Base Load Power Hub (BLPH)

OTP: NAVAIDS SYSTEM

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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.

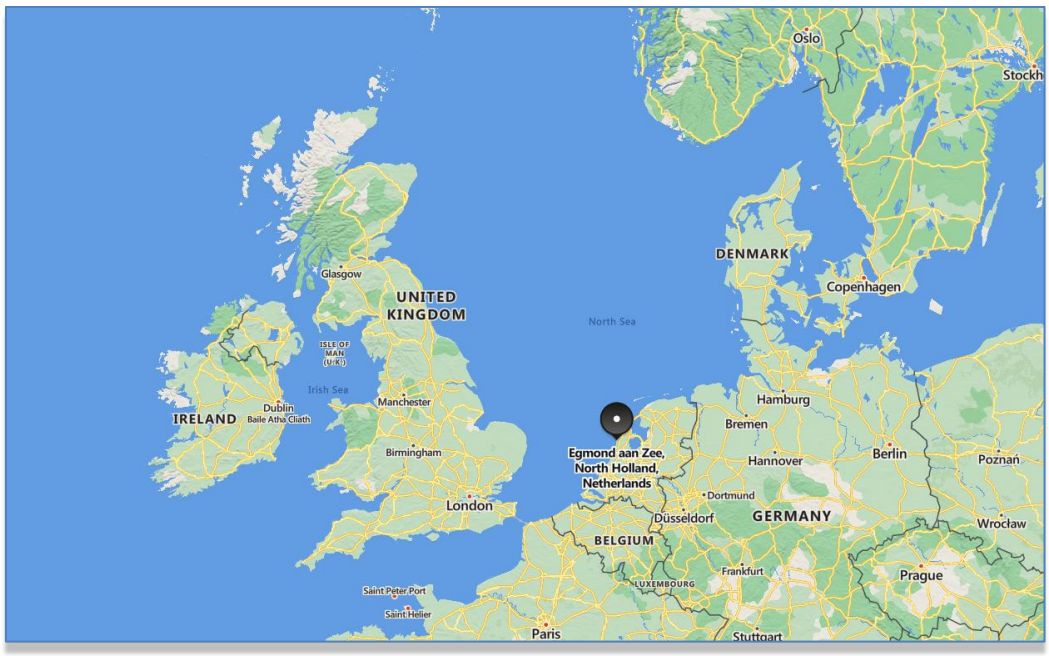


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

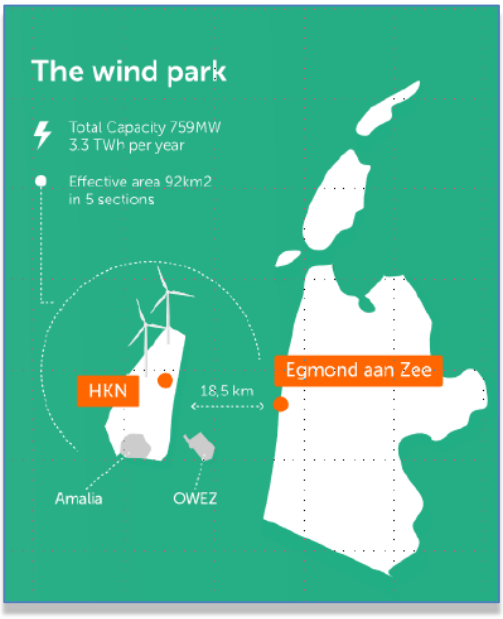


Figure 2 - Wind Park Details

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 topside 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.

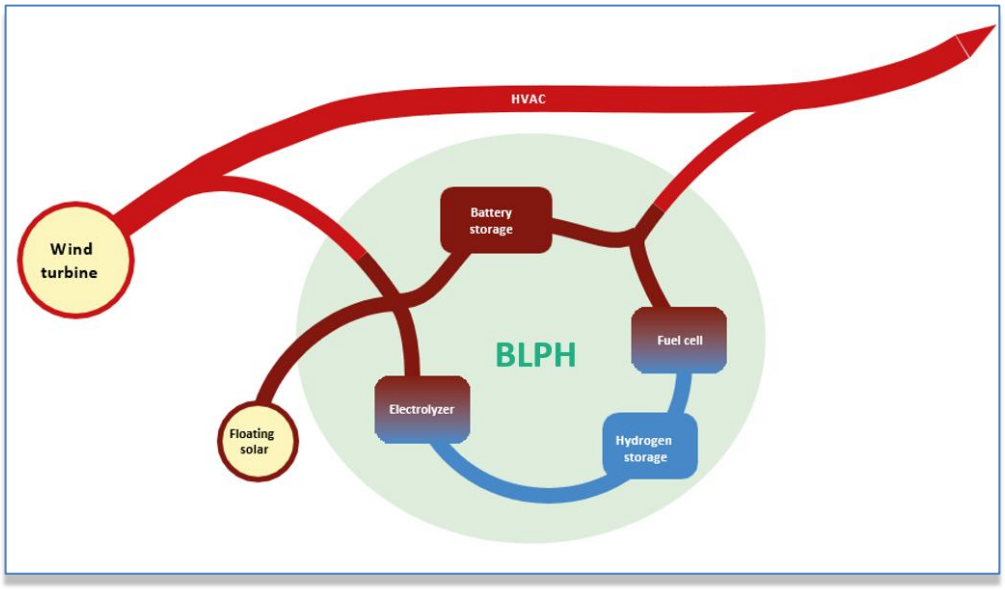


Figure 3 – BLPH Concept

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 NAVAID 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.

Activities shall be developed as follows:

- Onshore pre-commissioning and commissioning activities at Contractor site (WORKSITE)
    - PHASE 1: NAVAID with battery bank first charging, discharging and autonomy tests, full system functional tests, hardwired I/O function tests.
- Offshore commissioning (SITE)
    - Visual inspection of all components, NAVAID start up.

The overall system design is composed of the two following specific sub-systems.

1) NAVIGATION AIDS — system components consisting of flashing lanterns used for visually signalling the fixed offshore platform as an obstacle to local sea-born traffic according to IALA regulations

2) OBSTRUCTION LIGHTS — system components consisting of low and medium intensity lanterns used for signalling the fixed offshore platform as an obstacle to local air-born traffic according to ICAO regulations

Furthermore, all navigation and obstruction lighting system components can be controlled both manually and automatically (local and remote) – in local mode, system installed photocells are utilised to automatically manage lighting circuits, in remote mode all circuits will be managed by the ESD system.

In the event of a double AC supply black-out to the navigation aids power supply system, a dedicated set of batteries will ensure full continuous system operation with an autonomy of at least 96h.
Battery chargers are installed in the system control panel to restore battery autonomy upon return of either AC supply.

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3.2 System Boundary Limits

See below the affected systems and subsystems on the Overall Single Line Diagram

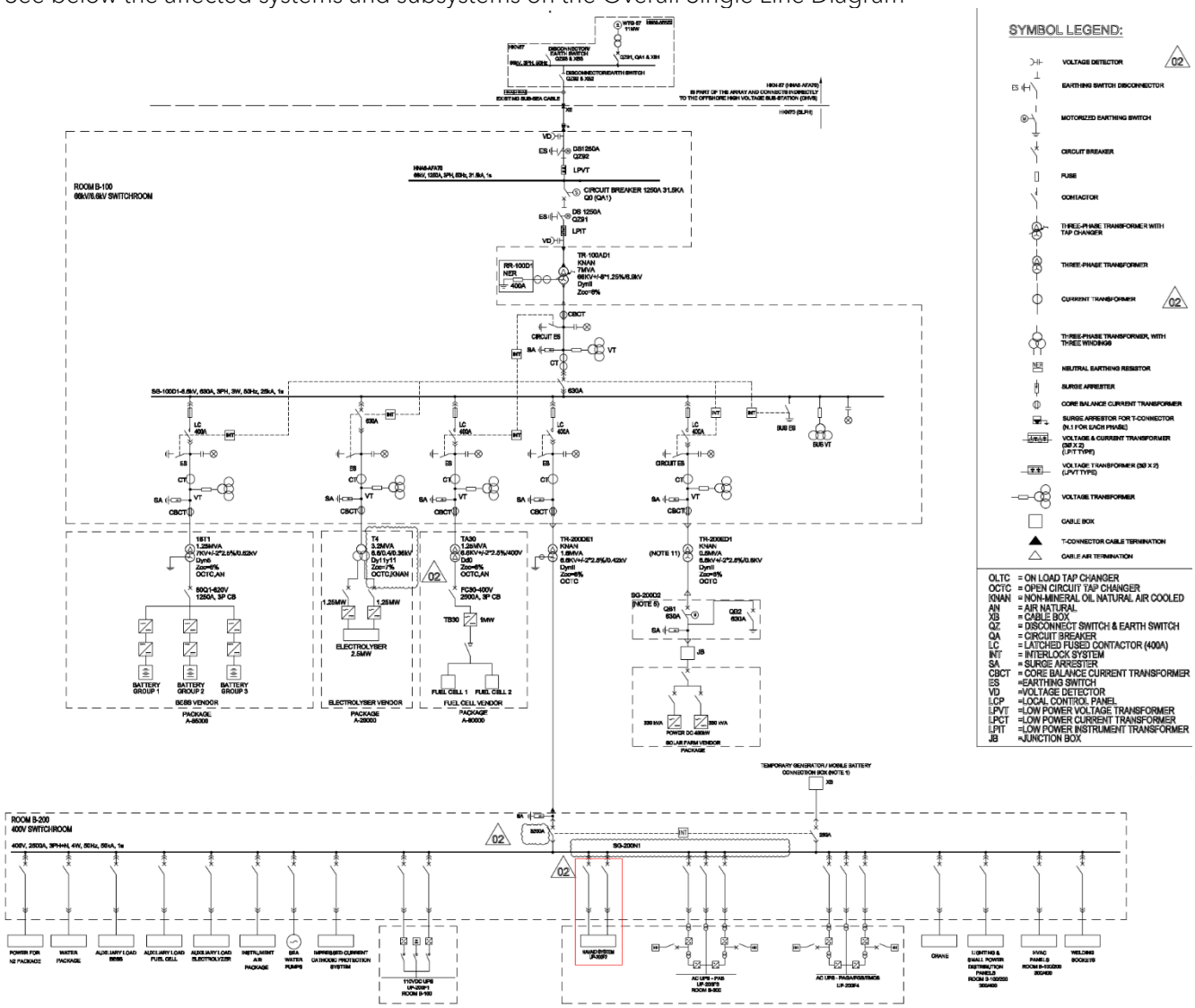


Figure 4 – OTP System Boundary Limits

3.3 Test and System Description

This document is related to the following systems/ subsystems:

- 83-00: 400/230V Switchboard SG-200N1
- 72-00: NAVAIDS BATTERY RACK BANK (BA-200F2)
- 72-00: NAVAIDS BATTERY CUT OFF BREAKER (CB-200F2)
- 79-00: EMERGENCY SHUTDOWN SYSTEMS (SIS)
- 87-10: FIRE&GAS SYSTEM (F&G)

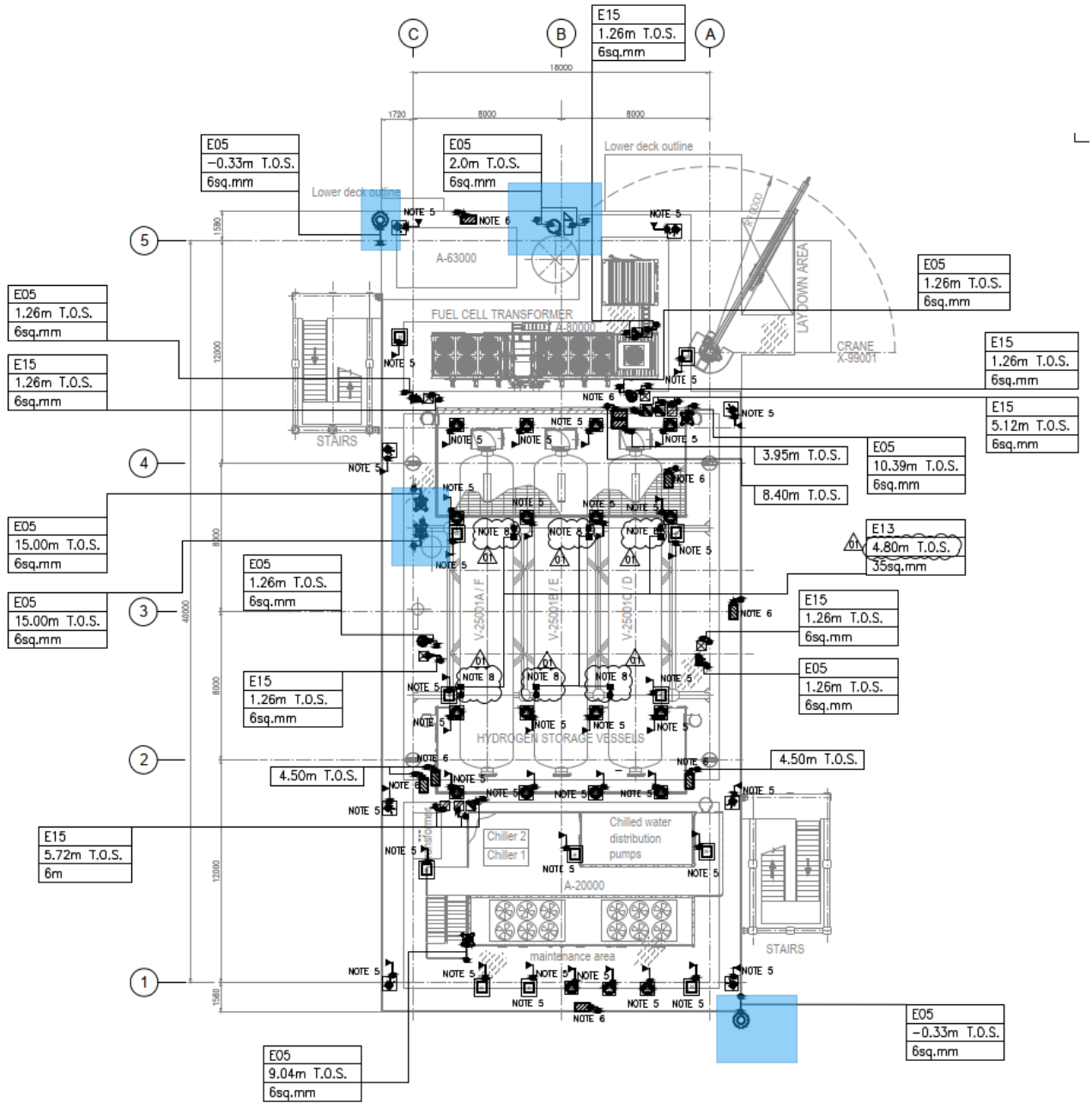


Figure 5 – Layout Installation Navaids Devices

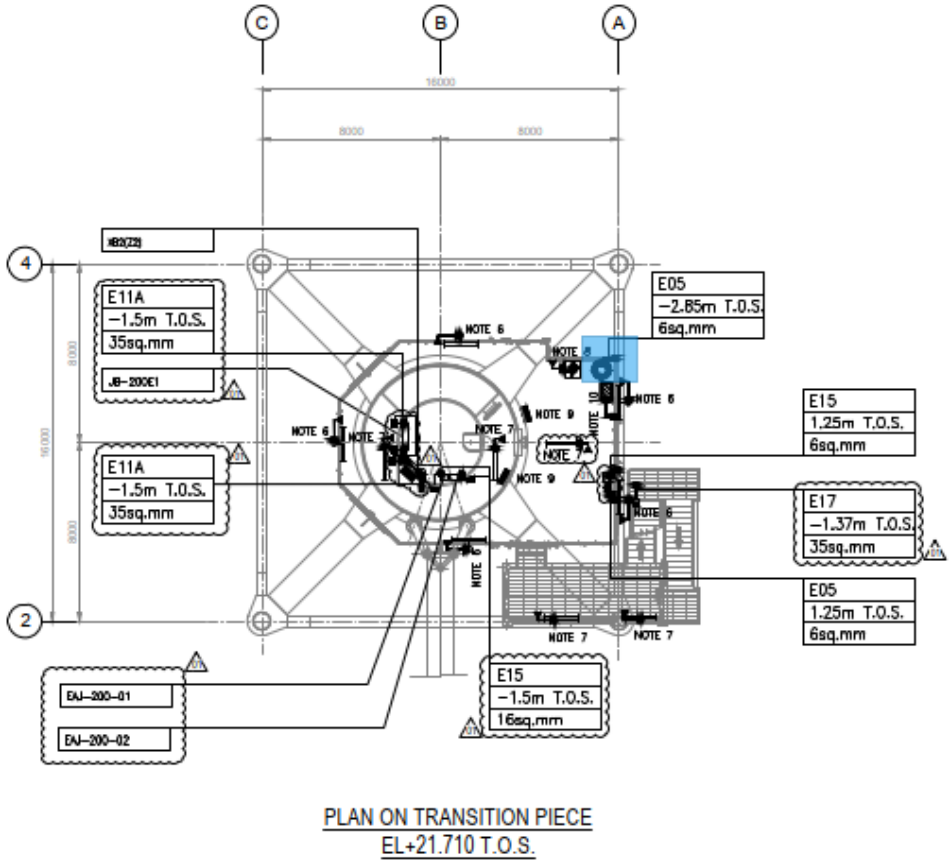
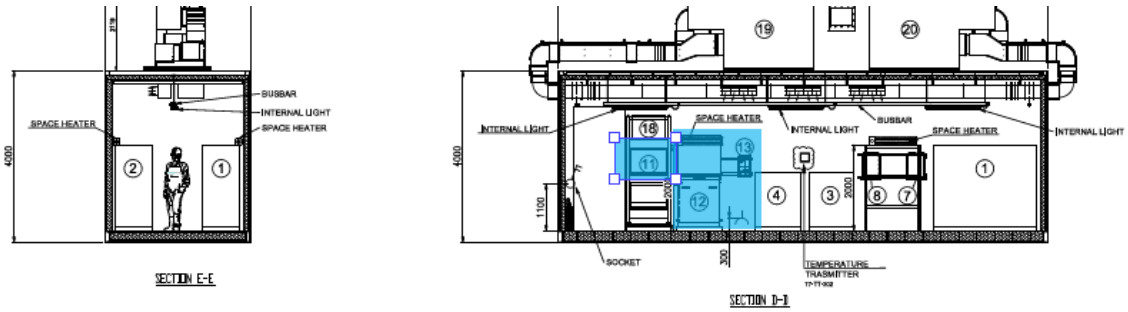


Figure 6 – Layout Installation Navaids Device



EQUIPMENT LIST

REF.	TAG No.	DESCRIPTION	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)	WEIGHT (Kg)
1	UP-200F3	AC UPS 35kVA	2400	860	1915	2258
2	UP-200F4	AC UPS 15kVA	2400	860	1915	2258
3	BA-200F3A	BATTERY RACK GEL VRLA 7y AC UPS 35kVA	1050	725	1272	914
4	BA-200F3B	BATTERY RACK GEL VRLA 7y AC UPS 35kVA	1050	725	1272	914
5	BA-200F4A	BATTERY RACK GEL VRLA 7y AC UPS 15kVA	1890	725	1761	3429
6	BA-200F4B	BATTERY RACK GEL VRLA 7y AC UPS 15kVA	1890	725	1761	3429
7	CB-200F3A	ISOLATOR BOX AC UPS 35kVA	600	300	800	100
8	CB-200F3B	ISOLATOR BOX AC UPS 35kVA	600	300	800	100
9	CB-200F4A	ISOLATOR BOX AC UPS 15kVA	600	300	800	100
10	CB-200F4B	ISOLATOR BOX AC UPS 15kVA	600	300	800	100
11	NC-200F2	NAVAID PANEL	1000	800	2600	535
12	BA-200F2	BATTERY BOX NAVAID	958	993	1210	1552
13	CB-200F2	ISOLATOR BOX NAVAID	500	400	765	70
14	B300-HSB-001	DISTRIBUTION & HVAC PANEL - AC/UPS ROOM	1600	600	2300	500
15	-	EYE WASH STATION	228	80	290	5
16	-	PORTABLE EXTINGUISHER (CO2) 5 Kg.	150	150	750	20
17	-	PORTABLE EXTINGUISHER (CO2) 5 Kg.	150	150	750	20
18	BC-200F2	BATTERY CHARGER NAVAID	607	607	2157	500
19	HHU-77005	AIR HANDLING UNIT A	2100	1000	2158	850
20	HHU-77006	AIR HANDLING UNIT B	2100	1000	2158	850
21	HSS-77-007	SPACE HEATER 1	184	145	1100	5
22	HSS-77-008	SPACE HEATER 2	184	145	1100	5
23	HSS-77-009	SPACE HEATER 3	184	145	1100	5

Figure 7 – Layout B-300 UPS TECHNICAL ROOM. Installation Navaids Control, Cut off and battery box

The items of equipment are principally installed on the UPPER DECK.

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

The UPS are metal enclosed prefabricated self-supporting type, for floor installation in compliance to the requirements of IEC 61439 1&2.

The NAVAIDS main data are the following:

GENERAL CHARACTERISTICS CLIMATIC CONDITION:
- Installation: Marine Offshore-Outdoor
- Design Ambient Temperature: -8,4+40°C
- Rel. Humidity average 95%

ENCLOSURES:
- Type: Floor Standing
- Finish Colour: RAL 7035

CONNECTIONS:
- Cable Compartment Access: Front (Incoming & Outgoing)
- Cable Entry From: Top
- Cabinet Access: Front

POWER SUPPLY:
- Rated Service Voltage: 230V
- Rated Frequency: 50 Hz
- Cabinet Rated Current: 7 A

BUSBARS:
- Busbars: 2P+PE
- Maximum Operating Temperature: 70°C
- Protection: Eexd

BATTERY:
- Configuration 1x100%
- Autonomy: 96 h
- Temp. Design: -8,4 – 40 °C
- Humidity: 95%
- Number of batteries = 12
- Rated battery Voltage = 2,00 V
- Nominal Battery System Voltage = 24 V
- Lead ACID VLRA GEL
- Capacity 1680 Ah
- Recharge: 10h
- Minimum Cell Voltage: 1,80 V
- Maximum Cell Voltage: 2,25 V
- Minimum Bank Voltage: 21,60 V
- Maximum Bank Voltage: 27,00 V

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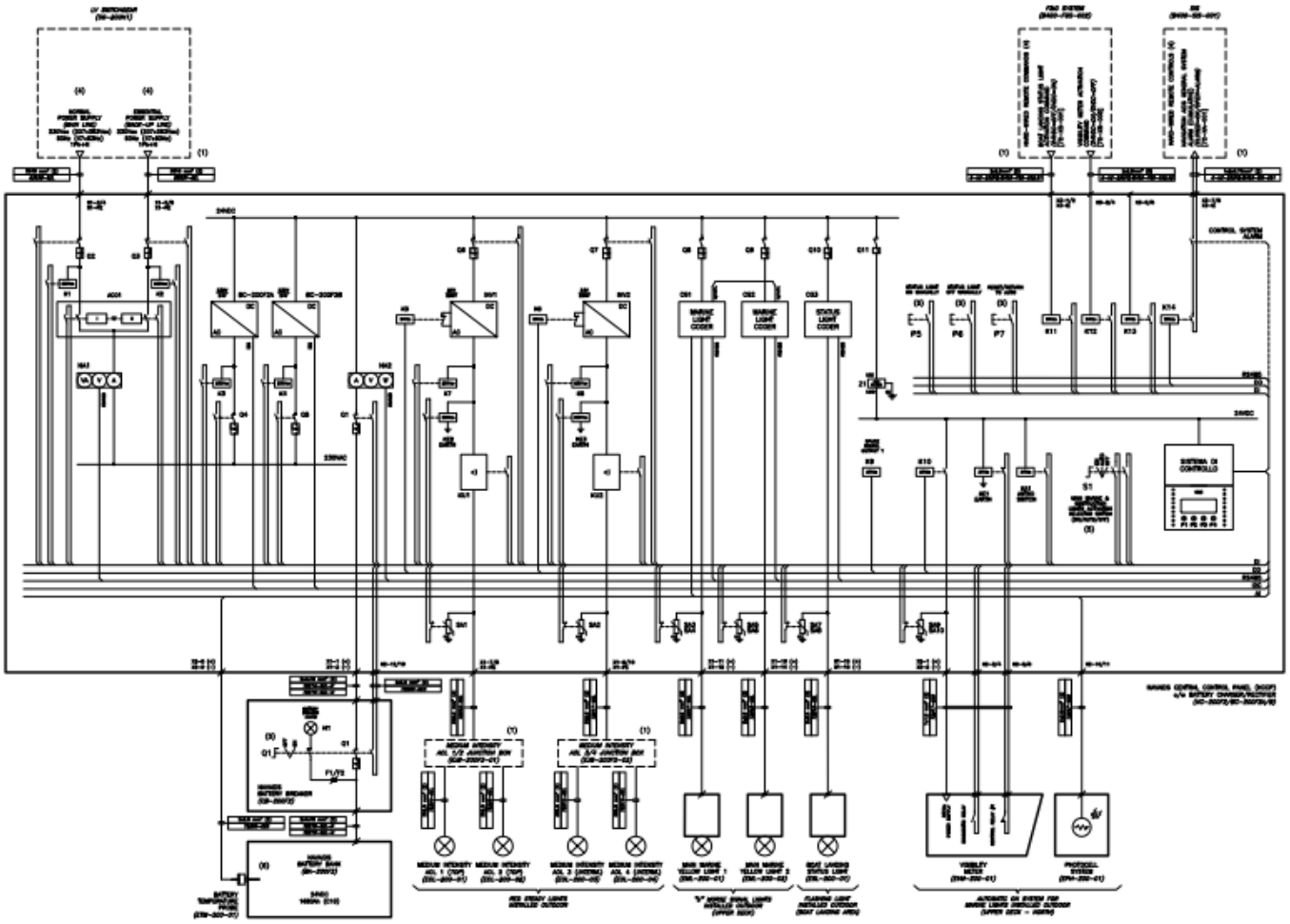


Figure 8 – NAVAIDS Single Line Diagram (ref. doc n° 172400075-EL-DG-00005)

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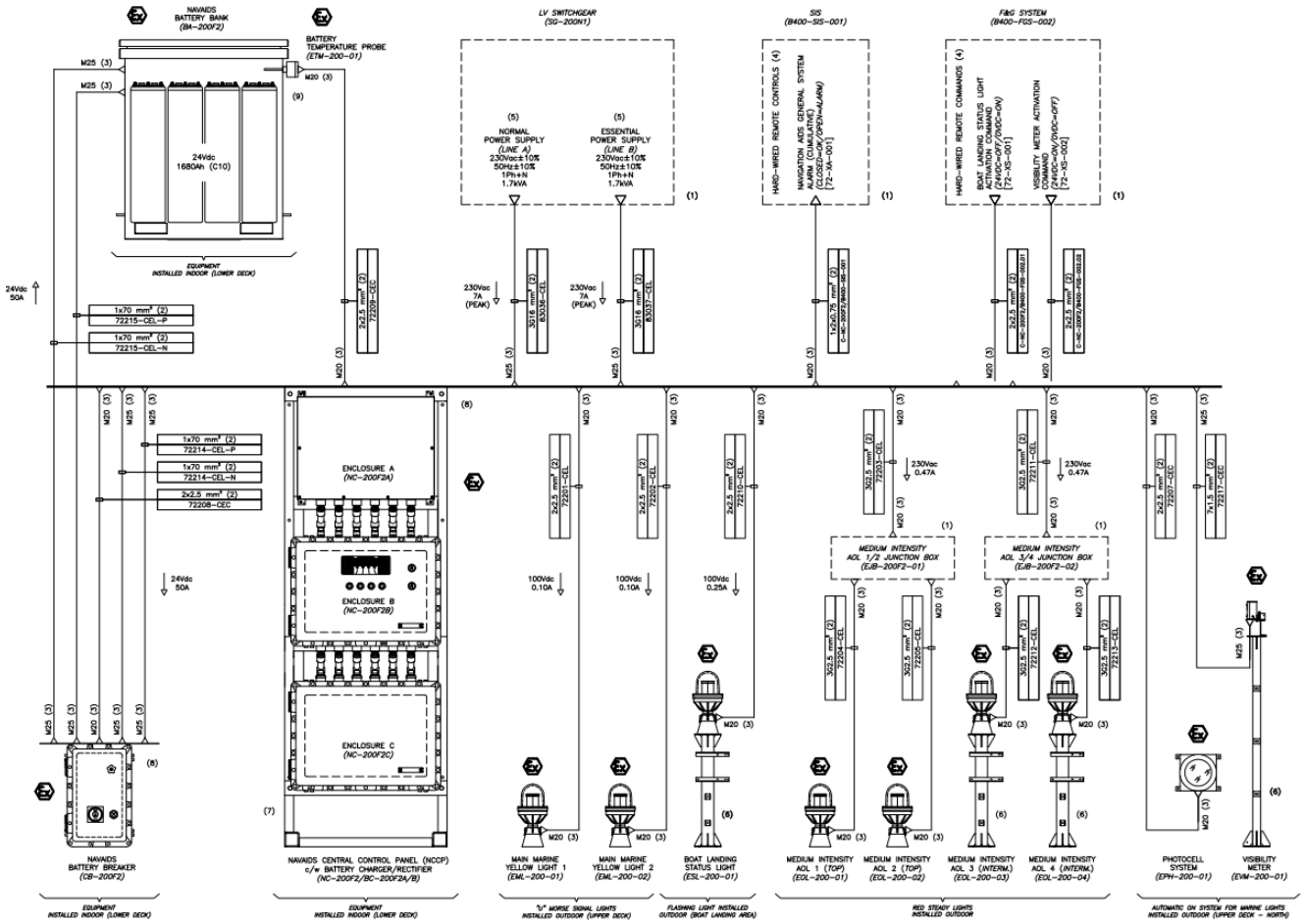


Figure 9 – NAVAIDS Diagram Block (ref. doc. n° 1724000775-EL-DG-00006

The basic Single Line Diagram of the NAVAIDS and relevant connections is shown in the document 123A90-DDL-EL-DG-20158 "Overall/Key Single Line Electrical Diagram".

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, 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 Power ON:
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 wrong connections.

Applicable panels:

- SS72-00 NC200F2
- SS72-00 BC-200F2A/B
- SS72-00 NCCP

The electrical ITEMS of the NAVAIDS system are summarised as follows:

Tag	Description	Sub-System	Quantity	Installation zone
NC-200F2A	Navaids Control Panel	1) Navigation Aids 2) Obstruction lights 3) Boat Landing Status Light	1	Electrical and Instrument Switchboards Room
BC-200F2A	Battery Charger	1) Battery Bank	1	Electrical and Instrument Switchboards Room
BC-200F2B	Rectifier	1) Navigation Aids	1	
CB-200F2	Battery Cut-Off Circuit Panel	1) Navigation Aids 2) Obstruction lights	1	HVAC UPS B-300 room
BA-200F2	Navaids Battery Bank	1) Navigation Aids 2) Obstruction lights	1	HVAC UPS B-300 room
EPH-200-01	General Photocell	1) Navigation Aids 2) Obstruction lights	1	ON TOP-DECK
EVM-200-01	Visibility Meter	1) Navigation Aids	1	ON TOP DECK
EML-200-01	Marine Yellow light 1	1) Navigation Aids	1	ON TOP DECK
EML-200-02	Marine Yellow Light 2	1) Navigation Aids	1	ON TOP DECK
ESL-200-01	BOAT LANDING Status Light	1) Boat Landing	1	ON TOP DECK
EOL-200-01	MIOL Obstruction Light 1	2) Obstruction lights	1	ON TOP DECK
EOL-200-02	MIOL Obstruction Light 2	2) Obstruction lights	1	Vent
EOL-200-03	MIOL Obstruction Light 3	2) Obstruction lights	1	Vent
EOL-200-04	MIOL Obstruction Light 4	2) Obstruction lights	1	Vent

Refer to Overall SLD with Marked-up Sub-systems.

After Power ON:
Powering ON the unit is an essential step to verify that the equipment is functioning correctly. Observing if everything is OK and any alarm will help detect possible errors or malfunctions.

Phase 1 will prove:
- Voltage, frequency and phase sequence to the terminals of Incoming power supplies A&B (Navaids) are according to specification
- NAVAIDS startup
- Charging/Discharging of battery bank
- System functional test
- System and battery bank autonomy test
- Validation of hardwired I/O

The scope of this procedure is to give the guidelines for the activities to be carried out on the NAVAIDS systems during the onshore and offshore commissioning phases to ensure that the system components are started up in a safe and controlled manner while verifying their correct operation according to the project requirements.

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The document defines the commissioning activities to be completed at the construction site and offshore. This will require the document to be amended and updated to reflect the system status at both construction sites and the offshore location due to a possible shift in work scope.

Additionally, this document shall contain or reference all relevant vendor information including FAT results where applicable.

The NAVAID CONTROL PANELs are located inside the "Emergency Electrical & Instrumentation Switchboards Room, the NAVAID BATTERY BANK and CUT-OFF SWITCH are located inside the dedicated "Batteries Room".

See project layouts to locate all other system components.

Functional tests of the NAVAIDs sub-system 72-00 shall be performed onshore, summarised as follows according to availability of main power supplies and according to platform operational normal / emergency scenarios.

- SCENARIO 01 NORMAL system operation with line A SG-200N1 power supply available and line B SG-200N1 power supply available
- SCENARIO 02 NORMAL system operation with SG-200N1 power supply available Line A and Line B SG-200N1 power supply unavailable
- SCENARIO 03 NORMAL system operation with line A SG-200N1 power supply unavailable and Line B SG-200N1 power supply available
- SCENARIO 04 NORMAL system operation with Line A SG-200N1 power supply unavailable and Line B SG-200N1 power supply unavailable

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 Key Reference Documentation

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-PM-PL-00001	Project Execution Plan
[3] 123A90-PML-QHSE-PL-00001	Project HSE Plan
[4] 123A90-PRO-HSE-23	RM Yard Permit To Work Procedure
[5] 123A90-PML-COM-PL-03002	Mechanical Completion & Commissioning Execution Plan
[6] 123A90-PML-COM-PRO-03007	Commissioning Strategy
[7] 123A90-PML-COM-LIS-03011	System/Sub-Systems List
[8] 123A90-PML-COM-LIS-03012	System/Sub-System Boundary Limit Diagrams
[9] 123A90-PML-COM-PRO-03038	Leak Test Procedure
[10]123A90-PML-COM-SP-03032	Pre-Commissioning Functional Test Sheet Template Collection (ITR-B)
[11]123A90-PML-COM-SP-03014	Commissioning TDS - Temporary Equipment & Facilities
[12]123A90-PML-COM-PRO-03019	OTP – Onshore Performance & Integrated Test Procedure
[13]123A90-PML-COM-LIS-03034	Inhibit-Override Register
[14]123A90-PML-COM-LIS-03035	PSV Calibration Register
[15]123A90-PML-COM-PRO-03036	OTP - Black Start Procedure
[16]123A90-PML-COM-LIS-03024	Commissioning Spare Parts and Consumables List
[17]123A90-PML-COM-PRO-03022	Initial offshore START-UP procedures
[18]123A90-PML-COM-SP-03057	Worksite WEF (Work Execution Flow Scheme)
[19]123A90-PML-COM-SP-03058	Site WEF (Work Execution Flow Scheme)
[20]123A90-PML-COM-RE-03001	Commissioning Final Dossier (ITR-B)
[21]123A90-PML-QHSE-PRO-00116	Flushing and Cleaning Procedures
[22]123A90-PML-QHSE-SP-00118	Mechanical Completion Check Sheet Template Collection (ITR-A)
[23]123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier (ITR-A)
[24]123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
[25]123A90- 123A90-PML-COM-PRO-03041	OTP - Hydrogen Storage & Venting Systems

Document ID	Document Title
[26]123A90- 123A90-PML-COM-PRO-03042	OTP - Sea Water Intake & Fresh Water Treatment Syst.
[27]123A90- 123A90-PML-COM-PRO-03043	OTP - Instrument Air System
[28]123A90- 123A90-PML-COM-PRO-03055	OTP - Nitrogen Generation System
[29]123A90- 123A90-PML-COM-PRO-03044	OTP - HVAC Systems
[30]123A90- 123A90-PML-COM-PRO-03045	OTP - HV Switchgear & 66 kV Transformer Systems
[31]123A90- 123A90-PML-COM-PRO-03046	OTP - MV Switchgear & 6.6 kV Transformer Systems
[32]123A90- 123A90-PML-COM-PRO-03047	OTP - LV Switch Boards & LV Distribution Board Syst.
[33]123A90- 123A90-PML-COM-PRO-03048	OTP - Lighting & Small Power Systems
[34]123A90- 123A90-PML-COM-PRO-03049	OTP - Electrical Heat Tracing Systems
[35]123A90- 123A90-PML-COM-PRO-03050	OTP - DC UPS System 10kVA UP-200F1
[36]123A90- 123A90-PML-COM-PRO-03051	OTP - Data Network Systems
[37]123A90- 123A90-PML-COM-PRO-03052	OTP - Telecom & Surveillance Systems
[38]123A90- 123A90-PML-COM-PRO-03053	OTP - Navaid System
[39]123A90- 123A90-PML-COM-PRO-03054	OTP - F&G and ESD C&E Logics
[40]123A90-PML-QHSE-PRO-00120	Proverlis Management Procedure
[41]123A90-PML-COM-PRO-03056	OTP – Document Template
[42]123A90-PML-COM-PRO-03059	OTP - AC UPS System 35kVA UP-200F3
[43]123A90-PML-COM-PRO-03060	OTP - AC UPS System 15kVA UP-200F4

Table 2: Reference Project Deliverables

4.1.3 Vendor Documents

Document ID	Document Title
1724000775-COM-LIS-00020	SPARE PART INDEX REGISTER (COMMISSIONING,2-YEAR'S OPERATION INSURANCE)
1724000775-QC-ITP-00002	INSPECTION AND TEST PLAN
[1] 172400075-EL-DA-00003	GENERAL ARRANGEMENT AND DIMENSIONAL DRAWINGS
[3] 172400075-EL-DG-00005	NAVAIDS SINGLE LINE DIAGRAM AND INTERCONNECTING DIAGRAM
[4] 172400075-EL-DG-00006	NAVAIDS -WIRING DIAGRAM
[5] 172400075-EL-DG-00011	NAVAIDS- INTERCONNECTING DIAGRAM
[6] 172400075-EL-CAL-00010	BATTERY SIZING CALCULATION
[8] 172400075-EL-LIS-00011	I/O LIST
[9] 172400075-MAT-PRO-00012	PAINTING PROCEDURE
[10] 172400075-EL-PRO-00013	NAVAIDS-FACTORY ACCEPTANCE TEST PROCEDURE
[11] 172400075-EL-PRO-00014	NAVAIDS-SITE ACCEPTANCE TEST PROCEDURE/PRE - COMMISSIONING/COMMISSIONING PROCEDURE
[24] 172400075-QC-PRO-00021	PACKING, SHIPPING, HANDLING AND STORAGE PROCEDURES

Table 3: Vendor Reference Documentation

4.2 Acronyms and Abbreviations

Acronyms / Abbreviations	Description
AIS	Automatic Identification System
AHU	Air Handling Unit
AOC	Achievement of Commissioning
C&E	Cause & Effects
CCS	Central Control System
CCTV	Closed Circuit Television
CMS	Completions Management System
CPI	Company Provided Item
CRS	Comments Response Sheet
CSU	Commissioning & Start-Up
E&I	Electrical & Instrumentation
EMCS	Electrical Monitoring & Control System
ESD	Emergency Shut Down
FAT	Factory Acceptance Test
FT	Functional Test
F&G	Fire & Gas
GALT	Gross Air Leak Test
HAZID	Hazard Identification Studies

Acronyms / Abbreviations	Description
HAZOP	Hazard and Operability Studies
HKN	Hollandse Kust Noord
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HSE	Health, Safety, & Environment
ICSS	Integrated Control and Safety System
ITR	Inspection & Test Record
LC	Locked Closed
LO	Locked Open
LoSH	Limits of System Handover
LOTO	Lock-Out / Tag-Out
LV	Low Voltage
MC	Mechanical Completion
MDR	Master Document Register
MOC	Management of Change
NUI	Normally Unmanned Installation
OEM	Original Equipment Manufacturer
OMAR	Operating Modes Assurance Review
OTP	Operational Test Procedure (Commissioning)
OR	Operations Readiness
ORR	Operations Readiness Review
PACO	Process Automation, Control and Optimisation
PC&C	Pre-Commissioning & Commissioning
PCS	Process Control System
PID (P&ID)	Piping and Instrumentation Diagram
PSSR	Pre-Start-up Safety Review
PSUA	Pre-Start-Up Audit
PSV	Pressure Safety Valve
PTW	Permit to Work
PVP	Piping and Vessels Preparation
RFC	Ready for Commissioning
RFO	Ready for Operation
RFSA	Ready For Sail Away
RFSU	Ready For Start-Up
SAT	Site Acceptance test

Acronyms / Abbreviations	Description
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
SoF	Statement of Fitness
TA	Technical Authority
TQ	Technical Query
TIV	Technical Integrity verification
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal

Table 4: Acronyms and Abbreviation

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5 OTP AT ONSHORE WORKSITE

This chapter refer to the activities on the Contractor worksite (construction yard).
Upon receipt of the Ready for Commissioning Certificate (RFC) the detailed system testing shall commence, with time and manpower estimation as follows.

NAVAIDs Sub-system 72-00:

- Energise the two feeders 230Vac 50Hz to the main NAVAIDs Control Panel, both supplied from SG-200N1,
- Conduct the specific battery bank testing according to the attached procedures:
- Close the battery cut-off switch to energise and charge the Battery Bank
- Verify correct start-up operation of main Control Panel
- ANNEX 1) Measurement of Battery Bank voltages before first charging sequence
- ANNEX 2) Measurement of Battery Bank cell voltages after first charging sequence (duration of first charge 12h min)
- ANNEX 3) Battery Bank capacity discharge test utilizing the installed equipment as electrical loads (NAVAIDS System to be powered and fully operational for a period of ≥96,0h)
- ANNEX 4) Measurement of Battery Bank cell voltages after first discharging sequence (as detailed in ANNEX 3)
- ANNEX 5) Measurement of Battery Bank cell voltages after second charging sequence (duration of second charge 12h min per Battery Bank)
- Verify Normal / Emergency OPERATING SCENARIOS 01 … 04
- Verify with dynamic testing all interface points with separate platform sub-systems, I/O from /to the F&G (F&G & SIS sections), correct functioning of panel meters, control systems, transducers and protection devices
- Verify correct operation of installed photocell sensors in normal / emergency operating scenarios, correct operation of NAVAID lanterns and anticollision lamps.

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
- 1 E&I commissioning supervisor from Contractor
- 1 E&I commissioning technicians from Contractor
- 1 Vendor technician
- 1 F&G/SIS Workstation Operators

5.1.2 Test duration estimate

The test duration should be as follows:

- 5 days approx.

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

5.1.3 Vendor Assistance

Equipment vendor SICE srl will provide a qualified specialist to assist with all aspects of commissioning of the NAVAIDS system.

5.1.4 Items Postponed to C&E OTP

Not applicable

5.1.5 HOLDS

Not applicable

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.
Specific details shall be reviewed on the completion management database Proverlis in order to access the latest updated status in real time.

5.2.2 Commissioning Achievement

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

- 83-00: 400V Switchboard SG-200N1

5.2.3 Status of Required Associated Subsystems

PHASE 1 – Battery Bank Charging/discharging tests, System Function Tests, Autonomy Test, I/O Tests.

Subsystems required RFC for Commissioning of NAVAIDS and the power supply from SG200N1:

- 83-00 400V Switchboard SG200N1
- 72-00 230V NAVAIDS System
- 88-00: Earthing Systems
- 79-00: F&G System
- 80-00: SIS System

5.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required (see vendor document 1723002197-EL-LIS-00053):

- Voltage, frequency, continuity tester (Multimeter)
- Phases sequence tester
- Infrared temperature instrument
- Portable radios

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

5.2.5 Consumable List

Not applicable

5.2.6 Commissioning Spare Parts

Reference is made to SICE document 1723002197-COM-LIS-00052 "Commissioning and operation Spare Parts Index Register" regarding the NAVAIDS spare parts.
Below the table list of spare part commissioning.

		MATERIALS DATA																		Commissioning spares
Item Number	Total number of identical spares installed	Description of recommended spare parts	Parts/drawing ref.			Material	Certificate Type (if applicable)	Certificate Reference (if applicable)	Shelf life (years)	Weight (net)	Weight (gross)	Volume	HS Code	ECCN Code	% US Content	Country of origin	Supplier part no.	Manufacturer part no.	Manufacturername	Quantity ordered
			Project Datasheet no.	Project Detail dwg. no.	Item ref.															
7		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	BATTERY CHARGER MODULE	1724000775-EL-DS-00004	1724000775-EL-DG-00006	BC	VARIOUS	NA	NA	2	2.1							RPB-1600-24	RPB-1600-24	MEAN WELL	0
2	2	POWER INVERTER MODULE	1724000775-EL-DS-00004	1724000775-EL-DG-00006	INV	VARIOUS	NA	NA	2	2.4							PHOENIX 24/250	PHOENIX 24/250	VICTRON ENERGY	0
3	2	CODER/DRIVER CIRCUIT MARINE SIGNAL LIGHT	1724000775-EL-DS-00004	1724000775-EL-DG-00006	CG	VARIOUS	NA	NA	10	NA							SICE266-10NM	SICE266-10NM	SICE	0
4	1	CODER/DRIVER CIRCUIT BOAT LANDING STATUS LIGHT	1724000775-EL-DS-00004	1724000775-EL-DG-00006	CG	VARIOUS	NA	NA	10	NA							SICE266-10NM	SICE266-10NM	SICE	0
5	1	EX-d PHOTOCELL (M25)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	FTC	VARIOUS	NA	NA	10	NA							FTC M25	FTC M25	SICE	0
6	1	INSULATION MONITORING RELAY (24VDC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	KE	VARIOUS	NA	NA	2	0.2							RI-R48	RI-R48	CONTREL	0
7	2	INSULATION MONITORING RELAY (230VAC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	KE	VARIOUS	NA	NA	2	0.3							RI-R22	RI-R22	CONTREL	0
8	1	POWER RELAY (24VDC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	NA							55.34.9.024.0094	55.34.9.024.0094	FINDER	1
9	1	DIN RAIL SOCKET FOR POWER RELAY	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	NA							94.04	94.04	FINDER	1
10	3	INTERFACE RELAY (24VDC) C/W SOCKET	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	0.03							TRS 24VDC 1CO	TRS 24VDC 1CO	WEIDMULLER	1
11	6	INTERFACE RELAY (230VAC) C/W SOCKET	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	0.03							TRS 230VAC RC 1CO	TRS 230VAC RC 1CO	WEIDMULLER	1
12	6	95sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.3							WDU95N/120N	WDU95N/120N	WEIDMULLER	1
13	6	35sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.05							WDU35	WDU35	WEIDMULLER	1
14	4	16sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.03							WDU16	WDU16	WEIDMULLER	1
15	2	6sqmm TERMINAL WITH FUSE HOLDER	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.02							WSI6	WSI6	WEIDMULLER	1
16	14	6sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU6	WDU6	WEIDMULLER	1
17	52	4sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU4	WDU4	WEIDMULLER	2
18	65	2.5sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU2.5	WDU2.5	WEIDMULLER	2

Table 5: Spare parts

5.2.7 Temporary Facilities

N/A.

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.			

Step	Description	Result	Verified by	Date
3	Factory Acceptance Test Procedure has been carried out successfully (refer to Doc. 1723002197-QC-PRO-00045)			
4	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).			
5	A final walkdown of the system has been completed, to ensure that the system and the area are ready for commissioning.			
6	Check that areas are free for work and escape routes are clear of any obstructions.			
7	All safety barriers and warning signs have been installed.			
8	Ensure that proper communications have been established between parties involved in the implementation of the procedure.			
9	Verify availability of test equipment and consumables as per section 3.6 on the table			
10	System(s) isolations as per LOTO procedure defined within HSSE Permits to Work and Commissioning procedures duly prepared and approved			
11	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	Check that grounding and bonding are in accordance with applicable documents.			
4	Review and confirmation of protection settings on up-stream LV Switchboards feeder power supply circuit breakers.			
5	Verify finalization of NAVAIDS, and Units internal power circuit connections in accordance with manufacturers documentation.			

Step	Description	Result	Verified by	Date
6	Verify finalization of the auxiliary contact connection between NAVAIDS System and MAIN DISTRIBUTION SWITCHBOARD SG-200N1 related to acquisition of the simultaneous CLOSED status of two circuit breakers NORMAL POWER SUPPLY (LINE A) A7/+05, ESSENTIAL POWER SUPPLY (LINE B) A7/+06			

5.3.3 Mechanical Preparation

Not applicable.

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.			

5.3.5 Piping Preparation

Not applicable

5.3.6 Additional Discipline Preparation

Not applicable.

5.4 OTP Test Steps – Onshore WORKSITE - PHASE 1

During the PHASE 1 will be tested:

- Startup NAVAIDS System
- First charge of battery rack (12 hours)
- Discharge of battery rack (≥96 hours) Autonomy Test
- Second recharge rack (battery bank in normal operation)
- Full system functionality test

- Validation of hardwired I/O signal with F&G and SIS

5.4.1 Test Preparation

Need to Verify:

- 230V Power supply is available
- All systems and subsystems involved in this procedure must be ready for commissioning and available.

5.4.1.1 NAVAIDS Start-Up Procedure

Step	Description	Result	Verified by	Date
TEST PREPARATION NAVAIDS				
	Preparation before start-up:			
1	Verify that 1P+N+PE power supply cable from switchboard SG200N1 position A7/+05 is correctly connected to main NAVAIDS CONTROL PANEL NC-200F2 terminals X1:3-4			
2	Verify that 1P+N+PE power supply cable from switchboard SG200N1 position A7/+06 is correctly connected to main NAVAIDS CONTROL PANEL NC-200F2 terminals X1:5-6			
3	Verify the correct polarity of all power cables between the main NAVAIDS CONTROL PANEL NC-200F2, the BATTERY CUT-OFF CIRCUIT PANEL CB-200F2, the battery bank terminals X1-3 X1-4, the LIOL OBSTRUCTION Lights, the MIOL OBSTRUCTION LIGHTS			
4	Ensure that all circuit breakers and switches on the main NAVAIDS CONTROL PANEL and BATTERY CUT-OFF CIRCUIT PANEL are open (de-energized off position) before starting this procedure.			
5	Verify correct installation and orientation of GENERAL PHOTOCELL SYSTEM EPH-200-01. Verify cable connections. If power supply is absent, then the panel will not be powered.			

Step	Description	Result	Verified by	Date
6	Verify correct installation of NAVAIDS and default position of selector switches: - S1 = AUTO ('ON / activated' command provided by the main NAVAIDS CONTROL PANEL			
7	Verify correct installation of LIOL OBSTRUCTION LIGHTS and default position of selector switch: - S1 = AUTO ('ON / activated' command Provided by main NAVAIDS CONTROL PANEL			
8	Verify correct installation of MIOL OBSTRUCTION LIGHTS and default position of selector switch: - S1 = AUTO ('ON / activated' command Provided by main NAVAIDS CONTROL PANEL			
Commissioning NAVAIDS				
9	Locate circuit breaker position A7/+05 switchboard SG-200N1 and close to energize first of Navaids Control Panel mains incomers			
10	Verify correct voltage 230Vac and phase to neutral configuration on terminals X1:3-4			
11	Locate circuit breaker position A7/+06 on switchboard SG-200N1 and close to energize second of two Navaids Control panel mains incomers			
12	Verify correct voltage 230Vac and phase to neutral configuration on terminals X1:5-6			
13	Activate the NAVAIDS CONTROL PANEL by following the instructions given in the General Operative Manual (together with Vendor personnel). Confirmation of correct operation required for all internal systems, comprising:			

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Step	Description	Result	Verified by	Date
	one battery chargers, automatic incoming power supply circuit, control system with LCD display installed on panel door, pilot light for power supply status indication installed on panel door, U-coders and current relays suitable to drive the marine signaling lights, and red obstruction lights.			
14	Confirm that the internal inverter driver units, each with its own 'on /off /remote' switch are set to the 'remote' position			
15	Confirm that the internal battery charger unit, each with its own 'on/off' switch are set to the 'on' position			
16	Confirm that the control system with LCD display on panel door is operational with no alarms present (after full system start-up completion), white pilot light H1 located on panel door is lit			
BATTERY CUT-OFF PANEL				
17	Locate BATTERY CUT-OFF CIRCUIT PANEL CB-200F2 inside the Batteries Room and confirm status of all internal circuit breakers = OPEN (dc line to battery bank BA-200F2 isolated, main distribution isolated)			
18	Locate internal circuit breaker Q1 and close to energize auxiliary control circuit of main contactor KM1.			
19	Confirm that RED light H1 located on front panel is lit when battery power contactor Q1 is ON position			

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5.4.1.2 Charge And Discharge Battery

Here follows the installed battery type datasheet:

Step	Description	Result	Verified by	Date
Battery bank FIRST Charging operation (commissioning charge)				
This mode can be used to fully charge the battery before operation. This activity will be performed with Vendor Technician.				
Verification of system status for CHARGING:				
20	Locate BATTERY BA-200F2 inside Technical Room B-300 and verify correct polarity of connections.			
21	Confirm the following circuit breaker status of BATTERY CUT-OFF CIRCUIT PANEL: - Q1 = Closed			
22	With battery bank isolated, measure individual cell voltages and compile the following: ANNEX 1: Measurement of Battery Bank cell voltages before 1st charging sequence			
23	Close main circuit breaker Q1 on BATTERY CUT-OFF CIRCUIT PANEL in order to initiate battery charging process from main NAVAIDS CONTROL PANEL. After 12h continuous charging, measure individual cell voltages and compile the following: ANNEX 2: Measurement of Battery Bank cell voltages after 1st charging sequence			
24	Remaining performance testing of battery bank cells with compilation of documents ANNEX 3 /4 and /5 shall be completed after end of NAVAIDS system testing.			

Step	Description	Result	Verified by	Date
	General photocell			
25	Locate GENERAL PHOTOCELL EPH-200-01 and confirm correct installation and orientation			
26	There is n°1 photocell connected to system controller with LCD display installed on the main NAVAIDS CONTROL PANEL. The status of the photocell is displayed on page 3/12. Confirm the correct operation and night / day detection status of the photocell.			
	Visibility meter			
27	Locate VISIBILITY METER device EVM-200-01 and confirm correct installation and orientation			
28	The VISIBILITY METER is used to control the switching on/off of the marine lanterns. The poor visibility detection signal is received by the system controller with LCD display installed on the main NAVAIDS CONTROL PANEL. The status of the VISIBILITY METER is displayed on page 8/12. Confirm the correct operation of poor visibility detection and device fault by obscuring the devices optical system.			
	FUNCTIONALITY TEST NAVAID CONTROL PANEL AND MARINE/AERONAUTICAL LIGHTS			
29	The following procedures define the activities necessary to demonstrate to correct operation of the following components when supplied and controlled from the main NAVAIDS CONTROL PANEL NC-200F2: - n°2 Marine White Lights NAV-000-4-4A/B - n°2 Marine Yellow Morse Signaling Light Auxiliary Lights EML-200-01/02			

Step	Description	Result	Verified by	Date
	- n°1 Boat Landing status light ESL-200-01 - n°4 MIOL Red Obstruction Lights EOL-200-01/02/03/04 Verify the correct diagnostic system of Yellow Marine Lamps, Boat Landing status light and white light on the HMI of the controller.			
30	Simulate automatic operation of n°2 Marine Yellow Lights by obscuring the n°1 photocell installed on the GENERAL PHOTOCELL panel. Confirm correct operation of both lights; - check on / off intermittence to IALA standard U-code morse with frequency of 15 seconds, generated by each marine signal light - check the synchronization between the lights, they must flash perfectly synchronized when activated			
31	The status of the marine yellow lights is displayed on the system controller with LCD display installed on the main NAVAIDS CONTROL PANEL. Confirm the correct status of operation displayed on the dedicated page of HMI of controller of "Marine yellow Lamps Page".			
32	Simulate an internal fault (i.e. open circuit breaker to U-coder or inverter) on marine yellow lights circuits and confirm local / remote signaling of alarm on LCD display and 'Navaids System General Alarm' on terminals X3:7-8			
33	Simulate automatic operation of n°4 MIOL Obstruction Lights by obscuring the n°1 photocell installed on the UPPER DECK. - EOL-200-01/02/03/04 Confirm the correct operation of all four lights.			

Step	Description	Result	Verified by	Date
34	The status of the MIOL Obstruction Lights is displayed on the system controller with LCD display installed on the main NAVAIDS CONTROL PANEL. Confirm the correct status of operation displayed on dedicated page of diagnostic.			
35	Simulate an internal fault (i.e. open circuit breaker to inverter) and confirm local / remote signaling of alarm on LCD display and 'Navaids System General Alarm' on terminals X3:7-8			
	F&G VALIDATION			
36	Verify that 0Vdc 'BOAT LANDING STATUS Lights ACTIVATION Command' signal from F&G panel is correctly activated to terminals X3:1-2 (OPEN circuit +0Vdc command = ON) Confirm activation of ESL-200-01 when command is 0V			
37	Verify that +24Vdc 'Visibility meter ACTIVATION Command' signal from F&G panel is correctly activated to terminals X3:3-4 (close circuit +24Vdc command = ON) Confirm activation of EVM-200-01 when command is 24V			
	DYNAMIC SYSTEM TESTING IN NORMAL OPERATION OF NAVAID CONTROL PANEL WITH 230Vac POWER SUPPLIES, POWER SUPPLIES BLACKOUT:			
38	Reference ANNEX SCENARIO 01 With Navaid system operation NORMAL, verify and confirm each item on annexed functional table SCENARIO 01 Battery chargers operational, battery cut-off closed, batteries are charging - power supply from SG-200N1 A7/+05 = 230Vac - power supply from SG-200N1 A7/+06 = 230Vac			

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Step	Description	Result	Verified by	Date
	Confirm normal working system operation.			
39	Reference ANNEX SCENARIO 02 With Navaid system operation NORMAL, verify and confirm each item on annexed functional table SCENARIO 02 Battery chargers operational, battery cut-off closed, batteries are charging - power supply from SG-200N1 A7/+05 = 220Vac - power supply from SG-200N1 A7/+06 = 0Vac Confirm normal working system operation.			
40	Reference ANNEX SCENARIO 03 With Navaid system operation NORMAL, verify and confirm each item on annexed functional table SCENARIO 03 Battery chargers operational, battery cut-off closed, batteries are charging - power supply from SG-200N1 A7/+05 = 0Vac - power supply from SG-200N1 A7/+06 = 230Vac Confirm normal working system operation.			
41	Reference ANNEX SCENARIO 04 With Navaid system operation NORMAL, verify and confirm each item on annexed functional table SCENARIO 04 Battery chargers non-operational, battery cut-off closed, batteries are discharging - power supply from SG-200N1 = 0Vac - power supply from SG-200N1 = 0Vac Confirm normal working system operation.			

Step	Description	Result	Verified by	Date
	BATTERY BANK CAPACITY TEST:			
42	Refer to the following ANNEXED documents for final commissioning of battery cells, with complete registration of overall battery terminal voltages and individual battery cell voltages. - ANNEX 3: Battery Bank BA-200-F2 96 hours capacity test - ANNEX 4: Measurement of discharge Battery cell voltages after 1st discharging sequence			

5.4.2 OT WORKSITE Phase 1 – Tests Notes and Remarks

5.4.2.1 OTP Worksite Phase 1 - Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.2.2 OTP WORKSITE Phase 1 - Tests Final Signatures and Company Acceptance

Name and Surname	Company Representative	Position	Signature

5.5 Post-test Conditions

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 healthy and safety condition and that they are operational.

5.6 Reinstatement and Preservation Tasks

Generally, the system/ sub-system shall be reinstated at its initial condition; and the following activities must be carried out as minimum:

- all inhibition done for the test shall be removed (as per Inhibit / Override List)
- all equipment/devices shall be returned in healthy functional conditions.

All preservation routines identified and required will be included in relevant Preservation ITR within the Proverlis Completions System.

6 OTP AT SITE

6.1 Planning and Manpower

6.1.1 Offshore Site overview

It is expected that all pre-commissioning tests, systems energization and commissioning steps will have been successfully performed during the Onshore Phases.
Consequently, during the offshore SITE phase, the respective systems will be inspected prior to re-energization.
Offshore commissioning includes a re-check of all tests carried out during the onshore phase.

Attention shall be paid to verify that there was no damage to components during transit and that all systems are fully functioning in the permanent platform configuration.

6.1.2 Planned tasks with estimated manpower

Estimated manpower for the entire duration of the Test:
- 1 E&I commissioning superintendent
- 1 E&I commissioning supervisor from Contractor
- 1 E&I commissioning technicians from Contractor

6.1.3 Test duration estimate

The test duration should be as follows:
- 1 day approx.

If necessary, the estimated time can be extended 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 Requirements – Offshore SITE

6.2.1 Pre-Commissioning Achievement

- Not applicable

6.2.2 Commissioning Achievement

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

The successful commissioning result, achieved during the WORKSITE commissioning phase for the functionality and safeguard of the UPS system, will allow for a smoother commissioning phase of the offshore SITE.
The systems and subsystems involved:

- 88-00: Earthing System
- 72-00: NAVAIDS System
- 83-00: 400V Switchboard SG-200N1
- 79-00: SIS (ESD)
- 70-00: Fire & Gas System (F&G)

6.2.3 Status of Required Associated Subsystems

The systems involved has been already energized and commissioned in WORKSITE Phase.
The subsystem SS 83-00 SG-200N1,must be already available, functioning and commissioned.

6.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required (see vendor document 1723002197-EL-LIS-00053):

- Voltage, frequency, continuity tester (Multi-meter)
- Phases sequence tester
- Radios
- Portable

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

6.2.5 Consumable List

- Not applicable

6.2.6 Commissioning Spare Parts

Reference is made to SICE document 1724000725-COM-LIS-00020 "Commissioning and operation Spare Parts Index Register" regarding the NAVAIDS spare parts.

		MATERIALS DATA																		Commissioning spares
Item Number	Total number of identical systems installed	Description of recommended spare parts	Parts/drawing ref.			Material	Certificate Type (if applicable)	Certificate Reference (if applicable)	Shelf life (years)	Weight (net)	Weight (gross)	Volume	HS Code	ECCN Code	% LIS Content	Country of origin	Supplier part no.	Manufacturer part no.	Manufacturer name	Quantity ordered
			Project Datasheet no.	Project Detail dwg. no.	Item ref.															
7		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	2	BATTERY CHARGER MODULE	1724000775-EL-DS-00004	1724000775-EL-DG-00006	BC	VARIOUS	NA	NA	2	2.1							RPB-1600-24	RPB-1600-24	MEAN WELL	0
2	2	POWER INVERTER MODULE	1724000775-EL-DS-00004	1724000775-EL-DG-00006	INV	VARIOUS	NA	NA	2	2.4							PHOENIX 24/250	PHOENIX 24/250	VICTRON ENERGY	0
3	2	CODER/DRIVER CIRCUIT MARINE SIGNAL LIGHT	1724000775-EL-DS-00004	1724000775-EL-DG-00006	CG	VARIOUS	NA	NA	10	NA							SICE266-10NM	SICE266-10NM	SICE	0
4	1	CODER/DRIVER CIRCUIT BOAT LANDING STATUS LIGHT	1724000775-EL-DS-00004	1724000775-EL-DG-00006	CG	VARIOUS	NA	NA	10	NA							SICE266-10NM	SICE266-10NM	SICE	0
5	1	EX-d PHOTOCELL (M25)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	FTC	VARIOUS	NA	NA	10	NA							FTC M25	FTC M25	SICE	0
6	1	INSULATION MONITORING RELAY (24VDC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	KE	VARIOUS	NA	NA	2	0.2							RI-R48	RI-R48	CONTREL	0
7	2	INSULATION MONITORING RELAY (230VAC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	KE	VARIOUS	NA	NA	2	0.3							RI-R22	RI-R22	CONTREL	0
8	1	POWER RELAY (24VDC)	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	NA							55.34.9.024.0094	55.34.9.024.0094	FINDER	1
9	1	DIN RAIL SOCKET FOR POWER RELAY	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	NA							94.04	94.04	FINDER	1
10	3	INTERFACE RELAY (24VDC) C/W SOCKET	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	0.03							TRS 24VDC 1CO	TRS 24VDC 1CO	WEIDMULLER	1
11	6	INTERFACE RELAY (230VAC) C/W SOCKET	1724000775-EL-DS-00004	1724000775-EL-DG-00006	K	VARIOUS	NA	NA	2	0.03							TRS 230VAC RC 1CO	TRS 230VAC RC 1CO	WEIDMULLER	1
12	6	95sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.3							WDU95N/120N	WDU95N/120N	WEIDMULLER	1
13	6	35sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.05							WDU35	WDU35	WEIDMULLER	1
14	4	16sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.03							WDU16	WDU16	WEIDMULLER	1
15	2	6sqmm TERMINAL WITH FUSE HOLDER	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.02							WSI6	WSI6	WEIDMULLER	1
16	14	6sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU6	WDU6	WEIDMULLER	1
17	52	4sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU4	WDU4	WEIDMULLER	2
18	65	2.5sqmm TERMINAL	1724000775-EL-DS-00004	1724000775-EL-DG-00006	X	VARIOUS	NA	NA	2	0.01							WDU2.5	WDU2.5	WEIDMULLER	2

Table 6: Spare parts

6.2.7 Temporary Facilities

- Not applicable

6.3 OTP Description – Site

The pre-requisite of energization in SITE of NAVAIDS are the following ITEMS:

- FAT for entire NAVAIDs systems is completed
- Mechanical completion for entire NAVAIDs system is completed
- Any modifications required during the construction / commissioning phases shall be completed
- Clearance of any punch list items on NAVAIDs system with an impact on the testing
- Remove any accumulated dust, dirt or waste residues left over from the construction phase with a clean dry cloth and suitable vacuum cleaner
- Panels correctly earthed
- Electrical interconnection completed, conduct visual inspection
- Pay particular attention to the ± polarity on connected direct current circuits
- Control and instrumental interconnection completed, conduct visual inspection
- Inspect and verify that all components are tight and well connected (e.g. relays on sockets, fuses on holders, etc.), electronic control boards and cards are properly secured, control boards connectors properly inserted, components free from damage after transportation and installation
- Check for proper ventilation of technical rooms (in particular the HVAC UPS B-300 Room)

In SITE (offshore) phase the first energization of main SWBD SG-200N1 will be done feeding the drawer A2/+08 via Temporary Diesel Generator and will be performed all steps starting with first energization.
NOTE: When it's confirmed the availability of permanent 66kV high voltage, the temporary power supply from the Temporary Diesel Generator will be removed. A final check on the correct functioning of the UPS system will be performed when BLPH will be energized via the permanent high voltage supply

N.B.: Kindly note that this procedure this note detail any activities related to BLACK START, consequently reference is made to dedicated document n. 123A90-PML-COM-PRO-03036.

6.3.1 OTP Test Preparation OFFSHORE

Step	Description	Result	Verified by	Date
1	System Ready for Operation (RFO from WORKSITE Phase) Certificate is issued and approved.			
2	No blocking punch list items are outstanding against the system to be commissioned.			
3	System(s), (de)isolations as per LOTO procedure enclosed within commissioning Work Permits procedures prepared and approved			
4	Verify and confirm that all steps performed at WORKSITE of this procedure are completed without any pending issues that would prevent from proceeding with the offshore SITE PROCEDURE			
5	All personnel involved in the implementation of this procedure are familiar with this procedure as well as with associated safety requirements (Toolbox Talk to be conducted before initiation of activities).			
6	A final walkdown after hook-up of the system has been completed, any preservation items have been removed and to ensure that the system and the area are ready for energization for following items: -NC-200F2 230V NAVAIDS			
7	Check that areas are free for work and escape routes are clear of any obstructions.			
8	Ensure that proper communications have been established between parties involved in the implementation of the procedure.			
9	Verify availability of test equipment and consumables as per chapters 6.2.4.			
10	Verify and confirm that the Temporary Diesel Generator is ready to start, that the diesel fuel tank is full.			
11	All personnel have been duly notified during dedicated daily SIMOPS meetings that the system(s) is ready for commissioning.			

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6.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
12	No blocking punch list items are outstanding against the system to be commissioned.			
13	Review and confirm no changes are required to be performed on existing protection settings.			
14	Verify and confirm that the Temporary Diesel Generator power cables connections have been tested with correct phase rotation before sail away. Perform walk down on Diesel Generator for a final check before energization			

6.3.3 Mechanical Preparation

Not applicable.

6.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
15	No blocking punch list items are outstanding against the system to be commissioned.			
16	Verify that all relevant associated control and protection systems / subsystems are ready.			
17	Verify as relevant Inhibit and Override list has been prepared and validated (as per JSA).			

6.3.5 Piping Preparation

Not applicable

6.3.6 Additional Discipline Preparation

Not applicable.

6.4 OTP Test Steps – Offshore SITE

The previous chapters must be successfully performed prior to commissioning of the NAVAIDS System.

In the next steps, the functionality of the NAVAIDS system will be tested:

- SS 72-00: NAVAIDS SYSTEM

6.4.1 Test Preparation

Verification of system and subsystem NAVAIDS.

Conduct system walkdown and thorough visual inspection of all related components.
Confirm no impediment to proceed with energization.

6.4.2 Energization of NAVAIDS.

Step	Description	Result	Verified by	Date
TEST PREPARATION OFFSHORE				
1	Confirm that diesel generator power supply is energized to upstream switchboard SG-200N1. A7/+05-line A A7/+06-line B			
2	Conduct a thorough visual inspection of all system components. Confirm absence of any visual damage, with nothing out of position.			
3	The Offshore commissioning procedure shall replicate the commissioning activities carried out Onshore. Once verified the system will remain in service.			
4	Confirm that 1P+N+PE power supply cable from switchboard SG.200N1 position A7/+05 is correctly connected to main NAVAIDS CONTROL PANEL NC-200F2 terminals X1:3-4			
5	Confirm that 1P+N+PE power supply cable from switchboard SG200N1position A7/+06 is correctly connected to main NAVAIDS CONTROL PANEL NC-200F2 terminals X1:5-6			
6	Conduct and confirm start-up operation for Navaids Control Panel NC-200F2 as defined on chapter 5.4.1.1 from pt.1			
7	Conduct and confirm start-up operation for Battery Cut-off Circuit panel CB-200F2 as defined on chapter 5.4.1.1 step 20			
8	Conduct and confirm start-up and charging operation for Navaids Battery Bank BA-200F2 as defined on chapter 5.4.1.1 step 25			
9	Conduct and confirm start-up operation for Navaids General Photocell EPH-200-			

Step	Description	Result	Verified by	Date
	01 as defined on chapter 5.4.1.1 step from 30			
10	Conduct and confirm start-up operation for Navaids Visibility Meter EVM-200-01 as defined on chapter 5.4.1.1 step from 32			
11	Conduct and confirm start-up operation for Navaids Control Panel NAV-000-4-1 as defined on chapter 5.4.1.2 from step29			
12	.Conduct and confirm normal and emergency operating scenarios as detailed on Annex01…05			
13	Confirm that the System is in normal working operation with no Alarms present.			

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6.4.3 OTP SITE Tests Notes and Remarks

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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

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 healthy and safety condition and that they are operational.

6.6 Reinstatement tasks

Generally, the system/ sub-system shall be reinstated at its initial condition; and the following activities must be carried out as minimum:

- all inhibition done for the test shall be removed (as per Inhibit / Override List)
- all equipment/devices shall be returned in healthy functional conditions.

7 APPENDICES

7.1 Vendor SAT Procedure

7.2 Proverlis Summary System Reports

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7.3 Equipment Related Technical Queries

7.4 As Built Documentation

7.5 Management of Change – Summary Table of Tasks and Details of Affected Related Documentation

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7.6 ANNEX CHARGE-DISCHARGE BATTERY RECORDS

7.6.1 ANNEX 1 12h CAPACITY CHARGE TEST RECORD

CROSSWIND

CROSSWIND BLPH PROJECT - COMMISSIONING PROCEDURE OF NAVAIDS SYSTEM

ANNEX 1
SUBSYSTEM 72-00: BATTERY CHARGE / DISCHARGE RECORD SHEET

ROSETTI MARINO

EQUIPMENT	NAVAIDS BATTERY RACK BA-200-F2	TEST MEASUREMENT:	ANNEX 1): BEFORE FIRST CHARGE

NAVAIDS BATTERY BANK TERMINAL VOLTAGE (TAKE MEASUREMENT ON BATTERY CUT-OFF SWITCH CB-200F2) = _____ V

Pos.	TAG UTILITY / TYPE	MANFIACTURER	MODEL	LOCATION	VOLTAGE (V)	DATE	TIME	NOTES
1	CELL N°1/ VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
2	CELL N°2 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
3	CELL N°3 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
4	CELL N°4 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
5	CELL N°25/ VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
6	CELL N°6 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
7	CELL N°7 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
8	CELL N°8/ VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
9	CELL N°9 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
10	CELL N°10 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
11	CELL N°11/ VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
12	CELL N°12 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
13	**TERMINAL VOLT. n.1°n.12**							

Table 7: DATA RECORD SHEET CHARGE BATTERY BANK

7.6.2 ANNEX 2 MEASUREMENT AFTER FIRST CHARGING

CROSSWIND

CROSSWIND BLPH PROJECT - COMMISSIONING PROCEDURE OF NAVAIDS SYSTEM

ANNEX 2
SUBSYSTEM 72-00: BATTERY CHARGE / DISCHARGE RECORD SHEET

EQUIPMENT	NAVAIDS BATTERY RACK BA-200-F2	TEST MEASUREMENT:	ANNEX 2): AFTER FIRST CHARGE

ROSETTI MARINO

NAVAIDS BATTERY BANK TERMINAL VOLTAGE (TAKE MEASUREMENT ON BATTERY CUT-OFF SWITCH CB-200F2) = _____ V

Pos.	TAG UTILITY / TYPE	MANFIACTURER	MODEL	LOCATION	VOLTAGE (V)	DATE	TIME	NOTES
1	CELL N°1 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
2	CELL N°2 / NVRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
3	CELL N°3 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
4	CELL N°4 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
5	CELL N°5 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
6	CELL N°6 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
7	CELL N°7 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
8	CELL N°8 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
9	CELL N°9 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
10	CELL N°10 / VRLA Cap.	FIAMM	SMG	UPS ROOM HVAC B-300				

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Table 8: DATA RECORD SHEET *AFTER FIRST CHARGE* BATTERY BANK

7.6.3 ANNEX 3 BATTERY DISCHARGE TEST RECORD WITH LOAD

CROSSWIND — ANNEX 3 — SUBSYSTEM 72-00: BATTERY CHARGE / DISCHARGE RECORD SHEET — ROSETTI MARINO

NAVAIDS BATTERY RACK BA-200F2

ANNEX 3): CAPACITY TEST RECORD WITH APPLIED EQUIVALENT SYSTEM LOAD 307.0W, 12.79 A @ 24Vdc

N° Hours	0,0	0,25	0,5	0,75	1,0	2,00	4,0	6,00	8,00	16,0	24,00	32,00	40,0	48,00	56,0	64,00	72,0	80,00	88,0	96,00	Note:
Time (hh:mm)																					
Discharge Voltage (V)																					
Discharge Current (A)																					
Ambient Temp. (°C)																					
Battery Cell Temp. (°C)																					
Battery Cell N°	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	(V)	Note:
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

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Table 9: DATA RECORD SHEET *DISCHARGE* BATTERY BANK

7.6.4 ANNEX 4 BATTERY AFTER FIRST DISCHARGE TEST RECORD

CROSSWIND

CROSSWIND BLPH PROJECT - COMMISSIONING PROCEDURE OF NAVAIDS SYSTEM

ANNEX 4
SUBSYSTEM 72-00: BATTERY CHARGE / DISCHARGE RECORD SHEET

ROSETTI MARINO

EQUIPMENT	NAVAIDS BATTERY RACK BA-200-F2	TEST MEASUREMENT:	ANNEX 4): AFTER FIRST DISCHARGE

NAVAIDS BATTERY BANK TERMINAL VOLTAGE (TAKE MEASUREMENT ON BATTERY CUT-OFF SWITCH NAV-000-5-1) = _____ V

Pos.	TAG UTILITY / TYPE	MANFIACTURER	MODEL	LOCATION	VOLTAGE (V)	DATE	TIME	NOTES
1	CELL N°1 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
2	CELL N°2 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
3	CELL N°3 / Ni-Cd Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
4	CELL N°4 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
5	CELL N°5 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
6	CELL N°6 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
7	CELL N°7 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
8	CELL N°8 / VRLA Cap. 1680 Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
9	CELL N°9 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
10	CELL N°10 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
11	CELL N°11 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
12	CELL N°12 / VRLA Cap. 1680Ah/10h	FIAMM	SMG	UPS ROOM HVAC B-300				
13	TERMINAL VOLT. n.1°n.12							

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Table 10: DATA RECORD SHEET *DISCHARGE* BATTERY BANK