breakers are to be supplied with lockable isolation handles and are to comply with the OHS Act and N.O.S.A. standard for "locking out" electrical equipment.
- Main incoming circuit breakers are to be housed in their own individual panel.
- All busbars are to run at the bottom of the panels. All busbars are to be insulated and coloured to correspond to the appropriate phase.
- The panels are to have vertical ways for easy accessibility to distribution cables.
- All cables will be bottom entry/bottom exit.
- The control circuitry voltage shall be 220V AC and be protected by means of a circuit breaker. Interposing relays are to be provided to pick up the start and stop signals from the PLC.

- All contactors are to be type 2 co-ordination is called for.
- The start and stop stations that are on the field shall be made of 3CR12 and supporting structure shall be stainless steel.
- For motors below 18.5kW, overloads are to be Siemens Thermal Overloads / similar to this (to suit the above contactors) or similar. Motors of 18.5kW and above are to have electronic overloads.
- For 18.5kW motors and below - All starters are to be Direct-On-Line (DOL) unless otherwise specified.

2.8.7.10 MCC Feeders

2.8.7.10.1 Metering

Metering shall be provided for the main low voltage distribution board / MCC.

The power monitor master meter complete with CT's and fuse protection with facilities using Modbus communication.

Metering of the electrical supply can also be monitored by the PLC System in order to provide real time information regarding consumption as well as load profiles.

2.8.7.10.2 MCC Panel

The MCC panels shall consist of the incoming circuit breaker, DOL, Star/Delta starter, local board with small breakers, instrumentation, PLC section with fuse and breakers board metering.

The MCC shall be as a minimum partially type tested with type 2 co-ordination and have a minimum internal separation of "Form 3b". The MCC and all internal control shall be rated for maximum full load currents and a minimum three phase fault level of 10kA.

The MCCs shall be designed for front access with top cable entries and top cable exit and shall be enclosed.

All motors shall be DOL / Star Delta (YD) / Forward Reverse (FR) controlled as per the operational control philosophy.

The panel shall be constructed of 3CR12 and powder coated with electric orange.

The MCC shall include for a marshalling PLC and all auxiliary equipment sections.

The marshalling / PLC section will communicate linked with the TNPA SCADA system where applicable. Also refer to Control and Instrumentation specifications and drawings.

2.8.7.10.3 Incomer Compartment

The incomer main ACB shall be rated as follows:

- Isolating point – 5-pin Isolator, IP66 – 250A Amps 3-phase + N + E

Each MCC incomer section shall include but not necessarily be limited to the following equipment:

- 1 No. suitably rated 3 pole 10 kA withdrawable Air Circuit Breaker complete with integral power measurement equipment or door interlocked MCCB of suitable KA rating with extended rotary handle 400V, Amps as per MCC withdrawable Air Circuit Breaker;
- Digital Power Monitor Meter;
- Surge Arrestors.

2.8.7.10.4 Starters

All direct on line starters shall incorporate intelligent motor protection relays using Profibus communication.

All starters will be installed with a lockable isolating switch but some with additional installation of a Local / Remote / Off selection switch.

2.8.7.10.5 MCC Equipment

A Local / Remote / Off selector switch will be provided at MCC starter panel with the following control modes:

- Local Position – Starter Control Panel

When the selector switch on the motor starter panel has been set on local the latching start button on the motor starter panel will be enabled and the remote PLC and Field Wireless control disabled.

The emergency stop button shall always be enabled. A new emergency stop station shall be installed at the motor for safety operation control. A control cable shall be installed and terminated from the station back to the MCC.

- Remote - PLC

This starter panel shall house the following:

- Primary short circuit protection by means of HRC fuses.
- Suitably rated contactor for DOL/YD starting.
- Suitably rated current transformers for measuring purposes
- 96mm square ammeter with thermal maximum demand indication.
- Suitably rated Siemens (or similar) electronic overload to suit motor.

- running indication light (green)
- stopped indication light (red)
- Tripped indication light (amber)
- Power on indication light (white)
- Selector switch – Local / Remote / Off
- Start button (green)
- Stop button (red)
- Digital meter
- Suitably rated controls for motor heating
- Panel anti-condensation heater

2.8.7.10.6 400V Motor Starters

All motor starters shall be in accordance with the TNPA standard specifications and drawings.

All starter equipment shall be suitable for a 3 phase, 400VAC, 50Hz system with a fault current level rating of 10kA.

2.8.7.10.7 Starter Control Philosophy for 400V Infrastructure

The motor starter at the MCC shall have two modes of control, namely local or manual and remote.

The operation is as follows:

- Local - When selected this gives total control to the operator in the field through the stop / start station. This mode is used to facilitate plant maintenance.

- Remote - When selected in this mode, control is through the PLC system. This mode is used during normal plant operation.

2.8.7.10.8 400V Motors

The *Contractor* is responsible for the supply, installation, testing and commissioning of induction motors and all the 1000/600V marine graded copper cables from the MCCs to the motors. All cables will be installed on cable tray and/or cable wireway. The *Contractor* will be responsible for the terminating up to and including the motor terminal box. The *Contractor* shall ensure that all termination's and isolators have Class II Division 2 classification.

The 3-phase / 400V, 50Hz motors shall be IP 66 (minimum), cast iron motor, class H insulation, and suitable for a coastal environment. Motors to have a minimum guarantee of 5 years.

Contractor shall be responsible for motor installation details which will include motor base plate.

Refer to motor schedule for detailed motor specification requirements of which the contractor must submit with returnable documents.

2.8.7.11 Ancillary Equipment

2.8.7.11.1 Control Panel Start/Stop Station

All local stop / start field stations with control panel for the pump speed shall be integral units with a spring return start button, latching mushroom head stop button. They shall have a minimum hazardous protection of IP 66 unless otherwise specified.

Control station shall be installed adjacent equipment to be controlled and shall be mounted on suitable 1200mm high Tubular 304 stainless steel Pedestals or on structural steelwork.

The local control station shall have the following as a minimum and as per manufacturer's specification:

- IP66 corrosion proof enclosure
- Start push button (green)
- Stop mushroom head push button (red) "Twist-to-release"
- Power signal
- A 2.5mm² x 4core copper cable shall be installed between each starter and pedestal

2.8.7.12 Cables

2.8.7.12.1 General

The Contractor shall allow for the numbering and labelling of cables. The Contractor shall produce a cable-pulling schedule, which must be approved by the Project Manager prior to the installation of any cables.

The entire cable installation must meet with the Employer's requirements and standards. Should any cable be installed and not meet with these requirements it will be re-laid at the Contractor's own cost. All cables are to be meggered or pressure-tested prior to final connections after termination.

2.8.7.12.2 LV Cables

All LV cables are to be manufactured in accordance with the IEC 60092-353, IEC 60332-1-2, IEC 60332-3-22, IEC 60754 and IEC 61034 standard code of practice and shall be of the 600 / 1000V LKSM-HF flex type with stranded copper conductors unless otherwise specified. Four core cables shall be used to supply motors with the fourth core used as the earth conductor.

Cables shall be provided with a separate earth conductor strapped to the cable at intervals not exceeding 1 (one) metre. Where ECC cables are used the earth cable may be omitted.

The power cable to the DOL / YD motors shall be of the trailing cable, 4 cores cable. It shall be incorporated in a cable carrier system.

Corrosion proof Enviro cable glands with an IP65 rating shall be used.

All cables shall bear the SANS mark.

All cables shall be installed in accordance with SANS 10198, the Manufacturer's specifications.

No cable joints shall be permitted unless otherwise approved by the *Employer*.

After installation of cables, all sleeves, cables etc. entering caisson shall be sealed with fire retardant "Pratliperl" to prevent ingress of vermin and water.

2.8.7.12.3 Instrument Cables

Single pair overall screened cable shall be used for cables between instruments and junction boxes. Conductor size shall be 1.5 mm² minimum.

Cabling between junction boxes, control stations, purpose made control panels and MCC marshalling cubicles shall be multi-core and multi-pair, armoured, overall screened, conductor size shall be 1.5mm² minimum.

Refer to control and instrumentation specification for details.

2.8.7.12.4 Cable Slack

At every termination, sufficient slack shall be provided for future repairs to the cable end should this become necessary due to a fault or some unforeseen circumstances on site.

2.8.7.12.5 Cable Identification

Every power distribution cable, switchboard interconnecting cable, and any other cable, shall be provided at both ends of the run with an approved Bowthorpe Hellerman tag showing the size and details of the cable. All identifications shall correspond with the *Employer's* requirements.

Cables shall be labelled at all terminations with suitable and approved labels (stainless steel Dymo-tape or Irvone white ivorene label written in black) indicating:

- Origin and Destination; (e.g. from Substation to MCC1);
- Cable size and no. of cores; (e.g. 16 mm² -4-core);
- Conductor type. (e.g. PVC/SWA/PVC Copper ECC cable).
- Phase rotation

2.8.7.12.6 Cable Glands

All cable glands shall be rated for IP 66 outside.

All cable glands shall conform to SANS 1213.

2.8.7.12.7 Cables Installed Underground

Cables shall be laid with the upper surface at the following minimum depths below ground level: -

- LV Cables : 700mm

Before excavation of cable trenches the *Contractor* shall acquaint himself with the route and site conditions and with existing services.

The *Contractor* shall ensure that the excavation can cause no danger or loss to property, structures or equipment on or adjacent to the site. The sides of trenches shall be shored up and the trenches pumped to maintain them dry. Temporary access bridges shall be provided where the route crosses paths and roads. Any nuisance to other services, works or access shall be avoided.

Excavated material shall be placed alongside the trench. The base of trench shall be smoothed.

Cables shall be bedded in river sand or soil, (no clay), sifted through 6mm mesh, 75mm below and 75mm over the cables before backfilling. The bedding under joint boxes shall be compacted to prevent later settling.

Concrete cover blocks shall be placed over the length of the cable trench in accordance to TNPA standards specifications, to protect them against accidental damage from future excavations. Surplus material shall be removed from site.

Yellow PVC marker tape, 150mm wide, inscribed "Buried electric cable below – caution", shall be laid 300mm below final ground level.

Cable markers shall be installed on cable routes at every change of direction and at spacing's not exceeding 50m on the straight routes. The positions shall be confirmed with the *Employer* prior to installation. The cable markers shall consist of 150mm x 150mm x 300mm high concrete blocks with "Electric Cable" and with the voltage rating and the route direction.

Where Cables run beneath roads and built structures then the cables shall run in cable sleeves.

All Cable sleeves shall be of the PVC type and shall be installed in the ground.

The cables shall be removed from the cable drum without stressing the cable beyond manufacturer's recommendations.

For cable runs exceeding 50 metres in length then cable rollers shall be used to prevent any damage occurring to the cables during installation.

Parallel cables shall be spaced apart by the following minimum distances:

- LV/LV/Instrument: 2 (two) diameters of the larger cable horizontally.
- LV/MV: 300mm horizontally.
- MV/MV: 300mm, horizontally or vertically.

Communication cables shall be spaced at least 1 (one) metre from nearest low voltage and high voltage cables.

2.8.7.12.8 Cable Support Systems

All cable rack shall be hot deep galvanised steel with a minimum required thickness as per SANS for cable ladder and cable tray. The *Contractor* shall allow for all brackets as detailed, fixings, cutting, welding and cleaning of welding. All spring nuts are to be galvanised. The cable ladder/tray routes are indicated on the drawing. Care has been taken in planning the routes; however the *Contractor* is still to check with other services routes to ensure that there are no clashes.

Additional earth terminals are to be provided on the cable rack, as the use of a joiner clip is insufficient.

The method of fixing the cable racks shall be confirmed with the *Supervisor* prior to installation. No drilling of structures shall be permitted for mounting of cable racking. All cable racks shall be mounted vertical to prevent the accumulation of product.

All cable ladder and cable tray are to be unpainted only galvanised finish.

Cable racks carrying cables of other voltages shall not be painted but shall be marked at 10m intervals by a 100mm thick paint strip of the relevant colour (as per the *Employer's* painting specification).

Sizes of racks used are generally:

- LV power cables: 300mm
- Instrumentation cables: 300mm
- Lighting and Power cables along gantries: 200mm

Details of the routing of cable racks are shown in the layout drawing.

2.8.7.12.9 Cable Tray

All cable trays and ladders shall be stainless steel Gr316L. Cable tray shall be in accordance with IEC 61084-1 specifications. It shall be of the Cable tray type with a specified on the drawing. The cable tray width shall be sized as required with a + 20% spare capacity and the side wall height shall be no less than 100mm. Cable tray mounting height shall be as per site requirement and all trays shall be mounted above all access openings.

Cables shall be strapped to the cable tray with stainless steel cable straps.

Allowance must be made for all brackets and additional galvanised supports that are required to adequately support the fully loaded tray in accordance with the manufacturer's specifications.

LV and instrument cables shall be installed on separate trays with a minimum spacing of 300mm where practical. Cables shall be individually strapped to the cable tray with PVC cable ties or clamps.

All new cabling will be run on new cable racking fixed to buildings or existing structures where possible.

Cable trays shall be earthed at the point closest to the source of supply and continuity shall be maintained across joints by means of jumpers. The minimum size of the earth continuity conductor shall be 6mm² and it shall be green PVC insulated with tinned lugs.

40mm x 40mm x 5mm angle iron manufactured from stainless steel Gr316L shall be used to support short lengths of cable from the cable tray to the equipment.

2.8.7.13 Lighting

2.8.7.13.1 General

Caisson lighting installations are shown on the drawing and the *Contractor* shall carry out this work in accordance with the relevant specifications. The layout of the luminaires as indicated on the drawings must be adhered to as far as possible.

The final mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect cable tray or other structural features of the space. The layout as shown in the lighting drawing shall generally be adhered to, but any discrepancies or clashes with structural or other features must be referred to the *Supervisor*, before commencing installation.

Where provision has not been made for the fixing of luminaires, the *Contractor* shall supply the necessary supports, hangers, conduit extensions, angle brackets or any other fixing method approved by the *Supervisor*.

Surface mounted LED luminaires installed against under the steel grid shall be mounted on the cable tray hot deep galvanised heavy duty cable tray or other approved type are to be provided.

All luminaires shall be as following:

- **Type A6** - Surface mounted 40W LED vapour proof rated IP65 lighting fitting complete acrylic diffuser with 1 hour emergency battery
- **Type B** - IP65 rated, Decorative streetlight 75W LED luminaire Neutral white (4000K), as per specification
- **Type C** - 75W LED floodlight optic 1700 with marine grade body, vapour-proof rate IP66 complete with diffuser and 1 hour emergency battery Neutral White (4000K) with 1 hour back-up battery, as per specification
- **Type F** - 75W LED floodlight 55W OPTIC 5244 with marine grade body, vapour-proof rate IP66 complete all mounting accessories

and as indicated on the lighting drawing. All luminaires comply with the SANS safety standard.

Samples of all luminaires must be approved by the *Supervisor* before any order is placed. All luminaires must be complete with lamps and where necessary, control gear. All control gear shall bear the SANS mark.

All luminaries are to have respective control gear / electronic ballast. All luminaries to be supplied by an approved SANS supplier and must meet all minimum requirement, and SANS approved standard.

2.8.7.13.2 Earthing

Earth conductors shall be drawn in with the circuit wiring and connected to the earthing terminal of all luminaires in accordance with the SANS 10142-1

2.8.7.13.3 Occupancy Sensor

At least one (1) light luminaire shall be controlled via an occupancy sensor that is IP66 rated and suitable for marine applications.

The photocell must be linked with the distribution board by 3 x 2,5mm² LKSM-HF conductors.

The *Contractor* shall install the sensor switch in the Caisson that is marine graded and with IP66 rating. The occupancy sensor switch will be used when one enters the caisson to light up an entrance inside the Caisson which will lead to the main light switch. The sensor shall be installed on a cable tray as indicated on the drawing. Mounting: round fixture box or single handy box. Relative humidity: 20% to 90% non-condensing. Loading rating on 1 phase 277 at 750W, 10A, 50Hz with a 5 year warrantee or more.

The feature shall include but not limited to patented dual technology with PIR/Micro phonics detection, self-contained relay, no power pack needed. Time delay from 30 seconds to 20 minutes.

A sample of an occupancy sensor shall be submitted to the *Engineer* for approval prior to placing the order;

2.8.7.14 Earthing and Bonding

The *Contractor* is to ensure that all earthing and bonding is carried out in accordance with SANS 10142, Lloyds standard regulations, TNPA standard specifications and the local authority's requirements. The earthing installation is to be carried out by a specialist.

The *Contractor* should note that as this installation is a Class II Division 2, all metal parts, and equipment are to be earthed and bonded to eliminate static build up. An earth mat is to be installed and the *Contractor* shall allow for a survey by a specialist and installation of it according to the relevant SANS code. The *Contractor* shall submit all test results to the *Project Manager*.

Earthing rods are to be sleeved. The *Contractor* shall install an earth point on all motors and metal structures in the Caisson. Earthing shall be provided for the LV installation equipment.

The earthing shall be carried out by a specialist and comply with SANS 61024 Parts 1 and 2.

The MCC must have surge arrestors.

Clean earth shall be installed as follows:

- Clean earth grounding system shall not be connected to any other earthing or grounding system.
- Clean earth grounding cables shall not be run parallel with other grounding cables or power cables.
- Clean earth grounding system shall comply with IEC 60950 and BS EN 50310.
- Clean earth grounding pits shall be separated from other earthing pits by a distance of at least 1800 mm.
- In general, clean earth grounding shall be provided for data system, telephony and other communication systems.
- Clean earth grounds shall have an earth impedance of less than 1 ohm.

2.8.7.15 Drawings

The *Contractor* produces the detailed layout design and individual wiring diagrams for each starter and panel in AutoCAD format fully in compliance with

the *Project Manager's* requirements. All drawings are to be submitted for approval prior to the start of manufacture.

In addition, the *Contractor* submits all cable pulling schedules, termination schedules as well as earthing system designs, for approval. Any installation or manufacture of equipment prior to the approval of drawings is entirely at the *Contractor's* own risk. Similarly, the cable numbering systems, plant ID numbers and tag numbers will be in accordance with the *Employer's* requirements.

2.8.7.16 Commissioning of Protection Equipment

The commissioning of protection equipment for LV systems can be broken up into a number of broad categories.

- Panel tests and visual Inspection;
- Implementation of applicable technical instructions;
- Secondary tests;
- Primary tests;
- Review and submission of documentation;
- Energisation and on load checks;
- Sign off and handover of electrical plant for use and operation by the owner.

Each of the categories requires documentation to reflect that the test(s) required have been completed. The documentary evidence must include:

- The MCC name,

- The relevant equipment or panel name.
- The checks performed;
- The name of the person who performed the checks;
- The date on which the checks were performed;
- The signature of the person who performed the checks.

2.8.7.17 Panel Tests and Visual Inspection

The purpose of this group of activities is to check and produce documentary evidence that:

- The panel and all contained equipment is visibly intact and mechanically sound,
- The panel and contained equipment has not been damaged in transit,
- The panel is wired according to the application drawings supplied, and that the design version between the equipment and the drawings is the same.
- The equipment contained in the panel corresponds in make, model and function to the application drawings.
- The panel and associated equipment is correctly earthed according to the SANS standards.

2.8.7.17.1 Implementation of Applicable Technical Instructions

The purpose of this activity is to ensure that modifications to the protection panels required by approved technical instructions are implemented to the protection equipment prior to secondary injection. Documentation is to be in the form of the instruction with reference number, the name of the person who implemented the instruction and the date of implementation is required.

2.8.7.17.2 Secondary Tests

This group of activities comprises the following:

- Application of settings of all protection devices.
- Relay characteristic tests and logic functions according to settings provided and manufacturer specifications.
- End to end checks for Impedance and current differential schemes.
- Verification that any transducer outputs are correct.
- Supervisory controls, alarms, indications and analogue outputs are correct to the control centre.
- To ensure that test blocks and shorting strips function correctly.

2.8.7.17.3 Primary Tests

All primary tests must be according to relevant SANS regulations.

2.8.7.17.4 Normalisation of Circuits

During the primary and secondary injection tests, the trip and alarm circuits are usually rendered inoperative by the removal of isolating links, relay trip latches and so on. It is therefore essential that, when the primary and secondary injection tests have been completed, the tripping and alarm circuits be checked. Certain settings may have been altered during testing and these have to be normalized. Certain protection functions may have been deactivated in order to test other complimentary functions and these have to be reactivated as per the settings and configuration documentation.

2.8.7.17.5 Consolidation and Review of the Test Results

The purpose of this group of activities is to consolidate the test results and;

- Ensure sure that all tests originally planned have been completed
- Ensure that all test results are consistent with reasonable Employer expectations
- Ensure that any defects have been addressed
- Ensure that the head of commissioning is satisfied that the equipment is ready to be made live and arrangements have been made with an authorized person and to clear all outstanding work permits.
- Complete the equipment test sheet that permits the equipment to be energised.
- Certificate of Compliance (CoC) must be issued with all other test results reports.

2.8.7.17.6 Energisation and On-Load Checks

There are some checks and tests that cannot be performed while the equipment is de-energised.

It must be stressed that the equipment cannot be considered to be completely commissioned until on-load checks have been completed and results documented.

The following checks are required:

- Correct phase rotation.
- Current measurement checks / on-load confirmation of CT ratios.
- On-load stability checks for differential schemes
- On-load directional checks for directional overcurrent and impedance relays.
- Confirmation of transducer loading if applicable.

On the successful completion of the on-load checks, a handover document / mechanism is required that indicates that the equipment has been fully commissioned.

2.8.7.18 Training

Contractor shall train the TNPA staff on new equipment on how to operate the LV panel / MCC, and other electrical related installations. Training shall include how to clear faults on the system once it has been attended to. Training to include all other electrical related issues that will be require by maintenance and operating the TNPA staff.

2.8.7.19 As-Built Drawings

As each portion of the work is completed, the *Contractor* shall provide the Engineer with "As Built" drawings showing the exact location of each outlet points, cable runs, etc. These drawings shall be drawn up by a licensed electrician and shall bear his / her name, signature and wireman's licence number.

In addition, a complete reticulation diagram showing all supply cables and switchboards shall be provided behind a plastic cover in MCC.

A "Certificate of compliance for Electrical Installation Machinery and Occupational Safety Act 1983 (Act 6 of 1983)" Annexure 1 shall be completed.

2.8.7.20 Final Documentation

The purpose of this phase of the process is to ensure that all documentation and test results are compiled and submitted to the *Employer*.

- a. **Handover Certificate:** is to be signed by the *Contractor* and the *Supervisor*.

- b. **Completed Checklists:** A hard copy of the all of checklists of completed activities to be forwarded to the *Project Manager*. All appropriate tests, dates, responsible persons and signatures are required. Electronic copies of scanned hard copy documents are also acceptable.
- c. **Commissioning Test Results:** four sets of hard copies of the Commissioning Test Results, including hard copies of manuals, etc are required to be submitted to the *Employer*. Dates, responsible person's name and signatures are required. Electronic copies of scanned hard copy documents are acceptable. The above shall be included in the data packs to prove completion.
- d. **Proof that all applicable technical instructions have been implemented:**
Technical Instructions that may be applicable to the equipment concerned.
- e. **Proof of Applied Settings:** All settings applied to all relays to be retrieved from the relays (downloaded) and hard or electronic copies to be forwarded to the *Project Manager*.

2.8.7.21 Small Power / Low Voltage Specification

2.8.7.21.1 Motor Control Centre

2.8.7.21.1.1 General

Motor Control Centre (MCC) and kiosk shall comply with the requirements of the standard specifications of these documents or shown on the drawings. The MCC must be dustproof with an IP66 rating and 2.0mm 3RC12 and/or as per drawings specification. They must have an epoxy finish.

Kiosk and MCC are to be manufactured by an approved switchboard manufacture and to have a SABS approved manufacturer circuit breakers and/or isolators (as per drawing) and lightning / surge arrestor. All electrical panels to have surge arrestors as per drawings. A thirty percent (30%) space must be included on all DB's.

Drawings / shop drawings of all electrical panels by the manufacturer shall be submitted by the Contractor to the Engineer for approval before commencement of manufacture of boards. After construction all electrical panels must be inspected by the Engineer before installation.

Installation of Electrical Panel

Electrical Panel / Boards shall be installed in the positions as shown on the respective drawings. The *Contractor* shall ensure that the electrical panel / boards with the necessary conduits, sleeves, and channels as required are placed in position and mounted when required, and he shall ensure that all equipment is installed in the correct positions. It must be emphasised that no chasing will be allowed in steel structure walls on the side in which boards and ancillary equipment are installed. In all such cases the *Contractor* shall place his equipment in its proper place for the ship contractor to build.

The costs of any additional work caused by late, incorrect or defective positioning of equipment and / or material by the *Contractor*, shall be recovered from him / her.

The *Contractor* shall, while material and / or equipment forming part of the electrical installation are / is being built in, and have a competent representative present to ensure that no unnecessary stress is placed on the material that will influence subsequent installation of equipment. Care shall be taken that all equipment of the board fit properly in their respective position without distortion, which can lead to a poor installation and appearance. All bolts, clamps and fasteners shall be examined and properly tightened.

The *Contractor* shall ensure that all circuit breakers and other equipment can be changed and replaced if and when required.

All support props and struts, packing pieces and material used by the board manufacturer to prevent damage during transit, shall be removed by the *Contractor*. The *Contractor* shall examine all boards and ensure that all equipment shown on the appropriate relevant drawings has been supplied and fitted.

Any conspicuous damage like scratches or chafe marks to paint work, shall be touched up with the same colour paint as supplied by the board supplier.

The mounting height of all distribution and meter boards, measured to the top of the edge of the board shall be 2 000 mm above finished floor level, unless otherwise specified or the position and circumstances dictate differently. The *Contractor* shall ensure that cables sleeves and provision for the entry of cables to distribution boards as shown on drawings are done properly and neatly.

2.8.7.21.1.2 Earthing

Earthing shall be done in accordance with the requirements of the standard specifications and those of the Supply Authority.

Earth system neutral and all non-current carrying metal parts of electrical equipment, conduit, cable racks, etc.

Earth metal parts of distribution boards, switch boxes, conduit, working surfaces, cable armouring and electrical equipment.

A separate isolated earth-bar shall be fitted specifically for instrumentation outlet. This earth-bar shall be earthed with an insulated earth conductor to a separate earth spike from the main earth. The instrumentation earth spike shall be inter-linked outside the building next to the caisson to an earth conductor, to the main earth spike of the caisson.

The current carrying capacity of earth conductors shall in general be not less than 50 % of that of the largest conductor which is protected, except that earth conductors smaller than 2,5 mm squared may not be used.

All luminaires shall be earthed to an earth conductor.

Additional equipment

Install three phase lightning arrestor in the motor control centre as per drawing.

2.8.7.21.1.3 Labels

All distribution boards shall be marked as follows:

- a) Name and number of distribution board and Fault level rating of distribution board, example "DB - A, 5kA";
- b) Origin of supply, and size of all cables, example "Supply from main DB - 25 mm² x 4c
- c) All circuit breakers shall have its current rating clearly indicated on the handle, or on the panel adjacent to the switchgear;
- d) All circuit breakers shall be properly labelled as to its service, as indicated on the drawings.

2.8.7.21.1.4 Colour Coding and Labelling of Motor Control Centre

The electrical panel/MCC/kiosk must be electrical orange or as in colour, with the following specification.

- MCC colour to be electric orange with electrical colour faceplate. The label will have black engraved letters on white ivorene label. Ivorene label super-glue or pop riveted to face plate or frame. MCC number as per drawing, e.g. MCC-1. Content of internal label on faceplate – MCC number indication of a feeder source, size of a feeder cable, fault level rating of a panel / board and phase rotation direction. The label of a MCC will be 6 mm label on faceplate to be 3 mm. labelling of cables – all incoming and outgoing cables shall be labelled with ivorene labels indicating the size of the cable.
- Kiosk colour to be baige with white colour faceplate. . The label will have black engraved letters on white ivorene label. Ivorene label super-glue or pop riveted to face plate or frame. Kiosk number as per drawing, e.g. Kiosk-1. Content of internal label on faceplate – Kiosk number indication of a feeder source, size of a feeder cable, fault level rating of a electrical panel/ board and phase rotation direction. The label of a Kiosk will be 6 mm label on face plate to be 3 mm. labelling of cables – all incoming and outgoing cables shall be labelled with ivorene labels indicating the size of the cable.

2.8.7.21.1.5 Balancing of Load and Phases

In multiphase distribution boards, all single phase circuits shall be equally distributed over all three phases so as to balance the electrical load as far as possible.

Each type of sub-circuit shall separately be balanced over all three phases as far as possible.

2.8.7.21.1.6 Provision for Future Equipment

Where space is required for future switchgear, the panel shall be correctly punched for such future switchgear.

Approved blank-covers must be provided.

2.8.7.21.1.7 Wiring

Wiring shall generally be done as described in these documents and shown on the drawings on condition that:

Where no mention is made of conduit, the requirements shall also apply to other wireways such as skirting and ducting where relevant, except that these wireways contain more than one circuit.

All circuits in these wireways shall, however, be strapped and marked as described in the documents. Where “clean lines”, i.e. separate circuits from the distribution board, are taken to dedicated socket outlets, more than one circuit may be taken through one conduit. These cases are, however, expressly shown on the drawings, if relevant. All wiring shall be new.

2.8.7.21.1.8 Mounting Heights and Positions

Mounting heights and positions of all equipment and fittings shall be as given in these documents and/or as given on the drawings.

All cases where doubt may exist shall be referred to the Engineer for a decision.

2.8.7.21.1.9 Cover Plates

Cover plates shall comply with the requirements of these documents. Where switched socket outlets are mounted in power skirting, the cover plates shall form an integral part of the equipment in which the switch socket outlets are mounted.

Where switched socket outlets and switches are mounted in wall outlet boxes and for blank cover plates they shall be WHITE enamel on steel.

All cover plates shall be PVC and white in colour with 3mm engraved lettering indicating distribution board and circuit number.

Colour coding is to be done as per SANS standard, namely: -

- Normal /Non-essential Supply: white,
- Emergency/Essential Supply: signal red – SANS 1091 code A11

2.8.7.21.1.10 Cable Sleeves

All cable sleeves and bends on site across roads and under hardened surfaces shall be supplied and installed by the *Contractor* and shall form part of his contract.

Cable sleeves shall be made from PVC and shall be at least Class 34, unless otherwise specified and shall be installed at dry dock area from the substation to the isolating point and such other places as may be specified elsewhere in these documents or shown on the drawings. During installation and until final sealing is done, the sleeves shall be kept clean of debris and blockage by temporary plugs. Final sealing shall be done with a weak cement mixture. Sleeves for future use shall be likewise sealed.

Cable sleeves to the distribution boards shall be installed with slow bends where applicable.

The sizes and number of cable sleeves are indicated on the drawings.

Where the diameter of cable sleeves is such that it cannot be hidden behind a plastered slot in the wall, an acceptable and suitable cover shall be provided and screwed over the cable slot.

Where cable sleeve installed by the *Contractor* shall ensure that the correct sizes, number and length of sleeves are supplied and installed cables can be pulled-through and installed.

2.8.7.21.1.11 Arrangement of Circuits

The arrangements of the various circuits are indicated on the drawings, together with the required protection (switchgear), control and the type and number of wiring (conductor or cable) of each circuit.

All protection shall be done with moulded case circuit breakers (MCCB's) from a SABS approved manufacturer.

No mixing of different types, ratings and manufacture of switchgear shall be allowed.

The *Contractor* shall check and make sure that the conductors as given for the various circuits, comply with the requirements of the standard specifications of these documents, as well as those of the SANS Code of Practice, SANS 10142-1 as amended.

The *Contractor* shall ensure that all circuits are connected such that the load is equally balanced over all three phases.

Isolators, Circuit Breakers, Earth Leakage Relays and Surge Arrestor

Isolating switches, circuit breakers and earth leakage relays shall comply with the relevant requirements given in the standard specifications of these documents and shall be of the SABS approved manufacture (commercial/industrial circuit breakers and switch disconnectors), or as may be specified elsewhere in these documents or shown on the drawings. The circuit breakers must be hydraulic magnet type.

The let through current of isolating switches and the rupturing capacity of circuit breakers shall be not less than that specified on the respective distribution board diagrams and kiosk.

2.8.7.21.1.12 Switched Socket Outlets

The weather-proof switched socket outlets (s.s.o) shall be 250V 16A 3 round pin in the positions as shown on the drawings and shall comply with the requirements of the Standard Specifications of these documents and shall be of approved manufacture and shall bear a SABS mark, white. The position of the sockets out will be 300 mm above floor finishing level (AFFL) or / and as per drawing. Sockets outlets with waterproof housing must be provided and must be installed as shown on the drawings be the same height of 1200mm AFFL, or as specified on the drawing.

All switch socket outlet shall be surface mounted and switch must be metal galvanised steel.

Labelling on the cover plate is to be engraved with black letters. Content on label shall be the distribution board number and circuit number feeding socket outlet, e.g. MCC/P1/1. Each socket outlet on a circuit shall be labelled.

2.8.7.21.1.13 Light Switches

Switches shall comply with the requirements of these documents, shall have a rating of not less than 16 A 240V and shall be suitable to break the load which is typical of fluorescent tube/LED luminaries. Light switches shall be of approved manufacture and shall bear a SABS mark. The position of the light switch must be 1 400 mm above floor finishing level (AFFL) or/and as per

drawing. Light switches with waterproof housing must be provided and must be installed as shown on the drawings.

Light switch cover plates are to be provided with an engraved label with black letters. Content on label shall be the distribution board number and circuit number feeding light switch, e.g. MCC/L1/1. Each light switch on a circuit shall be labelled. All switch covers must be metal steel.

2.8.7.21.1.14 Welding Isolators

All welding Isolators shall be 5 pin, 400V,3-phase, neutral, earth and shall be weatherproof to IP66 standards marine graded. Colour to be confirmed on site.

All final connections shall comply with the requirements of SANS 10142-1.

Isolators shall IP66 weatherproof surface mounted isolators wall-mounted at ± 1 200 m AFFL or as indicated on the drawing.

2.8.7.21.1.15 Design Drawings

The design drawings generally show the scope and extent of the proposed work and shall not be held as showing every minute detail of the work to be executed.

The position of power points, switches and light points that may be influenced by built-in furniture must be established on site, prior to these items being built in.

2.8.7.21.2 Luminaires

2.8.7.21.2.1 General

Luminaires which comply with the requirements of the standard and detail specifications of these documents shall be supplied and installed in accordance with these documents and/or drawings. The tender rates shall be for the type specified and if alternatives are offered it shall be under a covering letter submitted with the tender documents. The onus will be on the Contractor to prove that the alternatives are in all respects equal or better to the types specified by means of a supplying SABS approved photometric data.

Luminaire positions indicated on drawings are diagrammatic, and all positions, spacing, etc. must be determined in accordance with drawing.

2.8.7.21.2.2 Fixing of Luminaires

Luminaires shall be installed in the position(s) indicated on the drawings. Final positions shall be determined by the engineer when in doubt.

2.8.7.21.2.3 Supply and Installation of Luminaires

The contractor shall allow for ordering, receiving, packing out, storing, mounting/fixing and final connections, of all the luminaires indicated on the drawings, in his tender sum.

No luminaires shall be ordered prior to the Engineer's official written approval.

2.8.7.21.2.4 Damage to Luminaires


All luminaires damaged by the contractor or his staff before first delivery shall be replaced with new luminaires at his own cost.



2.8.7.21.2.5 SANS Specification


Luminaires shall comply with the relevant SANS specification where such specification exists and shall carry the SANS mark of approval.


Where a SANS specification does not exist for complete luminaires, the accessories and control gear shall be SANS approved and carry the SANS mark of approval.

2.8.7.21.2.6 Schedule of Luminaires

TYPE	DESCRIPTION	PHOTO
A6	<p>Surface mounted IP65 marine grade die-cast aluminium body luminaire 46W LED. Correlated colour temperature (CCT): Neutral white light (4000K) – 46W. Operating hours 60 000.</p> <p>The luminaire must consists of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and is designed to operate LEDs of 46W. The luminaire must bear the standard code SANS 60598-2-1 safety mark. The body and diffuser must be designed in such a way to prevent collection of dust and moisture on the accessible surface of the body, thus also preventing any grip of the luminaire. The luminaire must be designed to allow entry of surface conduits via 20mm conduit or and 2,5mm 3 core cable threaded entries at both ends, as well as a 25mm hole in the centre of the back of the body. A silicone sponge gasket ensures reliable IP 65 rating. The one-piece, injection-moulded polycarbonate diffuser must be vandal resistant. It must be secured to the body by six stainless steel Allen head screws. The removable gear tray must be manufactured from stainless steel, powder coated white to optimise luminaire efficiency. All control gear components are mounted on the gear tray. The gear tray can be removed by loosening four Allen head screws in keyhole slots, which allow the gear tray to be relieved into a suspended position, ensuring ease of maintenance. All control gear components are removable and bear the relevant SABS mark. All screws, bolts and metal parts must be stainless steel or non-corrosive material. Mains connections are by means of a suitable screw terminal block with a wire clamping contact.</p>	

	<p>The luminaire must have an electronic temperature monitoring prevents overheating of LEDs and power supply. Power factor $\geq 0,95$</p> <p>Uniform luminance with low glare due to prismatic diffuser design. Long service life: over 60 000 hours (L70B10). No ingress of dust and moisture into the LED and controller compartment - IP 65</p>	
B	<p>Bulkhead LED 20W with electronic ballast. Surface mounted bulkhead luminaires complete with high pressure die cast aluminium base, with trim ring casting mounted onto the base casting by stainless steel M5 Allen head screw, located outside lamp. With silicon sponge gasket. IP65 protection. Effective high-power LEDs, 4000k at a colour rendering index>80. Minimum 50 000 hours useful lifetime. SANS approved control gear bearing the SANS 60598-2-1 safety mark. With black base, opal diffuser</p>	
C	<p>Floodlight LED 75W optic 1700 Neutral White (4000K), 230V, 50Hz. IP66 floodlight with marine grade aluminium body</p> <p>The LED-floodlight must be high reliability to reduce energy consumption and maintenance in all types of lighting applications. The slim and unique design must optimize the thermal operating environment around the LEDs enabling the long useful lifetime (100 000hrs, L70) and low maintenance. The luminaire must designed to accommodate various mounting such as under-ceiling mounting / under cable tray mounting, wall mounting with stirrup Mount. The floodlight must have an emergency lighting back up battery to last for 1 hour. Must have electronic temperature monitoring to prevents overheating of LEDs and power supply within the LED compartment (ThermiX®). To maximize the reliability of the LEDs, the photometric engine and control gear compartment must be completely sealed to IP 66. This ensures that the photometric performance is maintained over time.</p> <p>The LED floodlight must offers flexible combinations of LED arrays, combined with various photometric</p>	

	<p>distributions (LensoFlex2®) and dimming control options to further maximize energy savings and reduce maintenance costs. Standard finish: Unpainted Aluminium.</p> <p>Marine grade, high-pressure die-cast aluminium housing. Surge protection 10kV/10kA.</p> <p>The compartment housing must ensure reliable ingress Protection. SANS approved control gear bearing the SANS 60598-2-1 safety mark.</p>	
D	<p>Decorative streetlight 75W LED luminaire Neutral white (4000K)</p> <p>The decorative streetlight LED luminaire must be a classical and aesthetic fitting. A range of LED photometric engines and a timeless form, it must be suitable for large urban centers as well as villages or city / waterfront look / metropolitan and residential areas. It must be an IP 66 FutureProof Lensoflex2® LED module, which can be easily replaced on-site. The luminaire must bear the IEC 60598 safety mark. The electronic power supply is suitable for operation with a 230V (+/-10%) 50Hz single-phase system. The fitting must have an electronic temperature monitoring prevents overheating of LEDs and power supply, positioned directly next to LEDs (ThermiX®). The power factor must be rated at $\geq 0,95$.</p> <p>Minimum 100 000 hours useful lifetime. SANS approved control gear bearing the SANS 60598-2-1 safety mark. With black base, opal diffuser</p>	
F	<p>Floodlight LED 55W optic 5244 Neutral White (4000K), 230V, 50Hz. IP66 floodlight with marine grade aluminium body</p> <p>The LED-floodlight must be high reliability to reduce energy consumption and maintenance in all types of lighting applications. The slim and unique design must optimize the thermal operating environment around the LEDs enabling the long useful lifetime (100 000hrs, L70) and low maintenance. The luminaire must be designed to accommodate various mounting such as</p>	

	<p>under-ceiling mounting / under cable tray mounting, wall mounting with stirrup Mount. The floodlight must have an emergency lighting back up battery to last for 1 hour. Must have electronic temperature monitoring to prevents overheating of LEDs and power supply within the LED compartment (ThermiX®). To maximize the reliability of the LEDs, the photometric engine and control gear compartment must be completely sealed to IP 66. This ensures that the photometric performance is maintained over time.</p> <p>The LED floodlight must offers flexible combinations of LED arrays, combined with various photometric distributions (LensoFlex2®) and dimming control options to further maximize energy savings and reduce maintenance costs. Standard finish: Unpainted Aluminium.</p> <p>Marine grade, high-pressure die-cast aluminium housing. Surge protection 10kV/10kA.</p> <p>The compartment housing must ensures reliable ingress Protection. SANS approved control gear bearing the SANS 60598-2-1 safety mark.</p>	
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2.8.7.21.2.7 Lighting Poles

The 9m long pole shall be manufactured from 316L stainless steel including the base plate. The filament winding shall be continuously applied with uniform tension onto a rotation mandrel, resulting in a minimum mass glass to resin ratio of 70:30, for optimum rigidity. The pole shall be seamless and circular in shape with a continuous taper of 16-18 mm diameter change per metre. A 80mm diameter hole shall be provided at 400 mm below ground level for the cable entry.

The pole surface shall be finished in a gel coat that complies with the requirements of SANS 141 and be applied to a uniform thickness of between 250 and 500 microns, achieving a smooth finish that provides a weatherproof, UV resistant, flame resistant and impact strong surface in the colour specified.

The minimum mechanical strength of the pole shall be designed for a fluctuating wind pressure of 500 Pa onto a wind surface area of 0.20 m² under which a maximum deflection of 5 % of its height above ground shall be permissible. The pole shall have a safety factor of 2.5 and be able to be manufactured to any other strength required.

An access door opening is required, the 250 mm x 80 mm cut-out shall be covered by an access door cover manufactured from glass filled nylon impregnated in the same colour as that of the surface coat. It shall be fixed securely by two M4 stainless steel captive Allen head screws that locate into M4 brass nut inserts embedded in the pole.

The pole shall be supplied complete with a 316L baeplate with a minimum size of 300 mm x 300 mm x 1.6 mm, two hot dipped galvanised steel M8 hook bolts and nuts, a hot dipped galvanised gland plate suitable for the incoming and outgoing cables complete with terminal block and mounting rail and a 5 A, 5 kA single pole miniature circuit breaker. The wiring from the MCB shall consists of 2,5 mm² 3c trailing cable and shall be taken up to the luminaire within the pole.

The supply cable to each pole shall be 2 x 16 mm² x 4-core ECC cable. A hole shall be provided at 0.4m below ground level for the supply cables.

Suitable brass terminal shall be provided within the pole and all earth conductors installed with the underground cables shall be connected to this terminal. The fitting shall be earthed to this terminal.

The pole shall bear the SANS 1749 mark and be manufactured by an ISO 9002 accredited factory.

TYPE	DESCRIPTION	TOTAL LENGTH [m]	MOUNTING HEIGHT [m]	DEPTH OF BURIAL [m]	APPROX POLE BASE DIAMETER [mm]
L1	Single	9.2	9.2	N/A	202

Foundations

No foundations for the poles are required.

Erection

The pole shall be supplied complete with a 316L base plate with a minimum size of 300 mm x 300 mm x 1.6 mm, two hot dipped galvanised steel M8 hook bolts and nuts. The poles shall be positioned generally 1000 mm away from the edge of the sea / caisson..

Final Colour

The final colour shall be Silver suitable for exterior

2.8.7.21.2.8 Photo-Electric Daylight Sensitive Switch

Exterior lighting shall be controlled by a photo-electric cell mounted on the kiosk or pole for phot-cell as shown on the drawing; with the unit positioned so that the extraneous light shall not affect its operation.

The unit shall comprise a photocell, thermal actuator and change-over switch, rated at not less than ten ampere (20A). The cover of the unit shall be manufactured from a tough, destruction resistant material for protection against tampering. The cover shall have good weather proofing properties, be ultra violet resistant and shall not deteriorate when exposed to sunlight for prolonged periods. Switch contacts shall be silver plated and shall be capable of breaking the load associated with fluorescent lamp luminaires. Contact rating shall be not less than 10 A.

A time delay of not less than 30 seconds shall be provided to prevent the unit from functioning due to lightning or other short period changes in illumination.

The unit shall be effectively safeguarded against surges by means of a suitable surge protector which shall preferably form an integral part of the unit.

Bypass switches shall be provided for exterior lights controlled via photocells so that testing and maintenance can be done at any time.

The external lighting shall be switched by contactor mounted in the distribution board / kiosk, which is controlled by a photocell or direct by the photocell. The photocell shall comply with NRS 025.

The photocell must be linked with the distribution board by 3 x 2,5mm² PVC conductors.

The photocell must comply with the following: -

- area lights shall be switched on when the illumination drops to 54 Lux;
- area lights shall be switched off when the illumination reaches 108 Lux;
- it shall be weather proof and be resistant to ultra violet light;
- it shall have a built in time delay of approximately 30 seconds;
- built in protection against voltage surges shall be provided;
- a sample of the proposed photocell shall be submitted to the Supervisor for approval prior to placing the order;
- 20 A rating shall be provided

2.8.7.21.2.9 Earthing and Bonding

The entire installation shall be properly and effectively earthed as prescribed in the Wiring Regulations and to the requirements of the relevant supply authority.

The existing plant earthing system and main earth bus bar shall be tested for 1 Ohm. If the amount not reach additional earthing equipment shall be installed by the *Contractor*.

The earthing installation shall be integrated with the instrumentation system earth and all other services.

The *Contractor*, however, will be responsible for the equipotential bonding of installed equipment, e.g. mechanical equipment, pumps, electrical equipment, cable ladders etc.

The connections for the 70mm² multi-stranded conductors shall be based on M10, high tensile, stainless bolts and nuts or equivalent. The minimum size bolts permitted for connections below 70mm², i.e. 16mm², shall be M8.

The *Contractor* shall provide these as well as the 70mm² green/yellow insulated conductor from the main earth loop.

The main cable support system as provided by the *Contractor* may also be used to support these conductors in the most economical route.

Under no circumstances shall any connection points, bolts, screws, etc., used for earthing be utilised for any other purpose.

It will be the responsibility of the *Contractor* to supply and fit earth terminals or clamps on Goods and Materials that must be earthed where these are not provided. Unless earth conductors are connected to proper terminals, the end shall be tinned and lugged. Earth conductors for individual circuits branching from the ring main shall be connected to the common earth conductor by means of exothermic welds. Insulation tape shall be used to cover all exposed metal and a PVC cable tie strapped over the tape ends to prevent unwrapping. The common earth shall not be broken.

Insulation tape shall be used to cover all exposed metal and a PVC cable tie strapped over the tape ends to prevent unwrapping.

All rods shall be threaded at either end so that extensions can be added to where deep driven installations are required. All connections shall be taped or waterproofed to ensure that corrosion does not affect the joint during the life of the installation.

The rods shall be supplied complete with a driving bolt for protecting the ends of the coupling whilst being driven into the ground.

The top of the rods, after installation, shall be 400mm below final ground level.

2.8.8 Control System Specification

A new PLC and SCADA system complete with related instrumentation and interfaces to electrically controlled equipment shall be installed to provide for the remote operation and display of the caisson emptying and filling operations, the caisson ventilation system as well as the display of the dry dock and harbour water levels. The caisson tanks levels, and filling/ emptying operations will be displayed on a dynamic graphic representation. Operation of the caisson will be made possible from two locations; one PC/ SCADA type station shall be installed in the dry dock control room while a second remote HMI type station mounted in a weatherproof control box and installed on a suitable location on the caisson deck. Communication between the two PLC location shall be done via radio telemetry.

2.8.8.1 Scope of Work

This scope of work furnishes information and sets out requirements for the installation of instrumentation equipment.

2.8.8.1.1 Control System

Installation of the control system shall be in two different locations.

PLC Rack and Computer and Network Hardware comprising the following equipment to be installed at the dock control room, exact location to be defined.

The equipment listed below is subject to minor modifications.

PLC Rack:

- 1 12 SLOTS BACKPLANE
- 1 HIGH POWER AC POWER SUPPLY
- 1 CPU340-20 MODBUS ETHERNET
- 1 EtherNet/IP & Modbus TCP M340 Module
- 1 DIG 32I 24 VDC SINK
- 1 DIG 32Q TRANS SOURCE 0.1A
- 1 Ana 8 U/I In Isolated Fast
- 1 Ana 8 Current Out No Isol
- FCN 2 X 20 WIRE 3M CABLE
- 1 28-wire preformed shielded FTB cable 3m
- 1 FTB 20 WIRE 3M SHIELDED CABLE
- 1 UNIV.POWER SUP 1P 24V 10A
- 1 ConneXium Switch 8TX
- 1 JR ethernet Radio, 2.4 GHz.

Dock Control Room Operator station:

- 1 Dell OptiPlex 3060 MT: I5-8500 (4.1Ghz 9MB) 8GB(2x4GB) DDR42666MHz, 1TB (7200Rpm) 3.5in Serial ATAll 3Gb/s,16XDVD +/- RW, Drive, USB Keyboard & mouse
- 1 DELL E2216H Monitor FHD (1920 X 1080) DP,
- VGA - Tilt

PLC Caisson rack to be installed beside the MCC cabinet comprising the following equipment:

- 2 12 SLOTS BACKPLANE
- 1 BACKPLANE EXTENDER KIT
- 2 HIGH POWER AC POWER SUPPLY
- 1 CPU340-20 MODBUS ETHERNET
- 1 EtherNet/IP & Modbus TCP M340 Module
- 5 DIG 32I 24 VDC SINK
- 3 DIG 32Q TRANS SOURCE 0.1A
- 7 Ana 8 U/I In Isolated Fast
- 1 Ana 8 Current Out No Isol
- 8 FCN 2 X 20 WIRE 3M CABLE
- 7 28-wire preformed shielded FTB cable 3m
- 1 FTB 20 WIRE 3M SHIELDED CABLE

One weatherproof control box with glass cover mounted on pedestal support including the following equipment, and to be accessible from the caisson deck. Final location to be defined:

- 1 HMI 12.1 Color Touch Panel SVGA-TFT
- 1 UNIV.POWER SUP 1P 24V 10A
- 1 ConneXium Switch 8TX
- 1 JR ethernet Radio, 2.4 GHz.

2.8.8.1.2 Field Instruments

The contractor shall install the following instruments and other equipment in accordance with the manufacturer's instructions, and the project drawings, taking into consideration the Standards and Codes listed in the Installation Specification.

- 2 Hydrostatic type level transmitters to measure dock and harbour levels, final location to be defined and approved by client and engineer.
- 6 Radar type flanged mounted level transmitters installed on the caisson tanks 4 Radar level transmitters screwed on suitable SS brackets fixed to the caisson deck and overlooking the harbour water for heel and trim measurements.
- 1 flooding level switch at the caisson.
- 2 Flow switches at the caisson pumps discharge piping
- 2 Pressure gauges with isolation valve at the caisson pump discharge piping.
- 1 Fire detection switch at the MCC room
- 40 On/ off control valves actuators to be connected to the control network. Mechanical and Electrical installation not in the instrument contractor scope.

2.8.8.1.3 Control Network

Network Ethernet cables to be installed as a redundant ring topology connecting all forty motorised valves. Network capacity to be checked and confirmed by engineer before the installation as two network rings may be needed. Cables to be installed in well-supported protective conduits.

2.8.8.1.4 Caisson and Field Instrument Cables and Trays

Analogue armoured and shielded instrument cables for the dock and harbour levels. Cables need to be run in a trench or a protected tray to the dock control room.

Analogue armoured and shielded instruments cables from the Caisson tanks level transmitters to the Caisson PLC I/O rack, cables to be installed in trays or protective conduits as required.

Digital armoured control cables to be installed between the flood detection level switch, the two pump flow switches, and the fire detector switch to the caisson PLC I/O rack. Cables to be installed in trays or protective conduits as required.

2.8.8.2 Instrument Locations

General locations of the instruments are shown on the instrument location drawing. It may however be necessary to make minor changes on site. In the interest of the prevention of rework, confirmation of the exact location shall be obtained by the contractor from the site representative before the work is carried out.

Where no instrument location drawing is available, the instrument shall be positioned as close as possible to the process monitoring point, taking into consideration the requirements as per the Installation Specification.

2.8.8.3 PLC and Remote I/O

A new PLC CPU, to comply with existing TNPA standards, complete with panel fitted with power reticulation, media converters and local I/O shall be located at the dry dock control station.

The PLC primary rack I/O which controls and monitor the pumps, the ventilation system MCC as well all associated pump suction and discharge valves will have their I/O and network allocated to PLC cards located in a rack beside the caisson MCC.

The PLC located in the caisson will be operated from with a remotely mounted HMI. The HMI shall be installed in a protective box mounted on the caisson deck

and configured for visualisation and remote control of all equipment on the caisson.

No provision has been made for the new PLC at the dock control room to communicate with the TNPA network Transnet WAN (this option is available is required). This option would permit the remote operation monitoring and tracking of various historical data. The system would be configured so that in the event of a loss of connectivity to the WAN the Dock System shall continue to operate locally.

The PLC software programming will be specified such that it will be developed by accredited software engineer/s and will be based on the Functional Design Specification (FDS) description.

All development shall comply with latest TNPA automation standards.

2.8.8.4 SCADA

The SCADA system operation terminal will be installed in the Dock control room office.

The systems shall be of Wonderware InTouch ArchestrA type and shall be able to integrate seamlessly into the TNPA SCADA network system already deployed across all the existing TNPA Wide Area Network (WAN)sites.

Monitoring and control of all connected equipment and process parameters and setpoints will be allowed at levels of password control as defined in the Functional Design Specification (FDS) description.

The SCADA software programming shall be developed by accredited Wonderware InTouch ArchestrA software engineer/s and will be based on the Functional Design Specification (FDS) description.

All development shall comply with latest TNPA automation standards.

2.8.8.5 Equipment and Instrumentation

Equipment to be monitored and controlled is as follows;

- Dry dock level monitoring using a hydrostatic sensor, this signal shall be connected and displayed on a graphic format at the dock control room PLC.
- Harbour level monitoring near the dry dock entrance, using a hydrostatic sensor, this signal shall be connected and displayed on a graphic format at the dock control room SCADA.
- Caisson tank level monitoring using a radar level sensor mounted on each tank. These signal shall be connected to the caisson PLC I/O rack located near the MCC cabinets. The tank levels will be graphically displayed at the caisson HMI and at the dock SCADA.
- Electrically actuated On/Off and Control valves on board the caisson shall be powered from the caisson MCC (400Vac). The valves will be controlled using a redundant Industrial Ethernet ring network to insure uninterrupted service.
- Valves positions and settings shall be graphically displayed and operated from Caisson local HMI and the dock SCADA.
- One flood alarm switch shall be installed at the caisson lower elevation and connected to the caisson PLC I/O rack located near the MCC cabinets. Flood alarm condition shall be alarmed and displayed at the caisson HMI and at the dock SCADA. A Caisson flood alarm level shall be audible. Alarm to be silenced whilst the visual alarm indicator will remain active (flashing) for as long as the condition exists. The system shall be hardwired and shall be operative even if the PLC is not in operation. This system shall be wired fail safe.
- One fire alarm switch shall be installed at the caisson lower elevation and connected to the caisson PLC I/O rack located near the MCC cabinets. Fire alarm condition shall be alarmed and displayed at the caisson HMI and at the dock SCADA. A Caisson fire alarm shall be audible. Alarm to be silenced whilst the visual alarm indicator will remain active (flashing) for as long as the condition exists. The system shall be hardwired and shall be operative even if the PLC is not in operation. This system shall be wired fail safe.

- Two flow switches monitoring the two pumps discharge flow and connected to the caisson PLC I/O rack located near the MCC cabinets. Pump protection for no flow conditions will be provided by a low flow alarm via PLC setpoints. Activation of the low flow alarm setpoint will stop the running pump after a pre-define period and will require to be acknowledged via the SCADA or HMI to start the pump again. All the variables will be input to the PLC and will be used with appropriate logic to either prevent starting and or stopping the pumps as will be defined in the detailed Functional Design Specification (FDS). Two pumps motors windings thermal protection to be included in the pump supply.
- Control and monitoring of MCC motors (pumps, ventilation fans, motorized valves) shall be graphically displayed and operated from the caisson HMI and at the dock SCADA operator station.
- Monitoring and interlock of the ventilation system and the caisson hatch openings: Entry into the caisson shall be permissible only after a pre-define period of ventilation. Permissible and restricted entry shall be signalled by red and green lights located near the caisson hatch entrance or on the HMI panel located on the caisson deck.

2.8.8.6 Instrumentation Specification

2.8.8.6.1 General

All panel mounted instrumentation and control equipment shall be capable of operating at the required capacity in ambient temperatures not exceeding 50°C, and an average over a period of 24 hours, not exceeding 40°C. The field mounted instruments and control equipment shall however, be suitable for operation under ambient temperatures not more than 55°C unless higher ambient temperatures are specifically stated in the Technical Specification.

All equipment and accessories shall be designed to withstand the atmospheric and marine operational conditions within the caisson.

Instrumentation sensing systems shall be electronic. Electric signal transmission shall be of common or converted standard. In general, electronic transmitters shall have analogue direct current signal output of 4 to 20mA range and make use of modern network technologies like TCP/IP. Preferred communication method to the control system shall use of a ring topology design with Media Redundant Protocol (MRP)

Special care shall be taken to make the equipment enclosures protected against entry of water, vermin and insects.

The design shall include all reasonable precautions and provisions for the safety of operating and maintenance personnel, as well as for their accessibility.

2.8.8.6.2 Panel Instruments

It is preferable to make use of the PLC / SCADA rather than any panel instruments.

Factory assembled panels or field assembled panels shall be furnished in accordance with the Panel and RIO specification document.

Where separate electric power supplies are required for electronic instrumentation systems, it shall be taken off the UPS supplying that area Instrumentation or from a dedicated supply if a UPS is not employed.

2.8.8.6.3 Field Instruments

All field mounted instruments shall be water-proof and dust-tight, suitable for use under ambient conditions prevalent in the caisson.

2.8.8.6.4 Metering Base and Chart Units

Pressure above 1 bar - kPa

Pressure below 1 bar	-	Pa
Temperatures	-	°C
Flow (all gases)	-	m ³ /hr
Flow (steam and condensate)	-	kg/hr tonne/hr
Flow (liquids)	-	kg/hr lt/hr lt/sec
Level	-	%, mm or m

2.8.8.6.5 Utilities

Electrical power, available from the plant system is 3 phase 415 V and 1 phase 240 V 50Hz. If the equipment is required to operate at any other voltage level, the necessary transformer and/or conversion units shall be included in the scope of supply by the Contractor.

A power supply calculation shall be performed to determine the capacity of:

- UPS capacity including battery.

Standard voltage:

Main power supply	-	3 x 415/240 V 50 Hz
UPS Supply	-	1 x 240 V ± 5%, 50 Hz
Instrument Control Voltage	-	1 x 240 V ± 5%, 50 Hz
	-	24 V ±5%, DC
Digital Signals	-	24 V ±5%, DC
Analogue Signals	-	4 to 20 mA DC

All alarm annunciation function will take place on the PLC/SCADA

2.8.8.6.6 Field Instrument Design

2.8.8.6.6.1 Tank Level Transmitters

The level transmitters to be supplied for the caisson internal tanks will be of a Radar type. The reflected radar impulses are received by the antenna and transmitted into the electronics. A microprocessor evaluates the signal and

identifies the level echo caused by the reflection of the radar impulse at the product surface.

The Current output shall be 4 to 20 mA

Installation

- Front side Uni slip on 3" flange/ DN80/ 80 Slip-on flange for nozzle installation suitable for 3" 150 lbs DN80 PN 16 flange

Commissioning

- Via SmartBlue (E+H Trade mark) (smartphone app) and DeviceCare / FieldCare, no special tools or adapters required

Operation

- Continuous self-monitoring
- Diagnosis information acc. NAMUR NE107 with clear text messages remedy directives
- Signal curve via SmartBlue (app) and DeviceCare / FieldCare
- Encrypted single point-to-point data transmission and password-protected communication via Bluetooth® wireless technology

Maintenance

- No maintenance required

General

- Ingress protection: IP66/68 / NEMA 4X/6P
- Measuring range: up to 20 m (66 ft)
- Process temperature: –40 to 80 °C (–40 to 176 °F)
- Process pressure: –1 to 3 bar (–14 to 43 psi)
- Accuracy: up to ± 2 mm (0.08 in)

2.8.8.6.6.2 Dock and Harbour Level Transmitters

Two hydrostatic level transmitters to be installed in the harbour, and inside the dock will measure the level of the water in each of the locations.

All the variables will be input to the PLC and will be used with appropriate logic to signal the readiness for the manual opening of the Caisson Gates as will be defined in the detailed Functional Design Specification. The transmitter shall meet the following minimum requirements:

- Accuracy: 0,2% of span or better
- Repeatability: 0,1% of span
- Dead band: Not to exceed 0,1% of span
- Ambient temperature effect: Not to exceed 0,5% of maximum span per 10°C change.
- Proof Pressure: 200% of max. process static pressure.
- Mounting: Universal bracket type

- Material: Case, primary element and wetted parts shall be made of material that is corrosion resistant to process fluid and ambient atmosphere.
- Adjustment: Independent for span and zero.

2.8.8.6.6.3 Pump Motors Winding Temperature Sensors

Thermistor type switches for Pump motor windings to be supplied with the pump/motor assembly.

Transmitter shall meet the following minimum requirements:

- Accuracy: 0,5% of span or better
- Repeatability: 0,1% of span
- Dead band: Not to exceed 0,1% of span
- Ambient temperature effect: Not to exceed 0,5% of maximum span per 10°C change.
- Mounting: Within motor
- Material: Corrosion resistant to ambient atmosphere.
- Adjustment: Pre-set

2.8.8.6.6.4 Valve Actuators

Electric Actuators

Actuators shall be fitted with a 3 phase 400 VAC squirrel-cage motor.

Output force of the motor shall be transmitted through a stage of spur gears, a spring-balanced worm with axial bearings, a worm wheel, and a clutch stage to the output shaft.

All actuators shall be fitted with a double torque-dependent switch.

For remote position indication of actuators fitted to modulating valves, provision for an analogue 4-20 mA attachment shall be provided. For isolation valves two limit switches shall be provided.

Provision for manual operation shall be made by means of a hand wheel – the mechanically independent hand-wheel shall be engaged by means of a clutch, which also de-clutches the motor drive from the output shaft.

Actuators shall be fitted with a mechanical or Electronic position indicator.

Technical Specifications

Torque and travel dependent switches

- No NC or change-over 10A at 30V AC, 5A at 250V AC, 5A at 30V DC, 0,4V at 250V DC
- Mechanical life time: $\pm 10^6$ cycles
- Ambient temperature: -20 to +80°C
- Electronic position indicator
- Supply voltage: 15 to 30V smoothed
- Output: 4-20 mA load R: 500 ohm at 15V, 1250 ohm max. at 30V
- Current consumption: Max. 40 mA at 20 mA output signal
- Linearity deviation: $\pm 1\%$ from 5 to 95% of measuring range
- Ambient temperature: -25 to +90°C
- Adjustment: Independent for span or better
- Linearity: 0,1% of span

- Hysteresis: 0,2% of span
- Accuracy: 0,5% of span or better
- Case: Dust-tight for general application

2.8.8.6.6.5 Flow Switches

- Calorimetric type switches to be used on the pump discharge line, switches to be located before the discharge valve.
- Switches to be intelligent, programmable.
- Protection IP 65
- Electrical connection: M12
- Power supply: output 18-30vdc 1PNP switch
- Display digital
- Application range: 0.03- 3 ms
- Adjustment; on site
- Process connection: G ½ male thread ISO 228, 316 SS
- Insertion length: 6mm
- Insertion diameter: 30 mm

2.8.8.6.6.6 Pressure Indicators

- Bourdon Tube Pressure Gauges, Stainless Steel
- Series
- Model: 232.50
- Measuring system: stainless steel
- Case filling: without

- Nominal size: 100 mm
- Scale range: 0...250 kPa
- Process connection: G 1/2 B
- Connector location: lower mount
- Window: laminated safety glass
- Pointer: standard pointer
- Accuracy class: class 1.0
- Material pressure element: Measuring System 316L
- Pressure Gauge Standard: International (standard Europe)

2.8.8.7 Instrument Installation Specification

2.8.8.7.1 General

This standard specification furnishes information and sets out requirements for the installation of instrumentation equipment.

All equipment and material shall be of a quality and type approved by the Engineer.

No equipment or material shall be installed unless it complies with the requirements of this specification.

All equipment and material shall be checked for suitability, quality and adherence to this specification. Every approval must be obtained by the Contractor prior to installation.

Any installation or installation procedure which is in contravention to this specification shall be made good or replaced, to the satisfaction of the Engineer,

and all costs for making good or replacement shall be for the contractors account.

Failure to adherence to the requirements of this specification may result in the equipment or material being rejected by the Engineer.

2.8.8.7.2 Standard of Work

The complete instrumentation installation shall be carried out by skilled, competent and qualified operatives to the highest standard of safety and workmanship, using the correct tools for the operations and best quality materials.

A clean, orderly and safe environment shall be maintained in the Instrumentation Contractor's workshop, the stores and offices and in the construction areas.

Cabling and wiring shall form a neat and functional appearance.

Work shall be planned such that access to equipment for the current installation or future maintenance shall not be obstructed.

The completed installation including supports, brackets, wiring, cabling and piping shall present a clean, tidy appearance and shall conform to good engineering practice.

The contractor shall install instruments and other equipment in accordance with the manufacturer's instructions, and the project drawings, taking due cognisance of the Standards and Codes listed in this Specification.

The standards and codes which shall apply to this project are those issued by the following organisations:

- British Standard Institution (BSI)
- Deutsche Industrie Normen (DIN)
- American National Standards Institute (ANSI)
- The International Society of Automation (ISA)
- South African Bureau of Standards (SABS)

2.8.8.7.3 Instrument Locations

General locations of the instruments are shown on the instrument location drawing. It may however be necessary to make minor changes on site. In the interests of the prevention of rework, confirmation of the exact location shall be obtained by the contractor from the site representative before the work is carried out.

Where no instrument location drawing is available the instrument shall be positioned as close as possible to the process monitoring point taking into consideration the requirements as listed below.

The instrument shall be mounted in an easily accessible position to facilitate maintenance and removal.

The contractor shall avoid, where possible, locating instruments in locations subject to leaks and spills. Where an instrument is unavoidably located where exposure to the above mentioned is likely, splash guard shall be provided over or around the instrument.

Field mounted instruments, excluding in-line and close-coupled devices shall be mounted so that the centre line of the housing, chart or scale is approximately 1,400mm above grade, floor or platform, unless otherwise specified on an installation drawing.

Instruments must not be mounted where there is excessive vibration.

Instruments are not to be mounted on hand rails or process parts of the plant.

Transmitters shall be located as close to the primary process connection as possible but instrument accessibility must be maintained.

Instruments shall be installed so as not to cause any obstruction to walkways, headroom or access to other plant items.

Instruments are not to be mounted near or in the way of sections of the plant that are regularly removed.

Direct mounted dial pressure gauges shall be plainly visible and accessible from floor or adjacent platform.

2.8.8.7.4 Supporting Bracketing and Fixing

The drilling of holes in structural steelwork is not permitted except with the prior written approval of the engineer.

The drilling of holes in vessels or pipework is expressly prohibited.

Instrument pipe stands where required are to be manufactured according to the drawings. All stands should be floor mounted unless otherwise stated. Fixing bolts, nuts and washers must not be cadmium plated. They shall be stainless steel.

Instrument supports and mounting brackets shall be of a suitable strength and rigidity to ensure proper operation of the instrument. Careful attention shall be given to ensure that instruments are not mounted on or attached to equipment or structures which are subject to vibration. All proposed locations must be approved by the Engineer before installation.

Brackets shall in general, be made of mild steel flat bar, angle or channel. All brackets shall be Stainless Steel.

2.8.8.7.5 Cable Racks and Supports

Cable rack/tray shall follow the building or mechanical construction line to which they are attached, with as few direction changes as possible.

Cable racks shall be mounted in the vertical plane and shall be positioned so as to avoid obstruction to walkways and access routes. Racks shall not be mounted in the horizontal position without the prior written permission of the Engineer.

Cable rack/tray bends and tees will be constructed as to allow all cables within trays to have a bending radii of not more than the manufacturer's specifications. No right angle jointing of rack/tray will be allowed.

Cable rack/trays shall be properly aligned and supported and the completed installation should have no visible deflection and be devoid of any distortion, kinks or sags.

The maximum distance between centres of adjacent supports shall be 2 metres. Additional supports shall be located at the joints of straight tray lengths and at every change in direction.

Supports shall be attached to permanent members of the caisson.

Cable racks to be stainless steel.

Single angle cable supports may be used under the following conditions:

- Up to no more than 3 cables may be run on an SS angle support.

- The size of the angle shall be such that in cross section, no part of any cable shall project beyond the square of which the angle forms two sides.
- The minimum size angle to be used shall be 25 x 25 x 5mm and maximum size 40 x 40 x 6mm.

Where required, any cable in danger of mechanical damage will be protected by using SS pipe or channel.

Cable rack/trays shall be installed in accordance with the route diagram. Minor deviations in routing to avoid interference may be allowed subject to the approval of the Engineer. Where no cable routing drawing is available the cable routes shall be "site" determined in conjunction with the Engineer.

All cables run on racking or angle iron supports shall be fully supported to within 150mm from the gland entry on the equipment serviced or as cable size dictates.

2.8.8.7.6 Cabling and Wiring

Cable sizes, number of cores and cable number shall be as indicated on the cable schedules.

Cables shall be tested per drum length on delivery to site prior to installation. Results shall be documented.

Cable drums shall be rolled in the proper direction to prevent loosening of the cable. Cable shall be drawn into position using a sufficiency of rollers and cornering apparatus to avoid damaging the cable by excessive bending or dragging.

Cable shall be stored in dry areas.

Where cables pass through a floor, they shall be protected by a metal pipe or suitable mechanical protection, extending from 50mm to 350mm above floor or ground level.

The contractor shall observe the manufacturer's recommendations for minimum bending radius but shall never use less than the following radii:

Unarmoured cables : 5 times the overall outside diameter of the cable.

Armoured cables : 10 times the overall outside diameter of the cable.

Clips, saddles or clamps for securing of cables shall have smooth and rounded edges and shall not damage the cable sheath or serving. The type of saddle or clamps shall be approved by the Engineer before installation commences.

Instrument signal and electric power may not run bunched in the same rack/tray. A minimum distance of 300mm shall separate such racks/trays. If instrument cables are required to run on the same cable rack as electrical cables, then there must be at least a 300mm gap between the electric and instrument cables.

To avoid interference arising from electrical power supply voltage dips or spikes, instrument signals and electrical power cables shall only cross at right angle to each other.

On no account will instrument signal and electrical power wiring be transmitted in the same multi-core cable

Instrumentation cables may only be installed a maximum of 2 deep on racks if approved by the Engineer.

Joints in cables are permitted only where the length of the run exceeds the standard manufactured length of cable available on a drum. In these cases, the joints will be made in a junction box. No through jointing of cables will be permitted on cable racks/trays or in any cable way.

Coaxial cable for data highways shall be run individually in 20mm conduit as per 7.16. Conduits used for this purpose shall be installed a minimum of 300mm from electrical cables.

All cables shall be labelled at each end and at 10m intervals along its length with a strap on plastic marker tags bearing the cable number as shown on the cable schedule. (Black letters on a yellow background).

All cables shall be mechanically anchored at the position of termination by the use of flanges of the correct size, as follows:

- Where equipment supplied is provided with cable entries having DIN, NPT, etc., threads, the contractor shall provide all necessary adapters to permit the use of standard ISO Metric thread cable glands.
- Where glands are to be used with non-threaded clearance holes, a heavy duty lock-but, together with suitable weatherproofing gaskets shall be provided. Holes with a tolerance greater than 1.5mm larger than the gland size will not be accepted.
- Cables shall always be made off according to the gland manufacturers recommendations.
- When glanding off SWA cables in non-conducting enclosures the gland shall be provided with an internal earthing washer and connected to a suitable earth connection.

Where wiring is specified to be run in conduit, the following shall be observed:

- The conduit used shall be heavy gauge seamless SS metal conduit. Flexible conduit shall be of the PVC sheathed variety.
- The conduit shall have a smooth bore. The smallest size to be used shall be 20mm and the largest 50mm nominal diameter.
- All conduit joints and entries shall be screwed a minimum of 20mm and made tight and weatherproof. Conduit threads shall be protected from corrosion by the application of an approved cold galvanising paint.
- Draw-in boxes shall be installed after every second bend or a combination of sets and bends which equal 180 deg. or after every 7,5m of straight run. All boxes shall be supplied with gaskets for weatherproofing.

- Where the possibility of condensation exists, the conduit shall be installed with a slope of approximately 3 in 100 and a 3mm diameter drain hole shall be drilled at the lowest point.
- Conduits shall be bonded and earthed. Conduit bends, boxes, flexible conduits, etc., shall not interrupt the earth continuity.
- Conduit must not be used as an earth continuity conductor.
- The minimum bending radius of conduit shall be 6 times the conduit diameter.
- Conduit shall be fixed with clips or saddles at a pitch not exceeding 1,5m.

2.8.8.7.7 Cable and Wire Termination and Connections

All instruments, control panels, junction boxes, etc., shall be wired in accordance with the relevant project drawings.

Each conductor shall be fitted with an insulated double crimp lug of the correct size. Pin lugs shall be used for pressure type terminals. Ring or spade lugs shall be used for post type terminals.

A proprietary type of wire stripper must always be used. The stripping tool must be checked regularly and is subject to inspection by the Engineer. The termination of stranded conductors where one or more strands have been damaged or broken is expressly prohibited.

The crimping tool used for attaching termination lugs shall be of the ratchet type which requires a specific amount of pressure prior to release, recommended by the manufacture of the crimp lugs.

All wires are to be terminated. Spare terminals shall be provided for unused pairs or cores. All spare terminals of field multi-cores shall be connected together and bonded to instrument earth.

Terminated wires shall be arranged neatly and loomed where necessary using cable ties. Spiral lacing shall be used for flexible or semi flexible looms.

Each wire shall be numbered with the respective terminal number by means of interlocking slip-on plastic ferrules of the correct size. Split or clip on ferrules are not acceptable. The ferrules shall be a tight or interference fit on the wire.

Cable colours:

- Normal signal cables - black outer sheath
- Earth cables - green

Conductors to be 0,5mm flexible stranded twisted copper wire for normal instrument signals.

Nylon washers shall be put on all cable glands and cable gland adapters on weatherproof boxes.

Cables must not be trapped in lagging.

Cables to field instruments must have at least 30cm slack which should be neatly looped before the instrument.

Cables incorporating shields or screens shall have the shield or screen isolated for electrical earth throughout its length and it shall be earthed only at the point indicated on the drawing.

Only cable in the following standard sizes shall be used:

- | | |
|---------|---------|
| 1 pair | 1 triad |
| 2 pairs | |
| 4 pairs | |
| 8 pairs | |

For field instrumentation power supply only 3 core S.W.A. or Dekobon cable shall be used.

The approved cable is Dekobon type M855 single pair, M877 multi pairs and M865, M887 respectively for triads. The conductor size shall be 0,5mm² for instrumentation signals unless specified otherwise in the instrument cable schedule.

A variation from this type of cable must have the permission of the engineer.

Instrument cabling identification.

Cables are to be labelled according to the cable schedule. The numbering will be made up as follows:

- Field instrument to JB or marshalling:
 - analogue = Instrument tag number + A1
 - digital = Instrument tag number + D1
 - power = Instrument tag number + P1
- JB to marshalling:
 - marshalling terminal strip number

2.8.8.7.8 Junction Boxes

Junction boxes where required must be numbered on the door or lid with an engraved plastic type label having numbers at least 5mm in height. (Refer section 12 Instrument Labels).

Terminal rails and individual terminals shall be numbered.

An earth plate or rings for the cable glands shall be put in the bottom of each junction box, where required.

Cables must enter from the bottom of the junction box.

Spare holes for cable glands must be plugged with the approved type of plugs.

Shield wires must be strapped together.

The box must be classified IP67 or better.

The box must be mounted securely.

Junction boxes shall be polycarbonate. Painting or other colouring is not required.

2.8.8.7.9 Specific Requirements – Control Valves

Control valves shall be mounted by others so that the direction of flow indicator (if any) on the valve body is compatible with the direction of flow of process fluid in the pipe. It is the responsibility of the instrumentation contractor to check that the correct valve is installed and that it is correctly installed and there is no damage visible before accepting the valve for hooking up to electrics.

The control valve shall be installed and piped up according to the instrument installation diagram. A bulkhead plate will be provided where stainless steel/dekabon lines end and flexible lines start.

Flexible lines are to be tidy and are not to be in contact with any hot surface.

The position of the limit switches on a valve should be made adjustable.

2.8.8.7.10 Specific Requirements - Level Measuring Instruments

Radar transducers shall be mounted in such a way that any vibration present at the site of installation cannot be mechanically transmitted to the transducer housing. In this respect, the manufacturer's instructions must be strictly adhered to.

Flange mounted transducers must be mounted on a thick gasket of soft resilient material and lightly secured with PVC or nylon nuts and bolts. Under no circumstances shall the bolts be over tightened, finger tightening is sufficient.

2.8.8.7.11 Specific Requirements - Pressure

All pressure points shall be fitted with ½ inch N.P.T. isolation cocks.

Gauges shall be mounted in a vertical position.

2.8.8.7.12 Instrument Labels

Each instrument shall be fitted with a label giving the function and tag number as detailed in the label schedule. Field mounted instruments including final control elements shall have labels mounted on a bracket which is fixed independent of the instrument and stays in position if the instrument is removed. The label must be in a clearly visible location.

Labels shall be made of laminated trafolite and have black letters on a white background.

The size of the labels shall be:

Type 1	Field Instruments/ Transmitters/ Control Valves	80mmW x 30mmH
Type 2	Cabinets/ Field Junction Boxes	200mmW x 30mmH
Type 3	Terminal Rails	39mmW x 18mmH
Type 4	Power Supplies	70mmW x 20mmH
Type 5	Power Rails	15mmW x 10mmH
Type 6	Marshalling Cubicles	150mmW x 50mmH
Type 7	Distribution Boards	150mmW x 50mmH

2.8.8.7.13 Instrument Numbering

The instrumentation shall be tagged according to the following system:

- Location: Cape Town = C
- Site : Dry Dock = DD
- Functional Area: Caisson = CA
- Instrument type : modified ISA abbreviation
- Instrument number : sequential number
- e.g. CDD-CA-LT-002
- Cape Town Dry Dock, Caisson, Level Transmitter, 2nd instrument in that area.

2.8.8.7.14 Acceptance of Instrumentation

When all the testing on an instrument loop has been completed the contractor shall notify the Engineer in writing and request inspection. Defects attributable to the contractor shall be punch listed and shall be rectified at the contractor expense. The Engineer shall accept equipment in a particular area on a loop by loop basis in writing, but the contractor shall retain responsibility for the loop until the complete area is handed over and accepted in writing by the Engineer.

2.8.8.8 PLC and Remote Panel Specification

This specification covers the manufacturing and supply of Programmable Logic Controller (PLC) and/or Remote panels used for process monitoring and control applications.

2.8.8.8.1 Abbreviations

In this specification the following abbreviations will apply: -

- SANS; South African National Standard
- BS: British Standards
- PLC: Programmable Logic Controller
- I/O: Input/output
- CPU: Central Processing Unit
- UPS: Uninterruptible Power Supply
- MCC: Motor Control Centre
- MCB: Miniature Circuit Breaker

2.8.8.8.2 Standards

All design standards for cabling shall be subject to the latest amendments and editions of the following standard specifications: -

- SANS 10142-1: National Standards for the wiring of premises.
- SANS 1091:2004: National Colour Standard.
- SANS 1274-2005: Coatings applied by the powder-coating process.

- BS 381C:1980: Paint colour chart.

2.8.8.8.3 General Requirements

The PLC control panel shall house the following items: -

- The PLC and all I/O modules and racks.
- All network switches and hubs.
- All field instrumentation and MCC interface cables shall be marshalled in this panel.
- All power supply and distribution circuitry and equipment.
- All lightning and surge protection devices as required.
- Marshalling terminals as required
- Interposing relays as required.
- Signal conditioners as required.
- Signal surge protection devices as required.

The supply and installation shall in general comply with the relevant clauses in all specifications attached to the tender documentation.

The panels shall be free standing units with bottom cable entry (via a glanding plate) and have front door access (hinged and lockable).

The gland plate shall be of sufficient size to accommodate all the cables to be glanded to the panel.

The panel should be manufactured from stainless steel 304L or 3CR-12 steel typically not less than 2,0 mm thick. The panel will have a door on the front which opens to practically the full width and height of the panel. The panel shall

be free standing and shall not be more than 2,200 mm high, 2,400mm wide and 600mm deep and it should be sized to accommodate all the PLC and associated equipment required for the actual PLC I/O and future spare capacity.

Once the door is open there should be no obstruction to prevent full access to every point inside the panel.

The panel shall be epoxy powder coated Grey (Shade RAL 7032) finish. Interior chassis mounting plates will be finished in appliance white. All removable parts and hardware will be cadmium yellow passivized.

Each panel and control function should be clearly labelled with labels engraved on laminated engraving board with black letters on a white background. All labels must be attached with chrome plated, screws and nuts or screws and tapped holes. On the backing plate only tapped holes may be used. Screws with nuts on the backing plate will not be acceptable.

The panel must be vermin-proof and must have a protection rating of no less than IP 55.

This specification must be read in conjunction with the PLC Hardware Specification (Volume 2 of the Automation and Control Standards).

2.8.8.8.4 Standard Features

Each panel shall have the following features as standard: -

- All panels shall be constructed using the same general arrangement. All incoming power terminals, receptacle and 24VDC power supply are mounted horizontally along an upper din-rail preferably in the following order:
 1. 230 VAC Double Pole Incomer Circuit Breaker;
 2. 230 VAC Single Pole Branch Circuit Breakers for 230 VAC equipment and Instruments;
 3. Neutral and Earth terminals for branch circuits'
 4. 230 VAC to 24 VDC Power Supply/s;
 5. 24 VDC Dual Redundancy Unit, if required,

6. 24 VDC Branch Circuit Breakers

7. 0 VDC Branch Terminals

- The PLC components are mounted horizontally in the next layer down in the panel.
- The lower section of the panel will contain vertically mounted din-rails providing for the mounting for all field terminal blocks, instrument signal isolators and signal convertors.
- An Instrument Earth Bar and Protective Earth Bar shall be located at the bottom of the panel
- Covered wire ways will be provided for all internal and field wiring.
- Field wiring will be terminated on the right of terminal blocks while internal wiring will terminate on the left.
- Ventilation fans with air filters shall be mounted on the PLC panel at low level with un-filtered air outlets at high level. The fans must pressurise the panel to prevent the ingress of dust.
- A 230V AC switch socket outlet, fed from a dedicated earth leakage unit, shall be mounted inside the panel. This socket must have a shaved earth which shall be used for the PLC programmer only.
- Interior LED lighting at the top of the panel, arranged to switch on, via a micro switch, when the panel door is opened.
- A substantial area of removable gland plates on the floor of the panel, split into two or more sections.
- A sheet steel pocket welded onto inside of the door to hold A4 sized drawings, books etc.
- A copper earth bar running the width of the panel at the bottom with solid electrical connection to the panel doors and to the steel of the panel at two or more places and provided with terminals for connection of equipment and screen earth wires.
- Separate AC and DC distribution sections if both AC and DC are used.
- A free-standing (i.e. not the PLC rack mounted) 24V DC Power supply for all analogue I/O cards (where required), 24V DC I/O distribution (if required), field instrumentation supplies (if required), etc.

2.8.8.8.5 Wiring and Terminals

All screwed terminals shall be mounted on raised DIN terminal rail, secured to the chassis plate at the back of the panel.

Not more than one wire shall be connected to one side of any terminal.

Every wire shall be marked at both ends with a numbering system approved by the Engineer, and all terminating wires shall also be suitably crimped to a terminal lug. Not more than one wire shall be crimped into a single lug unless the lug is purposely made for two wires.

All wiring shall be flexible, tinned, annealed, multi-strand copper wire not less than: -

- 1,5mm² for 230V AC or 110V AC power
- 1,0mm² for 24V DC or AC power
- 0,5mm² for all PLC I/O wiring between modules and marshalling terminals
- 4,0mm² for earth drain

Irrespective of the minimum wire sizes allowed in this specification, contractors must ensure that all cables and wiring are capable of carrying the full system currents, inclusive of de-rating factors as specified in the latest version of SANS 10142.

All wire terminations must be done by using suitable lugs. No more than one wire may be crimped into a single lug. Where pin lugs are crimped onto the ends of wires, correctly sized pin lugs must be used, which fit into the terminals properly and such that the tightening of the terminal does not result in the loosening of the pin lug.

All panel wiring shall run in suitable sized slotted trunking for as much of their course as possible, thereafter in spiral band or similar conduit to its destination if the exposed run would exceed 100mm.

The distance between the terminals and the trunking or between equipment (such as relays, surge protection, circuit breakers, etc.) and trunking shall not be less than 50mm.

Control wiring should not run with power wiring and all cross-overs shall be at ninety degrees.

A block of terminals shall be allocated to each I/O module. The terminal block shall be labelled with the PLC Drop/Rack/Slot number of the module.

The terminals allocated for the various I/O modules must be as per the design drawings submitted by the consultant. If it forms part of the contractor's scope of work to submit design drawings, the terminals allocated for the various I/O modules must be approved by the consultant. All terminals shall be sequentially numbered from top to bottom for each I/O channel for every type of I/O card.

Internal wiring shall be colour coded as follows: -

- 230V AC Power
 1. Live - Brown
 2. Neutral - Blue
 3. Earth - Green and Yellow
- 24V DC Power
 1. Positive - Red
 2. Negative - Black
- Digital Inputs
 1. 24V DC - Grey

- Digital Outputs
 1. 24V DC - Grey
- Relay Outputs
 1. 24V DC Grey
- Analogue Signals
 1. Positive - Grey
 2. Negative - Black

A terminal section for AC and DC power distribution shall be included in the PLC panel where both voltages are used for PLC I/O. The terminal groups shall be clearly identified to indicate the various voltages.

A separate power distribution section shall be used for the AC and DC supplies where both voltages are used. Miniature circuit breakers (MCB's) shall be used to feed the various items of equipment such as PLC I/O cards, fans, lights, field instruments, Module Terminal Rails, etc.

All wiring must be continuous from one termination (in a terminal strip or device such as a relay, contactor, surge arrester, etc.) to the next. No spliced wiring will be accepted.

2.8.8.8.6 Labels

Each device shall be identified with a label giving the tag number as detailed in the drawings. The label must be in a clearly visible location.

The labels shall be affixed to the panel and not the device itself.

Labels shall be made of laminated trafolite and have black letters on a white background.

The size of the labels shall be:

Type 1	Panel Instruments/ Field Instruments/ Transmitters/ Control Valves	80mmW x 30mmH
Type 2	Cabinets/ Field Junction Boxes	200mmW x 30mmH
Type 3	Terminal Rails	39mmW x 18mmH
Type 4	Power Supplies	70mmW x 20mmH
Type 5	Power Rails/ Circuit Breakers/ Power Supplies/ Signal Isolators/ etc.	15mmW x 10mmH
Type 6	Marshalling Cubicles	150mmW x 50mmH
Type 7	Distribution Boards	150mmW x 50mmH

2.8.8.8.7 Factory Acceptance

Before delivery of the PLC systems and/or the PLC/RIO panels, a comprehensive system Factory Acceptance Test (FAT) must take place.

When the panel/s are deemed to be complete the contractor shall notify the Engineer in writing and request a Factory Acceptance Test (FAT).

Defects attributable to the contractor shall be punch listed and shall be rectified at the contractor expense.

- The test shall comprise of at least, but not be limited to:
 1. Checking the panel manufacturing and assembly for compliance with this specification.
 2. Layout, numbering and labelling of equipment.
 3. Wiring – sizes, numbering, colours, termination, etc.
 4. Wiring as per drawings, I/O schedules, etc. (i.e. loop checks).

2.8.8.8.8 Over Voltage/Lightning Protection

The function of the over-voltage/lightning protection units is to prevent damage from occurring to the electrical and electronic devices due to destructive voltages, by resistive coupling, capacitive coupling or inductive coupling, arising from extraneous events such as lightning discharges, switching surges etc. All lightning and surge protection must be in accordance with the requirements in the Clean Power and Surge Protection specification (Volume 5 of the Automation and Control Design Standards).

The protection units on the 230V AC mains incomers of the PLC panel (if not provided on the mains elsewhere) shall consist of at least IEC Class II protection.

Preferably Class I and Class II, or a combined Class I + Class II protection must be used.

All analogue, digital input and output circuits leaving the building where the panel is situated must have Class III surge arresters for protection of these circuits.

Each individual supply from the 24V DC distribution and from the 230V AC distribution to field instruments or other field supplies must be equipped with at least Class II medium surge protection.

2.8.8.8.9 Spares

The tenderer will be required to provide at least 10% spare fuses and other consumable items which may be required during commissioning. In addition to commissioning spares, a recommended spare list for three years' maintenance, should be submitted. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

2.8.8.8.10 Painting

Switchboards and panels shall be epoxy powder coated in accordance with Type 1 coatings to SANS 1274-2005.

Unless specified otherwise, a high gloss finish in the following colour shall be provided:

- Colour - Light Orange, Colour No. B26, Munsell Ref. 2,5 YR C/14 to SANS 1091: 2004 and Colour No. 381C-557 to BS 381C: 1980.

Paintwork must be guaranteed against blistering, peeling, cracking and general deterioration which can lead to rusting, corrosion, etc. for a period of no less than three years. If the tenderer cannot comply with this requirement, it must be clearly stated as such in the tender.

The following specifications in accordance with SANS 1274-2005 shall be provided: -

PROPERTY	REQUIREMENT	TEST METHOD
Thickness, minimum	50 micron	6,7
Marking Resistance (400g)	No marking	6.20
Impact Resistance, J, minimum	6,78	6.10
Water Resistance, h, minimum	720	6.13

Humidity resistance, h, minimum	1000	6.14
Resistance to salt fog, h, minimum	1000	6.16

2.8.8.8.11 Surface Preparation

Surface preparation of sheet steel components shall be carried out prior to paint application.

All fabricated sheet steel components are to be degreased and de-rusted ready for treatment.

A steel surface is considered ready for treatment when all dirt, grease, rust, millscale, moisture or other contaminants have been removed in an alkaline degreaser to give a dry, clean, bright, metallic surface.

The prepared steel surface shall be passivated by means of immersion in the final treatment bath.

2.8.8.8.12 Powder Coating

A thermosetting powder consisting of epoxy/polyester resin shall be applied by means of an electrostatic spray gun to give a uniform coating thickness of 50 to 60 micron. Less than 50 microns will not be acceptable.

The powder coating shall be baked at a metal temperature of 185°C so as to melt the powders to form a continuous film over the metal substrate.

2.8.8.8.13 Drawings and Diagrams

The tenderer must submit layout drawings, showing the PLC panel size, cable entry, location of equipment, details of equipment (such as fans, lights, plugs, trunking size, circuit breakers, fuses, terminals, etc.), panel colour, material of

construction (e.g. 2mm mild steel), etc. for approval by the Engineer before any manufacturing commences.

The drawings must be accompanied with data lists of the proposed equipment. These data sheets must show the type, supplier, make, model, size, etc. of equipment where applicable. For example: Terminals - Phoenix SK12, 4mm, white, MCB's - Merlin Gerin, 5A, 10kA, single-pole.

2.8.9 Corrosion Protection Specification

TNPA requires that the Contractor supply, install and guarantee a robust marine grade corrosion protection system for use on the floating dock. The Contractor may select either a 3-Coat or 1-Coat system. The corrosion protection system selected for use shall be from an internationally recognised and reputable supplier e.g.: Hempel, Jotun, International Paints. The selected corrosion protection system shall carry a minimum 5year guarantee, defined as a maximum of 1% of the total area of corrosion protection breakdown per year. The Contractor shall be required to repair yearly, any corrosion protection breakdown exceeding 1% of the total surface area. The paint supplier shall carry the guarantee for the first 5 years. A guarantee certificate, from the paint supplier, is required prior to the construction Works.

The final paint selection by the Contractor shall be approved by the Engineer before its application to the caisson.

Sequence of Corrosion Protection Application – 3 Coat System

- High pressure wash, clean and remove oils and contaminants
- Descale
- Grit blast to SA 2 ½.
- Remove all slag and waste
- Stripe coat using 1st coat primer: angles, stiffeners, edges, corners, welding seams and all areas inaccessible by spray painting
- Spray 1st primer coat to all surfaces
- Allow sufficient drying time

- High pressure wash to remove dust before next coat application
- Stripe coat using 2nd coat primer: angles, stiffeners, edges, corners, welding seams and all areas inaccessible by spray painting
- Spray 2nd primer/intermediate coat to all surfaces
- Allow sufficient drying time
- High pressure wash to remove dust before final coat application
- Stripe coat using final coat: angles, stiffeners, edges, corners, welding seams and all areas inaccessible by spray painting
- Spray final coat to all surfaces
- Allow sufficient drying time

Paint Specification Required – 3 Coat System

- 1st Coat Primer to be 150 microns DFT
- 2nd Coat Primer to be 150 microns DFT
- Final Coat to be 160 microns DFT

Paint Application

The application instruction covers surface preparation, application equipment and application details for corrosion protection to steelwork according to the requirements of IMO Resolution MSC.215 (82): Performance Standards for Protective Coatings on Ship Steelwork.

- The steel surfaces shall be prepared so that the coatings achieve an even distribution at the specified nominal dry film thickness. Adequate adhesion ensured by removing weld spatter and any other surface contamination
- All welding seams shall be partially dressed to remove irregular profiles
- Surface pores, pits and craters shall be sufficiently open to allow penetration of the paint

- Sharp edges shall be treated to a round radius of minimum 2mm
- Before blasting any deposits of grease or oil must be removed from steel using a suitable detergent followed by fresh water hosing
- Minor spots of oil grease may be cleaned with thinner and clean rags
- Steel must be abrasive blast cleaned to SA 2 ½
- Welds as well as shop primed areas with damage, burn marks and rust must be blasted to SA 2 ½
- Surfaces with deposits of black iron oxides from gas cutting markings shall be cleaned by light abrasive sweep blast
- Welds coated with temporary primer after welding must be cleaned by hard abrasive sweeping, preferably abrasive blast
- Spot checks for possible salt contamination of the surfaces must be executed
- When blasting the importance of working systematically must be stressed. Poorly blasted areas covered with dust are very difficult to locate during the blast inspection made after the rough cleaning. Dust must be removed just before application of the paint to a dust quantity rating "1" for dust size "3","4","5". Lower dust size classes shall be removed from the surface if visible without magnification
- Overlap zones must be treated with great care
- Damage caused by possible over- blasting must be avoided; paint edges must be feathered and consecutive layers of paint coatings given larger and larger overlaps
- The relative humidity shall be 85% or below, the steel temperature shall be 3-5 degC above the dew point
- The paint layer must be applied homogeneously and as close to the specification as possible
- The finished coatings must appear as a homogeneous film with a smooth surface. Any defects of bubbles, voids, visible abrasive residue shall be marked and appropriate repair affected

2.8.10 Quality Management Specification

2.8.12.1 Definitions

TERM, ABBREVIATION	MEANING
Data	All drawings/documents/information required to be supplied under the Contract
Data Pack (DP)	A compilation of manufacturing data, certification, inspection and testing records prepared by the Supplier/Contractor to verify compliance with the Contractual requirements.
Employer	For the purposes of this document, the term Employer has the same meaning as applied to the term Employer.
Field Inspection Test (FIT)	A document that details the checks, requirements and test parameters for each type of equipment to permit field installation and pre- commissioning of the equipment.
Inspection Release Report (IRR)	A document issued to the Supplier/Contractor by the Employer advising release of the Materials for shipment. This does not relieve the Supplier/Contractor of its obligations in accordance with the Terms and Conditions of the Contract.
Inspection Waiver Report (IWR)	A document issued to the Supplier/Contractor by Employer advising that the Employer has waived final inspection for the materials listed in this document. The issue of this Report does not preclude further inspection by Employer, is issued without prejudice and does not relieve the Supplier/ Contractor from the guarantees and obligations included in the Contract
Project Quality Plan (PQP)	A document that outlines the Supplier/Contractor's strategy, methodology, resources allocation, Quality Assurance and Quality Control coordination activities to ensure that Goods and Services supplied meet or exceed the requirements defined in the Contract, drawings, codes and standards.
Quality Control Plan (QCP)	A document outlining specific manufacturing / construction inspection and testing requirements, including responsibilities, test acceptance criteria, nomination of witness and hold points.
Technical Query (TQ)	This refers to a document used by the Supplier/Contractor to formally clarify a Technical Query

	related to the scope of supply. This should not be used where a non-conformance has already been initiated.
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2.8.12.2 Applicable Documents

2.8.12.2.1 General

All work performed shall comply with the requirements of this Specification, the documentation referenced in the Contract and the latest revision/edition of the relevant Codes and Standards referenced herein.

2.8.12.3 Statutory Regulations

Occupational Health & Safety Act, Act No 85, of 1993 and Regulations as amended.

2.8.12.4 Quality System

2.8.12.4.1 General

The Supplier/Contractor shall be responsible for all quality activities necessary to ensure the Work meets the requirements specified in the Contract, and shall manage and coordinate all Quality aspects of Work in accordance with the requirements of this Specification, and the Supplier/Contractor's PQP and QCP's once reviewed and approved by the Employer.

The Supplier/Contractor shall ensure that all Sub-Suppliers/Sub-Contractors also conform with the requirements of this Specification.

2.8.12.4.2 Supplier/Contractor Quality System Requirements

The Supplier/Contractor shall have, maintain and demonstrate its use to the Employer, its documented Quality Management System. The Supplier/Contractors Quality Management System should be in accordance with the International Standard ISO 9001.

The Supplier/Contractor shall submit its Quality System documentation to the Employer at the time of tender and at Contract Phases as detailed below:

- Project Quality Plan
- Quality Policy
- Index of Procedures to be used
- Programme of internal and external audits

2.8.12.4.3 Supplier/Contractor Documentation Requirements

The Supplier/Contractor shall develop and maintain a comprehensive register of documents that will be generated throughout the project, and shall include all quality related documents. The register shall be submitted to TNPA for review.

The Employer, TNPA, shall indicate those documents required to be submitted for information/review and/or acceptance and this shall be indicated in the Supplier/Contractors' Document Register. The register shall indicate the dates of issue of the documents taking into account sufficient time to allow TNPA review/acceptance cycle prior to the document being required for use.

2.8.12.5 Quality Assurance

2.8.12.5.1 Project Quality Plan

Where specified, the Supplier/Contractor shall submit a PQP to TNPA within 28 days after the Contract start date. The PQP shall detail how the Supplier/Contractor's Quality System will be applied to the Scope of Work specified in the Contract, and shall address the following:

- satisfying the technical and quality requirements of the Supplier/Contractor's Scope of Work, and relevant elements of the applicable ISO 9001 standard
- include all quality activities relevant to the Scope of Work, identifying all procedures, reviews, audits, controls and records used to control and verify compliance with the specified Contractual requirements

Include a listing of all special processes (e.g. welding and non-destructive testing, cube testing etc.) envisaged for use, including confirmation of personnel certification as required:

- Include all proposed method statements (for site based work activities)
- Include a description of the Supplier/Contractor's project organisation, with key positions and responsibilities identified and individuals named. The organisation structure shall also indicate the resources committed to the management / coordination of QA / QC activities
- Include a listing of all Quality Control Plans (QCP's), and associated Field Inspection Checklists (FIC's), as applicable
- Identify in the Project Quality Plan any Sub-Supplier/Sub-Contractor work. Sub-Supplier/Sub-Contractor plans shall be approved by the Supplier/Contractor, and a copy forwarded to the TNPA
- Include the proposed Authorised Inspection Authority (where applicable - for pressurised equipment and systems, welds and structural alignment)
- Include a schedule of proposed quality records

The PQP shall be controlled and re-submitted for approval when required to incorporate any change necessary during the Contract duration to ensure that the document is maintained as an effective control, change management and records. The change management will be done to an agreed policy or procedure.

Note: Where the Supplier/Contractor is required to provide a PQP, no work shall commence until the PQP is approved by the Employer, TNPA.

2.8.12.5.2 Procedures

The Supplier/Contractor's PQP and procedures shall address the system elements and activities appropriate to the Scope of Work, in compliance with the specified Quality Standard. Where specified, the Supplier/Contractor shall submit copies of Quality Procedures for review. In addition, the Supplier/Contractor shall ensure that copies of all Procedures relevant to the Scope of Work are available for reference by TNPA at each work location.

These will include the following:

Document Control

The Supplier/Contractor's Project Quality Plan shall provide a description of how Supplier/Contractor and Sub-Supplier/Sub-Contractor documents are to be managed. The description shall address as a minimum:

- Management tools and databases
- Receipt, registration and maintenance
- Internal and external distribution to Employer, third parties and Sub-Contractors
- Management of Codes, Standards and Specifications
- Internal review and approval routines and authorities
- How it is ensured that the correct revisions of documents are available at the point of use including retention periods for all documentation.

Design Control

Where the Supplier/Contractor is responsible for any aspect of design related to their Scope of Work, the Quality Plan shall describe the Supplier/Contractor's methods and procedures for the control of these design activities.

Procurement

Where the Supplier/Contractor is responsible for any aspect of procurement related to their Scope of Work, the Quality Plan shall describe the Supplier/Contractor's methods and procedures for the control of these activities.

Supplier/Contractor Audits

The Supplier/Contractor shall:

- Carry out audits in accordance with its Quality System at its own and Sub-Supplier/Sub- Contractor's facilities to ensure project quality requirements are being achieved
- Include a QA Audit Schedule in the Supplier/Contractor PQP submitted to TNPA prior to commencement of the Scope of Work. The Audit Schedule shall include all audits to be implemented by the Supplier/Contractor and Sub-Supplier/Sub-Contractor during the execution of the Contract
- Where stipulated in the Contract, perform an audit within three months after the Contract start date and thereafter at a minimum frequency of three months. Audit reports shall be submitted to TNPA at the completion of each Audit. Where unsatisfactory performance is evident, additional audits shall be performed by the Supplier/Contractor as directed by TNPA

2.8.12.6 Inspection and Testing

The Employer, TNPA, may, at its discretion perform surveillance inspection at the Supplier/Contractor's premises, Sub-Supplier/Sub-Contractor's premises or at the location of the Scope of Work. Dependent on the nature of the Scope of Work and the frequency of inspections, TNPA may elect to have inspection personnel resident at the place of manufacture, fabrication, or assembly.

The Supplier/Contractor shall ensure free entry and access is given to TNPA, certifying authorities and statutory authorities to inspect the Scope of Work and review procedures and quality records at all parts of the Supplier/Contractor's and Sub-Supplier/Sub-Contractor's premises, or at the location of the Scope of Work while any work or test is in progress.

The Supplier/Contractor shall provide TNPA with all necessary tools, calibrated measuring equipment, safety equipment and workspace to verify or witness tests in progress.

While TNPA is at the Supplier/Contractor's premises, the Supplier/Contractor shall provide, free of charge, reasonable facilities including office facilities and reasonable access to a telephone, facsimile machine and computer connection point. The Supplier/Contractor shall provide notice in writing in within a time frame as agreed upon, to allow the attendance of TNPA and other representatives at nominated witness and hold points.

2.8.12.7 Special Processes

It is the Supplier/Contractor's responsibility to ensure that all processes which require prequalified procedures and/or work methods are tested and qualified before work begins. This typically covers such activities as welding, non-destructive testing, special fabrication techniques and painting. Unless specified such procedures are the Supplier/Contractor's responsibility and do not require submission to TNPA before work begins. When such procedures are requested, no work shall commence until procedures are approved by TNPA.

It is the Supplier/Contractor's responsibility to ensure all operators are qualified for the processes in accordance with the procedure and/or applicable standards.

Records of qualification of operators shall be maintained by the Supplier/Contractor and made available to TNPA when requested.

Records of qualification of procedures and processes shall be maintained by the Supplier/Contractor in accordance with the applicable procedure or code.

2.8.12.8 Welding Procedures

Where the Supplier/Contractor's Scope of Work includes fabricated weldments, Welding Procedure Specifications (WPS) defining the method, preparation and

sequences to be adopted to achieve satisfactory welded joint shall be provided for all weld types required in the execution of the Supplier/Contractor's Scope of Work. The procedure shall only be submitted to TNPA when requested in the Contract.

WPS shall include all welding essential and non-essential variables for each process used, including appropriate test results and shall comply with the standard or code pertaining to welding required in the execution of the Supplier/Contractor's Scope of Work.

When requested in the Contract a suitably marked "weld map" shall be completed by the Supplier/Contractor for all items to be fabricated. A summary of WPS shall be prepared and when used, shall be identified on the weld map. Where TNPA approval is required, fabrication shall not commence until written approval of WPS and Welding Procedure Qualification Records (WPQR) is received by the Supplier/Contractor. No welding fabrication will be accepted that is not covered by a TNPA approved WPS/WPQR.

Where the Supplier/Contractor's Scope of Work includes fabricated weldments, Welding Procedure Specifications (WPS) defining the method, preparation and sequences to be adopted to achieve satisfactory welded joint shall be provided for all weld types required in the execution of the Supplier/Contractor's Scope of Work. The procedure shall only be submitted to TNPA when requested in the Contract.

WPS shall include all welding essential and non-essential variables for each process used, including appropriate test results and shall comply with the standard or code pertaining to welding required in the execution of the Supplier/Contractor's Scope of Work.

When requested in the Contract a suitably marked "weld map" shall be completed by the Supplier/Contractor for all items to be fabricated. A summary of WPS shall be prepared and when used, shall be identified on the weld map. Where TNPA approval is required, fabrication shall not commence until written approval of WPS and Welding Procedure Qualification Records (WPQR) is received by the Supplier/Contractor. No welding fabrication will be accepted that is not covered by a TNPA approved WPS/WPQR.

Welding Procedure Qualification (WPQ) tests may be witnessed by TNPA and/or an independent inspection authority. Testing of the specimens prepared during the WPQ Tests shall be carried out by an independent approved testing laboratory independent of the Supplier/Contractor. In certain instances, a certificate to EN 10204 3.1 B may be required. Where actual weld deposit analysis and weld metal physical properties are required for procedure qualification, the information shall be taken from the procedure qualification tests. Data listed in the catalogues of the manufacturer of welding consumables is not acceptable.

Welders/welding operators shall be qualified in accordance with the relevant welding code prior to commencing production fabrication. Specific Welder Qualifications (WQ's) records will be reviewed by TNPA in the Supplier/Contractor's works.

A register of welders qualified to work shall be maintained by the Supplier/Contractor.

2.8.12.9 Material Traceability

Where, and to the extent that material traceability is required, the Contractor shall provide its procedures for the maintenance of material identification throughout all phases of manufacture. Methods of identification, routines for re-stamping or stencilling as appropriate shall be defined and agreed with the Employer.

Adequate records shall be maintained throughout construction enabling traceability of key materials from final product back to original material certificates. The material traceability records shall form part of the DP.

The Contractor shall prepare a schedule of materials and equipment that are subject to traceability requirements.

2.8.12.10 Non-Conforming Products

The Supplier/Contractor shall establish and maintain procedures to control material or products that do not meet the specified requirements.

All Supplier/Contractor product and/or materials identified as not conforming to requirements shall be dealt with promptly as follows:

- If the Supplier/Contractor discovers material or product which is not in accordance with the requirements of the Contract, i.e. a non-conformance (NCR), the Supplier/Contractor shall promptly initiate the non-conformance procedure in terms of the Supplier/Contractor's Quality Management System, advise TNPA promptly, and provide a copy of the NCR to TNPA
- If TNPA or its agent identifies a non-conformance a TNPA NCR may be raised
- Originals of all closed out NCR's shall be included in the DP

Corrective and Preventative Action

If the Supplier/Contractor proposes a disposition of any non-conforming materials or product which varies from the requirements of the Specification or Contract, such a proposal shall be submitted in writing to TNPA whose decision on the proposal shall be obtained in writing before the nonconforming material or product is covered up or incorporated into the Works, or is the subject of any other disposition.

The disposition of non-conformances which do not vary the requirements of the Contract, specification or drawings may be approved by the Supplier/Contractor following discussion and agreement with TNPA.

Technical Queries

For clarification of technical issues (only), Supplier/Contractor may submit a Technical Query (TQ) to TNPA in accordance with the Contract.

The TQ shall clearly identify all elements of the query, and all supporting documentation and/or drawings shall be attached where appropriate.

Completed original TQN's shall be included in the DP.

2.8.12.11 Quality Records

Supplier/Contractors shall maintain Quality Records necessary to provide objective evidence that demonstrates and verifies achievement of the QA / QC requirements associated with the Scope of Work. All Quality Records, including original source material test certificates and non-destructive test reports, shall be retained by the Supplier/Contractor during the project, and be provided to TNPA at the times, and in the quantities specified in the Contract. The Supplier/Contractor shall collate all quality records in the DP and submit the DP to TNPA in accordance with the Contract and all referenced standards and specifications. This DP shall be compiled progressively, and shall be available for review at all phases of manufacture or construction activities.

The Scope of Work shall not be complete until the Supplier/Contractor's DP including the quality records from Sub-Supplier/Sub-Contractors have been reviewed and accepted by TNPA. The DP shall be compiled progressively during the execution of the Scope of Work and shall be made available for review by TNPA as required.

2.9 Punitive Measures/Actions to be Instituted Against the Contractor Resulting from the Issuing of NCR's to the Contractor for First Time and/or for Repeat/Similar Non-conformities

Should the Contractor breach any of its accepted and approved designs, methodologies, procedures, practices, techniques, construction norms, specifications, Codes or Standards pertaining to the project resulting in an NCR being issued to the Contractor, the Engineer shall institute their entitled discretionary procedures/powers as follows:

- The Contractor shall remedy, following the Engineer's guidance and/or to the Engineer's acceptance, the defect for which the NCR was raised, with the complete cost of the remediation being carried by the Contractor. Furthermore, while the Contractor may not have a financial penalty instituted against them in this instance, the time implication/impact of the rework that must be completed by the Contractor shall in no way negatively impact/prejudice the project's

approved schedule i.e.: Any late completion by the Contractor possibly resulting from the reworks due to NCR close-out requirements shall not be considered as mitigation against the enforcement of punitive penalties against the Contractor as stipulated in the Contract. The Client shall record impacts to the schedule resulting from NCR close-out requirements, in detail, and shall use these time-delays as justification for the enforcement of penalties against the Contractor should that scenario arise

- Any subsidiary services, engineering or otherwise, that are disabled from performing any services/duties due to Contractors performing NCR close-out requirements shall issue the Client with a standing time invoice, which the Client shall use to extract the punitive costs for reimbursement from the Contractor i.e.: the Contractor will be fully and solely responsible for all these punitive costs

2.10 Pre-Preparation for the Works Execution

The Contractor shall fully inspect the site and ensure that the site is in an acceptable condition to commence with the Works. Any deviation from the Contractors expectations as it pertains to existing infrastructure damage, site access etc shall immediately be raised with the Supervisor

The Contractor shall take all precautions necessary to prevent any damage to components especially to electronic components installed on structures (if any) which could be affected by the welding work if applicable.

2.11 Service and Maintenance

For all Plant and Works, the Contractor shall provide the Engineer with the operating and maintenance procedures and instructions. These documents shall be in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust all parts of the Plant. The Works and the supply of Plant shall not be considered to be complete to commence commissioning and ultimately take-over until these documents have been supplied to the Engineer

2.12 Bill of Quantities Measurement for Contractor Payment

The steelwork repair quantities are provided on a tonnage basis in the BOQ. The rate supplied by the Contractor per ton shall incorporate the following:

- Procurement
- Fabrication
- Installation
- Commissioning

Thus the Contractor shall claim against these items on the following basis:

- Procurement = 35%
- Fabrication = 35%
- Installation=25%
- Commissioning=5%

The stated percentages shall be applied to the steel quantity to arrive at a breakdown tonnage for each of the items. The claim that shall be certified by the Engineer shall then incorporate these percentages as well as the proven percentage progress on each of the items. The Contractor shall substantiate their progress to the approval of the Engineer.

2.13 General Obligations of the Contractor

The Contractors obligations as contained in this document shall be deemed to cover, but not be limited to, the following:

- The project scope shall include the design, manufacture, supply, installation, erection, and commissioning of all Plant and Materials as required for completing the Works. The Contractor shall supply all necessary manpower, labour, supervision, materials, services and testing

devices for all aspects of this project as indicated hereunder and the Contractors quoted amount for the Works shall be deemed to cover all cost and expense thereof

- Project Management of the complete Scope of Work including planning, scheduling and reporting verbally to the Engineer on a daily basis and in writing by means of reports, updated project schedule etc. weekly. The Contractor shall make available, their specialist planning resource on a weekly basis, to supply and present the updated project schedule to the Client and the Engineer. Weekly written progress reports shall be issued to the Engineer for approval
- Implementation of an appropriate quality system including stringent quality control for all Plant and Materials stipulated in this document
- Submission and gaining Engineers approval of all quality control plans (in accordance with ISO 9000) and conforming to requirements as contained in this document
- Submission of a detailed Level 3, MSP generated, project schedule 1week after award and updated weekly or as advised by the Engineer for the project as well as for all Plant and Materials and Services to be supplied by Others
- The Contractor shall allow for any relevant information gathering exercises e.g. sample extraction and testing, dimensions, layouts, access routes, review surrounding structures, identify rigging points, checking, etc., to ensure that all Plant and Materials shall be erected in accordance with all the TNPA specifications and TNPA/Engineers' requirements
- Selection of appropriate Codes of Practice, Standards, Procedures and Specifications applicable to the Works
- Remove, replace, modify, reinstall and make good all existing equipment, Plant and Materials as required to facilitate the Erection of all new Plant and Materials. This shall also include all piping, valves, mud boxes, pipe fittings, steel members and sheeting elements
- Supply, installation, statutory compliance to relevant Codes and Standards and safe storage of all Plant, Equipment and Materials required to completely negate the detrimental effects to construction progress resulting directly or indirectly from loss of electrical power on site
- Mechanical fitting and alignment as required of all motors, gearboxes, couplings, pulleys, belts, sprockets, chains, bearings, seals, base plates, etc.

- Installation of all chemical anchors, bolts, fasteners, washers, nuts, clamps, brackets, fixing and securing elements as required
- All specialized equipment, dehumidifiers, fans, extraction units, tools, brackets, supports, packers, shims, etc., necessary to complete the Works in accordance with the Engineers and manufacturer's specifications, appropriate codes and the Project Standards
- Supply of all construction lighting and associated support structures, access platforms, etc. as required for the successful Erection of all Plant and Materials
- The Contractor shall, under the direction of the Engineer, carry out all hydraulic pressure testing on all Plant as required and in accordance with the Employers and Engineers specifications. This shall include ensuring all necessary testing equipment such as bolts, gaskets, spades, hoses, flanges, plugs, test pumps, gauges, etc. are supplied
- Should any flooding of work areas occur for whatever reason, related to the Contractor or not, the Contractor at their cost shall supply all required clean-up equipment including drainage pumps
- The Contractor shall engage the services of a certified (by relevant South African statutory organisation) welding inspection organisation for the execution and performance of all NDT, dye pen, Ultrasonic, X-ray and any other testing as required on all remediation work installations as is required by the appropriate codes, standards and the Project Standards
- The Contractor shall plan, in detail, the installation and erection sequence of the Plant and Materials to allow for accessibility for rigging purposes and the availability of respective pieces of Plant and Materials based on their delivery to site
- Within the Site, removal and disposal of all scrap and rubble generated by the Contractor to the scrap lay-down or dumping area
- Site safety supervision, personal protection and safety equipment
- Supply of all equipment and personnel required to comply with the Occupational Health and Safety Act, 1993. The Contractor shall take special note of the requirements of the latest editions of Construction Regulations
- Comply with the Employers Environmental Management Plan
- Complete all documentation to the satisfaction of the Engineer in order for the Taking Over Certificates as appropriate to be signed off by the Employer
- Assistance during Test on Completion (Pre-Commissioning and Commissioning) which shall be co-ordinated and directed by the Engineer

- The Contractor shall attend to all punch list items (Punch list A, B and C) as outlined by the Engineer upon the completion of the installation and during Tests on Completion (Pre-commissioning and Commissioning)
- Supply of all Contractors Documents, designs, drawings including all “As Built” drawings for Plant and Materials, specifications and details, NDT and hydraulic testing procedures and results

2.14 Contractor Document Submission after Award

The following documentation shall be included with the Contractors submission:

- 2.1.1 Final design report detailing all components, systems, Plant and Works tendered
- 2.1.2 Safe working area plan
- 2.1.3 Emergency plan
- 2.1.4 Lifting/rigging studies
- 2.1.5 Qualification documentation (all those resources involved with fabrication, quality, supervisory and HSE)
- 2.1.6 Approved and signed-off by Professional Engineers and Naval Architect: Engineering, Inspection, Assessment reports, drawings and programmes / schedules
- 2.1.7 Approved or evidence of approved welding procedures relevant to this Project scope of works
- 2.1.8 Insurance cover
- 2.1.9 Detailed Method statements for the individual Works
- 2.1.10 SHERQ plan
- 2.1.11 Supervision and site management plan
- 2.1.12 Maintenance plans
- 2.1.13 Pre-commissioning and Commissioning plans
- 2.1.14 Detailed Quality control plans
- 2.1.15 Detailed Work instruction/procedures
- 2.1.16 Quality control dossier
- 2.1.17 Compilation of “Completion Certificates” certified by the Employer

2.15 General requirements for the Works

Surface preparation and painting is done in accordance with a 60-month supplier guaranteed specification as well as the Transnet specification **EEAM-Q-008**.

All welds shall be checked for cracks. NDT or any other required weld testing procedure as approved by the Engineer shall be carried out on at least 30% of all welds. Any cracks found are repaired. A welding procedure specification for the repairs of the cracks is provided by the Contractor to the Engineers' acceptance.

All welding consumable specifications stipulated herein shall be strictly adhered to.

Should the Contractor deviate from the project requirements, TNPA reserves the right to stop the Works with the Contractor to rectifying the areas of concern.

The Contractor shall provide a detailed method statement stipulating how the Works are to be carried out in a safe manner. The method statement is to include stability calculations, and indicate weight to be added to crane(s) to stabilize when lifting. (If required)

2.16 Requirement for submission of Contractor's Works

The Contractor submits 1 (one) electronic copy and 2 (two) paper copies of all documentation. The Engineer and Client shall approve these.

2.17 Review and Acceptance of Contractor Documentation

The Project Manager comments on the proposals and forwards the comments electronically to the Contractor.

(One) paper copy of the approved drawings is stamped 'Approved by Employer' and returned to the Contractor.

The approval of the any drawings and documentation by the Engineer is done in principle only and does not mean the approval of the details contained therein.

2.18 Equipment required to be included in the Works

Electric generator, sized by the Contractor and relevant to their emergency needs on site.

2.19 As-built drawings, operating manuals and maintenance schedules

- a. As-built drawings are due 14 days before the Works completion.
- b. All submissions are in triplicate.
- c. By submitting drawings, the Contractor represents that he has determined and verified all site measurements, site instruction criteria, materials, catalogue numbers and similar data, or will do so, and that he has checked and co-ordinated each of his drawings with the requirements of the Works and the contract documents, taking into account drawings of all other relevant disciplines.
- d. At the time of submission, the Contractor informs the Engineer in writing of any deviation between the approved drawings packs and the requirements of the contract documents.
- e. The Engineer will review and approve drawings with reasonable promptness (so as not to cause a delay) only for conformance with the design concept and the contract requirements.
- f. The Engineer may, at his discretion and depending on the number of discrepancies, require amendment and resubmission prior to approval. Drawings are resubmitted until approved prior to any portion of the Works related to the drawings being commenced.
- g. Should the Contractor during drawing amendment, alter any portion of his drawings not specifically required by the Engineer; he points this out in writing when resubmitting the drawing.
- h. Approval of the Contractor's drawings is in no way indemnifies him from being responsible for the correctness of the drawings and satisfactory operation of the installation.

3 CONSTRUCTION

3.1 Temporary Works, Site services & construction constraints

- a. The Contractor complies with the Employer's Site entry and security control, permits, and Site regulations.
- b. The Employer provides coded ID cards to all Contractors' employees for access / egress of personnel (and Equipment) within the Site boundaries.

3.2 Site services and facilities

- a. For the duration of the Contract, the Project Manager provides an area, free of charge, for the Contractor to establish his offices, lay down areas, stores, Workshops, and other Contractor's Equipment.
- b. The Employer provides the following connections to services within the Site for Contractor's use:
 - i. 50mm Isolation valve for construction Potable Water.
 - ii. Circuit breaker for construction power at 380 Volts, 3-Phase and Neutral, 50 Hz.
- c. The Contractor provides a connection to the Employer's water borne sewage network. Where no suitable connection to a sewerage system is feasible, portable chemical type toilets may be used.

3.3 Facilities provided by the Contractor

- a. The Contractor ensures that this site establishment area is compliant with the relevant safety regulations and restrictions, is clearly sign posted, and has a suitable security fence, lighting and the necessary access control gates.
- b. All costs for preparation of the site establishment area are for the Contractor's account.
- c. The Contractor submits details of the layout of his site establishment to the Project Manager for his acceptance.
- d. The Contractor installs a metering device, accepted by the Project Manager, immediately downstream at each of the Employer's connections from where he draws services. The Contractor provides the Project Manager details of his monthly consumption of potable water and power.

- e. The Contractor is responsible for his own connection to the Employer's services and for the reticulation of his services from the connection point. The cost of meters, connections, reticulation and all other usage costs associated with the provision of services are for the Contractor's account.
- f. The Contractor provides the Project Manager with a "Certificate of Compliance" (COC), by an "Accredited" Person as defined by the OHS Act, in respect of his construction power electrical installation. The Project Manager only makes construction power available upon receipt of the COC.
- g. The Construction Manager (or his nominated representative) conducts routine inspections of the Contractor's construction power reticulation and power tools. If found to be un-safe and / or non-compliant with statutory requirements, the electrical power supply is disconnected until the Contractor rectifies all defaults.
- h. The Contractor provides, at his cost, a sufficient number of toilets and maintains them in a clean and sanitary working condition.
- i. The Contractor provides temporary lighting and fencing around every section occupied by him during the construction of the Works.
- j. Such fencing demarcates and secures the construction area. The fencing is erected before any work starts and is removed only upon completion of the work in that area.
- k. The Contractor includes for all costs for such lighting and fencing, including access control into and out of these restricted areas.
- l. Wherever the Contractor provides facilities (either his own or for the Project Manager and/or Supervisor) and all items of Equipment, involving, inter alia, offices, accommodation, laboratories, Materials storage, etc., within the Working Areas, then the Contractor makes good and provides full reinstatement to the land (including all apparatus of the Employer and Others in, on or under the land) and surrounding areas to its original standard, upon dismantling of such facilities and items of Equipment.
- m. Upon completion, and within one month of the date of acceptance of the Works, the Contractor completely removes from the Site and Working Areas all his Equipment, including the foundations of any structures, stores, office accommodation or any other asset belonging to him, and leaves the Site and Working Areas in a tidy condition to the satisfaction of the Project Manager.
- n. No excess or discarded materials or Equipment may be buried or dumped within the port boundary.
- o. Demolition of all permanent and temporary structures, surfaces etc. shall be first approved by the Project Manager prior to the work being carried out.
- p. The Employer does not provide any security for the Site and Working Areas. The Contractor provides same and indemnifies and holds indemnified the Project Manager and Employer against any claims and actions that may arise out of Site and Working Area security.
- q. No housing is available for the Contractor's employees. The Contractor makes his own arrangements to house his employees and transports them to site in a

closed vehicle specifically designed for passenger transport (bus or similar) which is in a roadworthy condition.

- r. Wherever the Employer provides facilities for the Contractor's use and the Contractor adapts such facilities for use, then the Contractor makes good and provides full reinstatement to the land (including all apparatus of the Employer and Others in, on or under the land) and surrounding areas to its original standard upon dismantling of such facilities and hand-back to the Employer.

3.4 Survey control and setting out of the Works

The Contractor shall ensure that they complete monthly laser alignment surveys to ensure that the structure has not deformed.

3.5 Excavations and associated water control

- a. Probability of Asbestos Contamination in Excavations:
 - ii. The Contractor ensures his staff and labour are equipped with the necessary PPE and are trained to recognise asbestos contamination.
 - iii. On encountering asbestos contamination, the Contractor immediately stops all work in the affected area, he summonses the Engineer and secures the area.
 - iv. The Engineer arranges for a specialist waste disposal Contractor to collect, bag, remove and dispose the contaminated material from the excavation or bulk earth Works.
 - v. The Contractor continues with the excavation or bulk earth Works on receipt of a written instruction from the Engineer.

3.6 Underground services, other existing services, cable and pipe trenches and covers

- a. As a guide only, the Project Manager provides the Contractor with drawing(s) showing various known existing underground services for his information. The position of these services is approximate and it is possible that other services exist which are not reflected, and which may affect the Works.
- b. The Contractor establishes the location of the various existing services situated within the Site and Working Areas, and records all such information on "marked-up" drawing(s) which remain available for reference at all times.
- c. The Contractor exercises due care and attention in carrying out any excavation work to avoid damage or disruption to existing services. The Contractor

accordingly consults the Project Manager prior to undertaking any excavation work.

- d. Should the Contractor fail to exercise the requisite care and attention in carrying out the excavation work, the Contractor will be held liable for any claims arising out of damage caused by such excavation.

3.7 Control of noise, dust, water and waste

Before moving Equipment onto the Site, Working Areas and commencing operations, the Contractor submits his proposed methods of construction which demonstrate the measures taken to avoid and or reduce any nuisance arising from dust, noise and vibration for acceptance by the Project Manager.

3.8 Giving notice of work to be covered up

The Contractor notifies the Supervisor in writing of any elements of the Works which are to be covered up. This notification is given not less than 24 (twenty four) hours prior to the proposed covering up.

3.9 Restrictions to access on Site, roads, walkways and barricades

- a. The Contractor is specifically excluded from entering the Employer's Operational Areas which are adjacent to the Site and Working Areas. The Contractor plans and organises his work in such a manner so as to cause the least possible disruption to the Employer's operations.
- b. The Contractor ensures the safe passage of Contractor's traffic to and around the Site and Working Areas at all times that includes providing flagmen, protective barriers, signage, etc. for protection, direction and control of traffic as detailed in the project specifications
- c. The Contractor ensures that any of his staff, labour and Equipment moving outside of his allocated Site and Working Areas does not obstruct the operations of the Port. To this end access routes are allocated and coordinated by the Project Manager.
- d. The Contractor ensures that all his construction staff, labour, and Equipment remains within his allocated and fenced off construction area.
- e. All Contractor's staff and labour working within Port's boundary complies with Transnet National Ports Authority's (TNPA) operational safety requirements and are equipped with all necessary personnel protective equipment (PPE).

3.10 People restrictions on Site; hours of work, conduct and records

- a. The Contractor keeps daily records of his people engaged on the Site and Working Areas (including Sub-Contractors) with access to such daily records available for inspection by the Project Manager at all reasonable times.
- b. The Contractor has access to the site from 07h00 to 17h00 daily on all working days Monday to Friday. The Contractor will be required to obtain permission from the Project Manager to Conduct Works out of the hours stipulated. Basic conditions of employment will be adhered to – a 45-hour week will apply, with a maximum of 10 hours' overtime.

3.11 Title to materials from demolition and excavation

- a. The Contractor has no title to all materials arising from excavation and demolition in the performance of the Works with title to such materials remaining with the Employer. The Project Manager instructs the Contractor to label, mark, set aside and/or dispose of such materials for the benefit of the Employer in accordance with ECC3 Clause 73.1.

3.12 Cooperating with and obtaining acceptance of others

- a. The Employer (including the agents of the Employer) operates on Site during the entire duration of the Contract period.
- b. Others, Contractor to be notified once appointed by the Employer, operate on Site during the entire duration of the Contract period.

3.13 Publicity and progress photographs

- a. The Contractor does not advertise the Contract or the project to any third party, nor communicate directly with the media (in any jurisdiction) whatsoever without the express written notification and consent of the Project Manager.
- b. The Contractor obtains the permission and approval of the Project Manager before erecting any notice boards or using the details of the contract in any advertising media.
- c. The Contractor provides a complete digital photographic record of the progress of the construction of the Works to the Project Manager, monthly as part of the Contractor's monthly programme narrative report

3.14 Completion, Testing, Commissioning and Correction of Defects

On or before the Completion Date, the Contractor completes everything required to provide the Works including the items listed below which is to be done before the Completion Date. The Project Manager cannot certify Completion until all the works including those listed below have been done and is also free of Defects, which would have, in his opinion, prevented the Employer from using the Works and others from doing their work.

Item of work	To be completed by
As built drawings as specified in the Works Information	Within 14 days prior to Completion.
Performance testing of the Works	To be conducted on completion of the Works.

3.14.1 The *Contractor* is permitted to carry out the following *Works* after Completion:

- Defects during maintenance period.

3.14.2 Use of the Works is required before Completion has been certified
None.

3.14.3 Provision of materials, facilities and samples for tests and inspections

The Contractor provides the following:

- The Contractor is to provide all materials, facilities and apparatus required for any test and /or inspections required by the Works Information.
- The Contractor is to provide samples as required by the Works Information.

3.14.4 Access given by the Employer for correction of Defects

The Contractor complies with the following constraints and procedures of the Employer where the Project Manager arranges access for the Contractor after Completion:

- a. Safety, access control and work procedures as determined by the Ports Manager.
- b. These may be the same as communicated elsewhere within this Works Information as at the starting date / access date, or as the Works are now in use by the Employer's occupation of the Site, the same may be incrementally or substantially changed post Completion.

4 PLANT AND MATERIALS STANDARDS AND WORKMANSHIP

4.1 Investigation, Survey and Site Clearance

The *Contractor* carries out the following investigations at the Site:

- a. Conducts an investigation to determine all the existing services on the site. Marks and records all these services.
- b. Maintains a concise record of the conditions of all existing site infrastructure and services

4.2 National Standards

The latest editions and/or amendments of the following Standards and Codes shall be considered a minimum requirement. In the event of differing requirements, the most stringent Code or Standard shall apply:

- a) Occupational Health and Safety (OHS) Act No. 85 of 1993;
- b) South African National Standards;
- c) DIN or British Standard Specifications. / DIN, EN and ASME Standard Specifications;
- d) N.O.S.A. Safety Guidelines;

4.3 Building Works

- 4.3.1 Where the Association of South African Quantity Surveyors Model Preamble for Trades 1999 are used within the Works Information, the following interpretations and meanings shall apply:
- 4.3.2 In case of any conflict in interpretation, ambiguity or discrepancy between any Model Preamble for Trades 1999 (whether standard or written as a particular project specification) contained in the Works Information and the conditions of contract, the conditions of contract take precedence within the ECC Contract.
- 4.3.3 In case of any conflict in interpretation, ambiguity or discrepancy between any Model Preamble for Trades 1999 (whether standard or written as a particular project specification) contained in this paragraph 4.2 of C3.1 Employer's Works Information and specific statements contained elsewhere in C3.1 Employer's Works Information, the specific statements contained elsewhere shall prevail, without prejudice to the Project Manager's express duty to resolve any ambiguity or inconsistency in the Works Information under ECC Clause 17.1.
- 4.3.4 Within the Model Preambles for Trades 1999, the following amendments and interpretations shall apply:
- 4.3.5 Where the word or expression "Contractor" is used, read "Contractor".
- 4.3.6 Where the Model Preambles for Trades 1999 mention "rates" for measured work and any contractual statements relating to payment, all such statements shall be discounted, with the ECC conditions of contract taking precedence.
- 4.3.7 Within the Model Preambles for Trades 1999, A. GENERAL, the following amendments and interpretations shall apply:
- 4.3.8 Where the word or expression "bills of quantities" is used, this shall be discounted for the purposes of the Works Information. The ECC Contract Data - Part One states the main option to apply within the ECC Contract between the Parties.
- 4.3.9 Within the Model Preambles for Trades 1999, B. ALTERATIONS, B.2 MATERIALS FROM THE ALTERATIONS, CREDIT, ETC and C. EARTHWORKS, C1.4 Materials from demolitions shall not apply. C3.1 Employer's Works Information paragraph 3.1.6 states details of the

Contractor's title (if any) to Materials arising from excavations and/or demolitions and how such Materials are either to be disposed of or re-used in the works.

4.3.10 Within the Model Preamble for Trades 1999 Q. PLUMBING AND DRAINAGE, Q.24 TESTS shall be deemed to be included within paragraph 3.2.1 of C3.1 Employer's Works Information.

4.3.11 Within the Model Preamble for Trades 1999 U. EXTERNAL WORKS, U.3.8 Process control tests shall be deemed to be included within paragraph 3.2.1 of C3.1 Employer's Works Information.

4.3.12 The principles, meanings and interpretation stated and established within paragraphs 6.2.1 to 6.2.8 with respect to the Model Preambles for Trades 1999 equally apply to the other Model Preambles for Trades 1999 references used within this paragraph 4.2 of C3.1 Employer's Works Information.

4.3.13 Building modifications are required for the purposes of this contract. They form an integral part of the civil and structural work, and are described under section 2.4 of the Works Information.

4.4 Civil Engineering and Structural Works

4.4.1 Where the SANS 1200 series of Specifications are used within the Works Information, the following interpretations and meanings shall apply:

4.4.2 In case of any conflict in interpretation, ambiguity or discrepancy between any SANS 1200 Specification (whether standard or written as a particular project specification) contained in the Works Information and the conditions of contract, the conditions of contract take precedence within the ECC contract.

4.4.3 In case of any conflict in interpretation, ambiguity or discrepancy between any SANS 1200 Specification (whether standard or written as a particular project specification) contained in this paragraph 4.3 of the Employer's Works Information and specific statements contained elsewhere in C3.1 Employer's Works Information, the specific statements contained elsewhere shall prevail, without prejudice to the Project Manager's express duty to resolve any ambiguity or inconsistency in the Works Information under ECC Clause 17.1.

- 4.4.4 Within SANS 1200 A: GENERAL, the following amendments and interpretations shall apply:
- 4.4.5 Where the word or expression “Employer” is used, read “Employer”;
- 4.4.6 Where the word or expression “Contractor” is used, read “Contractor”;
- 4.4.7 Where the word or expression “Supervisor” is used, read “Project Manager” or “Supervisor” as the context requires;
- 4.4.8 Where the word or expression “schedule of quantities” is used, this is deleted in entirety. Assessment and payment is in accordance with the conditions of contract (and the ECC main and secondary options stated therein);
- 4.4.9 Within SANS 1200 A: GENERAL 2.3 DEFINITIONS, the following apply:
- 4.4.10 “Acceptable. Approved (Approval)” is interpreted as either a Project Manager or a Supervisor communication or instruction in relation to Works Information compliance, consistent with the conditions of contract as the context requires;
- 4.4.11 “Adequate” is deleted. The Project Manager notifies the Contractor where the Contractor has not complied with the Works Information;
- 4.4.12 “Measurement and payment” and the further definitions contained within 6.3 c) are deleted. Assessment and payment is in accordance with the conditions of contract (and the ECC main and secondary options stated therein);
- 4.4.13 Within SANS 1200 A: GENERAL 2.6 APPROVAL, the following applies:
- 4.4.14 “Approval” by either the Project Manager and/or the Supervisor is without prejudice to ECC Clause 14.1 and, inter alia, ECC Clauses 13.1, 14.3 and 27.1.
- 4.4.15 SANS 1200 A: GENERAL 2.8 ITEMS IN SCHEDULE OF QUANTITIES, is deleted in entirety. Assessment and payment is in accordance with the conditions of contract (and the ECC main and secondary options stated therein).

4.4.16 SANS 1200 A: GENERAL 3.2 STRUCTURES AND NATURAL MATERIAL ON SITE, does apply.

4.4.17 Within SANS 1200 A: GENERAL 7.1 PLANT, the following applies:

4.4.18 Where the word or expression “Plant” is used, read “Equipment”.

4.4.19 SANS 1200 A: GENERAL 7.2 CONTRACTOR’S OFFICES, STORES AND SERVICES, applies but the Project Manager resolves any inconsistency with statements included within paragraph 3.1.12 of C3.1 Employer’s Works Information.

4.4.20 SANS 1200 A: GENERAL 5.1 SURVEY, does apply.

4.4.21 Within SANS 1200 A: GENERAL 3.2 WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS, the following applies:

4.4.22 Where the word or expression “specification” is used, read “Works Information”.

4.4.23 SANS 1200 A: GENERAL 3.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES applies only to the extent that it is consistent with the specific statements made elsewhere in C3.1 Employer’s Works Information and in any case and at all times consistent with the conditions of contract.

4.4.24 Within SANS 1200 A: GENERAL 5 TESTING, the following applies:

4.4.25 Where the word or expression “Supervisor” is used, read “Supervisor”.

4.4.26 SANS 1200 A: GENERAL 8 MEASUREMENT AND PAYMENT, is deleted in entirety. Assessment and payment is in accordance with the conditions of contract (and the ECC main and secondary options stated therein).

4.4.27 The principles, meanings and interpretation stated and established within paragraphs 6.3.1 to 6.3.15 with respect to SANS 1200 series and to SANS 1200 A: GENERAL equally apply to the other SANS 1200 specification reference parts G (concrete) and H (structural steelwork)

4.4.28 Code of Practice for Steel Construction

The relevant sections of this document shall conform to the requirements of the SANS 1200 H Series of Standards.

4.4.29 Rolled Steel

All structural steelwork, except where otherwise stated, shall be of rolled steel and shall comply in every respect with SANS 1431 for evadable structural steel. Structural steelwork shall be designed in accordance with SANS 10162.

4.4.30 Steel Castings

Steel castings shall be sound, clean and free from all defects and distortion of any kind and should, except where otherwise specified, confirm with the conditions and tests specified in SANS 407 : 2000 for the particular purpose according to service. They shall be thoroughly annealed and all working parts and bearing surfaces shall be machined and turned accurately with correct finish.

4.4.31 Steel Forgings

All steel forgings shall be free from flaws and surface defects of any kind and be accurately finished to the prescribed dimensions. They should conform to the conditions and tests specified in BS. No. 24, Part 4.

4.4.32 Workmanship and Finish to Steelwork

The workmanship and finish shall be of the best quality throughout with every individual part accurately made to size and form so as to fit exactly on erection. Generally, the workmanship on any steelwork shall be in accordance with the recommendations of SANS 1200H series & SANS 2001: CSI. Cutting of steelwork may be affected by shearing, cropping or sawing. Sheared or cropped edges shall be dressed to a neat and workmanlike finish and shall be free from any distortion. All holes for turned and fitted bolts shall be accurately drilled or reamed and the diameter of the hole shall not exceed the finished diameter of the bolt by more than 0, 25 mm. All steelwork which has been partially heated shall be properly annealed except in applications of minor detail.

4.4.33 Galvanising of Steelwork

This shall be in accordance with SANS 121: 2000 latest revision and the relevant Project Standards

Note: on National Standards: Where given, these are a minimum requirement, and not limited. Equivalent Standards are acceptable, but must be specified.

4.5 Materials, fabrication and finishing

All materials, where applicable, shall conform in respect to quality, manufacture, tests and performance, to the Project Standards, South African National Standards/the International Electro technical Commission, or where no such Standard exists, the appropriate British Standard. Materials not specifically stipulated shall be of the best commercial quality.

All welding activities performed by the Contractor shall be in accordance with appropriate codes, standards and the Project Standards and shall also include the following:

- 4.5.1 All welds shall be laid smooth and external welds strip polished;
- 4.5.2 All stainless steel and 3Cr12 welds shall be pickled and passivated.

4.6 Electrical and Mechanical Works

4.6.1 Code of Practice for the design of shipyards and sea locks

The relevant sections of this document and the Works in general as it pertains to design and fabrication shall conform to the requirements of BS 6349-3:2013 Maritime Works.

4.7 Ease of Operation and Maintenance

All Plant and Materials supplied by the Contractor shall be designed and constructed for ease of operation and maintenance to ensure that the availability, reliability requirements and operating time efficiencies stated in the Specifications are achieved and maintained throughout the life span of the Plant and Materials.

The Following shall also be noted:

- 4.7.1 All operational, maintenance and inspection points shall be safely accessible;
- 4.7.2 All working platforms shall be wide enough for safe and easy passage

The Contractor shall provide a specification and procedure that shall suggest the safest and most efficient operation to carry out the cleaning and maintenance of all Plant and Materials to be supplied by the Contractor as well as outline and supply all specialist tools required for these operations.

4.8 Safety equipment and name plates

The Contractor shall secure all safety equipment, guards, notices and nameplates associated with all Plant and Materials erected by the Contractor. This will include but is not limited to the following items:

- 4.8.1 Hot surface guards
- 4.8.2 Railings and chains
- 4.8.3 Signage and notices
- 4.8.4 Name plates

4.9 Scaffolding

The Contractor shall contract with a certified scaffolding contractor who will supply and erect all scaffolding. The Contractor shall manage their activities to ensure the timely and safe supply and erection of all scaffolding needed for the Erection of all work under this Contract as defined in the Scope of Work. The Contractor shall give the scaffolding contractor 48 (forty eight) hours' notice of scaffolding required. No standing time or extension of time shall be claimed by the Contractor due to unavailability of scaffolding if 48 (forty eight) hours' notice was not given.

4.10 Erection Planning

The Contractor shall develop and submit to the Engineer a detailed erection plan for the erection of all Plant and Materials, 10 (ten) days after the award date. The erection plan shall outline the following as a minimum:

- 4.10.1 Critical Path definitions
- 4.10.2 Installation start Dates
- 4.10.3 All site progress meeting dates
- 4.10.4 Installation milestone dates
- 4.10.5 Installation and Erection completion dates

4.11 Rigging

Before undertaking heavy lifting and rigging, the Contractor must undertake a rigging study and all rigging activities must have the following in place:

- 4.11.1 The rigging study must be reviewed by the Engineer and the Employers Safety Officer prior to any heavy lifting and rigging activities being undertaken by the Contractor;
- 4.11.2 The rigging study must be co-ordinated with the overall site planning and activities schedule.

The Contractor shall supply all qualified and experienced personal required to effectively and efficiently position, align, install and erect all Plant and Materials supplied (by others) in a timely manner. This shall also include the installation of all rigging equipment fixed and mobile, such as crawl beams, crawls, "A" frame, gantries, hoists, etc. as required to lift, suspend, position and align, etc.; all Plant and Materials in their respective positions and in accordance with the manufacturer's specifications and the Project Standards.

4.12 Workmanship

The Contractor shall only employ competent staff to execute the Works and submit a competency and compliance certificate of each employee (e.g. welding certifications or certificates, fitter qualifications, etc.) to the Employer for approval.

The Contract shall be executed in accordance with good engineering practice and the relevant standards, codes, statutory requirements and the Project Standards applicable to the satisfaction of the Employer.

Should any material or workmanship supplied and performed by the Contractor not be to the satisfaction of the Engineer/Employer; it shall be rectified at the cost of the Contractor and all rejected material removed from Site. The Contractor shall be responsible for the correct and complete installation of all Plant and Materials supplied by others.

Inspections by the Engineer shall not release the Contractor from his responsibilities within the Contract unless covered by a formal Take over Certificate.

4.13 Painting and Corrosion Protection

The Contractor shall carry out all preparation, priming, protection coating, painting and finishing activities as required in accordance with both the Project

Standard Technical Specification for Corrosion Protection as supplied by in this document and by TNPA

The final coat of paint or touch ups on Plant and Materials supplied by others shall be done by the Contractor.

Touch ups shall be limited to any damages, scratches, scraps etc. which occurred during the offloading, storage, retrieval, assembly, positioning, alignment, installation, erection and securing of all Plant and Material or unless approved by the Employer. All painting activities shall be undertaken by competent personnel supplied by the Contractor.

4.14 Lubrication

The Contractor shall ensure that all initial fluids, lubrication oils and greases, associated mechanisms and equipment required by all Plant and Materials and supplied by others are installed correctly and in accordance with the manufacturer's specifications. This shall also include consumables such as oil filters and chemicals, etc.

The Contractor shall ensure that all Plant and Materials installed, modified, removed and reinstalled by the Contractor are correctly lubricated prior to Commissioning.

4.15 Health, Safety and Environmental requirements

The Contractor shall comply with all applicable health, safety and environmental regulations and requirements for all persons entitled to be on the Site.

The Contractor shall be responsible for the precautions and measures to ensure the health and safety of all individuals on the Site and temporary areas (if applicable) outside of the Site, but utilised by the Contractor, with the prior approval of the Employer.

This shall also include any areas that may adjoin those areas or otherwise be affected or potentially endangered by the Works. The Contractor shall be responsible for the adequacy, stability and safety of all Site and Temporary Areas operations, methods of construction, all Contractor's Equipment, Temporary Works and structures.

The Contractor shall provide and/or install for all necessary safety protection equipment (e.g. rotating parts guards, hot surface insulation/guards, railings)

and necessary Contractor's Personnel, in accordance with the applicable legislation in South Africa, including the Occupational Health and Safety Act (1993) of South Africa. The Contractor shall take special note of the requirements of the Construction Regulations, 2003.

The Contractor shall comply with the Employer's Environmental Management Plan Requirements.

The Plant's noise level shall be less than 85 dBA when measured at any point further than three metres from the source(s) of the noise.

4.16 Quality Control Plan

The QCP shall be approved by the Engineer and shall conform to the requirements of ISO 9001 (2000) and shall incorporate the following as a minimum:

- 4.16.1 A detailed organisation chart;
- 4.16.2 A list of Subcontractors;
- 4.16.3 A list of the applicable quality assurance procedures;
- 4.16.4 A list of applicable Codes and Standards for design, construction, inspection and tests;
- 4.16.5 The Contractor's inspection plans;
- 4.16.6 Any Subcontractor's inspection plans;
- 4.16.7 Provisional programmes for expediting Works to be executed by Subcontractors;
- 4.16.8 Procedures to manage the non-conformance of Plant and Materials
- 4.16.9 An audit schedule for Contractor/Subcontractor activities.

The QCP shall indicate Hold Points and Witness Points proposed by the Contractor. The Engineer will determine, in consultation with the Contractor and the Employer, and notify the Contractor, the Hold Points and Witness Points to be witnessed by the Engineer and/or the Employer.

The Taking-Over Certificate shall not be issued to the Contractor until all the Hold Points on the QCP have been witnessed and approved by the Engineer and/or Employer as required.

The Contractor shall be responsible for updating the QCP regularly throughout the Contract. The QCP shall be required to demonstrate compliance with the requirements of the Contract.

The Engineer shall be entitled to audit any aspect of the QCP and details of all procedures and compliance documents shall be submitted to the Engineer for

information, before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor itself shall be apparent on the document itself.

The Contractor shall maintain the Contractor's Data Book for the Works at all times, and the Contractor's Data Book for the Works shall be made available to the Employer at all times during the Contract for review and approval by a Third Party Inspector.

4.17 Storage of existing Plant and Materials

Plant and Material to be stored for future use by the Employer shall be transported by the Contractor to a storage area to be advised by the Employer. All Plant and Materials shall as far a practically possible, be stored above the ground on wood block, palettes, etc.

4.18 Welders Certification

All welders employed by the Contractor shall be subjected to a welding test prior to carrying out any work on Site by an Approved Inspection Authority employed by the Contractor. These tests shall be co-ordinated and supervised by the Contractor. The testing process shall consist of each welder performing a series of test welds which shall be inspected by the Approved Inspection Authority to be supplied by the Contractor. The Inspection Authority shall provide the Engineer's Third Party Inspection Authority and the Site Manager with full certification for all welders tested. The Contractor shall be responsible for the supply all test materials, welding rods, welding machines and any other material and equipment required to carry out the above tests.

4.19 Weld maps, weld inspection and weld failures

The Contractor shall allocate each welder a unique hard stamp number prior to starting any work on Site. These numbers shall be used by the Contractor to outline on each drawing the welds to be carried out by the relevant welders. These drawings shall serve as a weld map to be used by the Engineers Third Party Inspection Authority's inspector during testing. In addition each welder shall hard stamp their own unique number next to each weld produced by them on Site. All hard stamps and hard stamp equipment and materials shall be provided by the Contractor.

The Engineers Third Party Inspector shall identify the welds to be tested by the Contractor. These shall include all NDT, X-ray; die pen or any other test as required by the relevant codes, standards and the Project Standards. For every weld failure, 2(two) additional equivalent tests shall be conducted for welds carried out by that same welder. Should these tests uncover further weld failures, testing of 100% of all that particular welder's welds may be conducted by the Contractor under the supervision of the Engineers Third Party Inspector. In the event that 30% of all welds produced by a particular welder fail the tests carried out during the 100% testing period, that particular welder shall be immediately be removed from Site The cost of all the additional testing, all rectification work and the removal of unsuitable welders shall be for the Contractors account.

5 LIST OF DRAWINGS

5.1 Drawings issued by the Employer

- Existing drawings pack

SECTION 2

6 MANAGEMENT AND START UP

6.1 Management meetings

- a. It is the Employer's specific intention that the Parties and their agents use the techniques of partnering to manage the contract by holding meetings designed to pro-actively and jointly manage the administration of the contract with the objective of minimising the adverse effects of risks and surprises for both Parties.
- b. The *Contractor* attends management meetings at the Project Manager's request. These meetings are to be held fortnightly or as regularly as maybe determined by the Project Manager. At these meetings the *Contractor* presents all relevant data including safety, health and environmental issues, progress, quality plans, Subcontractor management, as may be required.
- c. Meetings of a specialist nature may be convened as specified elsewhere in this Works Information, or if not so specified, be convened by persons at times and locations to suit the Parties, the nature and the progress of the *Works*. Within five

days of the meeting the person convening the meeting shall submit records of the meeting to the Project Manager.

- d. All meetings shall be recorded in a register, using minutes prepared and circulated by the person who convened the meeting. Such minutes (or register) shall not be used for the purpose of confirming actions or instructions under the contract as these shall be done separately by the person identified in the conditions of contract to carry out such actions or instructions.

6.2 Documentation Control

All documentation shall conform to the latest revisions of the following, i.e.:

- a. SANS 10111 - Code of Practice for Engineering Drawings, or
- b. ISO 9001:2000 - Quality Management Systems Requirements.

6.3 Safety risk management

The *Contractor* shall comply with the health and safety requirements contained in Annexure A to this *Works Information*.

6.4 Environmental constraints and management

The *Contractor* performs the *Works* and all construction activities within the Site and Working Areas in accordance with the provisions of the specification Standard Environmental Specification (SES), Project Environmental Specifications (PES) and specification Construction Environmental Management Plan (CEMP) contained in Annexure B, C and D as well as section C of the Scope of Works

The *Contractor* ensures that its Subcontractors comply with the requirements of the CEMP.

The CSHEO submits daily, weekly and monthly checklists as required by the CEMP to the ProjEM.

The CEMP is:

- a. *Contractor's* Declaration of Understanding.
- b. Environmental method statements for construction operations.
- c. Materials handling, use and storage.
- d. Re-vegetation and rehabilitation.
- e. Environmental closure certificate.
- f. Environmental inspections and audits.
- g. Environmental alignment meetings.

The roles and responsibilities of the various personnel acting on behalf of the Project Manager and who communicate directly with the *Contractor* and his key persons with respect to the CEMP and environmental issues are:

- a. The Construction Manager (CM) is responsible for environmental management on the Site and Working Areas and reports to the Project Manager with specific tasks to.
- b. Implementing the Employer's CEMP.
- c. Monitor *Contractor's* compliance to the CEMP.

The Project Environmental Manager (ProjEM) is responsible for ensuring that the *Contractor* complies with the CEMP and acts on behalf of the Project Manager.

The Project Environmental Officer (ProjEO) reports to the PSSM and ProjEM, conducts the day-to-day tasks to ensure that the *Contractor* complies with the CEMP and acts on behalf of the Project Manager.

6.5 Quality assurance requirements

6.5.1 Quality system

The supplier shall maintain an effective quality system in accordance with the relevant requirements of SABS/ISO9000 Series, or equivalent standard, to ensure and demonstrate that material, workmanship, procedures and services conform to the specified requirements.

A copy of the contractor's / supplier's Quality Manual may be requested for review by TRANSNET followed, at Transnet's option, by Quality Assessments or Surveillance's to obtain evidence that a satisfactory quality system is being maintained.

6.5.2 Work Procedures Plan

Within a maximum of two (2) weeks following Contract Award or as per order condition, the Contractor shall produce a Work Procedure Plan. This Procedure Plan, as a MINIMUM, identifies the following:

- Order Number, Job Title.
- Organogram with nominated personnel, including signatures and initials.
- Scope of Job, Equipment, Structure(s)
- Basis for Designs and Fabrication, e.g. codes and specifications.
- Communication e.g. contacts address, telephone number, facsimile number, numbering systems and formats.

- Bar Chart (Time Schedule) for production, supplies and repair works including Sub-Suppliers.
- Control documents, e.g. issuing and receiving, transmittals.
- Numbering of Documents.
- Specific Procedures and/or General Procedures list to be utilized.
- Internal Quality Audits and/or Surveillance's to be performed with actual dates.

6.5.3 Quality Control Plan

- 6.5.3.1 The Contractor shall provide a Quality Control Plan (Inspection and Test Plan) specifying his proposed quality control activities for the entire scope of supply and scope of works. The Quality Control Plan shall incorporate, as a minimum, an INSPECTION CHECK LIST. The Quality Control Plan shall reference the procedures, codes and standards which apply to the listed activities, the acceptance criteria, the records to be produced and similarly it shall incorporate all Sub-contractors and suppliers activities. The Quality Control Plan shall be prepared on the Contractors / Suppliers standard format.
- 6.5.3.2 Deviations from this Quality Control Plan may only be permitted following acceptance in writing by the Engineer and/or the appointed Third Party Inspection Authority.
- 6.5.3.3 The Contractor shall not undertake any work in advance of the review and acceptance of the Quality Control Plan without the written consent of Transnet.
- 6.5.3.4 During the review of the Quality Control Plan / Inspection and Test Plan, Inspection and Test intervention points will be included by Transnet and, where applicable, the Third Party Inspection Authority to indicate their intended monitoring during manufacturing, fabrication and installation.
- 6.5.3.5 The Contractor / Supplier shall ensure that any work sub-contracted will be covered by Quality Control Plans / Inspection and Test Plans generated by the relevant Sub-contractor or Supplier.

6.5.4 Pre Inspection Meetings

Pre-inspection meetings may be held at the discretion of Transnet. In such cases, the content of the agenda shall include, but not be limited to, the following:

- Documentation: Method of Submission, review etc.

- Quality Control Plan: Agreement of inspection, witness, review and hold points, Agreement of contacts for notification, etc.
- Code Data book / QC Dossier: Agreement to contents and format.
- QC Procedures: Agreement to Scope.
- AIA: Authorised Inspection Authority requirements.
- Communications: Responsible persons.
- Non-destructive Testing: Personnel qualification, method and extend required.

6.5.5 Inspection

6.5.5.1 Definition: Inspection means all activities such as measuring, examining, testing, gauging one or more characteristics of material or service and comparing these with specified requirements to determine conformity.

6.5.5.2 Inspection Point Definition:

- **Hold Point = H:** This indicates an inspection or test which is considered vital to quality, integrity and safe functioning of the material or services and which can only be achieved at this point. The Contractor shall not proceed beyond this point beyond this point without written approval by Transnet and/or the appointed Third Party Inspection Authority.
- **Witness Point – W:** This indicates an inspection or test which may be equally as important as a Hold Point, but which can be waived by the appointed Third Party Inspection Authority or Transnet.
- **Review Point – R:** This indicates that information collected is required to be reviewed and approved. The job may continue past the review point, however, if the information is inadequate or does not satisfy the requirements, may necessitate additional work.
- **Inspection Points – I:** During the review of the Quality Control Plan, Inspection points will be added by Transnet and where relevant, the Third Party Inspection Authority to indicate the intended monitoring of the Contractor's and/or Sub-Contractor's quality control.

6.5.5.3 Contractors Inspection

The Contractor shall as a minimum, carry out the inspections as detailed in the Quality Control Plan and maintain the required records for verification by Transnet and/or Third Party Inspection Authority. For sub-contracted material or services, the Contractor shall ensure that controls are effective, including, where necessary, monitoring at the Sub-Contractor's works and retention of the necessary records. Signing-off of the Quality Control Plan progressively by all relevant parties is a mandatory requirement following the indicated inspection activity.

6.5.5.4 Readiness for Inspection

6.5.5.4.1 Material or services shall be deemed ready for inspection by Transnet only when:

- Material or services shall be deemed ready for inspection by Transnet only when:
- The Contractor has firstly carried out his own inspection at the stage identified on the relevant Quality Control Plan and is satisfied that material, workmanship and services meet the specified requirements. Documented evidence shall be maintained by the Contractor including signing-off the Quality Control Plan.
- All applicable certificates and quality documents are available for review at the inspection location. Immediately following receipt by the Contractor ALL material and certification (including welding consumables), the Contractor shall review these certificates and endorse them "Verified to Code/Specification Requirements" including date and name. Immediately following, the material and certification shall be presented to Transnet and/or the appointed Third Party Inspection Authority for review and endorsement.

6.5.5.5 Notification of Readiness for Inspection

- Notification by fax/email/ telephone is required for both Hold and Witness points at least two (2) working days in advance of "Readiness of Inspection" or as agreed at the pre-inspection meeting. Review points do not require prior notification.

- The Contractor shall ensure that the latest revisions of approved drawings and/or procedures with evidence of acceptance by Transnet, his nominated representative or Third Party Inspection Authority are available.
- Contractors are advised that it is a condition of Purchase / Contract that all costs of Transnet's inspector, Engineer and/or Third Party Inspection Authority will be passed on to the Contractor for aborted inspection visits. A visit is considered aborted if:
- The Contractor / Supplier advises "readiness" for inspection and upon arrival of Transnet's Inspectors, Engineer(s) or Third Party Inspection Authority, the material or Services and/or the associated documentation is not ready; or if Transnet's personnel identifies that material or services are to specification such that the Contractor's Inspector should have identified the non-conformity prior advising readiness for Transnet's or Third Party Inspection Authority inspection.
- NOTE: An inspection report to this effect shall be generated by the Transnet's Inspector, Engineer or Third Party Inspection Authority and countersigned by the Contractor's duly authorised representative. This report shall form the basis of back-charges to the Contractor / Supplier by Transnet. In addition, a non-conformance report shall be raised by Transnet, the Engineer or the Third Party Inspection Authority which shall be replied to by the Engineer within twenty-four (24) hours.

6.5.5.6 Inspection Waiver

- Any Transnet Witness, or review or Hold point may, at the sole discretion of Transnet, be waived, which will be followed by an inspection waiver report.

6.5.6 Materials of Construction

- All material shall be purchased and certified in accordance with EN 10204 ff. requirements as a minimum. The term "Purchaser" in EN 10204 shall mean the Contractor. The certificates shall report mechanical properties in the heat treated condition and must be accompanied by the relevant verified furnace charts.

6.5.7 Assessment/Audit/Surveillance

- Transnet reserves the right to conduct a Supplier Quality Assessment, prior to the award of any Purchase Order, to verify that the Contractor's system complies with the relevant quality standard. Additionally, Transnet may conduct a Quality Assurance Audit or Surveillance at any time after the award of a Purchase Order. Four (4) days notification of a QA Audit and twenty-four (24) hours notification of a QA Surveillance will be given by facsimile / email to the Contractor's nominated QA/QC representative.
- Should the Contractor's quality system be found deficient during their assessments, audits or surveillance's, the Contractor will be given opportunity to carry out corrective action within a period of time to bring his system up to the required standard. A follow up audit surveillance will be carried out to verify that the Contractor has carried out the necessary corrective actions.
- If, during a follow-up audit or surveillance, it is found that the required corrective actions have not been carried out, Transnet reserves the right to take such actions as necessary to rectify the deficiencies. It is a pre-requisite that the Contractor fully supports any such actions
- Surveillance by Inspectors will also be carried out by Transnet as an alternative method of monitoring the Contractor's quality control. This will normally take the form of a verification of a Section of the Quality Control Plan where the physical and documentary evidence will be required to verify compliance with the Quality Control Plan.

6.5.8 Non-Conformities

- 6.5.8.1 Non-Conformity is defined as a deficiency in characteristic, documentation or procedure which renders the quality of an item, work or service unacceptable or indeterminate in accordance with specified requirements. Such Non-Conformities shall be identified by the Contractor/Supplier/Transnet and/or Third Party Inspection Authority.
- 6.5.8.2 Such non-conformities require the issue of a Non-Conformity Report (NCR) by the Contractor/Supplier in compliance with his own QA system. The NCR then becomes the means by which the Non-Conformity is identified and triggers the need for corrective action and measures.
- 6.5.8.3 The non-conforming material, work or service shall be reviewed by the Contractor in accordance with documented procedures and it might be:
- Re-worked to meet the specified requirements
 - Accepted, with or without repair; or
 - Re-graded for alternative application; or
 - Scrapped

- 6.5.8.4 All proposed re-working or repair shall, together with the relevant procedures, be firstly reviewed by Transnet and/or Third Party Inspection Authority where applicable.
- 6.5.8.5 In the event that the Transnet Inspector and/or Third Party Inspection Authority identifies a Non-Conformity that is not subject to a Contractor/Supplier NCR, the Transnet Inspector and/or Third Party Inspection Authority will raise an NCR on the Contractor. The Contractor must issue to the Transnet Inspector in writing within twenty-four (24) hours a response indicating the corrective action he propose to make.
- 6.5.8.6 Material, work and services which do not conform to requirements shall not be used unless written authority, on the returned NCR, is obtained for the Non-Conformity.
- 6.5.8.7 The Contractor shall maintain a register of his NCR's and shall submit this register to Transnet monthly. The Engineer will audit the register. Transnet reserves the right to request copies of NCR's for review of deviation and disposition.
- 6.5.8.8 Corrective actions will necessitate additional inspections and/or tests shall be included in an updated Quality Control Plan which shall be submitted for review to Transnet.
- 6.5.8.9 The Contractor shall ensure that his procedures provide for the identification and segregation of all non-conforming materials, work or services.
- 6.5.9 Recording 'AS-BUILT' sizes
- 6.5.9.1 The Contractor shall complete the "as-built" details wherein all actual weld sizes, material thicknesses shall be recorded.
- 6.5.9.2 The actual point of measurement will be clearly indicated.
- 6.5.10 Contractor Document Submissions
- 6.5.10.1 When the Contractor submits his documents for re-view, he shall, where relevant, submit them to the Transnet document handling nominated contact.

Transmittals shall only cover one item per PO and shall be submitted in complete sets in order to perform a full review, e.g.. WPS's, weld procedure, weld map summary, material lists and GA drawings and calculation, etc.

6.5.11 Handover Acceptance System

The Purpose of this system is to provide essential handover and acceptance information to all parties engaged in the design, construction, modification, demolition, refurbishment and commissioning of plant and equipment at the Cape Town dry-dock. The information and guidelines required to achieve a smooth sequence between all construction and commissioning activities, and thereafter the successful start-up operations and transfer of ownership of plant and equipment to TNPA.

6.5.11.1 This procedure provides for a sequenced, construction completion and checkout of plant / equipment leading up to the transfer of care, custody and control to Transnet.

6.5.11.2 This procedure adopts a two package handover system:

- Quality Control Dossier
- Management Package

6.5.11.3 Quality Control Dossier and Management Package Compilation

- The Contractor shall in accordance with this procedure and requirements in the Purchase Order / Technical Specifications, compile the Quality Control Dossier and Management Package with the accepted contents.
- The Contractor shall compile the Quality Dossier which includes the Code Data Book (format as stipulated in this document) in accordance with this procedure to ensure that all requirements have been met and the relevant documents are included in the Quality Control Dossier.
- For multiple disciplines e.g. new installations, fabrications, modification or welding works, the QC Dossier shall be developed for each discipline or system.
- Management Package: consists of:
 - Completed "Punch-List", signed off by operations, area manager and the Engineers appointed 16.2 responsible for the area/unit.
 - Drawing Package "as-built"
 - Vendor Data Documentation as per Bill of Material of detail designs and as built documentation.

The Engineer shall:

- Collect and compile the Management Package in accordance with this procedure, to ensure all requirements have been met. This ensures that:
- The QC Dossier has been signed off by Transnet and the Inspection Authority (where applicable)
- The plant/facility/equipment has been commissioned (or handed over) by and with operations,
- All required performance tests have been successfully carried out by operations and maintenance department,
- Copies of approved test run certificates have been inserted into the Management Package.
- All maintenance documents have been updated and new instructions been inserted.

The Contractor submits his Quality Management System documents to the Project Manager as part of his programme under ECC3 Clause 31.2 to include details of:

- a. Quality Plan for the Contract
- b. Quality Policy
- c. Index of Procedures to be used and
- d. A schedule of internal and external audits during the Contract

The *Contractor* develops and maintains a comprehensive register of documents that will be generated throughout the Contract including all quality related documents as part of its Quality Plan.

6.5.12 Code Data Book

The Code Data Book shall have the following content and format:

- Cover Page:
 - A MANUFACTURER / CONTRACTOR
 - B ENGINEERING CONTRACTOR (if applicable)
 - C AUTHORISED INSPECTION AUTHORITY (or certifying body)
 - D PURCHASE ORDER NUMBER
 - E CONTRACT NUMBER
 - F EQUIPMENT / PLANT / WORKS DESCRIPTION
 - G MAUFACTURERS SERIAL NUMBER (if applicable)
 - H CODES AND STANDARDS USED
-
1. Index of Contents
 2. Release of Notes (Contractor/AIA/Client)
 3. "As-Built" drawings
 4. Authorised Inspection Authority Certificate of Compliance
 5. Design Calculations
-
6. MATERIAL AND CONSUMABLES CERTIFICATIONS
 - 6.a Material List
 - 6.b Material Map (Outline Drawings)
 - 6.c Mill Test Certificates marked with item number.
 - 6.e Heat treatment charts, NDE and mechanical testing.
-
7. WELDING DOCUMENTS
 - 7.a Weld Map(s)

7.b Weld Procedure Specification Summary

7.c Welding Procedure Specifications

7.d Procedure Qualification Records

7.e Welder Performance Qualification Test Record Summary

7.f Weld Consumables Certification

7.g Pre- and Post heating Procedures

8 INSPECTION REPORTS

8.a Quality Control Plan

8.b Dimensional Inspection Report (sizes etc.)

8.c Heat Charts and Certificates.

9 NON-DESTRUCTIVE TESTING DOCUMENTS

9.a NDT Map

9.b NDT Procedure Record Summary

9.c NDT Personnel Qualification Record Summary

9.d NDT Reports

10 PRESSURE TEST DOCUMENTS

10.a Applicable Standards

10.b Inspection Authority

10.c Pressure Gauge Calibration certificates

10.e Pressure Test certificate

6.6 Tests on Completion

6.6.1 Introduction

The required tests on completion shall consist of the following:

- Pre commissioning
- Commissioning
- Trial operation
- Performance

The Contractor shall complete all pre-commissioning and commissioning tests on all Plant and Works completed under this Contract.

In order to achieve this the Contractor shall fulfil the following requirements:

- Development and supply of commissioning and test plans for the approval of the Engineer
- Implementation of formal handover procedures and documentation from construction to commissioning

6.6.2 'Punch List' category Items

- Category A: Items which compromise safety and integrity of personnel, plant, equipment and infrastructure and must be completed following the pre-commissioning tests but prior to the commissioning and trial operation tests being undertaken
- Category B: Items which require correction prior operational acceptance and are required to be remedied following the commissioning and trial operation tests but before Employers taking over
- Category C: Items required to be remedied during the defects notification period

6.6.3 Pre commissioning

The Contractor shall complete all pre-commissioning tests and all Punch List Category A items shall be compiled during these tests and be attended to prior to the commencement of the commissioning tests.

6.6.4 Commissioning

The Contractor shall as soon as practical after carrying out the pre-commissioning tests and once all Punch List Category A items have been attended to, carry out the commissioning tests.

The Punch List Category B items shall be compiled during these tests and be attended to prior to the commencement of the trial operation tests.

6.6.5 Trial Operation

As soon as is practicable after completion of the commissioning tests, a 72 hour trial operation of the Plant shall take place.

6.6.6 Taking Over

Prior to the Employer being required to take-over the Plant all The Punch List Category B items shall be remedied.

The Works and the Plant shall be taken over when the Tests on Completion have been passed and punch List Category B items have been attended to.

6.7 Programming constraints

6.7.1 Tender Program

A summary program, hereinafter referred to as the "Tender Program" for the duration of the contract are submitted by the Contractor, reflecting all Milestone deliverables and Events.

The level of this program must at least be "compatible" to the Price Schedule columns and or the breakdown of sections in the bills of quantities as applicable. The incidence of Payment Schedules or Cash Flow Forecast, submitted with the Contractor's program must be based on this program.

The Contractor's Programs are evaluated by the Project Manager to assess the Contractor's ability to plan his portion of the project to the extent necessary for the high degree of mutual co-ordination demanded by the Project.

Non-compliance with this specification may lead to the disqualification of the tenderer. At the Project Manager's discretion, the Contractor may be requested to prepare and submit a new Contract Program.

6.7.2 Initial Program, Contract Program and Subsequent Revisions

- a. The Contractor submits a program within 1 weeks of the date on which he was notified of having been awarded the contract / order.
- b. Any program submitted which does not supply all the required documentation set out in this document shall be deemed to be rejected, whether or not the Project manager does so in writing.
- c. This Initial Contract Program, hereinafter referred to as the "Initial Program", is be drawn up at the level of detail necessary in the opinion of the Project Manager to ensure effective control over the work, usually to Level 4 detail.
- d. A "Summary" or "ham-mocked" program is submitted with the Initial Program. The summarized activities are inserted in such a way that the Milestone Dates as well as major interfaces of services and/or other contracts logically required for the completion of the contract are clearly shown. The start and finish of the summarized or ham-mocked activities are clearly indicated on the detailed network.
- e. Unless stated to the contrary, the Project Manager will examine and comment on the Initial Program within 2 weeks of submission and the Contractor amends and submits this program, hereinafter referred to as the "Contract Programme" for approval within a further period of 5 days.
- f. The Project Manager may not in every instance be able to provide all information or working drawings, where applicable, of every aspect of the Works but such non-availability will not be deemed to be an excuse for non-presentation of programs. In such instances the relevant part of the program should be based on the Contractor's best estimate with a statement on which assumptions or drawings it is based.
- g. Should the Project Manager so require, or should problems occur during the execution of the contract, the Project Manager might request that portions of the program be expanded to enable closer control to be exercised e.g. site construction and commissioning programs. In such cases the more detailed Works fit exactly into the logic and time span of the Contract Program, but may be presented as separate programs.
- h. Minor revisions to the Contract Program may be introduced from time to time by mutual agreement. Should the Project Manager require a major revision to the Contract Program, such revision will be specified to the Contractor in writing.
- i. The Project Manager specifies the date by which the Contractor is required to submit the revision in question. This date is not, unless otherwise agreed, be less than 2 weeks from the date of notice.
- j. Revised Payment Schedules are required based on the revised Contract Program. These revisions are made when changes occur in this program and must be updated every month to include actual payments.

- k. Should the Contractor require a major revision affecting the logic or dates of the program, such revision will be specified to the Project Manager in writing for approval before the revision is performed.
- l. A revision to the program does not invalidate the "Date of Completion" in terms of the General Conditions of Contract and as given in the appropriate schedules. Changes to these dates can only be effected through a contract amendment.
- m. Progress is monitored against the latest revised program and payments controlled by the latest revised Payment Schedule accepted by the Project Manager.

6.7.3 Progress Reporting

- a. The Contractor updates the program and supplies the progress reports to show actual and expected progress compared to the latest agreed Contract Program. Progress information may be verified by the Project Manager at any stage.
- b. Progress reports on design, manufacturing, shipping, transport and site progress are submitted separately as per Table 1: Progress Reporting Requirements.
- c. The methodology to define work content in the progress curves needs to be agreed to between the Contractor and Employer within 5 days of Contract Award and may include parameters such as man-hours, m³ concrete, tons of steel, length of cable and cable rack to be installed, number of terminations, etc.
- d. The work content needs to be specifically designed to suit the type of work and to effectively indicate actual progress against planned progress.
- e. Progress reports are submitted in line with the requirements as specified in the table below.

TABLE 1: PROGRESS REPORTING REQUIREMENTS

ITEM	DESCRIPTION	FREQUENCY
1.	General Planning Report and revised network if logic has changed since the previous report.	Weekly
2.	Critical Activities Report. (Look ahead)	Weekly
3.	Milestone Report.	Weekly
4.	Updated Bar Charts.	Weekly
5.	Updated Program Graphs.	Weekly
7.	Progress S-Curves.	Weekly
8.	Expediting Report	Weekly

9.	Milestones of Deliverables	Weekly
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- f. The Contractor uses Microsoft Projects for his programme submissions or a similar programme software package equivalent to Microsoft Projects 2003 or later version subject to and with the prior written notification and acceptance by the Project Manager.

6.7.4 Reporting and monitoring

The Contractor submits programme narrative report to the Project Manager at weekly intervals in addition to the intervals for submission of revised programmes stated under Contract Data Part One. Contractor submits monthly programme narrative report to the Project Manager.

The Contractor completes an assessment of all activities in progress and to completion to determine percentage complete, forecast completion dates, deviations from the Accepted Programme and proposes remedial actions to rectify deviations.

The Contractor shows on each revised programme he submits to the Project Manager a resource histogram showing planned progress versus actual, deviations from the Accepted Programme and any remedial actions proposed by the Contractor.

- a. The Contractor submits the programme narrative report detailing the status and performance of operations on the Site and Working Areas; status and performance of operations outside the Working Areas; manpower histograms; plant and equipment histograms; S-curve of overall progress; and critical action items (top 10). Report indicates “progress this period” and “progress to date”.
- b. The Contractor’s weekly programme narrative report, updated and issued weekly, includes:
 - i. Level 4 Project Schedule – showing two separate bars for each task i.e. the primary bar must reflect the current forecast dates and the secondary bar the latest Accepted Programme.
 - ii. 3-week Look-ahead Schedule – showing two separate bars for each task i.e. the primary bar must reflect the current forecast dates and the secondary bar the latest Accepted Programme.
 - iii. Manpower Histogram – reflecting actual, forecast and planned activities
 - iv. Plant and Equipment Histogram – reflecting actual, forecast and planned activities

- v. S-curves – reflecting the actual percentage complete versus the planned percentage for the overall contract utilising the earned values.
- c. The Contractor's monthly programme narrative report is submitted a week before the last Friday of each month, or as required by the Project Manager. The report indicates "progress this period" and "progress to date" and include, but is not limited to, the following:
 - i. Summary of progress achieved during the reporting period.
 - ii. Latest Accepted Programme.

6.8 Contractor's management, supervision and key people

The Contractor provides an Organogram and Curriculum Vitae's of all his Key people (both as required by the Employer and as independently stated by the Contractor under Contract Data Part Two) and shows how such Key people communicate with the Project Manager, the Supervisor and their delegates.

The Contractor employs a CSHEO, based on the Site, as a key person under ECC3 Clause 24.1.

The CSHEO reports to the PSSM in respect of issues relating to safety risk management. The CSHEO submits the CHSMP to the Project Manager for approval and ensures that the Contractor implements the CHSMP.

The CSHEO reports to the ProjEM on the Site in respect of issues relating to environmental management. The CSHEO submits the CEMP to the Project Manager for approval and ensures that the Contractor implements the CEMP.

The CSHEO tasks include but are not limited to:

- a. Reports a safety incident to the Project Manager;
- b. Reports a safety incident to the Project Manager;
- c. Attends all SHE meetings, toolbox talks, induction programmes and monitors compliance with the CHSMP;
- d. Submits daily, weekly and monthly reports and data as required by the CHSMP to the PSSM;
- e. Reports an environmental incident to the Project Manager;
- f. Undertakes daily, weekly and monthly inspections of the Site and Working Areas as required by the CEMP and submits reports to the ProjEM;
- g. Monitors compliance with the CEMP and the environmental method statements submitted to the Project Manager; and
- h. Ensures the Contractor clears litter from the Site and Working Areas.

The Contractor employs a QA/QC Manager (CQA/QCM), based on the Site, as a key person under ECC3 Clause 24.1.

The CQA/QCM reports to the Supervisor. The CQA submits the PQP to the Project Manager for approval and ensures that the Works meet the standards stated in the Works Information.

The CQA/QCM tasks include but are not limited to:

- a. Maintains the comprehensive register of documents required by the PQP;
- b. Undertakes all inspections and testing required by the PQP;
- c. Prepares and regularly updates the CDR, and
- d. The Contractor employs a Contractor's Industrial Relations Practitioner (CIRP), based on the Site, as a key person under ECC3 Clause 24.1.
- e. The CIRP ensures that all reports and Industrial Relation requests are submitted accurately and in a timely manner to the Project Manager.

The CIRP tasks include but are not limited to:

Dedicated to human resources, industrial relations and any other Contractor employee related function; Resolve all human resources and industrial relations matters arising from the Contractor's employees;

The Contractor employs the Contractor's Planner (CP), based on site, as a key person under ECC3 Clause 24.1.

The CP is based on the Site and is responsible for all construction programming, planning and reporting as stated under paragraph 2.6 of this Works Information.

The CP tasks include but are not limited to:

Undertakes the planning and scheduling of all activities comprising the Works.

Ensures the Contractor submits the first and all subsequently revised programmes accurately and in a timely manner to the Project Manager.

Ensures the Contractor submits programme narrative report to the Project Manager at weekly intervals.

6.9 Training Workshops and technology transfer

The Contractor facilitates the following requirements for training Workshops:

- a. A safety pre-mobilisation Workshop.
- b. Contractor employee safety training programme.
- c. The Contractor utilises local people for staffing up some of his requirements and ensures that there is adequate skills transfer taking place.

6.10 Insurance provided by the Employer

The insurance that will be provided by the Employer is as per the procedure manual contained in Part C1.

The procedure manual further details the cover to be arranged by the Contractor and subContractors as well as exclusions and deductibles.

The Contractor liaises with the Employer and the Project Manager at the Contract Date to declare the ECC3 contract details to the Employer's insurance brokers WILLIS SOUTH AFRICA (PTY) LTD.

Where the Works involve the assembly, erection and installation of Plant, the Contractor declares the full replacement value and not the value included in the ECC3 contract.

The Contractor liaises with the Employer and the Project Manager when a claim is made and assists in completing the Claims Advice Forms that are provided.

6.11 Contract change management

At the Contract kick off meeting, the Contractor will be provided with the format of the standard forms to be used for communication of Contract change management (ECC3 Clause 60).

6.12 Provision of bonds and guarantees

The form in which a bond or guarantee required by the conditions of contract (if any) is to be provided by the Contractor is given in Part 1 Agreements and Contract Data, document C1.3, Sureties.

The Contractor provides a bond or guarantee as required by the conditions of contract concurrently with the execution by the Parties of the form of agreement for the ECC3 contract.

6.13 Records of Defined Cost, payments & assessments of compensation events kept by Contractor

7 PROCUREMENT

7.1 Code of Conduct

Transnet aims to achieve the best value for money when buying or selling goods and obtaining services. This however must be done in an open and fair manner that supports and drives a competitive economy. Underpinning our process are several acts and policies that any supplier dealing with Transnet must understand and support.

These are:

- a. The Transnet Procurement Procedures Manual (PPM);
- b. Section 217 of the Constitution - the five pillars of Public PSCM (Procurement and Supply Chain Management): fair, equitable, transparent, competitive and cost effective;
- c. The Public Finance Management Act (PFMA);
- d. The Broad Based Black Economic Empowerment Act (B-BBEE); and
- e. The Anti-Corruption Act.
- f. This code of conduct has been included in this contract to formally apprise Transnet Suppliers of Transnet's expectations regarding behaviour and conduct of its Suppliers.

7.3 People

Suitably qualified and certified persons are allocated to tasks.

7.4 Subcontracting

Contractor does not employ or bring a Subcontractor onto the Site and/or Working Areas without the prior approval of the Project Manager.

Where the Contractor employs a Subcontractor who constructs or installs part of the Works or who supplies Plant and Materials for incorporation into the Works which involves a Subcontractor operating on the Site and/or Working Areas, then the Contractor ensures that any such Subcontractor complies with the CHSMP (described under paragraph 5.3 of the Works Information) and the CEMP (described under paragraph 5.4 of the Works Information) as appropriate and that the subcontract documentation places back-to-back obligations on the Subcontractor which reflect the Contractor's obligations under the CHSMP, CEMP and PQP.

The Contractor ensures that a Subcontractor complies fully with the Contractor's Quality Management System (as described under paragraph 5.5 of the Works Information). Quality system requirements are applied on all subcontracts to the point where the acceptability of supplies can be demonstrated solely by the conduct of inspection and/or examination of goods upon receipt at the designated point of delivery.

7.5 Plant and Materials

The Contractor provides all Plant and Materials for inclusion in the Works in accordance with the Works Information.

The Contractor replaces any Plant and Materials subject to breakages (whether in the Working Areas or not) or any Plant and Materials not conforming to standards or the specifications stated and notifies the Project Manager and the Supervisor on each occasion where replacement is required.

The Employer generally provides no "free issue" Plant and Materials but in this case sealing face materials shall be free issue.

7.6 Tests and inspections before delivery

At the discretion of the Project Manager some equipment and components is inspected at place of manufacturer before it is delivered to site.