Base Load Power Hub (BLPH)

OTP – Sea Water Intake & Fresh Water Treatment Systems

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Attachment 1 – N/A

1. INTRODUCTION

1.1 Project Overview

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.2 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

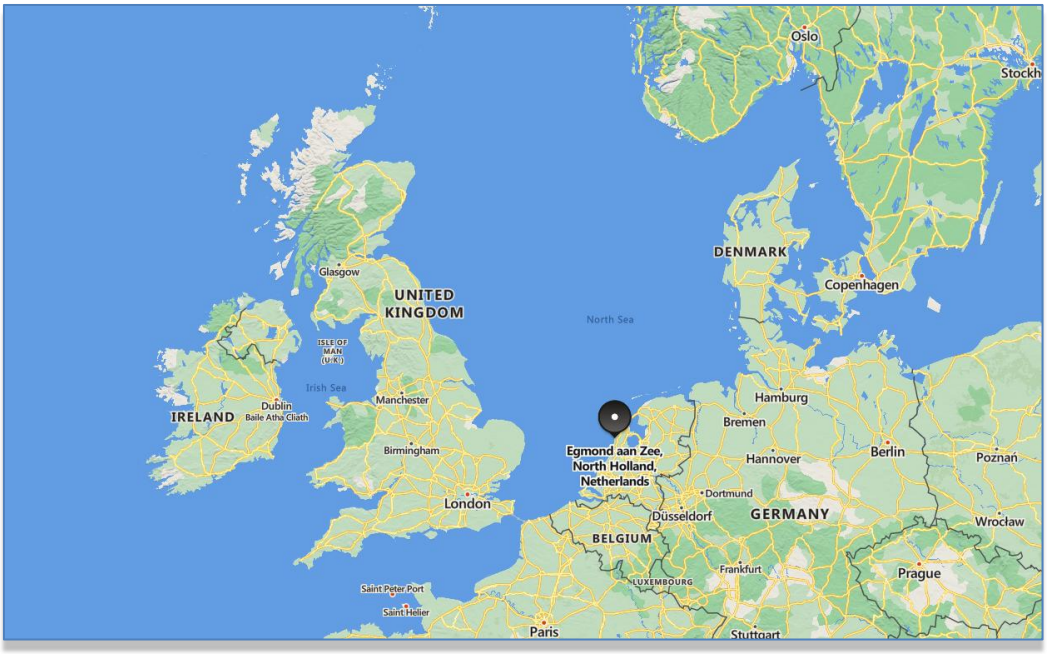


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

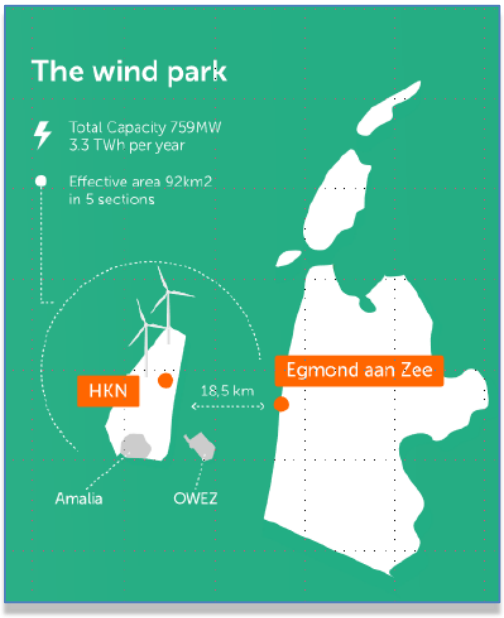


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile is located on coordinates E 590719.1, N 5841602.3 and is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.3 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

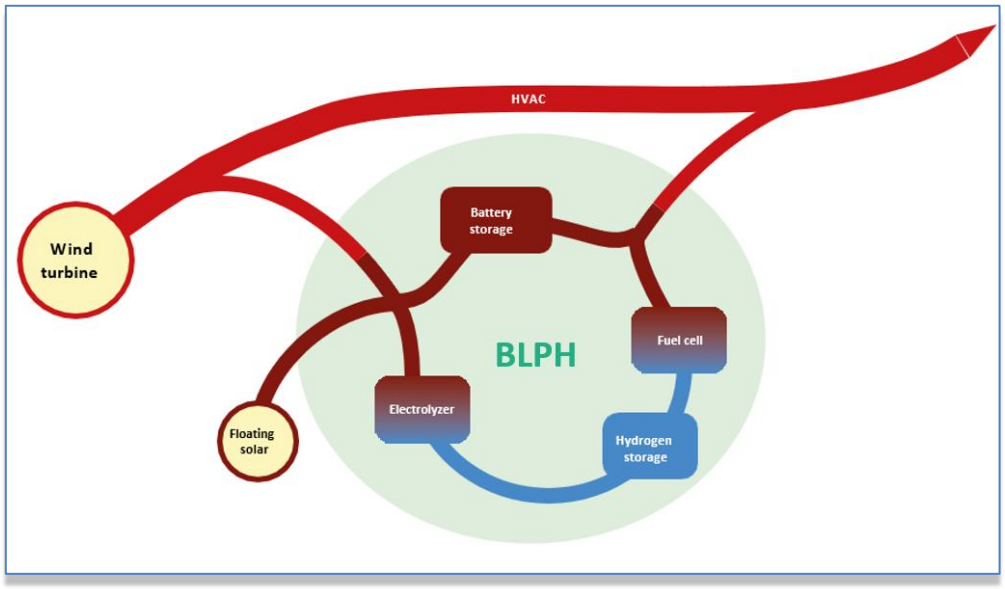


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH is to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. DOCUMENT SCOPE

The purpose of this document is to describe the methodology and the planned actions to be implemented for the preparation and execution of Mechanical Completion, Pre-commissioning, Commissioning & Start-Up activities to be performed on the PLANT, including COMPANY PROVIDED ITEMS, at the onshore premises of CONTRACTOR located in Milan (Italy) offices and Piomboni yard - Marina di Ravenna (Italy).

CONTRACTOR, pursuant to CONTRACT and PROJECT requirements, shall implement an exacting methodology, complete with a distinct set of tools and documentation to meet the following key objectives:

Perform the Mechanical Completion, Pre-commissioning and Commissioning on the WORKSITE to the maximum extent possible so as to minimise the commissioning operations on SITE;

- Ensure safety for the people, environment and facilities during the execution of the Commissioning activities at WORKSITE,
- Ensure integrity and operation of the equipment for their lifetime in accordance with PROJECT design and specifications,
- Plan a smooth and flawless execution of the Commissioning activities avoiding unforeseen downtimes and delays.

Achievement of the above objectives shall be obtained by:

- Defining and prioritizing a predetermined sequence of the Mechanical Completion checks, Pre-commissioning and Commissioning tests and tasks,
- Checking, testing systematically and exhaustively all the components of PLANT in compliance with PROJECT approved procedures and CONTRACT terms, managed by a dedicated team of inspectors, technicians and field engineers who will perform the Mechanical Completion, Pre-commissioning, Commissioning and Start-Up tasks and subsequently record the results via discipline specific check, inspection and test sheets (ITR's) & where applicable via discrete Operational Test Procedures (OTP's).
- Ensuring full traceability of the performed checks and tests, through implementation of a dedicated Project Completions Management System (CMS) containing individual references to all tagged items.

3. OTP SUMMARY

3.1 Test Objective

The operating test of the Sea Water Intake System is executed to ensure that the system is started up in a safe and controlled manner and to verify the correct operation according to the project requirements.

The scope of this document is to explain the principal procedure for inspection and test of the Sea Water Intake System associated with the functional logics for the Sea Water Treatment package.
The worksite location will require the installation of temporary facilities for pumping sea water from the yard quayside to holding tanks with a rated capacity of approximately 13 mc. From the temporary holding tanks, sea water will be manually pumped directly to the Sea Water Treatment package in substitution of the incoming piping from the permanent Sea Water Intake system.

3.2 System Boundary Limits

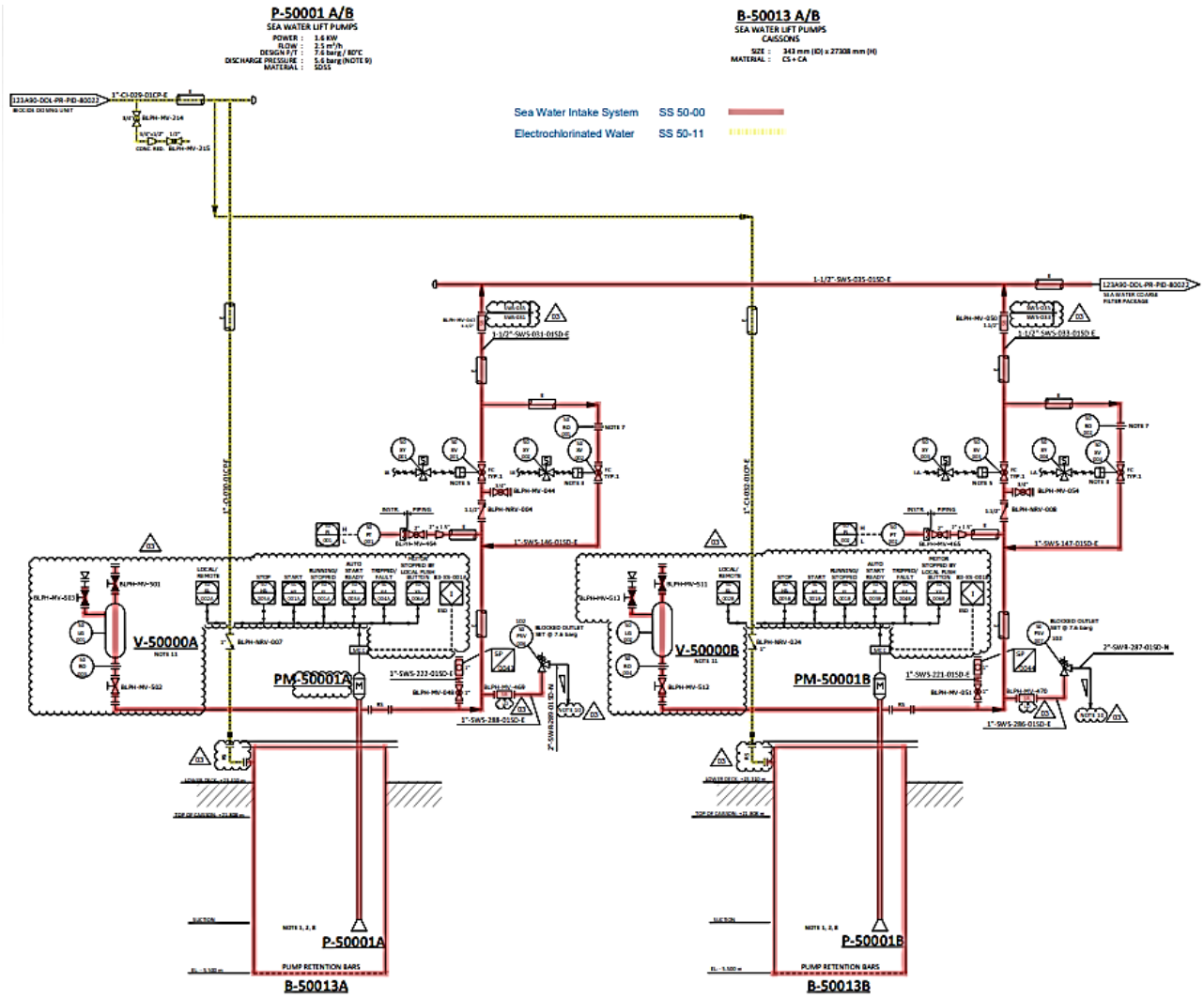


Figure 4 – System Boundary Limits

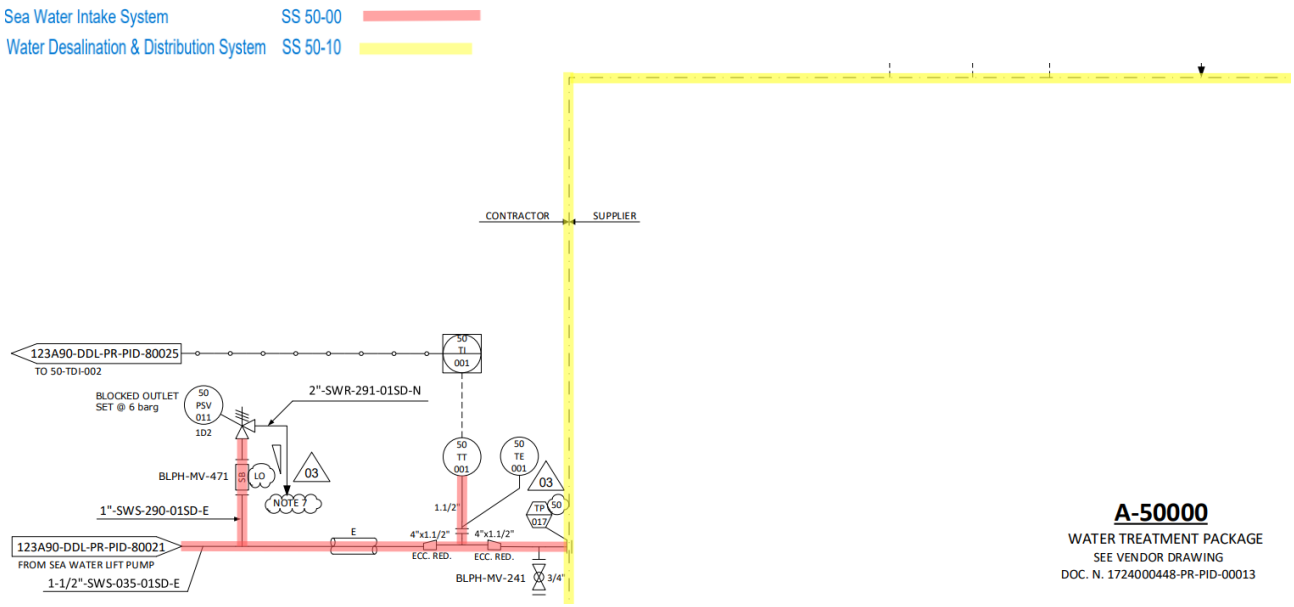


Figure 5 – System Boundary Limits

3.3 Test and System Description

This document is specifically related to the following systems:

- 50-00: Sea Water Intake System (incomplete during Worksite phase)
- 50-10: Sea Water Desalination Package and Distribution System
- Temporary Sea Water Pump (only manually operation)

All equipment must be properly installed in according with vendor documentation.

These parts of the system shall be tested on worksite and on site.

Main components of the Systems:

- SS 50-00: Sea Water Lift Pumps
  - Power: 1.6 Kw
  - Flow: 2.5m³/h
  - Design: 7.6 barg/80°C
  - Discharge pressure: 5.6 barg
  - Material: SDSS

- SS 50-10: Sea Water Desalination Package

  - Containerised Solution for entire sea water treatment package
  - Sea water coarse filter 2.5 m3/h
  - Electric heater 30 kW
  - Sand filter 2.5 m3/h
  - Filtered Water Tank 3 m3
  - Backwash pump head 1.5 bar(a), 5 m3/h
  - Container electrical heater 8.4 kW
  - SW Booster pump head 4 bar(a), 2.5 m3/h
  - SW 1st Cartridge Filter 20 µm, 2 m3/h, 6 barg
  - SW 2nd Cartridge Filter 5 µm, 2 m3/h, 6 barg
  - HP Pump 64.5 bar(a), 2 m3/h
  - Sea water reverse osmosis units 0.8 m3/h, 69 barg
  - Fresh water tank 2.2 m3
  - Fresh water pump 0.8 m3/h, head 5.2 bar(a)
  - UV Sterilizer 0.8 m3/h, 8 barg
  - Water Softening Filter 0.8 m3/h, 6 barg
  - Caustic soda dosing tank 0.05 m3
  - Caustic soda dosing pump 0.05 l/h, head 4 bar(a)
  - Antiscalant dosing tank 0.05 m3
  - Antiscalant dosing pump 0.01 l/h, head 4 bar(a)
  - Non oxidant biocide dosing tank 0.1 m3
  - Non oxidant biocide dosing pump – container inlet, 0.03 l/h, head 4.5 bar(a)
  - Non oxidant biocide dosing pump – sea water intake, 0.85 l/h, head 4.5 bar(a)
  - Non oxidant biocide dosing pump – waste water tank, 0.33 l/h, head 4.5 bar(a)

3.4 Safety Devices

- Appropriate Personnel Protective Equipment (PPE) and safety equipment e.g., safety shoes, hand gloves, helmet, earplugs etc. are available and must be used in line with the site requirements.
- Warning safety signs are to be posted with restricted access to essential personnel only.
- Adequate firefighting equipment.

3.5 HSE Management

All necessary safety precautions must be taken to avoid any risk for personnel injury.

- All personnel involved in this operational test shall be competent for the tasks they will be required to undertake
- Place safety / warning signs and segregate the entire area with barrier tapes (safety barriers) of a colour distinguished (blue and white) from those used for construction activities
- Restrict access into area only to authorized personnel
- Conduct "Toolbox Talk" with all personnel prior to starting test work
- Appropriate Personnel Protective Equipment (PPE) and safety equipment e.g. safety shoes, safety glasses, hand gloves, helmet, earplugs etc. are available and must be used in line with the site requirements
- All activities carried out on the project shall be performed in accordance with the "Permit to Work" system Doc. PRO-HSE-23

- Electrical and mechanical isolations are to be assured as per Doc. PRO-HSE-08 and "Commissioning and start-up operation" procedure.
- Observe and enforce all international codes and regulations to safeguard personnel, plant and environment.
- Ensure that the working area is clean, tidy, well illuminated and that access and escape routes are free from obstructions.

Before starting work on any of the activities in this OTP it is the responsibility of the persons performing the work to:

- Familiarize themselves with the plant/equipment to be worked on
- Ensure they are aware of all other work activities that are taking place, or due to take place
- If necessary, re-plan any situation/activity
- Ensure proper communications between parties involved in the execution of the OTP
- Read the relevant Vendor documentation for the equipment covered by this OTP and observe any special requirements and limitations recommended or imposed by Vendor
- Verify that all personnel involved in the implementation of this procedure are familiar with its content as well as the associated safety requirements (Toolbox Talk).

3.6 Acceptance Criteria

Before commissioning the systems:
Visual inspection and verification are a crucial step to identify any obvious issues with the installation, such as loose connections, missing components, or damage to the equipment.
Crosschecking the installation with engineering documentation ensures that the installation is done correctly and according to the manufacturer's guidelines. These steps can help identify any missing or incorrect components and connections.

Test Phase: Preparation and Package Operations Tests

- The Sea Water Lift Pumps P-50001A / P-50001B will receive their power supplies from LV 400V Switchboard SG-200N1, drawers A06/+01 and A07/+01.
- The Sea Water Treatment Package A-500000 will receive power its main supply from LV 400V Switchboard SG-200N1, drawer A03/+08. The secondary LV 230V power supply for the internal control panel will be supplied from UPS UP-200F3.

The main testing phase will validate the following:

- Verify the are powered on and there are no alarms present
- Verify control loop check from SIS to LV 400V Switchboard.
- Verify control loop check from SIS to Sea Water Treatment Package.

Performing the steps in this OTP as per engineering documents is crucial to ensure that the equipment is operating correctly and that it meets the desired design specifications. Observing the results will help identify any issues that may arise during the operation.
Overall, following these steps shall provide a comprehensive and effective way to verify the equipment installation and functionality.

4. DOCUMENTS REFERENCES AND ABBREVIATIONS

4.1 Reference Documents

4.1.1 Company Documents and Standards

Document ID	Document Title
[1] K559-2254-CG-PHI-001	Commissioning Philosophy
[2] K559-2254-EL-ELL-002	BLPH Electrical Load List (CCS MODE 2(A) 'HOT STANDBY')
[3] K559-2254-EL-ELL-003	BLPH Electrical Load List (CCS MODE 3(C) 'DISCHARGING')
[4] K559-2254-EL-ELL-004	BLPH Electrical Load List (CCS MODE 4(A) 'COLD STANDBY')
[5] K559-2254-EL-ELL-005	BLPH Electrical Load List (CCS MODE 4A(D) 'EMERGENCY MODE (Island))
[6] K559-2254-EL-ELL-006	BLPH Electrical Load List (CCS MODE 5(D) 'POWER OUT (Blackout))
[7] K559-2254-PR-PHI-001	Main process control philosophy

Table 1: *Company Documents and Standards*

These documents were produced in FEED and made available to RM for info. They have subsequently been superseded by Detailed Design, similar or same deliverables.

4.1.2 Project Documents

Document ID	Document Title
[1] 123A90-PML-PM-LIS-01001	Master Document Register
[2] 123A90-PML-COM-PL-03002	Mechanical Completion & Commissioning Execution Plan
[3] 123A90-PML-COM-LIS-03011	System/Sub-Systems List
[4] 123A90-PML-COM-LIS-03012	System/Sub-System Boundary Limit Diagrams
[5] 123A90-PML-COM-PRO-03007	Commissioning Strategy
[6] 123A90-PML-COM-PRO-03038	Leak Test Procedure
[7] 123A90-PML-COM-SP-03032	Pre-Commissioning Functional Test Sheet Template Collection (ITR-B)
[8] 123A90-PML-COM-SP-03014	Commissioning TDS - Temporary Equipment & Facilities
[9] 123A90-PML-COM-PRO-03019	OTP – Onshore Performance & Integrated Test Procedure
[10] 123A90-PML-COM-LIS-03034	Inhibit-Override Register
[11] 123A90-PML-COM-LIS-03035	PSV Calibration Register
[12] 123A90-PML-COM-PRO-03036	OTP - Black Start Procedure
[13] 123A90-PML-COM-LIS-03024	Commissioning Spare Parts and Consumables List

Document ID	Document Title
[14] 123A90-PML-COM-PRO-03022	Initial offshore START-UP procedures
[15] 123A90-PML-COM-RE-03001	Commissioning Final Dossier (ITR-B)
[16] 123A90-PML-QHSE-PRO-00116	Flushing and Cleaning Procedures
[17] 123A90-PML-QHSE-SP-00118	Mechanical Completion Check Sheet Template Collection (ITR-A)
[18] 123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier (ITR-A)
[19] 123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
[20] 123A90-PML-COM-PRO-03041	OTP - Hydrogen Storage & Venting Systems
[21] 123A90-PML-COM-PRO-03042	OTP - Sea Water Intake & Fresh Water Treatment Systems
[22] 123A90-PML-COM-PRO-03043	OTP - Instrument Air System
[23] 123A90-PML-COM-PRO-03055	OTP - Nitrogen Generation System
[24] 123A90-PML-COM-PRO-03045	OTP - HV Switchgear & 66 kV Transformer Systems
[25] 123A90-PML-COM-PRO-03046	OTP - MV Switchgear & 6.6 kV Transformer Systems
[26] 123A90-PML-COM-PRO-03047	OTP - LV Switch Boards & LV Distribution Board Systems
[27] 123A90-PML-COM-PRO-03048	OTP - Lighting & Small Power Systems
[28] 123A90-PML-COM-PRO-03049	OTP - Electrical Heat Tracing Systems
[29] 123A90-PML-COM-PRO-03050	OTP - DC UPS System 10KVA UP-200F1
[30] 123A90-PML-COM-PRO-03051	OTP - Data Network Systems
[31] 123A90-PML-COM-PRO-03053	OTP - Navaid System
[32] 123A90-PML-COM-PRO-03054	OTP - F&G and ESD C&E Logics
[33] 123A90-PML-COM-SP-03057	Worksite WEF (Work Execution Flow Scheme)
[34] 123A90-PML-COM-SP-03058	Site WEF (Work Execution Flow Scheme)
[35] 123A90-PML-QHSE-PL-00001	Project HSE Plan
[36] 123A90-PML-QHSE-PRO-00120	Proverlis Management Procedure
[37] 123A90-PML-COM-PRO-03056	OTP – Document Template
[38] 123A90-PML-COM-PRO-03059	OTP - AC UPS System 35kVA UP-200F3
[39] 123A90-PML-COM-PRO-03060	OTP - AC UPS System 15kVA UP-200F4
[40] 123A90-PML-COM-PRO-03061	OTP – Electrolyser (CPI)
[41] 123A90-PML-COM-PRO-03062	OTP – Fuel Cell (CPI)
[42] 123A90-PML-COM-PRO-03063	OTP – BESS (CPI)

Table 2: Project Documents

4.1.3 Vendor Documents

Document ID	Document Title
[1] 1724000936-MD-LIS-00001	SMIR - SUPPLIER MASTER INFORMATION REGISTER
[2] 1724000936-QC-ITP-00002	INSPECTION TEST PLAN-PROGRESSIVE CAVITY PUMPS
[3] 1724000936-MAC-RE-00003	VIBRATION ANALYSIS DATA-LATERAL ANALYSIS-PROGRESSIVE CAVITY PUMPS
[4] 1724000936-MAC-DA-00004	GENERAL ARRANGEMENT AND DIMENSIONAL OUTLINE DRAWINGS (INCLUDING: NAMEPLATE, BASE FRAME, SEAL SYSTEMS, FOUNDATION LOADS NOZZLES LOADS BATTERY LIMITS LIFTING DETAILS)
[5] 1724000936-MAC-DG-00005	MOTOR OUTLINE DRAWING AND WIRING DIAGRAM-PROGRESSIVE CAVITY PUMPS
[6] 1724000926-MAC-DD-00006	PUMP CROSS SECTIONAL DRAWING AND BILL OF MATERIAL (INCLUDING SPEED REDUCER)
[7] 1724000936-MAC-DD-00007	SHAFT SEAL DRAWING AND BILLS OF MATERIAL (INCLUDING FLUSHING PLAN 51)
[8] 1724000936-MAC-DD-00008	SHAFT COUPLING ASSEMBLY DRAWING AND BILL OF MATERIALS
[9] 1724000936-MAC-DD-00009	SPEED REDUCER ASSEMBLY DRAWING AND BILL OF MATERIALS
[10] 1724000936-MAC-DD-00010	PRIMARY AND AUXILIARY FLUSH PIPING SCHEMATICS AND BILL OF MATERIALS
[11] 1724000936-MAC-DD-00011	HEATING JACKET SYSTEM DETAILED DRAWING (INCLUDING ELECTRICAL CONNECTIONS)
[12] 1724000936-MAC-DS-00012	PUMP DATA SHEETS INCLUDING WEIGHT DATA SHEET-PROGRESSIVE CAVITY PUMPS
[13] 1724000936-MAC-DS-00013	PUMP AND MOTOR NOISE DATA SHEET - PROGRESSIVE CAVITY PUMPS
[14] 1724000936-MAC-DS-00014	ELECTRIC MOTOR DATA SHEET - PROGRESSIVE CAVITY PUMPS
[15] 1724000936-MAC-DS-00015	PUMP PERFORMANCE CURVES - PROGRESSIVE CAVITY PUMPS
[16] 1724000936-MAC-DS-00016	ELECTRIC MOTOR PERFORMANCE DATA -PROGRESSIVE CAVITY PUMPS
[17] 1724000936-MAC-LIS-00017	ELECTRICAL LOAD LIST - PROGRESSIVE CAVITY PUMPS
[18] 1724000936-MAC-PRO-00018	COATING PROCEDURE- ACCORDING TO CROSSWIND PROJECT SPECIFICATION
[19] 1724000936-WEL-PRO-00020	WELD PROCEDURE SPECIFICATION (WPS), WELD LOCATION PLAN (WLP) AND QUALIFICATIONS (PQR) RECORDS
[20] 1724000936-NDT-PRO-00021	NON-DESTRUCTIVE EXAMINATIONS PROCEDURES (NDE) NDE OPERATORS LIST and QUALIFICATIONS
[21] 1724000936-QC-PRO-00022	HYDROSTATIC AND OR PNEUMATIC TEST PROCEDURE - PROGRESSIVE CAVITY PUMPS
[22] 1724000936-QC-PRO-00023	FAT (FINAL ACCEPTANCE TEST) PROCEDURES - PROGRESSIVE CAVITY PUMPS
[23] 1724000936-COM-PRO-00024	PRE-COMMISSIONING -COMMISSIONING PROCEDURES - PROGRESSIVE CAVITY PUMPS

Document ID	Document Title
[24] 1724000936-QC-LIS-00025	EQUIPMENT MANUFACTURER RECORD BOOK INDEX - PROGRESSIVE CAVITY PUMPS
[25] 1724000936-MAC-LIS-00026	VENDOR ASSET REGISTER (REF DOC N 123A90-DDL-MAC-SP-50013 - PARA 9 DIGITAL DOCUMENT REQUIREMENTS)
[26] 1724000936-MAC-LIS-00027	ATEX REGISTER - PROGRESSIVE CAVITY PUMPS
[27] 1724000936-QC-DB-00028	EQUIPMENT MANUFACTURERS RECORD BOOK – COMPLETE (A4 bound volume(s) to Purchaser specifications)
[28] 1724000936-COM-LIS-00029	SPARE PART INDEX REGISTER (COMMISSIONING, 2 YEAR OPERATION) - PROGRESSIVE CAVITY PUMPS
[29] 1724000936-MAC-LIS-00030	SPECIAL TOOLS LIST (PUMP AND MOTOR) - PROGRESSIVE CAVITY PUMPS
[30] 1724000936-MAC-MAN-00031	INSTALLATION, OPERATING AND MAINTENANCE MANUAL (PUMP AND MOTOR, INCLUDING SITE ERECTION INSTRUCTIONS AND PROCEDURES)
[31] 1724000936-QC-PRO-00032	PREPARATION FOR SHIPPING PROCEDURES (A4 procedure) INCLUDING BELOW DOCUMENT
[32] 1724000936-QC-PRO-00033	PREPARATION FOR HANDLING AND STORAGE PROCEDURES (A4 procedure) - PROGRESSIVE CAVITY PUMPS
[33] 1724000936-MAC-LIS-00035	UTILITIES & LUBRICANT LIST - PROGRESSIVE CAVITY PUMPS

Table 3: Vendor Documents

4.2 Acronyms and Abbreviations

Acronyms and Abbreviations	Description
AOC	Achievement of Commissioning
BLPH	Base Load Power Hub
BESS	Battery Energy Storage System
C&E	Cause & Effects
CCR	Central Control Room
CCS	Central Control System
CCTV	Closed Circuit Television
CMS	Completions Management System
CPI	Company Provided Item
CSU	Commissioning & Start-Up
E&I	Electrical & Instrumentation
EMCS	Electrical Monitoring & Control System
ESD	Emergency Shut Down
F&G	Fire & Gas
FAT	Factory Acceptance Test
FT	Functional Test

Acronyms and Abbreviations	Description
GALT	Gross Air Leak Test
HAZID	Hazard Identification Studies
HAZOP	Hazard and Operability Studies
HKN	Hollandse Kust Noord
HSE	Health, Safety, & Environment
HSSE	Health, Safety, Security & Environment
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
ICSS	Integrated Control and Safety System
ITR	Inspection & Test Record
LC	Locked Closed
LO	Locked Open
LOTO	Lock-Out / Tag-Out
LV	Low Voltage
OCC	Onshore Commissioning Complete
OEM	Original Equipment Manufacturer
OICT	Onshore Utility Commissioning Complete
OMAR	Operating Modes Assurance Review
OR	Operations Readiness
ORR	Operations Readiness Review
OTP	Operational Test Procedure (Commissioning)
PACO	Process Automation, Control and Optimisation
PCS	Process Control System
PC&C	Pre-Commissioning & Commissioning
PID (P&ID)	Piping and Instrumentation Diagram
PSV	Pressure Safety Valve
PSSR	Pre Start-up Safety Review
PTW	Permit to Work
PV	Photovoltaic
PVP	Piping and Vessels Preparation
RFC	Ready for Commissioning
RFO	Ready for Operation
RFSA	Ready For Sail Away
RFSU	Ready For Start-Up

Acronyms and Abbreviations	Description
SAT	Site Acceptance test
SECE	Safety Environmental Critical Element
SIF	Safety Instrumentation Function
SIL	Safety Integrity Level
SIMOPS	Simultaneous Operations & Maintenance
SIS	Safety Instrumented System
SLD	Single Line Diagram
SMIR	Supplier Master Information Register
SoF	Statement of Fitness
TIV	Technical Integrity verification
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VooW	Van Oord Offshore Wind
VSAT	Very Small Aperture Terminal
VSAT	Very Small Aperture Terminal
WEF	Work Execution Flow Scheme

Table 4: Acronyms and Abbreviation

5. OTP TEST REQUIREMENTS – ONSHORE WORKSITE

This section refers to the activities on the Contractor worksite (construction yard).

5.1 Planning and Manpower

5.1.1 Planned Tasks with Estimated Manpower

Estimated manpower for the entire duration of the Test:

- 1 E&I commissioning superintendent from Contractor.
- 1 E&I commissioning supervisor from Contractor.
- 1 E&I commissioning technicians from Contractor.
- 1 Yokogawa Operator workstation field engineer.

5.1.2 Test Duration Estimate

The test duration is forecast as follows:

- 1 days.

If necessary, the estimated time can be extended in order to complete all required pre-commissioning and commissioning activities.

5.1.3 Vendor Assistance

Vendor PSC will provide a qualified specialist to assist with all aspects of commissioning of the Water Treatment Package.

5.1.4 Items Postponed to C&E OTP

- Not Applicable

5.1.5 Summary of Items HARDWIRED to be Tested

Signal tag:	Signal description:
50-PT-001	Sea water from pump P-50001A
50-PT-002	Sea water from pump P-50001B
50-TT-001	Sea water from lift pump P-50001A/B
50-XV-001	Sea water from pump P-50001A
50-XV-002	Sea water recirculation from pump P-50001A
50-XV-003	Sea water from pump P-50001B
50-XV-004	Sea water recirculation from pump P-50001A

Table 5: *Items HARDWIRING to be Tested*

5.1.6 Summary of Items HARDWIRED and Modbus to be Tested

Signal tag:	Signal description:
50-XS-001	SHUT-DOWN A-500003 Sea water treatment PKG
50-XA-003	A-500003 Sea water treatment PKG F&G LCP fault
50-XA-001	A-500003 Sea water treatment PKG confirmed gas alarm
50-XA-002	A-500003 Sea water treatment PKG confirmed fire alarm
83-XS-001A	SHUTDOWN SEAWATER LIFT PUMP P-50001A
83-XS-001B	SHUTDOWN SEAWATER LIFT PUMP P-50001B

Table 6 *Items HARDWIRING and PROFINET to be Tested*

5.2 OTP TEST REQUIREMENTS – ONSHORE WORKSITE

5.2.1 Pre-Commissioning Achievement

Prior the commissioning operation starts, the relevant pre-commissioning ITRs should be fully signed.

Note that Worksite testing activities will be limited due to restrictions imposed by incomplete construction that can only be finalized at Site.

5.2.2 Commissioning Achievement

The commissioning achievement will be the successful operation, functionality of, installed and put in operation during the WORKSITE phase:

- SS 50-10 Water Desalination & Distribution System
- Temporary Sea Water Pump (only manually operation)

5.2.3 Status of Required Associated Subsystems

MAIN TEST PHASE: Preparation Operations Tests
Subsystems required RFC for Commissioning of Sea Water Intake & Fresh Water Treatment Systems

- SS 50-10 Water Desalination & Distribution System
- SS 83-00 LV 400V Switchboard SG-200N1
- SS 84-10 UPS UP-200F3
- SS 88-00 Earthing System
- SS 79-00 SIS (ESD)
- SS 87-10 PCS System Cabinet

5.2.4 Special Tools & Test Equipment

The following special tools and Test Equipment are required:

- Continuity tester (Multimeter)
- Toolbox
- Hart Communicator
- Portable radios (2 pcs + 1 per Technical Room)

TESTING & MEASUREMENT INSTRUMENT USED			
Type	Serial N.	Calibration certificate	Validity

5.2.5 Consumable List

- Not applicable

5.2.6 Commissioning Spare Parts

- See reference document 1724000936-COM-LIS-00029

5.2.7 Temporary Facilities

- Functional testing and successive continuous operation of the Fresh Water Treatment Package A50000 will require the implementation of temporary yard facilities for the pumping of sea water from the quayside to temporary storage tanks, from where sea water will be pumped directly to the inlet manifold of package A50000.
- The temporary sea water storage capacity will be approximately 13 m3.
- All sea water pumping operations to the temporary storage tanks, and successively to package A50000 will be managed manually by Rosetti's Commissioning team. No automated control devices will be applied to the temporary facilities.

5.3 OTP DESCRIPTION – ONSHORE WORKSITE

5.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1.	System Ready for Commissioning Certificate (RFC) is issued and approved.			
2.	No Mechanical Completion or Pre-commissioning punch list 'A' items are outstanding against the system to be commissioned.			
3.	Factory Acceptance Test Procedure for Sea Water Lift Pumps has been carried out successfully, refer to document 1724000936-QC-PRO-00023.			
4.	Site Acceptance Test Procedure for Fresh Water Treatment Package has been carried out successfully, refer to document (1724000448-QC-PRO-00028).			
5.	All personnel involved in the implementation of this procedure are familiar with its content as well as with associated safety requirements (Toolbox Talk to be conducted before initiation of activities).			
6.	A final walkdown of the system has been completed, to ensure that the system and the area are ready for commissioning.			
7.	Check that areas are free for work and escape routes are clear of any obstructions.			
8.	All safety barriers and warning signs have been installed.			
9.	Ensure that proper communications have been established between parties involved in the implementation of the procedure.			
10.	Verify availability of test equipment as per section 5.2.4.			

11.	System(s) (de)isolations as per LOTO procedure defined within HSSE Permits to Work and Commissioning procedures duly prepared and approved			
12.	All yard personnel have been duly notified by dedicated LUN (Livening Up Notification) that the system(s) is ready for commissioning.			

5.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1.	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
2.	Verify that all relevant associated systems / subsystems are completed.			
3.	Verify and confirm the completion of the final connections between the LV 400V Switchboard A06/+01 & A07/+01 and the two Pumps 50001A / 50001B.			
4.	Verify and confirm the completion of the final connections between the LV 400V Switchboard A03/+08 and package A50000.			
5.	Verify and confirm the completion of the final connections between the UPS UP-200F3 and package A50000 (UCP).			

5.3.3 Mechanical Preparation

Step	Description	Result	Verified by	Date
1.	Check the correct flow direction of the valves			
2.	Confirm mechanical alignment of all package pumps & equipment.			
3.	Visual Check.			

5.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
1.	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
2.	Verify that all relevant associated systems / subsystems are ready.			
3.	Check Inhibit and Override register has been prepared and validated.			
4.	Verify that relevant equipment/ components are available and in operation for start of commissioning activities.			
5.	Verify availability of test equipment as per section 5.2.4.			

5.3.5 Piping Preparation

Step	Description	Result	Verified by	Date
1.	Verify the completion of piping in conformity with system battery limit.			
2.	Review Rosetti flange management and confirm all interface connections have been torqued and leak tested with details recorded and signed for.			
3.	Ensure piping system allows for routing of on spec water to drain without the functionality of the Ovivo package.			

5.3.6 Additional Discipline Preparation

- Temporary sea water pumping and storage facilities described in Section 5.2.7.

5.4 OTP TEST STEPS - ONSHORE WORKSITE

In the following steps the functionality of the Sea Water Intake & Fresh Water Treatment Systems

- 50-10 Water Desalination & Distribution System

5.4.1 Test Preparation

Need to Verify:

- SS 50-10 Water Desalination & Distribution System

- SS 83-00 LV 400V Switchboard SG-200N1
- SS 84-10 UPS UP-200F3
- SS 88-00 Earthing System
- SS 86-00 Server Cabinet
- SS 86-00 Network Cabinet
- SS 79-00 SIS (ESD)
- SS 87-10 PCS System Cabinet
- Temporary Sea Water Pump (only manually operation)

All systems and subsystems involved in this procedure must be ready for commissioning and available.

5.4.2 Test Steps

Step	Description	Result	Verified by	Date
Sea Water Intake & Fresh Water Treatment Systems				
MAIN TEST PHASE: Preparation and Operations Tests				
• System 50-10 Water Desalination & Distribution System				
1	This test is performed with a temporary sea water lift pump. The commands/states will be temporarily forced by PCS. Once the test is successfully completed, all commands/states and simulations will be reset and checked.			
2	The temporary sea water pump is positioned near the yard quayside with a draft of approximately 3 meters below sea level to ensure seawater quality will be comparable with the required project parameters.			
3	Since this test is performed with a temporary pump, it will be connected to the insertion point boundary limit of the Water Treatment Package A50000 with a temporary hose.			
4	The Water Treatment Package will be controlled by the local control panel 50-LP-001. All package control signals (status and commands) will be exchanged with the control system PCS. The package will be placed in auto and allowed to start the process of producing on spec water. Temporary drainage facility will be required to drain on spec water without the need for the Ovivo			

Step	Description	Result	Verified by	Date
	water treatment package to be functional as to ensure standalone functionality of the PCS package refer to document (1724000448-QC-PRO-00028). The following values are expected: • 50-TT-021 SEAWATER TEMPERATURE 50001 TEMPERATURE TRANSMITTER ➢ 10 / 23°C • 50-TT-022 SEAWATER TEMPERATURE 50001 TEMPERATURE TRANSMITTER ➢ 10 / 23°C • 50-FT-020 SEAWATER FLOW 50001 MAGNETIC FLOW TRANSMITTER ➢ 2.5 m3/h • 50-FT-020 SEAWATER FLOW H-50001 MAGNETIC FLOW TRANSMITTER ➢ 5 m3/h (Only Backwash) • 50-PT-050 PRESSURE INLET S-50001 PRESSURE TRANSMITTER ➢ 1 / 2 barg • 50-PT-051 PRESSURE OUTLET S-50001 PRESSURE TRANSMITTER ➢ 1 barg • 50-PT-025 FILTERED SEAWATER PRESSURE FROM P-50003A PRESSURE TRANSMITTER ➢ 4 barg • 50-PT-026 FILTERED SEAWATER PRESSURE TO P-50004A PRESSURE TRANSMITTER ➢ 3.5 barg • 50-PT-027 FILTERED SEAWATER PRESSURE FROM P- 50003B PRESSURE TRANSMITTER ➢ 4 barg • 50-PT-028 FILTERED SEAWATER PRESSURE TO P-50003B PRESSURE TRANSMITTER			

Step	Description	Result	Verified by	Date
	➢ 3.5 barg • 50-FT-022 FILTERED SEAWATER FLOW FROM P-50003A MAGNETIC FLOW TRANSMITTER ➢ 2 m3/h • 50-FT-023 FILTERED SEAWATER FLOW FROM P- 50003B MAGNETIC FLOW TRANSMITTER ➢ 2 m3/h • 50-AT-023 FILTERED SEAWATER CONDUCTIVITY TO P-50003A/B ANALYZER TRANSMITTER - CONDUCTIVITY ➢ 55000 mS/cm • 50-PT-030 FILTERED SEAWATER PRESSURE FROM P-50004A PRESSURE TRANSMITTER ➢ 55 / 64 barg • 50-PT-032 FILTERED SEAWATER PRESSURE FROM P- 50004B PRESSURE TRANSMITTER ➢ 55 / 64 barg • 50-AT-024 (contractual parameter) FRESH WATER CONDUCTIVITY FROM A-50007A/B ANALYZER TRANSMITTER – CONDUCTIVITY ➢ ≤ 703 mS/cm • 50-FT-024 FRESH WATER FLOW FROM A-50007A/B MAGNETIC FLOW TRANSMITTER ➢ 0.8 m3/h • 50-PT-047 FRESH WATER PRESSURE FROM P- 50009A/B PRESSURE TRANSMITTER ➢ 4,5 / 5 barg • 50-PT-041 FRESH WATER OUTLET PRESSURE TRANSMITTER ➢ 3,5 / 4,5 barg • 50-AT-026 (contractual parameter) FRESH WATER CONDUCTIVITY FROM A-50007A ANALYZER TRANSMITTER - TOTAL HARDNESS			

Step	Description	Result	Verified by	Date
	➢ < 9 ppm CaCO3 • 50-TT-024 (contractual parameter) FRESH WATER OUTLET TEMPERATURE - TEMPERATURE TRANSMITTER ➢ 10 / 23 °C • 50-FT-026 (contractual parameter) FRESH WATER FLOW FROM S-50010 MAGNETIC FLOW TRANSMITTER ➢ 0.8 m3/h • 50-AT-027 (contractual parameter) FRESH WATER OUTLET pH ANALYZER TRANSMITTER - pH ➢ pH 7 – 7.9			
5	The PCS package is required to run in a standalone steady state for: The time for the PCS package to produce on spec water will be recorded: The package will then shutdown and the piping system aligned to forward feed into the Ovivo package	_____*min.* _____*min.*		
6	The Water Treatment Package will be controlled by the local control panel 50-LP-001. All packet control signals (status and commands) will be exchanged with the control system PCS via a Modbus TCP/IP communication. • All signals are tested with Seria Communication Test Reference Doc.:1724000448-IN-LIS-00019 To allow the automatic start of the water treatment sequence, the Local/Remote selector switch is in "Remote Position", the following serial signals between 50-LP-001 and PCS must be exchanged. PCS waits for the signal "Sea water pump start request" from panel 50-LP-001 Water Treatment Package (serial signal 50-HS-001S). The PCS sends the "Operating status of the main seawater pump" to the Water Treatment Package (50-LP-001 panel). The scope of the system is to produce and provide pure water to the downstream Electrolyser Package.			

Step	Description	Result	Verified by	Date
7	Make sure there are chemicals inside the tank to allow the dosing pumps to work. Biocide:10kg Antiscalant:10kg The solution NaOH due to the variable pH value of the seawater at the entrance of the package, the solution with the correct concentration of caustic soda must be prepared.			
	The parameters necessary to send water to the Electrolyser are: • Permeate Flow Rate 50-FT-026: 0.8 m^3/h • Permeate Conductivity 50-AT-024: 703 µS/cm • Permeate Hardness 50-AT-026: 0.9 °F • pH 50-AT-027: 7-7.9 pH • Temperature 50-TT-024: 10-23 °C If the values are not reached, the PSC sends the water to the drain line.			
8	Through the PCS control system, the Water Treatment Package sends the information to the Electrolyser. The following information: • pH (50-AI-027) • Temperature (50-AI-026) • Hardness (50-AI-026) • Conductivity (50-AI-024)			
9	The temporary sea water pump will be started by a Commissioning team technician when the PCS receives the water request signal from the Water Treatment Package. 50-XS-001S _____ [ ]. The Running state is simulated by an Operator workstation field engineer on the PCS.			
10	The temporary sea water pump will be stopped by a Commissioning team technician when the PCS receives a pump stop signal from the Water Treatment Package.			

Step	Description	Result	Verified by	Date
	50-XS-005S _____ [ ]. The stopped state is simulated by an Operator workstation field engineer on the PCS.			

5.4.3 OTP Worksite Tests Notes and Remark

5.4.4 OTP Worksite Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.5 OTP Worksite Test Final Signatures and Company Acceptance

Name and Surname	Company Representative	Position	Signature

5.5 POST TEST CONDITION

the previous chapters are successfully performed.

- All necessary tests are performed and accepted for that system.
- All Communication Cables are tested and completed.
- All panels are in normal operation and no alarm pending.

5.6 REINSTATEMENT AND PRESERVATION TASKS

- All the electrical contacts which were disconnected for the testing purposes must be reconnected.
- After functional tests have been completed, system / sub-systems are left in safety condition and that they are operational.
- all preservation routines identified and required will be included in relevant Preservation ITR within the Proverlis Completions System.

6. OTP AT OFFSHORE SITE

6.1 PLANNING AND MANPOWER

6.1.1 Offshore Site Test Overview

The propose of this test is to recheck the good condition of all equipment and the commissioning of the Wate Treatment Package. At the end of the test the equipment will remain in operation.

6.1.2 Planned Tasks with Estimated Manpower

Estimated manpower for the entire duration of the Test:

- 1 E&I commissioning supervisor from Contractor.
- 1 E&I commissioning technicians from Contractor.
- 1 Operator workstation field engineer.

6.1.3 Test Duration Estimate

The test duration should be as follows:

- 1 day.

If necessary, the estimated time can be extended in order to complete all required pre-commissioning and commissioning activities.

6.1.4 Vendor Assistance

- Not applicable

6.1.5 Items Postponed to C&E OTP

- Not applicable

6.1.6 HOLDS

- Not applicable

6.2 OTP TEST REQUIREMENT – OFFSHORE SITE

6.2.1 Pre-Commissioning Achievement

- Not applicable

6.2.2 Commissioning Achievement

- Not applicable

6.2.3 Status of Required Associated Subsystem

Subsystems required for Commissioning of Sea Water Intake System:

- SS 50-00 Sea Water Intake System (N.B. Fully completed during Site phase)
- SS 50-10 Water Desalination & Distribution System
- SS 83-00 LV 400V Switchboard SG-200N1
- SS 84-10 UPS UP-200F3
- SS 88-00 Earthing System
- SS 86-00 Server Cabinet
- SS 86-00 Network Cabinet
- SS 79-00 SIS (ESD)
- SS 87-10 PCS System Cabinet

6.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required:

- Continuity tester (Multimeter)
- Hart communicator
- Toolbox
- Portable radios (2 pcs + 1 per Technical Room)

TESTING & MEASUREMENT INSTRUMENT USED			
Type	Serial N.	Calibration certificate	Validity

6.2.5 Consumable List

- Not applicable

6.2.6 Commissioning Spare Parts

The commissioning spare parts are indicated in the document 1724000936-COM-LIS-00029.

6.2.7 Temporary Facilities

- Not applicable (all temporary facilities required during the Worksite testing phase will not longer be necessary).

6.3 OTP DESCRIPTION – OFFSHORE SITE

6.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1.	System Ready for Operation (from WORKSITE Phase) (RFO) Certificate is issued and approved.			
2.	Confirm completion of SS 50-00 Sea Water Intake System (caissons and pumps installation). ITR-As completed and signed off without any blocking punch items.			
3.	All personnel involved in the implementation of this procedure are familiar with its content as well as with associated safety requirements (Toolbox Talk to be conducted before initiation of activities).			
4.	A final walkdown of the system has been completed, to ensure that the system and the area are ready for start-up.			
5.	Verify availability of test equipment as per section 6.2.4.			
6.	All personnel have been duly notified that the system(s) is ready for start-up.			

6.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1.	Verify that all relevant associated systems / subsystems are ready.			
2.	Verify and confirm the completion of the final connections between the LV 400V Switchboard 06/+01 & 07/+01 and the two Pumps 50001A / 50001B.			

6.3.3 Mechanical Preparation

Step	Description	Result	Verified by	Date
1.	Verify that all relevant associated systems / subsystems are ready.			
2.	Confirm completion of all offshore hook-up scope of works.			
3.	Confirm mechanical alignment of all package pumps & equipment.			

4.	Visual Check of piping, valves and process instrumentation.			

6.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
1.	Verify all Panels are available as per section 6.2.3			
2.	Verify availability of test equipment as per section 6.2.4.			

6.3.5 Piping Preparation

Step	Description	Result	Verified by	Date
1.	Verify the completion of piping in conformity with system battery limit.			
2.	Review Rosetti flange management and confirm all interface connections have been torqued and service tested with details recorded and signed for.			

6.3.6 Additional Discipline Preparation

- Not applicable

6.4 OTP TEST STEPS - OFFSHORE SITE

6.4.1 Test Preparation

Need to confirm availability of the following systems:

- SS 50-00 Sea Water Intake System has been completed and is available.
- SS 50-10 Water Desalination & Distribution System is available.
- SS 83-00 LV 400V SG-200N1 (06/+01 & 07/+01) is available.
- SS 84-10 UPS UP-200F3 is available.
- SS 86-00 NETWORK CABINET is available.
- SS 86-00 SERVER CABINET is available.
- SS 79-00 SIS SYSTEM is available.
- SS 87-10 PCS SYSTEM is available.

All systems and subsystems involved in this procedure must be ready and available.

6.4.2 Test Steps

Step	Description	Result	Verified by	Date
Energization of Sea Water Intake & Fresh Water Treatment Systems				
MAIN TESTING PHASE: Preparation and Operations Tests				
System 50-00 Sea Water Intake System is completed. System 50-10 Water Desalination & Distribution System				
1.	Check that there are no alarms present and that all instrumentation devices are powered.			
2.	Check and confirm that the A6/+01 and A7/+01 drawers on the LV 400V switchboard SG-200N1 are ready for power on.			
3.	Close and energize drawers A6/+01 and A7/+01 from LV 400V switchboard SG-200N1 and verify line voltage and phase rotation are all correct for starting.			
4.	Before starting the pump, ensure that no persons are in a hazardous position.			
5.	LOCAL MODE Put the selectors in Local mode SA1-A (PUMP A), in front of the drawer 06/+01 and SA1-B (PUMP B), in front of the drawer 07/+01. Check on HMI the signals are set in Remote mode. 50-HS-002A _____[ ] 50-HS-002B _____[ ]			
6.	In the Local Mode all Valves by-pass isolation (50-XV-002 for P-50001A and 50-XV-004 for P-50001B) and discharging isolation valves (50-XV-001 for P-50001A and 50-XV-003 for P-50001B) will be manually managed by operator.			
7.	Before starting the pump in Local mode, make sure that the by-pass valves are closed, and the discharging valve are open.			

Step	Description	Result	Verified by	Date
8.	Start the pushbutton PM1-A (PUMP A), in front of the drawer 06/+01 or PM1-B (PUMP B), in front of the drawer 07/+01to start the selected pump.			
9.	To stop the selected pump pushes pushbutton PA1-A (PUMP A), in front of the drawer 06/+01 or PA1-B (PUMP B), in front of the drawer 07/+01.			
10.	The shutdown pumps are given by the: • Emergency push button 50-XA-006A PM-50001A • Emergency push button 50-XA-006B PM-50001B in • Trip alarm from SIS 83-XS-001A _____ [ ]. • Trip alarm from SIS 83-XS-001B _____ [ ].			
11.	<u>REMOTE MODE</u> Put the selectors in Remote mode SA1-A (PUMP A), in front of the drawer 06/+01 and SA1-B (PUMP B), in front of the drawer 07/+01. Check on HMI the signals are set in Remote mode. 50-HS-002A _____[ ] 50-HS-002B _____[ ] 50-HS-003 is set to select pump A or B in Standby mode.			
12.	The main seawater lift pump is automatically started/stopped by the PCS according to the water demand of the Water Treatment Package. The Water treatment package sends a water request signal to the PCS. The PCS sends the pump started/stop status to the Water Treatment Package.			

Step	Description	Result	Verified by	Date
13.	The PCS requires automatic opening/closing of the (on/off) discharging isolation valves (50-XV-001 for P-50001A and 50-XV-003 for P-50001B).			
14.	A software interlock is provided to prevent the pump from starting if the valve XV is closed. • If the valve 50-XV-001 is closed (50-ZSL-001 closed valve status active), the software interlock prevents pump "A" to start. • If the valve 50-XV-003 is closed (50-ZSL-003 closed valve status active), the software interlock prevents pump "B" to start.			
15.	Auto start of designed stand-by pump will be activated on: • Loss of running status of duty pump. • low pressure alarm (50-PAL-001/002) of duty pump.			
16.	The pumps stop in case of: • Pressure transmitter on duty discharge line in High Pressure Alarm (50-PAH-001 or 50-PAH-002), duty pump will be stopped. • Pressure transmitter on duty discharge line in Low Pressure Alarm (50-PAL-001 or 50-PAL-002) when the main pump is already started, duty pump will be stopped and stand-by pump started. • Running Status (50-XL-001A or 50-XL-001B) of duty pump missing during pump operation, duty pump will be stopped and stand-by pump started.			

Step	Description	Result	Verified by	Date
	If after the selected pump is started, the relevant PT doesn't reach the min set value, within 2 minutes (Adjustable time), the stand-by pump shall be started.			
17.	The temperature transmitter 50-TT-001 with remote indication (50-TI-001) is required just at inlet of water treatment system.			
18.	Confirm correct interface and operation with Fresh Water Treatment package A50000.			
19.	Confirm absence of water leaks and absence of pumps and piping vibrations.			

6.4.3 OTP Site Tests Notes and Remarks

6.4.4 OTP Site Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

6.4.5 OTP Site Tests Final Signatures and Company Acceptance

Name and Surname	Company Representative	Position	Signature

6.5 POST TEST CONDITIONS

- The previous chapters are successfully performed.
- All panels are in normal operation and no alarm pending.

6.6 REINSTATEMENT AND PRESERVATION TASKS

After the test are completed, the system is left in a safe condition and that it is operational.

7. APPENDICES

7.1 Vendor SAT Procedure (where applicable)

7.2 Proverlis Summary System Reports

7.3 Equipment Related Technical Queries (where applicable)

7.4 As Built Documentation (where applicable)

7.5 Management of Change – Summery Table of Tasks and Details of Affected Related Documentation (where applicable)