Triton Naval Architects

Tel: +27 21 418 2090
Fax: +27 21 425 2722
mark@triton.co.za
www.triton.co.za

Unit 8, Foregate Square
Heerengracht Ext
Cape Town, 8001
South Africa

Naval Architects and Marine Engineers

IN COOPERATION WITH AURECON

STURROCK DOCK CAISSON
DRAFT OPERATIONAL PHILOSOPLY
DETAIL DESIGN PHASE

REVISION	DESCRIPTION	DATE
0	Initial Submission	22/01/2020
1	Revised to align with the Design Report	07/04/2020

DOCUMENT NO.	TNA 3501/001 Rev 1	DATE
PREPARED BY	Barry KINGWILL	APR 2020

Barry Kingwill

Triton Naval Architects
No. 8 Foregate Square Harbour Rd, Foreshore, CAPE TOWN
Tel +27 21 418 2090, Fax +27 21 425 2722
Web: www.triton.co.za, Email: triton@triton.co.za

TABLE OF CONTENTS

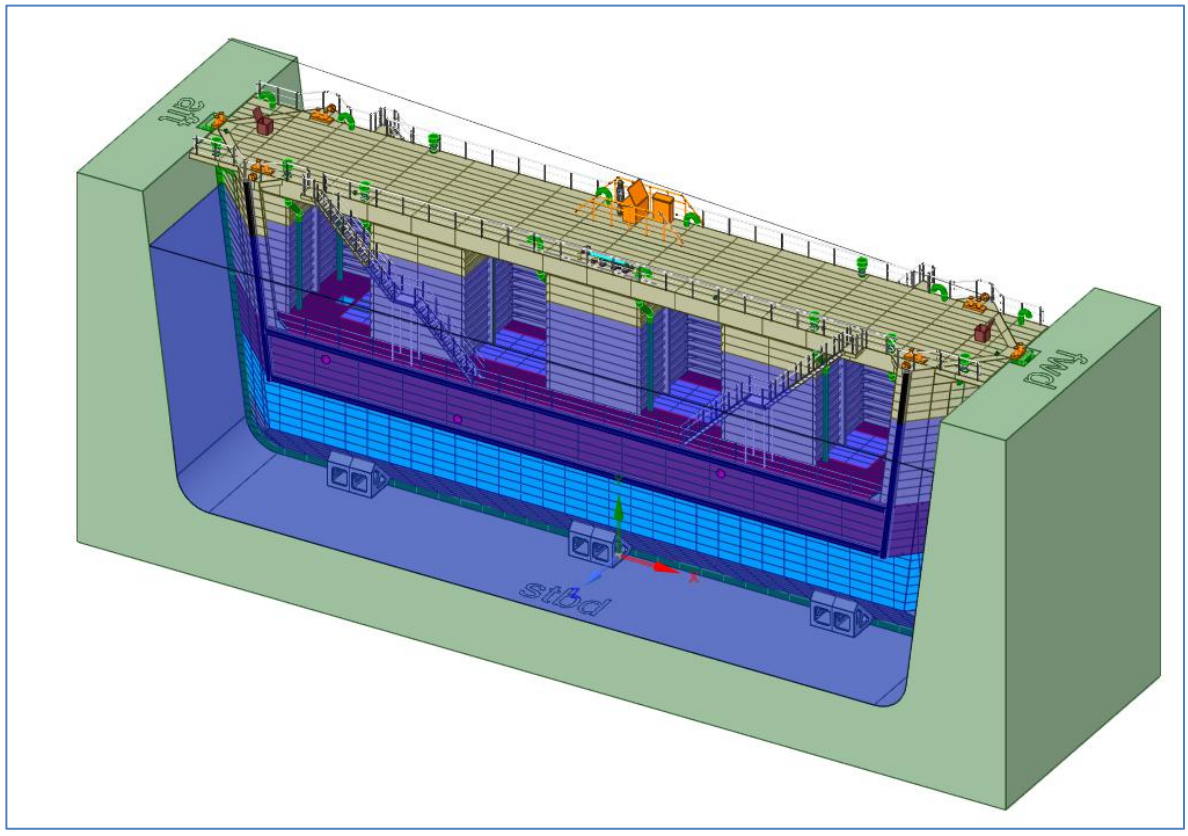
1 INTRODUCTION

This report describes the proposed operation of the newly designed Sturrock Dock Centre Floating Caisson.

As before, the caisson is of floating type, steel structure, comprising solid ballast, water ballast, air spaces, scuttle tanks and a non-enclosed tidal zone.

The air spaces, being the area immediately below the wet deck, surrounding the scuttle tanks (also located below the wet deck) and includes the end columns which offer the stability whilst being submerged. The air spaces also being the access to all valves. Access routes will be described in this report.

The scuttling or docking process, of the caisson, involves filling the three scuttle tanks with seawater from the surrounding dock.



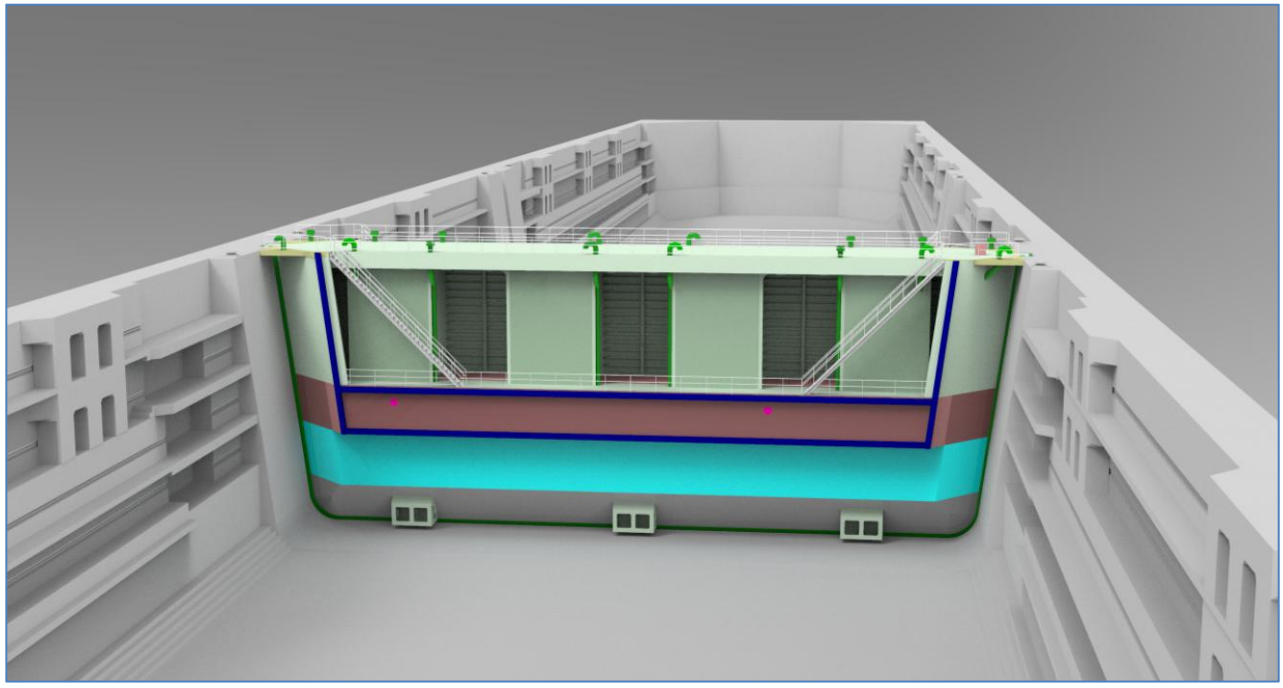
The caisson, in its floating state, will float with a draft of approx 9.9m (which is 100mm below the level of the wetdeck). This floating draft is achieved during design, through the balancing of the weight of the caisson, the buoyancy, and the applied ballast (water and fixed). It is imperative that the caisson does not have excessive freeboard to the wetdeck (i.e. much more than 100mm), else it requires too much extra weight of scuttle water to submerge the wet deck (with the caisson having a maximum waterplane area at that draft, hence maximum tonnes/cm to displace). The caisson also has its maximum stability *(see The Stability Report)* in its floating state (100mm freeboard to wet deck) as it has its minimum VCG in this state, and maximum waterplane area in this state. Once the caisson submerges its wetdeck through the introduction of water in the scuttle tanks, the waterplane area drastically diminishes, and with it the GM_T (stability), which is a function of waterplane area.

The size of the end columns are sized accordingly so as to maintain the desired level of stability (positive GM) through all drafts, with minimum added buoyancy to overcome whilst submerging.

Positive stability must remain for all drafts, including the scenario of being docked in the groove and subjected to upward docking forces.

Upward grounding force has the effect of negative weight at a location low down, hence has the effect of increasing the virtual VCG of the body, and thus decreasing the stability.

The scuttle filling and emptying water pipes are 250mm diameter with remote operable controlled throttle valves. The compressed air (and scuttle tank vent pipes) are 150mm diameter, with remote operable open/closed control valves. *More on the scuttling and filling process in later sections.*



2 APPLICABLE DRAWINGS & DOCUMENTS

2.1 New Caisson Drawings

Triton Naval Architects.....Feb 2019
Project..... TNA 3501
3501-02-1…..

2.2 3D Model

Triton Naval Architects.....Feb 2019
Project..... TNA 3501

2.3 VENTILATION FAN

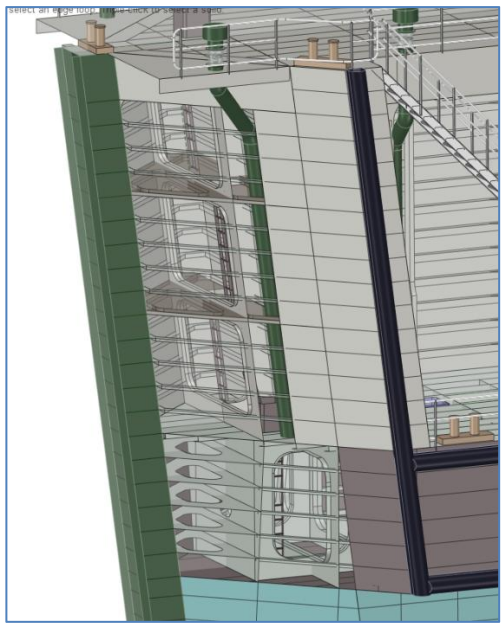
Triton Naval Architects.....Feb 2019
Project..... TNA 3501

3 STABILITY

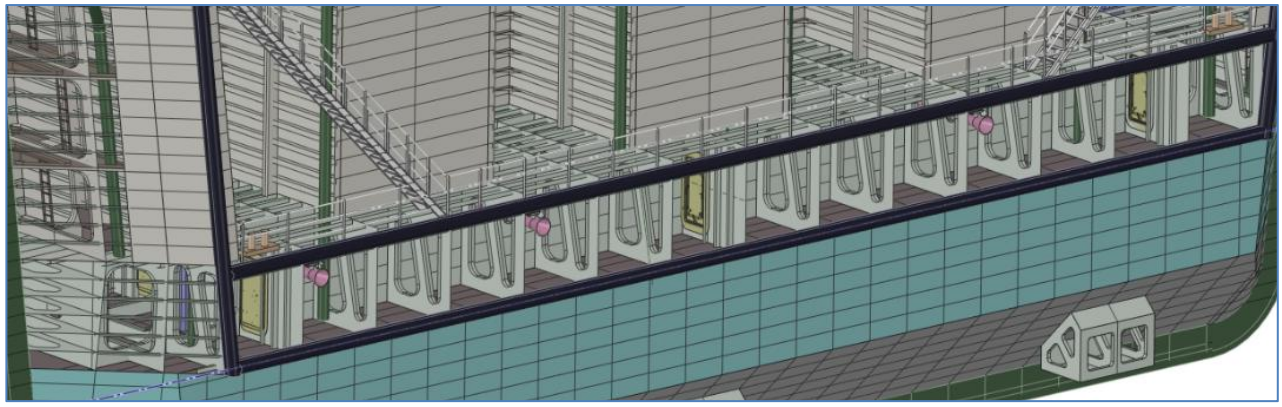
Section relocated and expanded in the Stability Report.

4 ACCESS ROUTES

Access from the road deck to the air spaces are via road deck hatches at either end. These hatches in turn lead to a series of 3 vertical (near vertical) ladders to two tweendeck landings before getting down to wet deck level. One then proceeds through another watertight hatch, and down a 4th vertical ladder into the end air spaces.



Once in the lower end air space, one can then proceed down either side gallery (the spaces outboard of the scuttle tanks) through water tight doors.

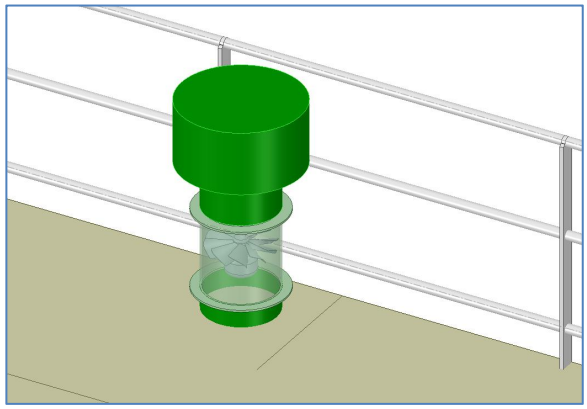


5 VENTILATION

All air spaces are “forced air” ventilated, with supply and exhaust vent pipes. The supply pipe is fitted with an inline axial fan on road deck level, with the vent pipe extending to the bottom of the compartment being ventilated. The exhaust vent extends from the top (ceiling) of the compartment being ventilated.

The subdivision of the air spaces is governed by damage stability, i.e. its ability to be able to withstand the flooding (through external impact damage) of any one compartment. There are 6 watertight compartments under the wetdeck level, and two watertight compartments in the end columns.

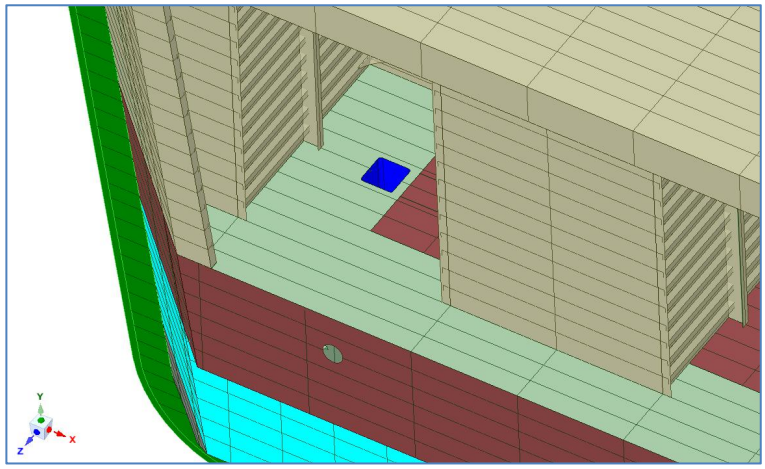
There are no control elements for the ventilation due to the small electrical power consumption of the fans. Hence it is a case of when the caisson is connected to shore power, the ventilation is active.



Location of Axial In-Line Fans in Vents

6 PERMANENT BALLAST TANK

The water ballast tank is permanently filled with sea water, and needs to remain full for stability purposes. There are two (permanently open) ducts between the water ballast tank and the wet deck. This ensures that the water ballast tank would refill (should it not be full for whatever reason) prior to the caisson being submerged. The ducts also serve as vents. These duct openings at wetdeck are closed with a grating only.



Location of Ballast Tank Duct (on wet-deck level) shown in blue

7 GRAVITY FED SCUTTLING PROCESS

The scuttling or docking process, of the caisson, involves filling the three scuttle tanks with seawater from the surrounding dock.

The scuttling procedure dictates that the central scuttle tank is filled first. The centre tank is sized such that the caisson keep will just touch the bottom of the groove (at mid and low tides), and just off touch down at spring high, when filling this tank only. The intention here, is that if only using the center tank for initial submergence and touch down on the groove, the chances of the caisson trimming during submergence is much reduced compared to when filling the end tanks first, or simultaneously.

As there is always water on both sides of the caisson at the time of commencement of scuttling, BOTH valves are opened at the same time. This also reduces the time to scuttle each tank. During the filling process, the displaced air is vented through the compressed air filling pipes (1 per tank).

Once the centre tank has been filled, the two end scuttle tanks are then filled simultaneously.

The means to throttle the submergence rate is by electronically throttling the fill pipe valves, via the control panel on road deck, or via the handheld control tablet.

(See GHS Simulation of Scuttling Process)

All water valves to the scupper tanks will be closed at this point (else the caisson would not be in its floating position)
Procedure:

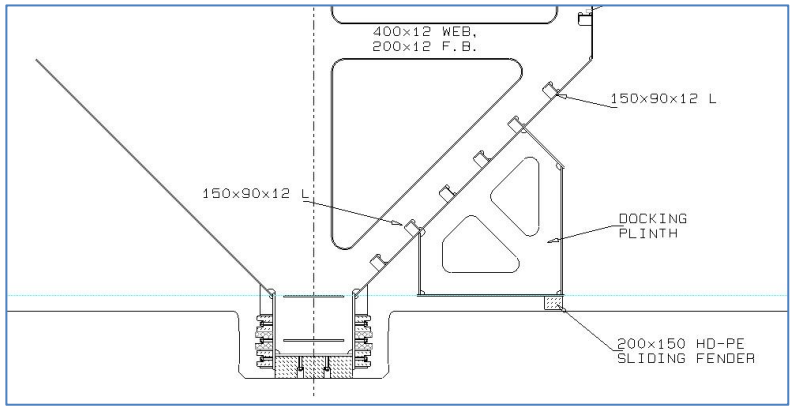
- Ensure all air valves are open on road deck, and the air hose it NOT connected so that the tanks can vent when they are filled.
- Open the two water pipes into the centre scuttle tank, and throttle according to desired rate of fill.
- The draft will increase, and the caisson keel might dock (depending on tide), will dock at anything less than spring high, with the centre tank alone.
- Once the centre tank is full, close the two water tanks
- Open both water pipes for each of the fwd and aft scuttle tanks (both tanks simultaneously). Throttle valves if need be, but if the caisson keel is already in the groove then no point in throttling the flow.
- Once the two end scuttle tanks are full, close all water valves.
- Leave all air valves open as vents.

Tank levels can be monitored at the control panel.

8 SIDE SUPPORT FRAMES / DOCKING PLINTHS

The new Caisson is designed with 6 side frame supports, which perform two functions.

1. The one function of the side frames is to avoid the need for a cradle to dock the vessel in the drydock for maintenance purposes. Standard docking blocks are stacked in way of the positions of the 6 side frames, and then caisson is then docked on these frames, making the keel entirely clear for maintenance or refurbishment of the wood or rubber.
2. The other purpose of the side frames, is (when coupled to the use of rubber spacers) to ensure the caisson cannot lean over by more than the rubber gaps allow, during the normal scuttling process. Although the positive stability will tend to hold the caisson upright, once the water is drained, the caisson could theoretically lean over within the width of the groove. These side frames with spacer blocks will reduce this effect significantly.



9 COMPRESSED AIR SYSTEM AND REFLOAT PROCEDURE

The procedure to refloat, begins with blowing out the fwd and aft scuttle tank first. This does not necessary result in the keel lifting off, but removes the ground force.

- Setting both water valves for each of the fwd and aft scuttle tank, wide open,
- Connecting the compressed air hose to the manifold on road deck.
- Setting the air valves for the fwd and aft scuttle tank to be open, and then closing the air valve to the centre scuttle tank.
- Opening the source of the compressed air (Aurecon to investigate what this involves)

The compressed air at 2bar (which will effectively be discharged into the scuttle tank at about 1.2Bar (due to first having to overcome the +/-8m waterhead at that point), will then start blowing the water out through the two water pipes. As the draft reduces, so the effective pressure will increase, as there is then less waterhead to overcome.

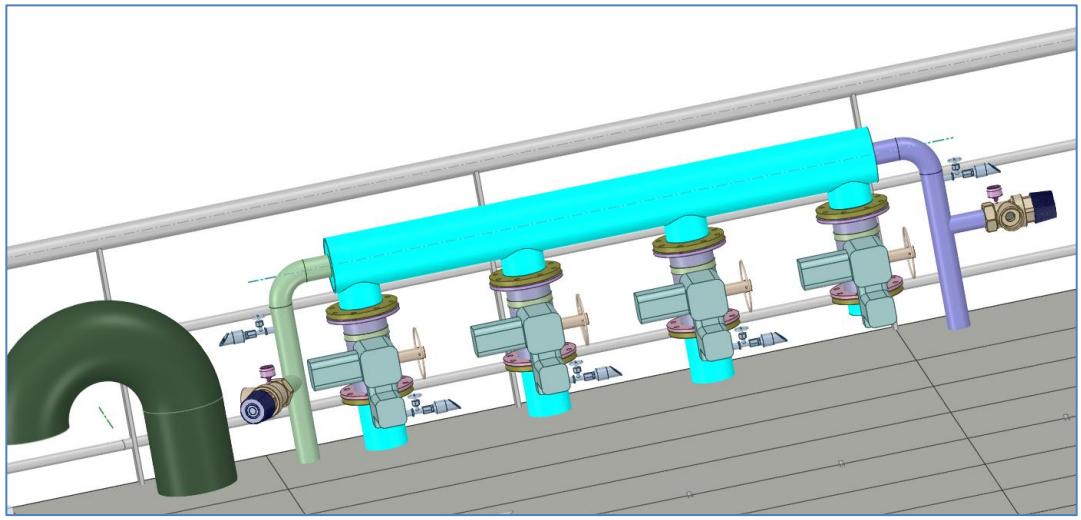
Once the aft and fwd scuttle tanks have been blown out (empty), the water valves are closed. A small amount of water in the waterpipe will then fall back into the well in the bottom of the scuttle tank. The caisson (depending on the tide) will then have neutral or a small remaining ground reaction between the keel and the groove.

The next procedure is to blow out the centre tank which will revert the caisson to a floating position with a draft at approx 9.9m (which is 100mm below thew wet deck)

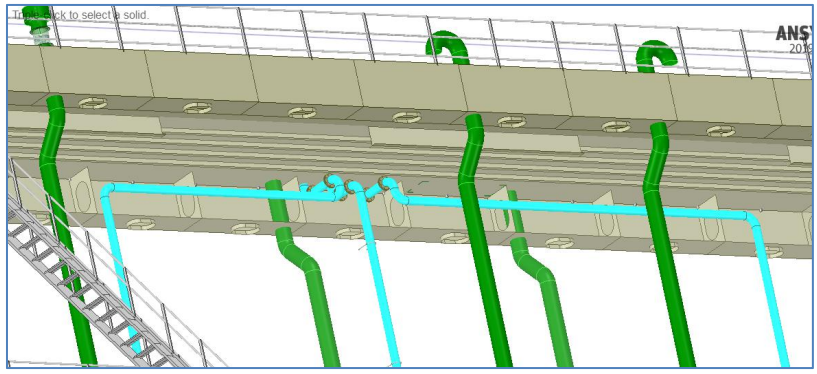
This procedure is as follows:

- Setting both water valves for the centre tank to wide open,
- Setting the air valves for the fwd and aft scuttle tank to be closed, and then opening the air valve to the centre scuttle tank.
- Setting the VENT valve on the manifold to Closed.
- Blowing out the water of the centre scuttle tank

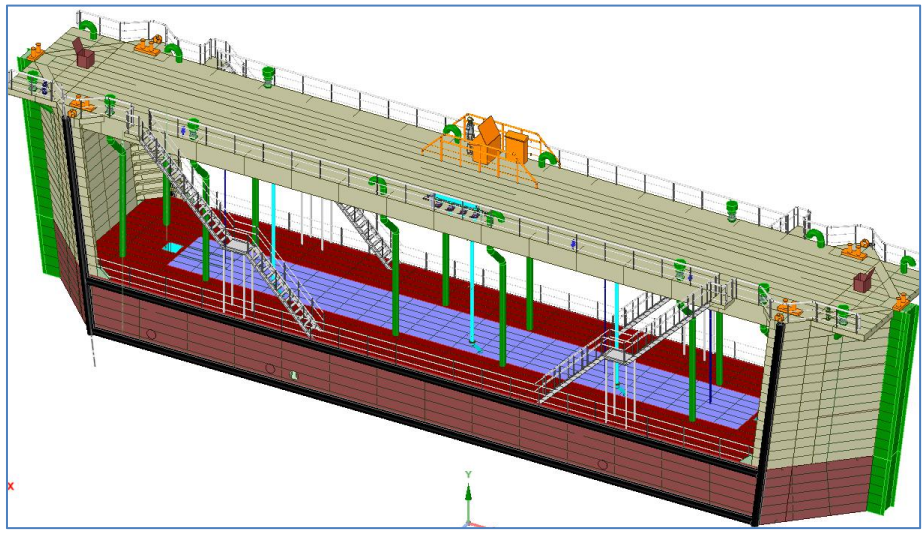
- Close both water valves of the centre scuttle tank
- Close the hose connection valve
- Switch off the compressed air supply
- Disconnect the compressed air hose,
- Open the vent valve on the manifold



Compressed Air Manifold on Road Deck



Road Deck and Swedge Bulkhead Structure removed for clarity on pipe routings of compressed air lines



Overview of Piping into the Airspaces and Scuttle Tanks (structure removed for clarity)

10 DOCKING FOR MAINTENANCE

The procedure when docking the caisson for maintenance purposes involves the following:

As the caisson will have a minimum floating draft of 9.9m **it can only be docked in Sturrock Dock,** as that draft exceeds the maximum for both the Syncrolift and Robinson Dock.

Rather than docking the caisson on a cradle, she has dedicated 6 feet/frames for this purpose.

Docking blocks, typically 1.2m to 1.4m high, would be arranged to suit the 6 feet positions, and then the caisson would be docked on the feet. This would ensure that the caisson is stable (without a cradle) and that the entire keel is accessible for inspection, maintenance and replacement of any wood or rubber should that be required.

For 1.4m docking blocks the keel would be +/-470 mm off the bottom of the dock.

The caisson must be docked and undocked with the ballast tank completely full, for stability purposes. This dictates the 9.9m draft.

Most maintenance dockings would not require access to the bottom of the keel, and in such cases the Caisson can be docked with a combination of docking blocks under the keel and under the Docking Feet.

It is only when the timber of the underside of the keel needs replacement that the Caisson needs to be docked solely on the Docking Feet.

SPECIFICATION: AUR 0005

(Version: November 2013)

QUALITY CONTROL

TABLE OF CONTENTS

© Copyright – Aurecon South Africa (Pty) Ltd

1. SCOPE

Specification AUR 0005 specifies the standard requirements for quality control of Materials and Plant manufactured for the Contract.

Additional quality control requirements may be noted for specific processes or types of Materials and Plant in other parts of the Contract Documentation. In that case, those specific quality control criteria shall have precedence if in conflict with the requirements stated here.

2. NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

The following International Organization for Standardization (ISO) standards are referred to in this specification:

- ISO 9001: Quality management systems – Requirements
- ISO 14001: Environmental management systems - Requirements with guidance for use

3. GENERAL REQUIREMENTS

The Engineer's quality surveillance shall in no way relieve the Contractor or his Subcontractors of any of their obligations with respect to design, manufacture and supply of Materials and Plant of superior quality and workmanship in accordance with the Specification. The Contractor shall be fully responsible for the quality of the workmanship and the material used.

The Contractor and all approved Subcontractor(s) shall:

a) Be responsible for compliance with the Specification and shall carry out all inspections and tests called for in the Specification in the presence of the Engineer or his assistant.

b) Abide by the approved Quality Control Plan (QCP) throughout all the intended stages of testing during manufacture, cleaning, preparation and application as well as hold points for independent quality surveillance.

All Materials and Plant manufactured for the Contract shall be done at facilities which are in possession of ISO 9001 certification. ISO 14001 certification for manufacturing facilities will be specified in the Amendments to this Specification.

The Contractor and his Subcontractor(s) shall satisfy the Engineer that they have the management, facilities, equipment, skilled staff, quality control procedures, required test methods and standards to carry out the quality control committed to in the approved Quality Control Plan.

In this regard, the Contractor and his Subcontractors shall be subject to quality audits.

4. FACILITIES FOR TESTING

The Contractor shall provide at his own cost, all material, samples, facilities and equipment required for testing and shall carry out all tests at his own expense. Complete records of test results shall be kept.

Test calibration certificates from an independent accredited laboratory, verifying the accuracy of all measuring and testing instruments requiring calibration, shall be provided by the Contractor. Recalibration shall be carried out as necessitated by circumstances but at intervals not exceeding 3 months.

© Copyright – Aurecon South Africa (Pty) Ltd

5. QUALITY CONTROL PLAN

Manufacturing or fabrication of items may not commence until the QCP and related procedures have been approved by the Engineer.

The Quality Control Plan and related procedures shall address (as a minimum) the following inspections and tests:

a) Material certification.

b) Preparation and approval of design and shop drawings.

c) Non Destructive Evaluation (NDE) testing.

d) Verification of tolerances.

e) Workmanship.

f) Surface preparation (e.g. cleanliness and blast profiles for corrosion protection).

g) Material identification.

h) Personnel certification (including welders and NDE).

i) Welding procedures and certification.

j) Weld preparation.

k) Compliance with drawings.

l) Hydrostatic testing.

m) Witnessed inspections and testing.

6. REFERENCE DOCUMENTS

The Contractor's and his Subcontractor's personnel involved with quality control and manufacturing/fabrication shall have the latest issues of the following on hand:

a) The approved QCP.

b) The relevant Specification, Standards and codes of practice.

c) The relevant approved design drawings and (if applicable) shop drawings.

d) The relevant manufacturer's instructions (data sheets) for the materials being used in the manufacturing process.

7. QUALITY CONTROL RECORDS

Accurate and sufficiently detailed records shall be kept by the Contractor for all stages of work to prove compliance of the manufacturing processes with the approved QCP.

Additional details such as responsible personnel, inspectors, batch numbers of materials used, ambient environmental conditions and other relevant data shall also be recorded.

A complete set of quality control records shall be handed over to the Engineer upon completion of the work.

8. INSPECTORATE

The Engineer may, at his sole discretion, appoint an independent inspection authority (independent inspectorate) to carry out additional quality surveillance at the premises of the manufacturer. The

© Copyright – Aurecon South Africa (Pty) Ltd

manufacturer shall provide all facilities and shall facilitate access to their premises at reasonable times as may be necessary for the independent inspectorate to perform its function.

The manufacturer's quality control records shall be available for inspection by the Engineer or the independent inspectorate at all reasonable times, and copies of such records shall be made available on request.

The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to surfaces for inspection/testing which are to be, have been, or are being coated.

9. WITNESSED INSPECTIONS AND TESTING

Where inspection of the Materials and Plant at the manufacturer's works is required to be done in the presence of the Engineer, this shall be done by the Engineer, his appointed representative or an independent inspectorate.

The Engineer shall be notified at least seven days in advance, or as otherwise agreed, of impending inspections or tests that are to be carried out as well as for witnessing the points in terms of the agreed Quality Control Plans (QCP's).

10. SUB-STANDARD QUALITY

If any deviation to the approved QCP or product quality is found, additional testing and quality surveillance shall be carried out at no additional cost to the Employer.

If the additional testing confirms inaccurate quality control by the Contractor, all work on that particular Material or Plant item shall be stopped and shall only proceed after remedial action has been implemented to the satisfaction of the Engineer.

11. DESPATCH RELEASE

No item which requires inspection or testing at the factory may be despatched to the Site until the item has passed the necessary inspections and/or tests.

12. MEASUREMENT AND PAYMENT

Refer to the Pricing Instructions.

--o0o--

© Copyright – Aurecon South Africa (Pty) Ltd