Coastal Virginia Offshore Wind

Balance of Plant

Engineering, Procurement, Transportation and Installation Services

Double Big Bubble Curtain Plan

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1 INTRODUCTION

Virginia Electric and Power Company, operating as Dominion Energy Virginia (Dominion Energy), is proposing to construct, own, and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (Project) in the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS) Offshore Virginia (Lease No. OCS-A 0483, the Lease Area) and in coastal waters where an Offshore Export Cable Route Corridor will be established.

Within the pile driving Scope of Work, Dominion Energy intends to use impact and vibratory pile driving to install Wind Turbine Generator (WTG) Monopile Foundations and Offshore Substation Jacket Foundations (jacket foundations with pin piles).

Both the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of Ocean Energy Management (BOEM) have advised that construction activities (including monopile and pin-pile installation activities) have the potential to cause acoustic harassment to marine species, in particular marine mammals.

Dominion Energy will deploy dual noise abatement systems (NAS) that are capable of achieving, at a minimum, 10 decibel (dB) of sound attenuation, during all vibratory and impact pile driving of monopiles and pin piles. A Double Big Bubble Curtain (DBBC) will be used, without being paired with another noise attenuation device, during pile-driving activities (i.e. identical layout during vibratory and impact piling) to avoid or minimize impacts on marine mammals, sea turtles, fishes, and mobile invertebrates. Dominion Energy may consider alternative technologies that are anticipated to achieve at least a similar level of attenuation.

All DBBC deployment will take place between 22m and 38m depth. For specific depth at each WTG location, reference is made to the Performance reports as per section 3.2 on reporting.

1.1 Objective

DEME Offshore US LLC will amongst more scopes on the project execute the installation of the foundations for the 176 WTG's. The purpose of this document is to provide a description of activities related to noise mitigation that will be performed during the pile driving activities of the WTG foundations and OSS Jacket installation of Coastal Virginia project. More details of the pile driving operation can be found in the Pile Driving Monitoring, Mitigation and Management Plan (PDMP) [1]. For more details on the regulatory requirements, reference is made to the Construction Mitigation & Monitoring plan (CMMP) [2].

The installation activities are performed by heavy lift vessel (HLV) except for the noise mitigation activities. These scenarios are further described in this document.

2 DEFINITIONS & ABBREVIATIONS

2.1 Definitions

Term	Definition
Project	Coastal Virginia Offshore Wind
Owner	Dominion Energy
Contractor	DEME Offshore US - Prysmian
EXTERNAL PARTIES	External parties as any Consultant, Subcontractor or supplier

2.2 Abbreviations

Abbreviation	Definition
ASFV	Abbreviated Sound Field Verification
CVOW	Coastal Virginia Offshore Wind Project
BOEM	Bureau of Ocean Energy Management
CFM	Cubic Feet per Minute (CFM)
CMMP	Construction Mitigation and Monitoring Plan
COP	Construction and Operations Plan
CR	Dominion Energy Client Representative
CVOW-C	Coastal Virginia Offshore Wind
CZ	Clearance Zone
dB	Decibels
DBBC	Double Big Bubble Curtain
DEME	DEME Group
DP	Dynamic Positioning
FOU	Foundation
HLV	Heavy lift Vessel
HSE	Health and Safety
HZ	Harassment Zone
ITA	Incidental Take Authorization
LOA	Proposed Letter of Authorization
LFC	Low Frequency Cetaceans
LPSO	Lead Protected Species Observer
m	Meters
MFC	Mid-Frequency Cetaceans
MMPA	Marine Mammal Protection Act
MP	Monopile
MVZ	Minimum Visibility Zone
NARW	North Atlantic right whale

NAS	Noise Abatement System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NVD	Night Vision Device
OCS	Outer Continental Shelf
OSS	Offshore Substation
PAM	Passive Acoustic Monitoring
PDMP	Pile Driving Monitoring, Mitigation and Management Plan
PSO	Protected Species Observer
QHSE	Quality Health Safety and Environment officer
RPM	Revolutions Per Minute
SFV	Sound Field Verification
SZ	Shutdown Zone
TP	Transition piece
TSFV	Thorough Sound Field Verification
VSA	Vessel Strike Avoidance
WDA	Wind Development Area
WM	Works Manager
WTG	Wind Turbine Generator

2.3 References Documents

Document Title
[1] Pile driving monitoring, mitigation, and management plan
[2] Construction Mitigation & monitoring plan

3 ROLES & RESPONSIBILITY

The table below describes the DBBC specific roles :

Table 1 DBBC Roles and responsibility

Function	Function description
Vessel Master	The Vessel Master is the first in command on board of the vessel and is responsible for the overall safety on board the DBBC vessel. He instructs the crew. He is responsible for carefully analysing the weather forecasts prior to operations. He takes the lead in case of incidents and emergencies, such as oil pollution, fire on board, man overboard, collision, abandon ship, etc.
DEME Offshore representative	The DEME Offshore representative manages the offshore operations on board of the DBBC vessel, including coordination with the DBBC subcontractor, in accordance with the method statements and in consultation with the Vessel Master. Any operation will only start when the DEME Offshore representative and the vessel master agree that it's safe to do so.
DBBC subcontractor works manager	The DBBC subcontractor works manager is responsible for the operations of the DBBC subcontractor on board of the DBBC vessel
DBBC operators	The DBBC subcontractor team is responsible for operation and maintenance of the DBBC and tools onboard.

3.1 Communication

The communication between the installation vessel and the Double Big Bubble Curtain (DBBC) vessel will be according to the below flowchart (Figure 1) and below Table 2.

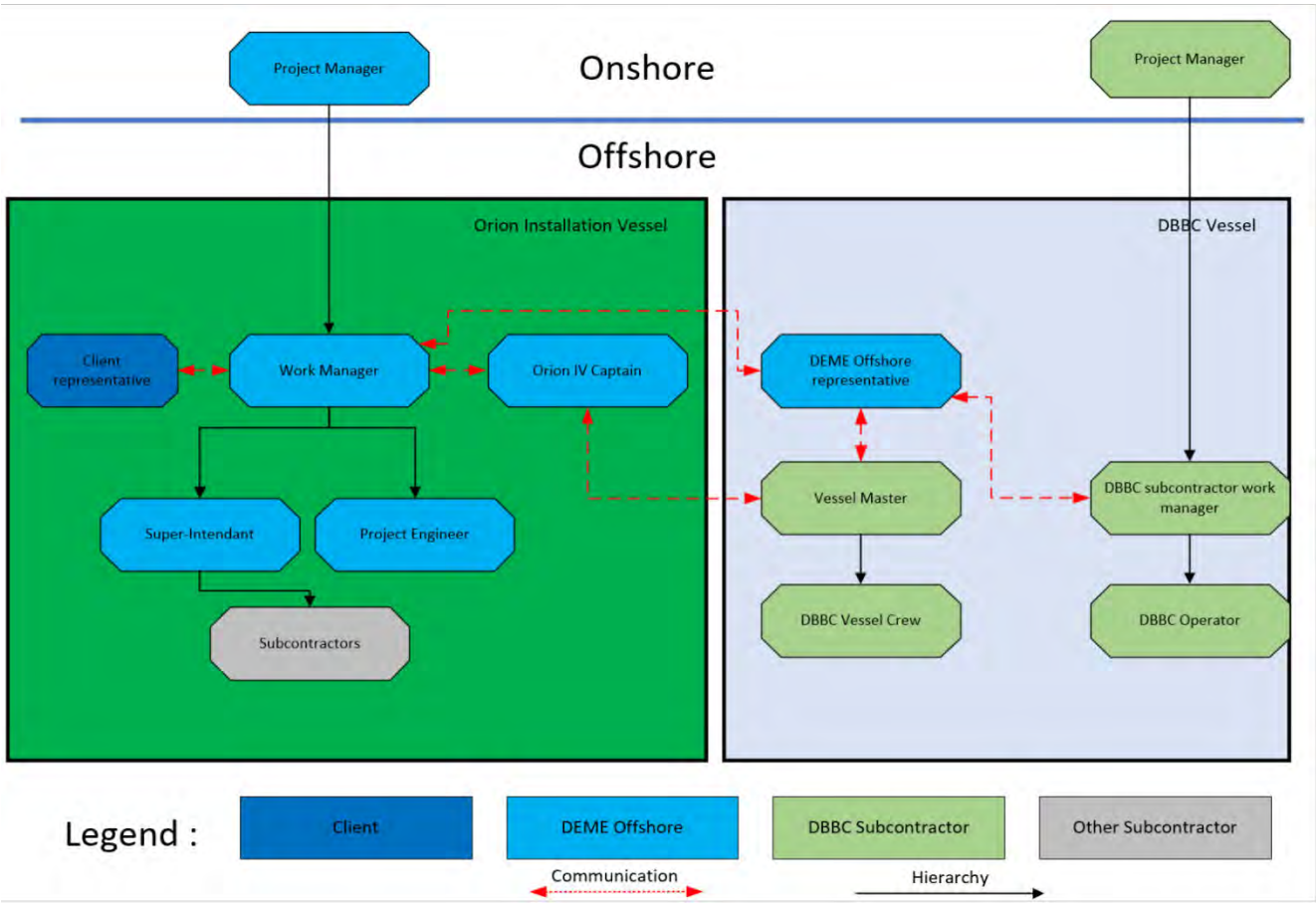


Figure 1 : Offshore organisation Chart for DBBC (Preliminary)

The installation vessel's (IV) captain communicates with the DBBC vessel captain about vessel manoeuvres and simultaneous operations. The Installation vessel's Works Manager communicates with the DBBC DEME Offshore representative on board in case present or the DBBC Works Manager about the start-up and readiness of the DBBC hoses and pile driving completion. When the DEME Offshore representative is on board the DBBC vessel, he/she is involved in all communication with the aim to ensure a smooth execution.

An example of the notification times given for each piling event are provided in Table 2 below. A VHF radio channel to be agreed upon and checked at the start of the project operations.

Table 2 DBBC internal Notification Table (for example)

Direction of communication	Information	Window	Medium
IV→ DBBC Vessel	Pile driving operation will start in 3 days	3 days before start pile driving	E-Mail Daily progress meeting
IV→ DBBC Vessel	Pile driving operation will start in 24h	24h before start pile driving	E-Mail Daily progress Meeting
IV→ DBBC Vessel	Pile driving operation will start in 12h	12h before start pile driving	E-Mail VHF Radio
IV→ DBBC Vessel	Pile driving operation will start in 6h	6h before start pile driving	E-Mail VHF Radio
IV→ DBBC Vessel	Pile driving operation will start in 3 h	3h before start pile driving	E-Mail VHF Radio
IV→ DBBC Vessel	Pile driving operation will start in 1 h	1h before start pile driving	E-Mail VHF Radio
IV→ DBBC Vessel	Pile driving operation will start in 15 minutes	15 min before start pile driving	VHF Radio
DBBC Vessel → IV	DBBC Operational (full pressure reached)	Immediately	VHF Radio
IV→ DBBC Vessel	Pile driving Operation at location Finished	Immediately	VHF Radio
DBBC Vessel → SFV Contractor	DBBC performance summary (compressor log information)	Post piling	E-Mail
SFV contractor → DBBC vessel	Interim report	36h post piling	E-Mail

The communication on board the DBBC vessel is done in person or via UHF radio, as this is a small crew. In general, in case of any discussions or any safety concerns, the DBBC vessel master is the end responsible and makes the final decision.

3.2 Reporting

Dominion Energy will provide the Regulators (NOAA fisheries) with a bubble curtain performance test and maintenance report to review within 72 hours after each pile using a bubble curtain is installed (see BOEM COP requirement 5.14.3.5 & 5.14.3.6 and LOA 3(c)(9)(v)). Additionally, a full maintenance check (e.g., manually clearing holes) must occur prior to each pile being installed. All reports will be submitted by email to nmfs.gar.incidental-take@noaa.gov and PR.ITP.MonitoringReports@noaa.gov.

For piles for which thorough SFV (TSFV) is carried out, an interim DBBC performance report will be submitted as soon as it is available, as attachment to the 48h due interim TSFV report for the respective pile.

For the piles having an Abbreviated SFV (ASFV), performance reports will be submitted following the strategy agreed in the CMMP Appendix E – Sound Field Verification plan, section on ASFV, during next available weekly report.

Following parameters will be reported:

Performance reports for each bubble curtain deployed will include water depth, current speed and direction, wind speed and direction, bubble curtain deployment/retrieval date and time, bubble curtain hose length, bubble curtain radius (distance from pile), diameter of holes and hole spacing, air supply hose length, compressor type (including rated Cubic Feet per Minute (CFM) and model number), number of operational compressors, performance data from each compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times), free air delivery (m^3/min), total hose air volume (m^3/(min m)), schematic of GPS waypoints during hose laying, maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and timing of those tests, and the length of time the bubble curtain was on the seafloor prior to foundation installation. Additionally, the report must include any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure.

3.3 Weather forecast and limitations

A weather assessment (check of weather limitations and windows) will be performed prior operations. This weather assessment is done to identify if a suitable weather window is available to make the transition from one safe state to another. Operations can only be started when favourable conditions are forecasted for the duration of the operational reference period and when these conditions are not contradicted by live weather monitoring devices (i.e., anemometers on HLV Orion and wave buoys on site). This operational reference period is different for each of the operational phases described in this plan.

4 PLANT AND MACHINERY

4.1 DBBC Vessel

A DP auxiliary vessel will be used for installation of the DBBC. This vessel will have a deck space of approximately 860m^2 to house the required equipment for the DBBC Spread. The deck layout including the equipment described in this section is presented in Figure 2. A detailed deck layout of the vessel will be added in the plan once the vessel is selected and final position of the components are defined.

Positioning of the DP DBBC supporting vessel will be on the opposite side of the MP from the IV Orion (see Figure 5 for a schematic). Positioning will be targeted to be as far away as possible from the TSFV and ASFV buoy locations, to minimise potential confounding factors.

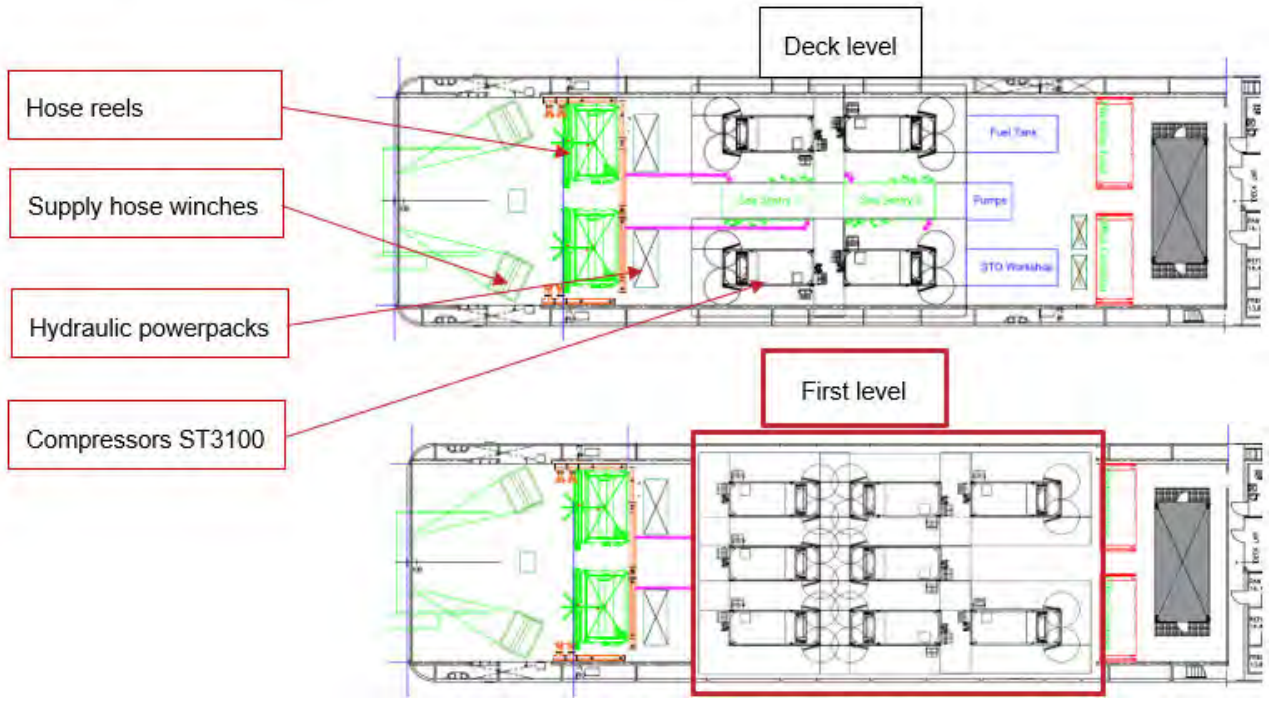


Figure 2: DBBC Deck Layout (for example)

The equipment of the DBBC spread is typically composed of hoses, compressors and hose reels which are described further below in this section and in the following list of equipment.

- DBBC Roller
- Supply hose winches
- Tugger winch
- A 20ft Workshop and a 20ft spare part container
- Hydraulic powerpack for the hose reels.

The compressors presented in the first level are stacked on top of the compressors, sea sentry, fuel tank and workshop container installed on the deck level. Specific stacking frames will be designed to ensure a proper seafastening of compressors. A top view of the stacking frames is presented in Figure 3.

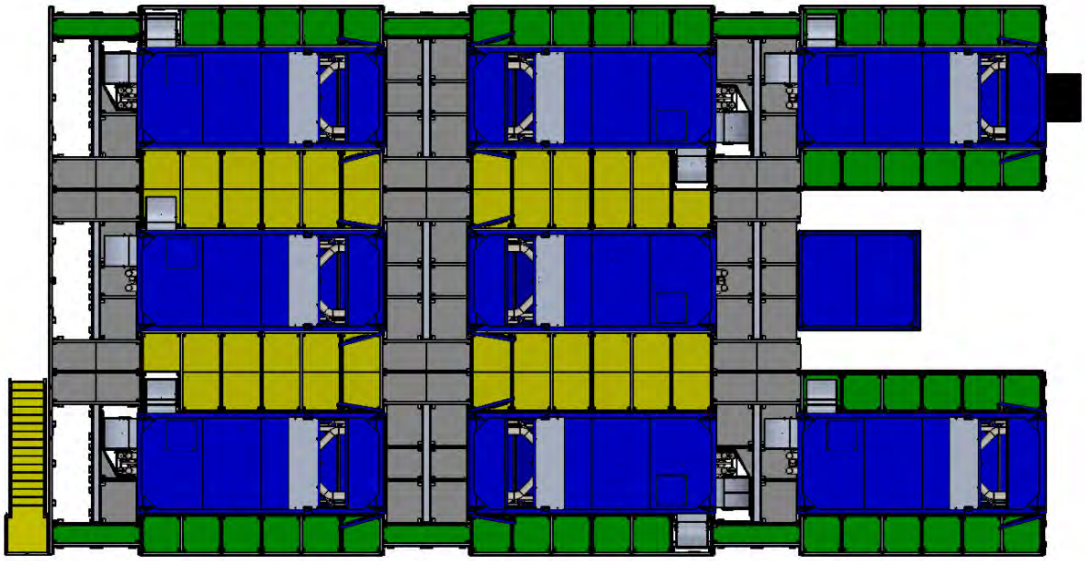


Figure 3. Top view of compressor stacking frame upper level. Blue are compressors, Yellow and green are walkways.

4.2 Compressors

The compressed air for the operations of the bubble curtain is generated by oil free diesel driven compressors. These will be installed on board the DBBC vessel.

ST3100 type of compressors, for which more details are presented in Appendix G-1, will be used.

In the event a single compressor malfunctions, the offshore personnel operating the bubble curtains will incorporate an additional compressor to guarantee the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtains is achieved. On top of the necessary compressors to deliver necessary air supply and operating pressure, two additional compressors in-rotation are foreseen.

Figure 4: ST3100 compressor

4.3 Hoses

A bubble curtain consists of 3 types of hoses, namely:

1. Supply hose: Supplies the compressed air from the vessel to the riser hoses. These are buoyant so they are situated on the water surface.
2. Riser hose: This hose connects the supply hose with the nozzle hose. Therefor this hose will go from the water surface to the seabed.
3. Nozzle hose: This is the hose that is laid out on the seabed and produces the bubble curtain by the holes inserted in them. These are non-buoyant and have steel parts to ensure a full circumferential contact with the seabed.

The DBBC hoses will be deployed before the foundation installation vessel is in position. Two air hoses will be placed in a circular shape around the WTG monopile of OSS jacket. DBBCs will be pre-deployed at two to three foundation installation locations that are close to one another, recovered as soon as the piling is completed, and re-deployed at other foundation installation locations to reduce the number of times the curtain has to be moved.

In the BiOp, exact reference and language to be found in the CMMP [2], regulatory requirements proposes radii of the installed hose rings of approximately 591 ft (180 m) and 755 ft (230 m) from the pile installation location. This would result in a total hose length for the inner and outer hose ring of 1131m and 1445m, respectively.

Reference is made to Bellman *et al*. 2020, ITAP, renown underwater noise expert, scientifically underpinning a significant efficiency decrease of the noise abatement system if the DBBC single inner ring or outer ring is longer than 1000m.

Hence, as per agency concurrence on December 8th, 2023 on the approved design, Dominion Energy proposes a radius of 85m and 123.6m (measured from the outer edge of the MP), respectively, for the inner and outer hose rings, resulting in total hose lengths of 560m and 800m. This proposition considers industry best practice, regulatory requirements of air flow rate of at least 0.5 m^3 /(min*m) and foreseen water current in order to ensure that the DBBC will surround 100 percent of the piling perimeter throughout the full depth of the water column.

In Figure 5 the distance between the outer edge of the MP and in Figure 6, the OSS pin pile and the inner and outer DBBC hoses is presented. The riser hoses will be connected to a buoy after deployment. In Section 5 the pre-lay method and execution method is further elaborated.

To guarantee the lowest bubble ring to be in contact with the seafloor for the full circumference of the ring a buoyancy calculation is added in Attachment G-4. The total buoyancy of the inner and outer hose is 10.4kg/m and 7.65 kg/m, respectively. The weights attached to the bottom of the rings plus the hoses weights amount to 15.05 kg/m. Henceforth a negative buoyancy of 4.61 kg/m and 7.40 kg/m is achieved, ensuring 100-percent seafloor contact at foreseen air flows.

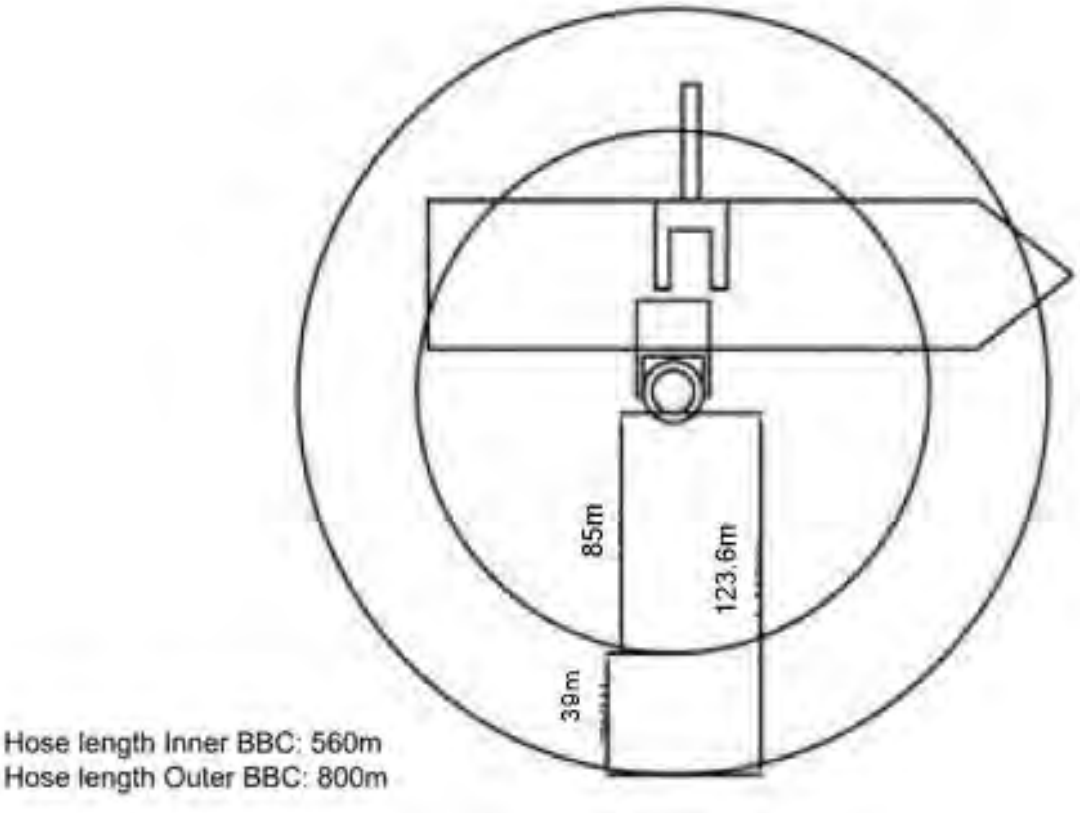


Figure 5: DBBC Hose layout MP installation

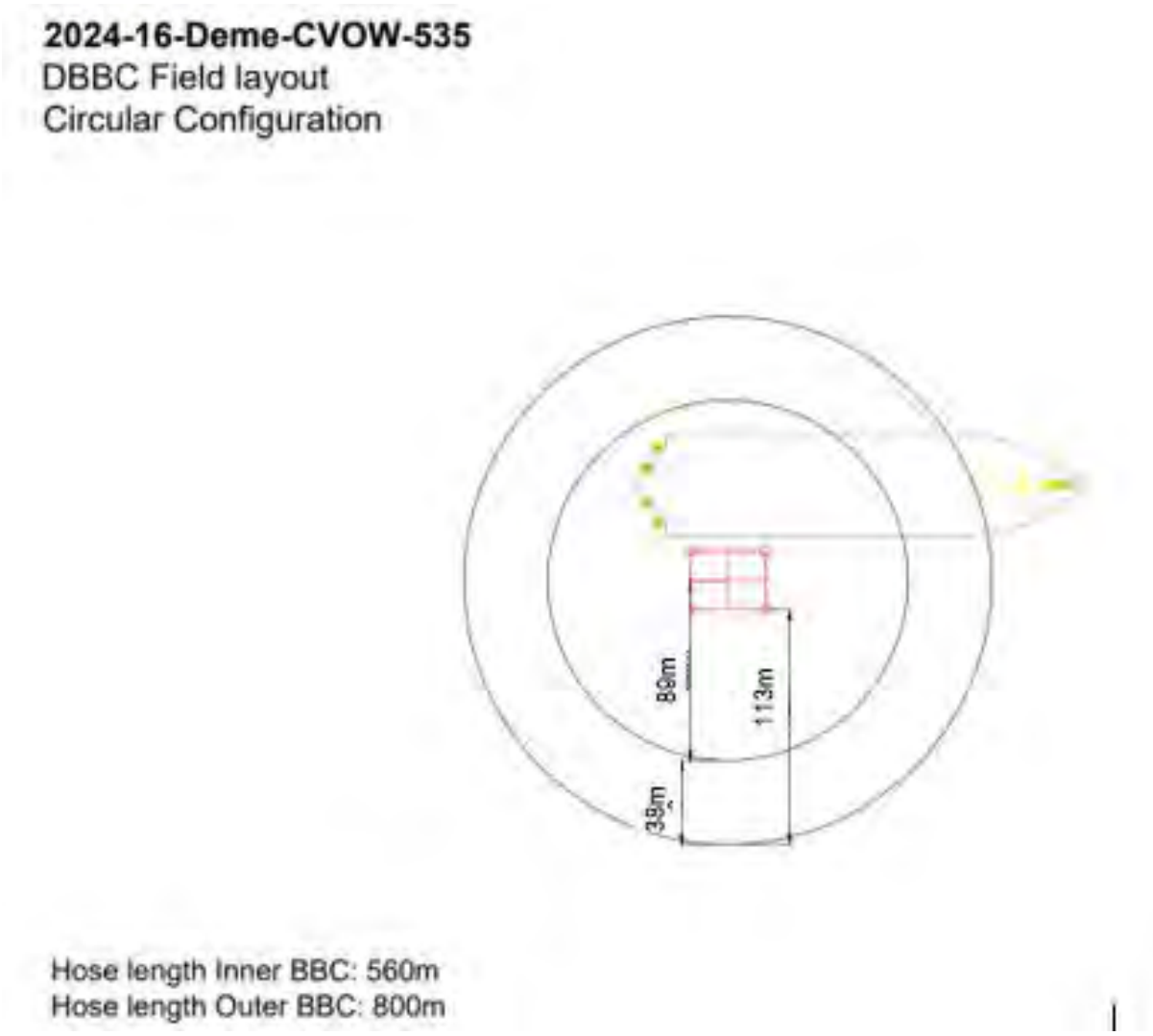


Figure 6 : DBBC hose layout OSS installation

To monitor the hose position, DBBC subcontractor will provide a GPS to enter the DBBC waypoint. The DP operator will ensure the CoR of the vessel follows the DBBC waypoints for the entire duration of the deployment and recovery operations described in the section 5.1.

CoR tracking and DBBC way point will be part of the DBBC Performance report.

The cycle principle per trip of 6 monopiles to lay out the DBBC hose will be as described below:

- The DBBC hoses for the first two monopile installation locations of the trip are pre-laid.
- After completion of the piling operations, the DBBC Subcontractor will retrieve the inner and outer hoses from the respective location and prepare the next location which is following the monopile installation sequence.

The above cycle is named leapfrog principle and shown in Figure 7.

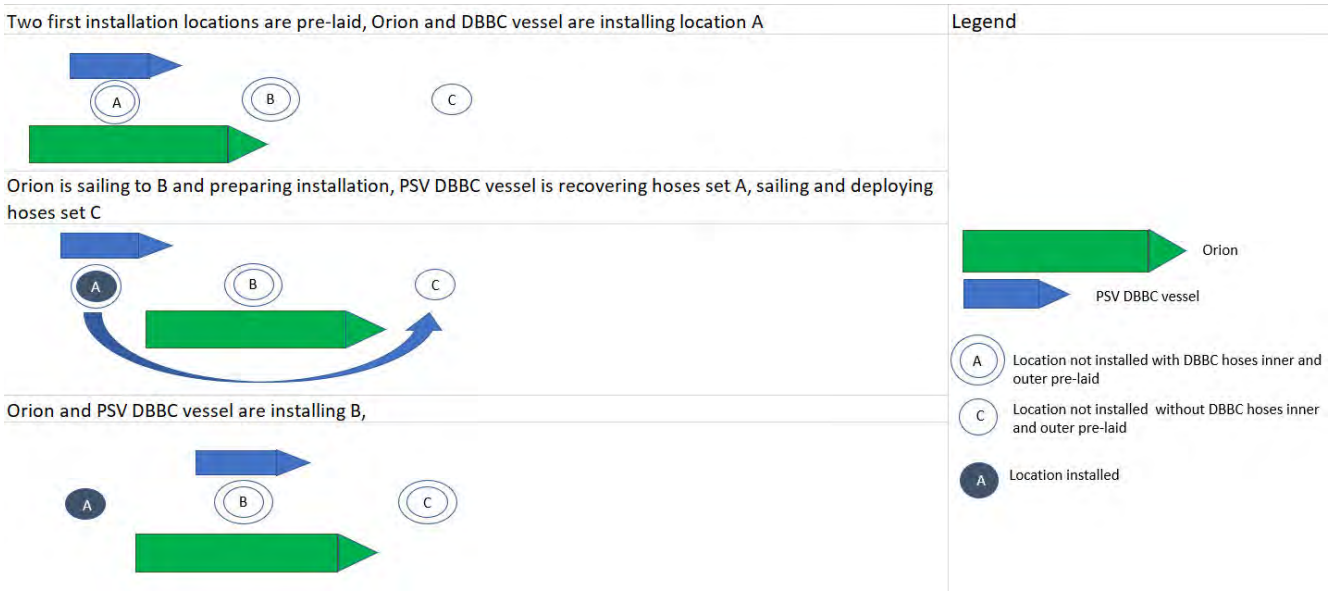


Figure 7: Leapfrog principle

To ensure the application of the leapfrog principle, a minimum of two hose sets (including inner and outer hose) will be used. Characteristics of the supply, nozzle and riser hoses are described in Attachment G-2: Hose datasheet:

4.4 Hose reels

The nozzle hoses will be stored on two hose reels for storage and transport. These will be positioned on the DBBC vessel. The reels will have sufficient capacity to store the hoses required for the DBBC. The reel's hydraulic motors are driven by hydraulic power packs.

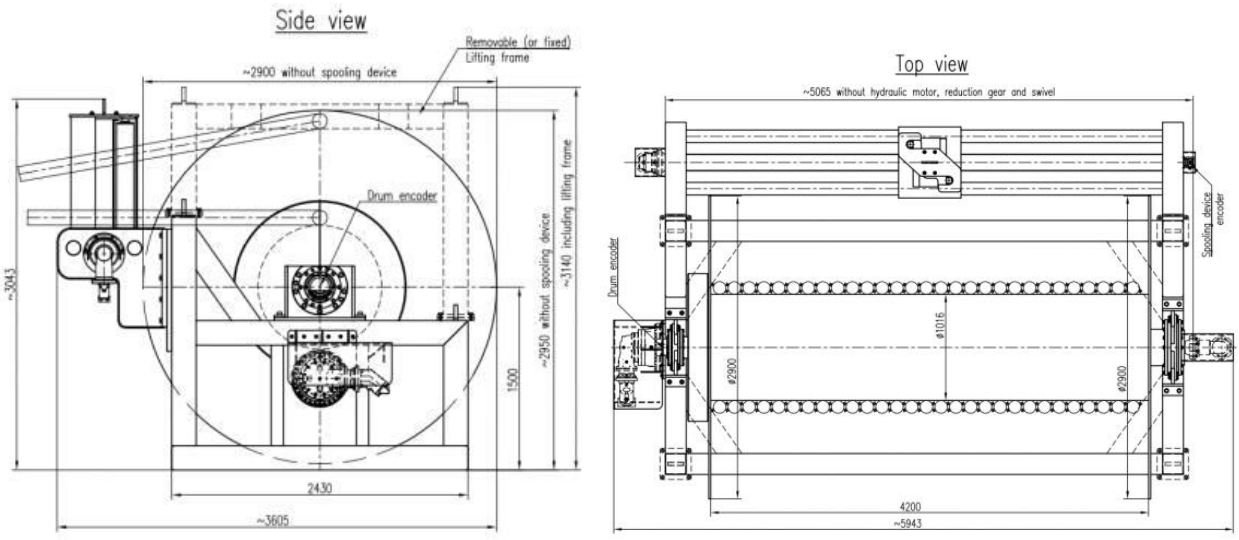


Figure 8: Hose reel arrangement

5 SAFE WORK METHODOLOGY

5.1 DBBC step by step procedure

The Step-by-steps written below have an integrated approach, where there is made a link between the MST, the relevant ITP step and Risk Assessment sections for the installation scope. The table below gives an explanation what information is required in each column.

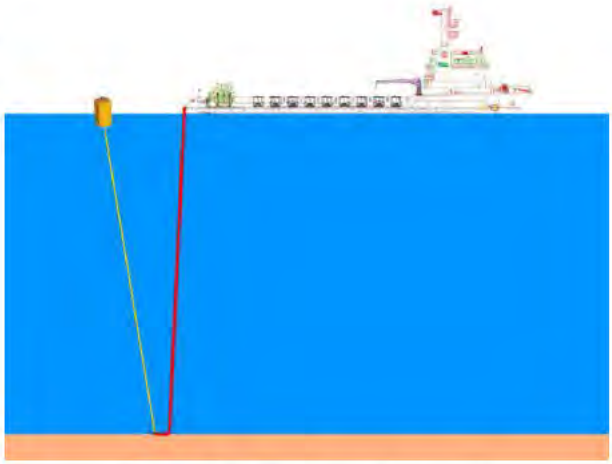
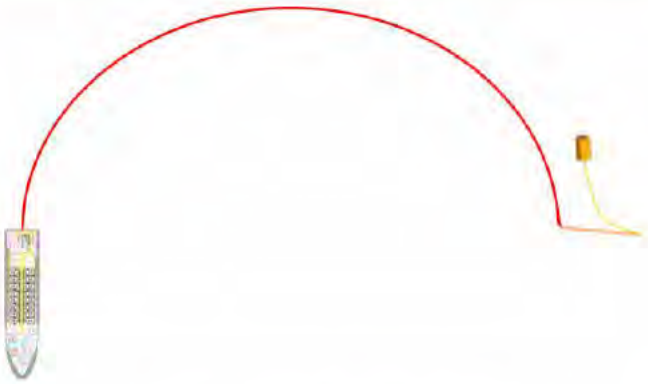
#	Step number
Description	Detailed description of the step to be taken, if possible with an illustration (e.g. Picture, drawing, sketch, etc.)
Responsible	Person who is responsible for the step
Reference	Reference to the relevant sections of operating manuals and/or other MST

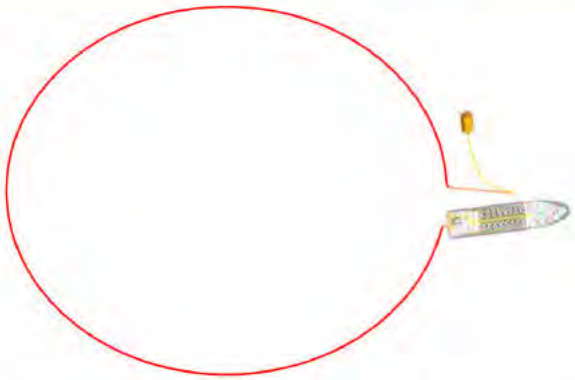
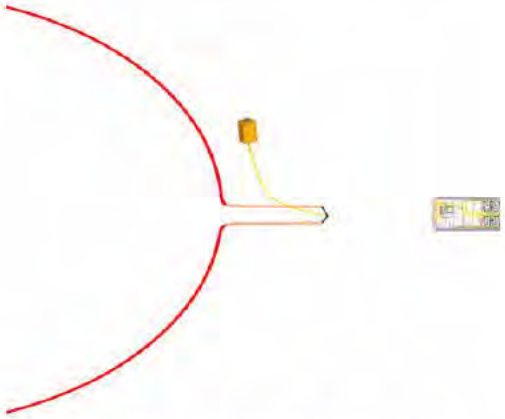
5.1.1 DBBC deployment

The DBBC Deployment is dependent of the Orion IV arrival. This means the DBBC vessel must pre-lay one set of hoses before the IV positions for the monopile or OSS jacket installation.

The below procedure describes the process assuming one vessel would deploy all hose sets. The final Method Statement will contain the exact details of how the operations will be performed, e.g. one vessel might be used to lay out the hoses and another vessel might be equipped with all the compressors.

#	Description	Resp.	REF
0	Prior the start of the installation process, • Weather conditions will be assessed to determine a weather window is available for operations. • Predefine heading of Orion and subsequently the riser hose position, prior to DBBC deployment to the foreseen environmental parameters. *Note*: Throughout the installation process, the weather is continuously monitored. *Note*: Riser hose will ideally be placed on the Port side of the Orion (MP is on starboard) at mid ship length		
1	Enter the field, perform DP trials and position vessel. Alteration of the Orientation of the DBBC vessel if needed.	Vessel Master	
2	Connect buoy to end of first riser hose.	DBBC operators	
3	Connect riser hose to nozzle hose, connect clump weight between riser hose and nozzle hose.	DBBC operators	
4	Deploy buoy and first riser hose. Figure 9 show the DBBC vessel starting nozzle hose deployment after the riser hose,	DBBC operators	

#	Description	Resp.	REF
	- Yellow: riser hose - Red: nozzle hose - Clump weight is connected between riser and nozzle hose 		
	Figure 9 : Riser hose deployed		
5	Deploy full length of nozzle hose. Figure 10 show nozzle hose deployment halfway completed. During deployment visual inspection of the hose is being executed and if needed, maintenance can be executed.	DBBC operators DBBC captain	
	- Red: nozzle hose - Yellow: riser hose 		
	Figure 10: nozzle hose deployment		
6	Connect clump weight between second riser hose and nozzle hose	DBBC operators	

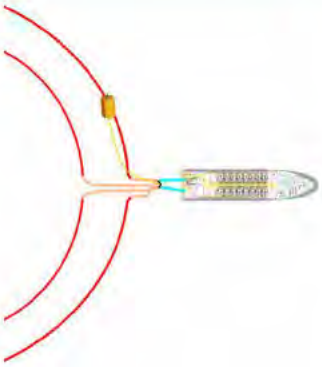
#	Description	Resp.	REF
	- Red: nozzle hose - Beige: riser hose - Yellow: buoy 		
	Figure 11: nozzle hose fully deployed, deployment of the riser hose		
7	Recover buoy and lift end of first riser hose on deck.	DBBC operators	
8	Connect buoy with each of riser hoses and deploy all in the water.	DBBC operators	
9	Relocate the vessel to outer hose to start the deployment process. Figure 12 show the vessel relocation to start the outer hose deployment.	Vessel Master	
	- Red: inner nozzle hose - Beige: riser hose - yellow: inner buoy 		
	Figure 12: relocation for outer hose deployment		
10	Connect buoy to the first riser hose.	DBBC operators	
11	Deploy buoy and riser hose to water.		
12	Connect riser hose to nozzle hose. Connect clump weight between riser hose and nozzle hose.		

#	Description	Resp.	REF
13	Deploy full length of nozzle hose.	Vessel Master DBBC operators	
14	Connect clump weight between riser hose and nozzle hose.	DBBC operators	
15	Recover both buoys from the outer and inner hose and lift all riser hoses on deck.		
16	Connect clump weight to all riser hose on deck.	DBBC operators	
17	Deploy clump weight and positioning buoy.		
18	Notify DEME Offshore representative DBBC is fully deployed.	DBBC work manager	
	End of Buoy Deployment. Hoses on seabed ready to be reconnected for DBBC in-field inspection prior to MP installation		

5.1.2 DBBC Operation

DBBC operations can start once the deployment of the hoses is completed, and the piling operations are about to commence.

#	Description	Resp.	REF
1	Receival 3 hours' notice.	Orion WM or SI	
2	Sailing and positioning to installation location.	Vessel Master	
3	Recover buoy from the outer and inner DBBC and lift all riser hoses on deck.	DBBC operators	
4	Connect all riser hoses to the supply hoses.	DBBC operators	
5	Connect a buoy to all connections.	DBBC operators	
6	Deploy buoy and riser hoses back into the water,	DBBC operators	
7	Deploy full length of supply hose. Figure 13 show the DBBC connected to the DBBC vessel.	DBBC operators Vessel Master	

#	Description	Resp.	REF
	- Red: inner and outer nozzle hoses - Beige: inner and outer riser hoses - Blue: inner and outer supply hoses - Yellow: DBBC buoy  **Figure 13: inner and outer hoses connected to the DBBC vessel**		
8	Once fully deployed: connect supply hoses to the manifold and start one compressor to maintain air in the system.	DBBC operators	
9	Receive 1 hour notice. Start of in-field maintenance inspection • Start all compressors, flush inner and outer hoses • Pressure tests • Visual check of a complete bubble curtain around the installation location	Orion WM or SI	
10	DBBC on full power	DBBC operators	
11	Communication to the Orion IV, DBBC is fully operational and pile driving can start	DBBC work manager	
12	Pile driving, DBBC active during vibratory and impact pile driving durations	DBBC operators DBBC work manager Vessel Master	
13	Pile driving completed, Compressors turned off and recovery procedure started	DBBC Operators	

5.1.3 DBBC Recovery

Once the piling operations are completed, the DBBC must be recovered. The DBBC recovery is dependent of the Orion IV de-positioning.

The hose system shall be inspected and redrilled every three installations. This maintenance is done during the recovery operations as described in appendix C 6.3.

#	Description	Resp.	REF
1	Disconnect supply hoses from manifolds and connect them to the hose reels.	DBBC operators	
2	Start recovery of both supply hoses simultaneously while moving the vessel towards inner and outer buoys.	Vessel Master DBBC operators	
3	Recover all riser hoses to the deck. Disconnect both supply hoses and connect one end of the outer to the hose reel.		
4	Redeploy inner riser hoses into the water with a buoy.	DBBC operators	
5	Deploy the other riser hose of the outer hose with a buoy to the water.	DBBC operators	
6	Recover the outer nozzle and riser hoses. Recovery hose maintenance inspection • Visual inspection of the hoses for damages. • If performance tests indicated adaptive approaches are necessary, such as manually clearing holes or re-drilling, necessary measured will be taken at this stage in preparation of next deployment	Vessel Master DBBC operators	
7	Once outer hoses are fully recovered, recover the outer buoy on deck.	DBBC operators	
8	Position vessel to inner hose buoy, Recover inner buoy and riser hoses on deck.	Vessel Master DBBC operators	
9	Disconnect one of the riser hoses from buoy and connect it to the hose reel.	DBBC operators	
10	Redeploy the other riser hose with a buoy into the water.	DBBC operators	
11	Recover the inner nozzle and riser hoses. Disconnect the clump weight once nozzle hose is fully recovered.	Vessel Master DBBC operators	
12	Once outer hoses are fully recovered lift the buoy on deck.	DBBC operators	
13	Notify DEME Offshore representative DBBC is fully recovered.	DBBC WM	
14	Within 24h: Share performance report with SFV operators for their interim TSFV report or ASFV weekly reporting	DBBC WM	
15	Within 72h After completion of each installation: Performance report will be submitted to Project management and BOEM, BSEE, NMFS GARFO-PRD and NMFS OPR as separate communication or as attachment to the Sound Field Verification (TSFV interim or weekly ASFV) reports.	DBBC WM	

6 ATTACHMENTS

6.1 Attachment G-1: Compressor specification sheet

Big Bubble Curtain Air Compressor

ST3100

Stage V complaint air compressor designed to support large scale bubble curtain projects. High volume / medium pressure provides optimal FAD for projects even in deep waters (~60metres).

Stackable design allowing clients to optimise available deck space.

For more information on how ScanTech Offshore can add value to your offshore operations, please visit www.scantechoffshore.com or contact our business development team at sales@scantechoffshore.com or call +44 (0) 1651 871 440.

Benefits
Stackable Design (Both CSC & DNV 2.7-1 Compliant)
Best In Class Emissions
Unique Patented Cooling Matrix (suitable for placement on vessels with High Sides)

All equipment offered is subject to availability at point of order confirmation.

Technical Information	
Model	ST3100
Delivered Flow @ 12 Bar	3100cfm / 87.5m3/min
Delivered Flow @ 14 Bar	2700cfm / 76.4m3/min
Stackable	Yes
Sound Level	Power (Lwa) >90dBA
Fuel Consumption	200 litres per hour
Fuel Tank Capacity	700 litres (designed for auto refuelling set up)
Compressed Air Outlet	4" ASA150 flange
Compressor Start Up	Battery Electric Start
Compressor Electrical Supply	360-440V @ 50HZ 440-480V @ 60 HZ Max current 7A (16A plug fitted)
Automatic Refuelling System Electrical Supply	380 – 480V @ 50/60Hz Max current 20A (32A plug fitted)
Ambient Operating Range	-10°C to + 45°C
Emission Compliance	EU Stage V & US EPA Tier 4 Final
Air Quality	Class Zero (ISO8573-1:2010) when operated via ScanTech SeaSentry™

Weight & Dimensions	
Length	6058mm
Width	2438mm
Height	2896mm
Weight	Gross 16,800Kg
Container Rating	CSC / DNV 2.7-1

MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 ISO 14001
OHSAS 18001

ScanTech Offshore
ScanTech House, Morton Peto Road, Great Yarmouth, NR31 0LT
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FUEL SPEC

ST1600 and ST3100 - Big Bubble Curtain

EN590 ULS DIESEL				
Property	**Unit**	**Lower limit**	**Upper limit**	**Test method**
Cetane number		49		EN ISO 5165
Cetane index		46		EN ISO 4264
Density @ 15°C	kg/m3	820	860	EN ISO 3675, EN ISO 12185
Viscosity at 40°C	mm2/s	2.0	4.5	EN ISO 3104
Sulphur content	mg/kg		10.0	EN ISO 20846, EN ISO 20847, EN ISO 2088
Flash point	°C	55		EN ISO 2719
Carbon residue	%m/m		0.30	EN ISO 10370
Ash content	% m/m		0.01	EN ISO 6245
Water content	mg/kg		200	EN ISO 12937
Total contamination	mg/kg		24	EN 1SO 12662
Fatty Acid Methyl Ester (FAME) (biodiesel) content	% v/v		7	EN 14078
Polycyclic aromatic hydrocarbons	% m/m		11	EN ISO 12916
Copper strip corrosion (3 hours at 5°C)	Index	Class 1	Class 1	EN ISO 2160
Lubricity, corrected wear scar diameter (wsd 1.4) at 60°C	um		460	EN ISO 12156-1
Oxidation stability	g/m3		25	EN ISO 12205
Distillation recovered at 250°C, 350°C	% v/v	85	65	EN ISO 3405
95% (V/V) recovered at	°C		360	
Cold filter plugging point (winter)	°C	-	-15	
Cold filter plugging point (summer)	°C		-5	

ASTM D975 ULS DIESEL				
Property	**Unit**	**Lower limit**	**Upper limit**	**Test method**
Cetane number		45*		D613
Cetane index		45*		D976
Density @ 60°F	API	34	38	D287
Viscosity at 40°C	cSt	1.9	4.1	D445
Sulphur content	mg/kg		15**	D2622, D4294
Flash point	°C	52		D93
Carbon residue	%m/m		0.35	D524
Water and sediment	% v/v		0.05	D2709
Ash content	% v/v		0.01	D482
Copper strip corrosion (3 hours at 212°F)	Index		No. 3	D130
Lubricity, corrected wear scar diameter (wsd 1.4) at 60°C	um		520	D6079
Distillation temperature 90% recovered	°F	282	338	D86

** Maximum allowable for EPA Tier 4
* Caterpillar specification states minimum Cetane of 45

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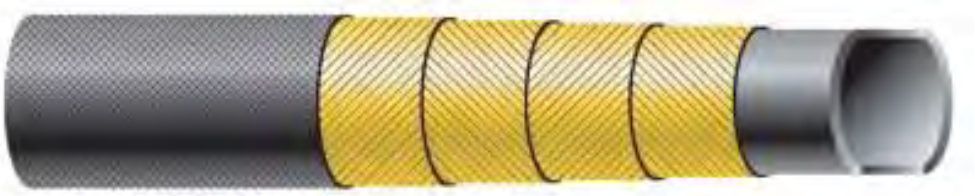
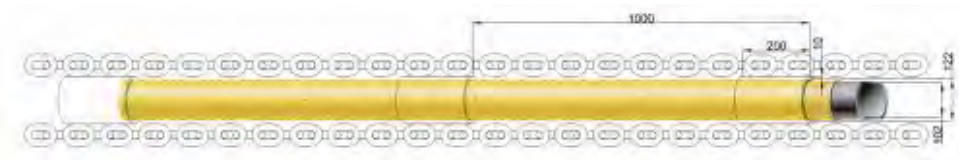
6.2 Attachment G-2: Hose datasheet for illustration only

Manufacturer	Semperit or (Similar)
Type	PLD HD
ID [mm]	101,6
OD [mm]	121,6
Wall [mm]	10
Weight [g/m]	6000
WP [bar]	40
Operating Temperature	-35°C +80°C
TUBE	BLACK SBR/NBR -OIL MIST RESISTANT
REINFORCEMENT	HIGH TENSILE STEEL CORDS
COVER	BLACK ABRASION AND OZONE RESISTANT
SAFETY FACTOR	3,15:1



The Nozzle Hose will be ballasted by a steel chain to ensure contact with the seabed.



Hole diameter	~2mm nozzle holes
Hole distance	100-300mm

6.3 Attachment G-3: Bubble curtain performance and maintenance procedure

Coastal Virginia Offshore Wind

Balance of Plant

Engineering, Procurement, Transport and Installation Services

DBBC Performance report

CVOW Document Number	
DMN/DOUS Document Number	
PRY Document Number	NA

Document Approval Status

[redacted]

Document Revision Status

Rev.	Date	Issue purpose
00		Issued for Owner's Review

TABLE OF CONTENTS

1 INTRODUCTION & OBJECTIVE

1.1 Introduction

A general introduction of the project can be found in the FOU project execution plan [1]. Additional information can be retrieved from the Construction Monitoring & Mitigation plan (CMMP) appendix G.

1.2 Objective

DEME Offshore US LLC will amongst more scopes on the project execute the installation of the foundations for the 176 WTGs. Each foundation consists of a monopile (MP) and a transition piece (TP). The purpose of this document is to provide the DBBC Performance report that will be submitted after each MP installation to BOEM, BSEE, and NMFS GARFO-PRD.

2 DEFINITIONS & ABBREVIATIONS

2.1 Definitions

Term	Definition
Project	Coastal Virginia Offshore Wind
Owner	Dominion Energy Virginia
Contractor	DEMIAN Wind
External Parties	External parties as any Consultant, Subcontractor or supplier

2.2 Abbreviations

Abbreviation	Definition
CMMP	Construction Monitoring & Mitigation plan
CVOW	Coastal Virginia Offshore Wind
DBBC	Double Big Bubble Curtain
DP	Dynamic Positioning
FOU	Foundations
HRM	Running Hour
MP	Monopile
RPM	Rotation Per Minute
TP	Transition Piece
WTG	Wind Turbine Generator

2.3 References Documents

2.3.1 Contractor Documents

Document Title	Document number
[1] FOU T&I Project Execution Plan (Fir input)	CVOW1-TIP-DMN-PLN-PM-00019
[2] Appendix G- Double Big Bubble Curtain Plan	CVOW1-TIP-DMN-PLN-EN-00005

DBBC PERFORMANCE REPORT

The DBBC performance report contains the following general information:

- water depth,
- current speed and direction,
- wind speed and direction,
- bubble curtain deployment/retrieval date and time,
- bubble curtain hose length,
- bubble curtain radius (distance from pile),
- diameter of holes and hole spacing,
- air supply hose length,
- compressor type (including rated Cubic Feet per Minute (CFM) and model number),
- number of operational compressors,
- performance data from each compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times),
- free air delivery (m^3/min),
- total hose air volume (m^3/(min m)),
- schematic of GPS waypoints during hose laying,
- maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and timing of those tests,
- the length of time the bubble curtain was on the seafloor prior to foundation installation.
- Additionally, the report includes any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure.

2.4 Site and weather data:

Monopile ID	Date	Time	DP current speed	DP current direction	Wind speed	Wind direction	Water Depth

2.5 Hose deployment Report:

RID-2250			
Vessel	2024-16-Deme-CVOW-535	Date	14.03.2024
Status	Preparing	Created By	Martin Linden
Job	Hose Deployment Report		
Description of Events:			

BBC Inner

No.	Question	Comment	OK?
1	Serial No BBC	CDOW-BBC-01	
2	Date / Time start Deployed	2024.05.01 08:00	
3	Date / Time end Deployed	2024.05.01 09:00	
4	Date / Time start Recovery	2024.05.06 10:00	
5	Date / Time end Recovery	2024.05.06 11:00	
6	Maintenance during recovery	Not needed	
7	Time BBC on seabed prior Start flushing	28 hours	

BBC Outer

No.	Question	Comment	OK?
1	Serial No BBC	CDOW-BBC-03	
2	Date / Time start Deployed	2024.05.01 10:00	
3	Date / Time end Deployed	2024.05.01 11:00	
4	Date / Time start Recovery	2024.05.06 08:00	
5	Date / Time end Recovery	2024.05.06 09:00	
6	Maintenance during recovery	Not needed	
7	Time BBC on seabed prior Start flushing	30 hours	

BBC Installation details

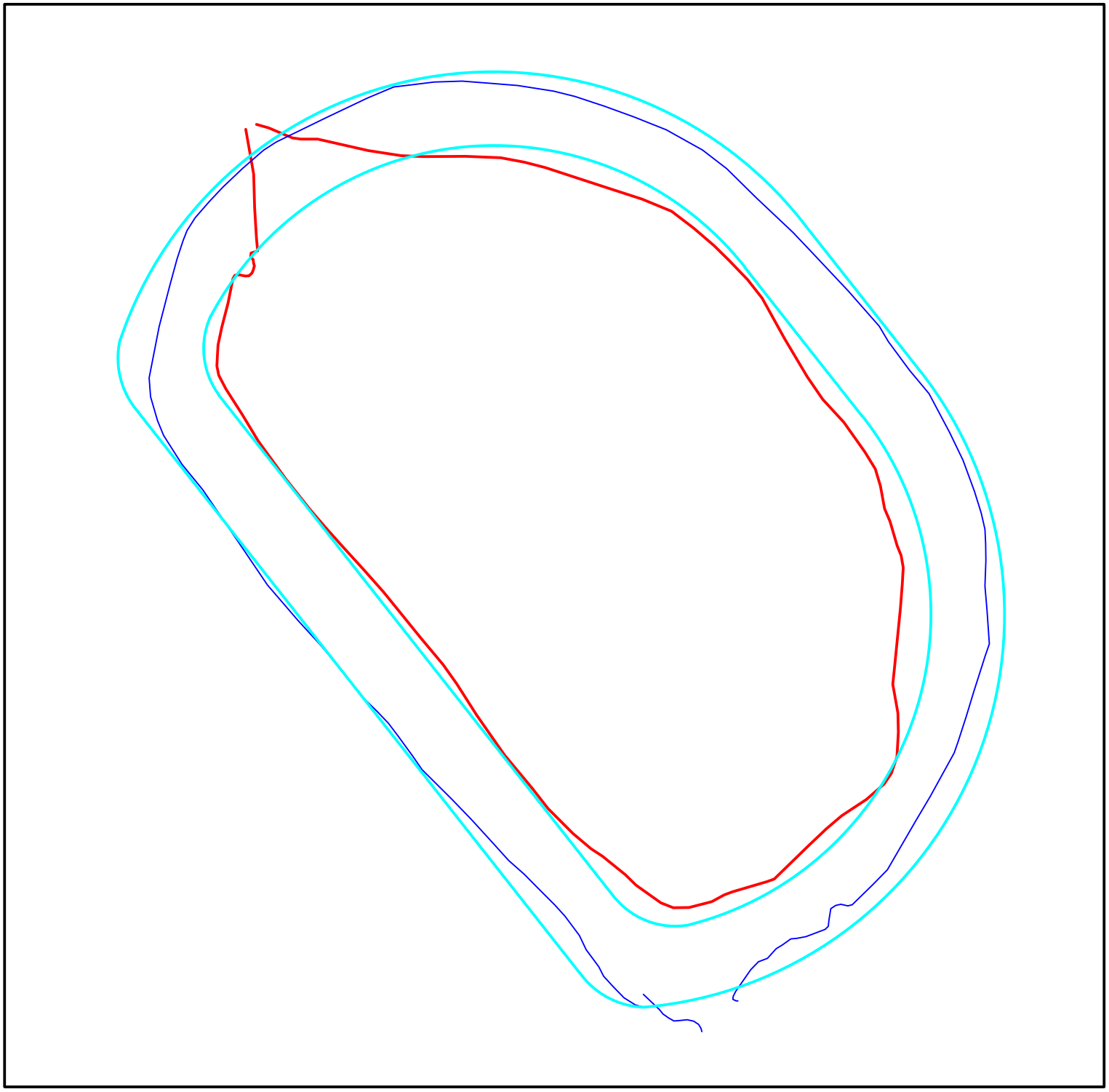
No.	Question	Comment	OK?
1	Foundation	CVOW-FOU-01	
2	Hoselength Outer BBC	800m - Radius= 127m	
3	Hoselength Inner BBC	560m - Radius = 89m	
4	Supply Hose length	30m	
5	Riser Hose length	45m	
6	Diameter of holes	2,5mm	
7	Hole spacing	5/75cm	
8	Date / Time Connecting	2024.05.04 09:00	
9	Date / Time Flushing	2024.05.04 10:00	
10	Date / Time BBC Full pressure	2024.05.04 11:00	
11	Date / Time deactivated	2024.05.04 14:00	

History

Status	Creator	Created At	Comment
Preparing	Martin Linden	14.03.2024 17:29:29	

Tasks

Title	Start Date	Target Date	Closed Date	Status	Responsible



2.6 Compressor log report :

2.6.1 Compressor performance report

Air & Filtration Equipment Performance Data – ST3100 + SeaSentry

Main Contractor		Vessel Name		Date	
Project Name/No		Location		Scantech Supervisor (Day)	
ScanTech Client		Monopile Location ID		Scantech Supervisor (Night)	
Bubble Curtain Hose Length		Compressor Package Start Time		Compressor Package Finish Time	
Water Depth of Location		Piling Start Time		Piling Finish Time	
Number of Operational Comps (During Piling)		Total Free Air Delivery (m^3/min)		Total Spare Compressors Available	

Reading Time (HH/MM)				Main Buffer Fuel Tank Level			%					Automated Refuelling System	
Comp No.	Air Compressor ID	Air Compressor (FAD M^3/min)	Discharge Pressure (PSI)	HMR	RPM	Water Temperature	Comp End Temperature	Fuel Pressure	Oil Pressure	Visual Fuel Tank Level	Visual Water Tank Level	Fuel Pressure	Fuel Temp Deg C
1										%	%		
2										%	%		
3										%	%		
4										%	%		
5										%	%		
6										%	%		
7										%	%		
8										%	%		
9										%	%		
10										%	%		

All compressors above are connected to ScanTech SeaSentry below

SeaSenty ID	SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Outlet Discharge Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Air Temperature Deg C		SeaSentry Twin Pot (Port Side / Stbd Side) Cooling Water Temp Deg C	

Important Notes:-

Minimum back pressure on SeaSentry to be maintained during operations at all times based on number of compressors operational (ref equipment labels)

ST3100 @ 13.8 bar = 76m3/min

ST3100 @ 11.5 bar = 87.5m3/min

Air & Filtration Equipment Performance Data – ST3100 + SeaSentry

Reading Time (HH/MM)				Main Buffer Fuel Tank Level			%					Automated Refuelling System	
Comp No.	Air Compressor ID	Air Compressor (FAD M^3/min)	Discharge Pressure (PSI)	HMR	RPM	Water Temperature	Comp End Temperature	Fuel Pressure	Oil Pressure	Visual Fuel Tank Level	Visual Water Tank Level	Fuel Pressure	Fuel Temp Deg C
1										%	%		
2										%	%		
3										%	%		
4										%	%		
5										%	%		
6										%	%		
7										%	%		
8										%	%		
9										%	%		
10										%	%		

All compressors above are connected to ScanTech SeaSentry below

SeaSenty ID	SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Outlet Discharge Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Air Temperature Deg C		SeaSentry Twin Pot (Port Side / Stbd Side) Cooling Water Temp Deg C	

Important Notes:-

Minimum back pressure on SeaSentry to be maintained during operations at all times based on number of compressors operational (ref equipment labels)

ST3100 @ 13.8 bar = 76m3/min

ST3100 @ 11.5 bar = 87.5m3/min

Air & Filtration Equipment Performance Data – ST3100 + SeaSentry

Reading Time (HH/MM)				Main Buffer Fuel Tank Level			%					Automated Refuelling System	
Comp No.	Air Compressor ID	Air Compressor (FAD M^3/min)	Discharge Pressure (PSI)	HMR	RPM	Water Temperature	Comp End Temperature	Fuel Pressure	Oil Pressure	Visual Fuel Tank Level	Visual Water Tank Level	Fuel Pressure	Fuel Temp Deg C
1										%	%		
2										%	%		
3										%	%		
4										%	%		
5										%	%		
6										%	%		
7										%	%		
8										%	%		
9										%	%		
10										%	%		

All compressors above are connected to ScanTech SeaSentry below

SeaSenty ID	SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Outlet Discharge Pressure (Bar)		SeaSentry Twin Pot (Port Side / Stbd Side) Inlet Air Temperature Deg C		SeaSentry Twin Pot (Port Side / Stbd Side) Cooling Water Temp Deg C	

Important Notes:-

Minimum back pressure on SeaSentry to be maintained during operations at all times based on number of compressors operational (ref equipment labels)

ST3100 @ 13.8 bar = 76m3/min

ST3100 @ 11.5 bar = 87.5m3/min

Notes

PURPOSE OF DOCUMENT

- ✓ The aim of the 'Equipment Performance Data' log is to provide 60 Min recordings of critical data relating to the operation of the air compressors and filtration equipment. By completing the log, we are able to determine how the equipment is performing during testing operations and the data can be used to proactively maintain the equipment.

- ✓ The document also serves as a pre-emptive tool for the servicing of machines and as a powerful historical reference aid prior to going onto the project. It gives guidance to possible problems with the machines in terms of layout and overheating issues that might need to be addressed during the testing operations and thus gives you some insight prior to the project starting.

COMPLETION GUIDANCE

- ✓ Under normal circumstances the 'Equipment Performance Data' log shall be completed on a daily basis by all Scantech engineers during their 12-hour shift.
- ✓ In the area which calls for 'Visual Fuel Tank Level' & 'Visual Water Tank Level' the level viewed is to be noted in the box as a percentage.
- ✓ The 'Equipment Performance Data' log shall be emailed at the end of the job[s] to the Scantech Operations Manager and/or Operations Supervisor for uploading to the web system and for printing to a hard-copy file.

DOCUMENT COMPLETION

- ✓ Completion of the document is self-explanatory

2.6.2 Compressor weekly maintenance report

Compressor Weekly Check List

Client Name:	
Rig Site Name:	

Description		Frequency	Checked
Compressor ID	Air Filter Elements	Clean Weekly	☐
	Check Radiator And Cooler For Crystallised Salt – Clean As Required	Check Weekly	☐
	Door Hinges Locks	Lubricate Weekly	☐
	Fuel Shut off valve operation	Check Weekly	☐
	Routing And Condition Of Flexible Hose	Check Weekly	☐
	Start Machine Function Test For 1 Hour	Start Weekly	☐
	Stop/ Throttle Ram Operation	Check Weekly	☐
	Water And Sediment In Fuel Tank	Drain Weekly	☐
	Check Exhaust & Exhaust Extension Clamps and Fittings	Check Weekly	☐
Current Hour Meter Reading:			
Operators Name:		Date:	
Operators Signature:			
Comments:			

Description		Frequency	Checked
Compressor ID	Air Filter Elements	Clean Weekly	☐
	Check Radiator And Cooler For Crystallised Salt – Clean As Required	Check Weekly	☐
	Door Hinges Locks	Lubricate Weekly	☐
	Fuel Shut off valve operation	Check Weekly	☐
	Routing And Condition Of Flexible Hose	Check Weekly	☐
	Start Machine Function Test For 1 Hour	Start Weekly	☐
	Stop/ Throttle Ram Operation	Check Weekly	☐
	Water And Sediment In Fuel Tank	Drain Weekly	☐
	Check Exhaust & Exhaust Extension Clamps and Fittings	Check Weekly	☐
Current Hour Meter Reading:			
Operators Name:		Date:	
Operators Signature:			
Comments:			

6.4 Attachment G-4: Hose Buoyancy calculation

Indicative DBBC hose buoyancy calculation

	Items	Unit	Inner DBBC hose	Outer DBBC hose	Formula
Hose Parameters	Da (Hose)	mm	121,60	121,60	Parameters
	Di (Hose)	mm	101,60	101,60	
	Ai (Hose)	mm^2	8107,32	8107,32	
	Aa (Hose)	mm^2	11613,34	11613,34	
	L (Hose)	m	800,00	560,00	
Inner and Outer Hose volume	Vi (Hose)	m^3	6,49	4,54	L(Hose) x Ai
	Va (Hose)	m^3	9,29	6,50	L(Hose) x Aa
Water and gravity parameter	ρ (Water)	kg/m^3	1000,00	1000,00	Parameters
	g	N/kg	9,81	9,81	
Hose buoyancy	F (Buoyancy)	N	91141,49	63799,04	ρ (Water) x Va x g
	F (Buoyancy)	kg	11610,00	9290,67	F(buoyancy) / g
	F (Buoyancy per Meter)	N/m	91,14	63,80	F(buoyancy) / L
	F (Buoyancy per Meter)	kg/m	9,29	6,50	F(buoyancy) / (g*L)
Hose weight	m (Hose per meter)	kg/m	6,00	6,00	m(hose) x g
	F (Downforce Hose per meter)	N/m	58,86	58,86	
Air parameter	ρ (Air, standard conditions)	kg/m^3	1293,00	1293,00	Parameters
	P (Nominal pressure)	Pa	500000,00	500000,00	
	Ri (Gas constant)	J/(kg*K)	287,10	287,10	
	T (Temperature in hose)	K	293,00	293,00	
In hose air weight	ρL (Air in nominal pressure)	kg/m^3	5,94	5,94	P (Nominal pressure)/(Ri x T)
	m (Air in the hose)	kg	48,20	38,55	ρL (Air in nominal pressure) x Vi
	m (Air in the hose)	kg/m	0,05	0,05	m (Air in the hose) L(Hose)
Parameter	m (Chain per meter)	kg/m	9,00	9,00	Parameters
	ρ (Steel)	kg/m^3	7850,00	7850,00	
	V (Chain per meter)	m^3 (/m)	0,00115	0,00115	m (chain per meter) /ρ (Steel)
Chain buoyancy	F (Buoyancy Chain)	N/m	11,25	11,25	ρ (Water) x V(chain) x g
	F (Buoyancy Chain)	kg/m	1,15	1,15	ρ (Water) x V(chain)
Result	Total weight hose + chain	kg/m	15,05	15,05	
	Total submerged weight	kg/m	4,61	7,40	

Legend

Buoyancy

Weight