Base Load Power Hub (BLPH)

SIMOPS/MOPO TOR

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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.

1.1.1 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.

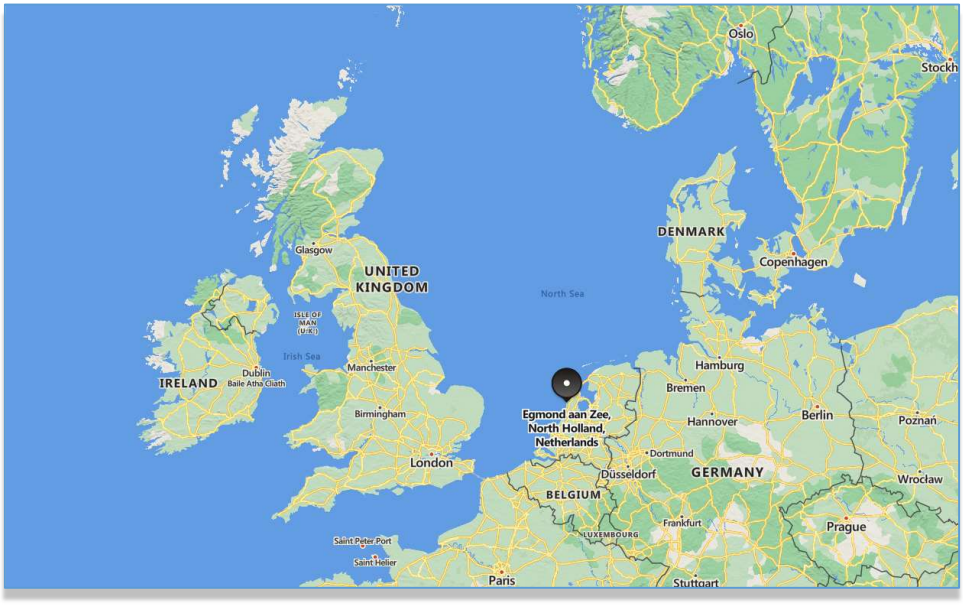


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

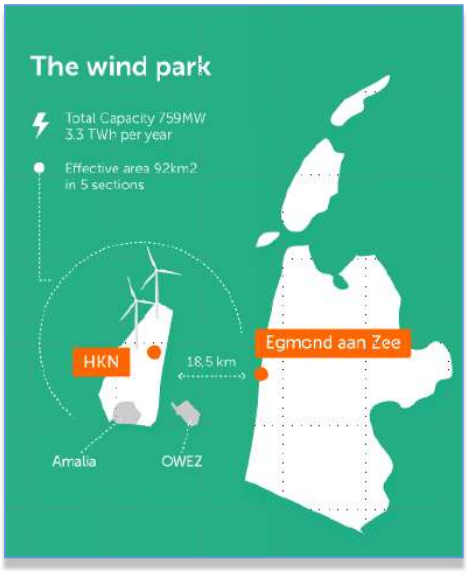


Figure 2 - Wind Park Details

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 located on coordinates E 590719.1, N 5841602.3 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.

1.1.2 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.

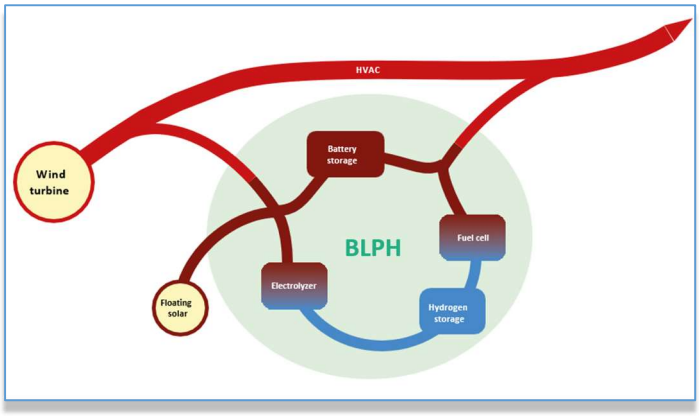


Figure 3 – BLPH Concept

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 s 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.

1.2 DOCUMENT SCOPE

The scope of the present document is to define the details of the work session, which must contain at least the following information:

- Description of the PROJECT and the Battery Limits of the analysis.
- Project documents with all the information about the activities potentially affected by SIMOPS during:
    - Onshore Commissioning activities
    - Offshore Commissioning activities.
- Date of the session, Schedules and agenda.
- Procedure and methodology of the session, based on this document.
- Objectives and expected results of the session.
- ~~Date of the session, Schedules and agenda.~~
- ~~Procedure and methodology of the session, based on this document.~~
- ~~Objectives and expected results of the session.~~

2 MAIN REFERENCES

Ref.	Description
[1]	IOGP RP 577 - SIMOPS GUIDELINE
[2]	ISO 17776 - Petroleum and natural gas industries – Offshore production installations – Major accident hazard management during the design of new installations
[3]	DNVGL-OS-A101 - Safety principles and arrangements, 2019
[4]	123A90-DDL-SAF-RE-30004 - HSSE Action Tracking Register and Close out report
[5]	123A90-DDL-SAF-RE-30046 – HSE Design Philosophy
[6]	123A90-DDL-SAF-RE-30049 - Human Factors Engineering Report
[7]	123A90-PML-COM-PL-03002 - Mechanical Completion & Commissioning Execution Plan
[8]	123A90-PML-COM-PRO-03007 - Commissioning Strategy
[9]	123A90-PML-COM-LIS-03011 - System/sub-system list
[10]	123A90-PML-CON-PL-04000 - Construction Execution Plan
[11]	123A90-PML-CON-RE-04008 - Construction method
[12]	123A90-PML-PM-RE-00160 - MONTHLY PROJECT MANAGEMENT REPORT No.12 Rev.0 (for On-shore/ Off shore Commissioning activities)~~Crosswind - Subsystem Construction and Commissioning~~

Table 1 - Reference Documents

3 DEFINITIONS AND ABBREVIATIONS

3.1.1 Definitions

ALARP	is short for "as low as reasonably practicable, s the concept of "reasonably practicable"; this involves weighing a risk against the trouble, time and money needed to control it. Thus, ALARP describes the level to which we expect to see workplace risks controlled.
COMPANY or Client (CPY)	Crosswind
CONSEQUENCES	The outcome of an event. For the purpose of this project, the outcome is identified in terms of harm to exposed persons and assets.
EPC CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
EVENT	Occurrence or change of a particular set of circumstances.
FREQUENCY	The estimated number of events per defined unit of time (normally refereed to one-year time).
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
RISK	Combination of frequency and consequence of scenarios. For the purpose of the present project, the risk is evaluated on exposed persons and on project equipment, due to the effects of events caused by LOC of hazardous substances

Table 2 - Definitions

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3.1.2 Abbreviations

ALARP	As Low As Reasonably Practicable
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
DNV	Det Norske Veritas
H&MB	Heat and Material Balance
HKN	Hollandse Kust Noord
HyRAM	Hydrogen Risk Assessment Model
HSE	Health, Safety and Environment
SIMOPS	Simultaneous Operations
RM	Rosetti Marino
TOR	Terms of Reference
MOPO~~MOPO~~	Matrix of Permitted Operations~~Matrix of Permitted Operations~~

Table 3 - Abbreviations

4 METHODOLOGY

4.1 GENERAL PRINCIPLE

Simultaneous Operations (SIMOPS) involve the concurrent execution of two or more activities, significantly increasing operational complexity and associated risk levels. This complexity is especially apparent when these activities occur in the same location at the same time, potentially leading to a compounded risk due to the possible failure of controls designed for each individual activity.

SIMOPS is characterized as any combination of two or more distinct sets of macro-activities executed concurrently within a defined area. These activities, possibly undertaken by different organizations or under varied management systems, can adversely interact due to their proximity or other critical factors. This interaction may result in undesirable events impacting health, safety, environment, asset integrity, production continuity, and consequently causing economic losses.

SIMOPS Risk Assessments are typically conducted as a multidisciplinary endeavour in a workshop setting, focusing on identifying potential hazards arising from simultaneous operations in a shared area.

SIMOPS Risk Assessments are typically conducted as a multidisciplinary endeavour in a workshop setting, focusing on identifying potential hazards arising from simultaneous operations in a shared area.

The main steps for planning and managing SIMOPS include:

- Identification of SIMOPS Activities: This should be done prior to the execution phase to recognize potential simultaneous operations. Only the activities performed at the same time will be investigated.
- Identification of the interference risk from SIMOPS activities: Evaluate the risk arising from each SIMOPS activities in order to determine necessary mitigating actions and measures.

~~The foundational steps for planning and managing SIMOPS include:~~

- ~~Identification of SIMOPS Activities: This should be done prior to the execution phase to recognize potential simultaneous operations. Only the activities performed at the same time will be investigated.~~
- ~~Identification of the interference risk from SIMOPS activities: Evaluate the risk arising from each SIMOPS activities in order to determine necessary mitigating actions and measures.~~

Activities, whether essential or not, must be suspended if the risk level surpasses the maximum acceptable threshold, except for operations critical to the restoration of safety barriers.

In high-risk operations, minimizing the number of personnel involved is crucial until normal operations can be safely resumed.

4.2 CAUSES OF PRESENCE OF SIMOPS

Each installation, construction, and commissioning activity within the project necessitates a thorough evaluation to discern any concurrent occurrences with normal site operations. The study these simultaneous activities and their interplay is underscored by several critical factors, which include but are not limited to the following:

- Non-Disruption of Production: It is crucial to avoid halting production activities for the entire duration of construction. Any necessary interruptions to production should be meticulously planned and limited only to periods deemed absolutely essential.
- Scheduling Constraints: The general schedule for production interruption is determined by site-specific needs, while the timeline for construction activities is driven by project demands, such as the timing of engineering tasks, acquisition of permits, etc. It is impractical to delay construction activities to align them with the general site interruption schedule.

For the present study, as agreed during the Kick off meeting of August 2024, the SIMOPS will be based on:

- ON-SHORE commissioning activities;
- OFF-SHORE commissioning activities;

as better described in the following chapters.

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- ~~ON-SHORE commissioning activities;~~
- ~~OFF-SHORE commissioning activities;~~

~~as better described in the following chapters.~~

4.2.1 ON-SHORE commissioning activities

Regarding ON-SHORE commissioning activities, considering that detailed SIMOPS are performed on daily basis according to project progress on RM yard, the team agrees to analyse, during the meeting, the possible restriction arising from each commissioning activities to other platform areas.

Thus, the platform is sub-divided in six different sections as for below pictures.

~~4.2.1 ON-SHORE commissioning activities~~

~~Regarding ON-SHORE commissioning activities, considering that a details SIMOPS are performed on daily basis according to project progress on RM yard, the team agrees to analyse, during the meeting, the possible restriction arising from each commissioning activities to other platform areas.~~

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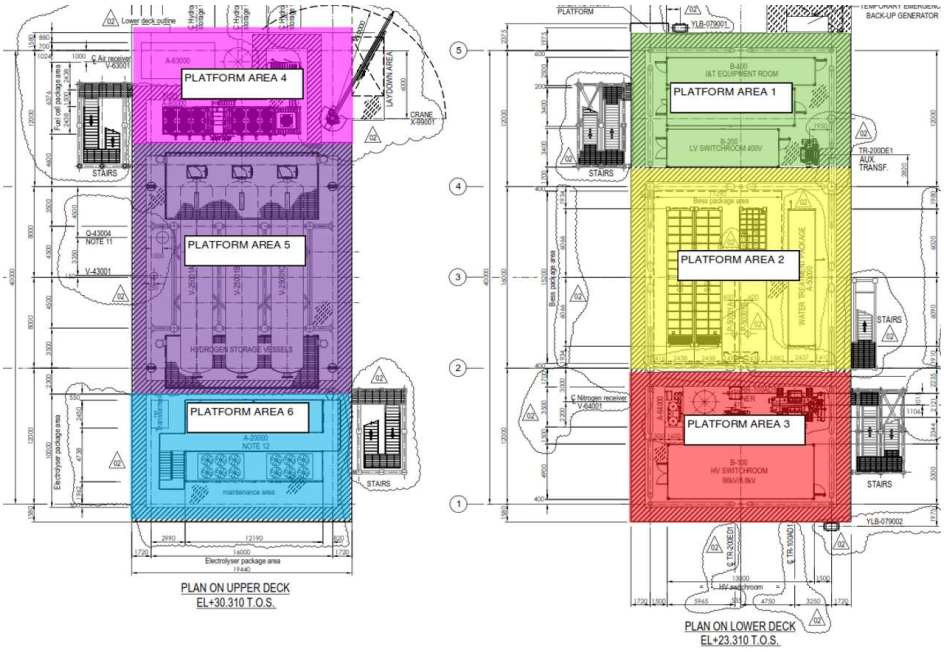


Figure 4 Platform area identification

The platform areas from 1 to 3 are located in lower deck, while the areas from 4 to 6 are located in upper deck.

For ON-SHORE activities, the methodology requires to investigate, for each commissioning activities as reported in the project documentation [12], the main task performed which may have some impact/constrains to other section of the plant.

The reference worksheet for the analysis is reported in **Attachment 1**. The worksheet contains the list of the commission activities and their description, in order to support the team in the identification of main hazards. The worksheet contains, also, six distinct columns, each one dedicated to a platform area, inside which the team shell report possible restrictions for the work.

No MOPO elaboration is required for ON-SHORE activities, considering the SIMOPS performed on daily basis on RM yard.

~~The platform area from 1 to 3 are located in lower deck, instead the areas from 4 to 6 are located in upper deck.~~

~~For ON-SHORE activities, the methodology requires to investigate, for each commissioning activities as reported in the project documentation [12], the main task performed which may have some impact/constrains to other section of the plant.~~

~~The reference worksheet for the analysis is reported in **Attachment 1**. In the worksheet are reported the commission activities and their description, in order to identify the main hazards and six columns, each dedicated to a plat area, in order to identify possible restrictions for the work.~~

~~No MOPO elaboration is required for ON-SHORE activities, considering the SIMOPS performed on daily basis on RM yard.~~

4.2.2 OFF-SHORE commissioning activities

Regarding OFF-SHORE activities, on the basis of expected commissioning activities as for project documentation [12], a detailed MOPO has been elaborated and pre-compiled; MOPO is reported in Attachment 2. MOPO illustrates, by means of orange boxes, the possible simultaneous operations. During the meeting for each simultaneous operation, the team will allocate, on the basis of the tasks performed and specific risk, the possible limitation between the two activities, according to criteria expressed in the table reported here below.

~~4.2.2 OFF-SHORE commissioning activities~~

~~Regarding OFF-SHORE activities, on the basis of expected commissioning activities as for project documentation [13], a detailed MOPO are elaborated and reported in **Attachment 2**. The figure reports, with the orange rectangle, the possible simultaneous operation. During the meeting for each simultaneous operation, the team will allocate, on the basis of the tasks performed and specific risk, the possible limitation between the two activities, according to the below table.~~

Legend	
A	Combination allowable with normal procedures including PTW
P	Activity permitted subject to additional risk assessment and approval
N	Activity not permitted in these circumstances
NA	Not applicable (not simultaneous operation is foreseen based on schedule)
	No Value Assigned

Table 4 – Off-shore acceptability criteria

In particular, for simultaneous operation falling in the category "P" and "N", a specific worksheet will be elaborated in order to report the main issue connected to the operation, and possible recommendations, if any.

The reference worksheet for the analysis is reported in Attachment 3.

For the identified couple of interfering activities, the team shall compile the report for identification of the specific risk and the existing safety measures already in place. If the team identify additional means for improvements, a SIMOPS action will be raised.

~~In particular, for simultaneous operation which falling in the category "P" and "N", a specific worksheet will be elaborated in order to report the main issue connected to the operation, and possible recommendation, if any.~~

~~The reference worksheet for the analysis is reported in **Attachment 3**.~~

~~In the worksheet are reported the two interfering activities, the specific risk and the existing safety measures already in place. If the team identify additional improvements, a SIMOPS actions will be raised.~~

5 SIMOPS TEAM MEMBERS

The SIMOPS session would be conducted by a third-party Facilitator, who will ensure the correct application of the SIMOPS methodology.

The SIMOPS team shall include all functions involved in SIMOPS; it shall be composed, indicatively, of the following figures:

- Facilitator - Consultant for SIMOPS session
- Scribe - Consultant for SIMOPS session
- Operation & Maintenance Representatives from Company side (if any)
- Construction Representatives from Contractor side
- HSE Site Representatives
- Safety Representatives
- Process Representatives
- Others on call

Facilitator

The Facilitator, assisted by a scribe, will guide the session in a systematic way, inviting the participants to provide the required information, to summarize the description of the activities and to confirm or correct the preliminarily identified SIMOPS activities, making sure that all the possible overlaps of activities are considered and recording the results of the discussion.

6 SCHEDULE AND VENUE

6.1 SCHEDULING

The SIMOPS session is foreseen on September 6th 2024.

The session will start at 09:00 and the scheduled completion is at 17:00. There will be a one-hour break for lunch at 13:00 and two 15 minutes coffee breaks at 11:00 and at 16:00.

~~The SIMOPS session is foreseen on September, 6th 2024.~~

~~The session will start at 09:00 and the scheduled completion is at 17:00. There will be a one-hour break for lunch at 13:00 and two 15 minutes coffee breaks at 11:00 and at 16:00.~~

6.2 VENUE

The session will be held at the offices of Rosetti Marino in Assago (MI) and could be followed also in Videoconference by means of Teams.

7 RECORDING AND REPORTING

At the end of the SIMOPS sessions, a report will be produced with the intent of recording all the main aspects of the activity.

The SIMOPS study report shall clearly list all the recommendations and identify the assigned parties.

The report identifies the operations that can be performed simultaneously with the objective of optimizing the activity program.

In particular, the MOPO "Allowed", "Allowed with restrictions" and "Not allowed" must be clearly compiled.

Furthermore, for the SIMOPS that the risk assessment has deemed "allowed with restrictions", recommendations and preventive actions must be provided and rules for drawing up work ~~programmes~~programs.

The report must contain the following key points:

- A general description of the project.
- A description of the MOPO decision matrix specifying the operations that can be developed simultaneously without any restriction and the operations that require the adoption of reduction measures and the simultaneous operations that are not permitted.
- The following attachments:
    - the MOPO for OFF-shore activities;
    - the SIMOPS worksheet for ON-SHORE activities;
    - the list of participants in the SIMOPS session "SIMOPS meeting";

When preparing the report, the following assumptions must be taken into consideration:

- the risk assessment is referred exclusively to the operations to be carried out within the project;
- the feasibility of SIMOPS is based on the risk level of each combination of operations, considering that all risk reduction measures and recommendations established in the risk assessment will be implemented before the execution of the operations

ATTACHMENT 1 – ON-SHORE SIMOPS TEMPLATE

Study	Base load Power Hub (BLPH)
Client	Rosetti Marino / Crosswind
Activity	SIMOPS - ON-SHORE activities
Session n° / data	1 06/09/2024
Leader- Scribe	Manning / Baldassarri
Note	

ROSETTI MARINO CROSSWIND

#	Activity	Description / Potential risk	Lower deck			Upper deck			Mitigative action	Rif.	By	Note
			Platform area 1	Platform area 2	Platform area 3	Platform area 4	Platform area 5	Platform area 6				
1	20-39.S.20.SS.2000 Electrolyser Package (A-20000)											
2	20-39.S.25.SS.2501 Hydrogen Storage Vessel A (V-20001A)											
3	20-39.S.25.SS.2507 Hydrogen Storage Vessels Header (Inlet)											
4	20-39.S.25.SS.2508 Hydrogen Storage Vessels Header (Outlet)											
5	40-49.S.43.SS.4300 Hydrogen Vent Header & Drum System											
6	50-69.S.50.SS.5000 Seawater Intake System (Lifting Pumps)											

ATTACHMENT 2 – MOPO FOR OFF-SHORE COMMISSIONIG ACTIVITIES

OFF-SHORE COMMISSIONING ACTIVITIES SIMULTANEOUS OPERATIONS (SIMOPS) Activities and Influences

	COMM-OFF1020 FO Cable Termination	COMM-OFF1060 66kV Power Cable Termination	COMM-OF1080 PV Power Cable Termination	COMM-OFF1090 Sea Water Pump & Caisson HU	COMM-OFF1150 Water Disposal Sump Caisson HU	COMM-OFF1160 Cathodic Protection HU	COMM-OFF1010 HUB Power-Up by Mean of Temporary Generator Connected to the JB	COMM-OFF1030 FO Panel Commissioning	COMM-OFF1040 Network Integration	COMM-OFF1050 CCS Integration	COMM-OFF1070 66kV Switchboard Commissioning	COMM-OFF1110 Sea Water Pump Commissioning	COMM-OFF1100 HUB Energization from the 66kV Switchboard	COMM-OFF1130 Desalinator Start-Up	COMM-OFF1170 Cathodic Protection Commissioning	COMM-OFF1120 Bess Offshore re-test	COMM-OFF1180 Electrolizer Offshore re-test	COMM-OFF1140 PV Commissioning	COMM-OFF1190 Fuel Cell Offshore re-test (H2 Produced by Electrolizer)	COMM-OFF2100 Offshore Integrated Test Completed
COMM-OFF1020 FO Cable Termination	I		I	I	I	I	I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1060 66kV Power Cable Termination			I	I	I	I	I	I	I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OF1080 PV Power Cable Termination				I	I	I	I	I	I	I	I	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1090 Sea Water Pump & Caisson HU					I	I	I	I	I	I	I	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1150 Water Disposal Sump Caisson HU						I	I	I	I	I	I	I	I	I	NA	NA	NA	NA	NA	NA
COMM-OFF1160 Cathodic Protection HU							I	I	I	I	I	I	I	I	NA	NA	NA	NA	NA	NA
COMM-OFF1010 HUB Power-Up by Mean of Temporary Generator Connected to the JB								I	I	I	I	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1030 FO Panel Commissioning										NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1040 Network Integration											NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1050 CCS Integration												NA	NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1070 66kV Switchboard Commissioning													NA	NA	NA	NA	NA	NA	NA	NA
COMM-OFF1110 Sea Water Pump Commissioning														NA	NA	NA	NA	NA	NA	NA
COMM-OFF1100 HUB Energization from the 66kV Switchboard															I	NA	NA	NA	NA	NA
COMM-OFF1130 Desalinator Start-Up																NA	NA	NA	NA	NA
COMM-OFF1170 Cathodic Protection Commissioning																	I	NA	NA	NA
COMM-OFF1120 Bess Offshore re-test																		NA	NA	NA
COMM-OFF1180 Electrolizer Offshore re-test																			NA	NA
COMM-OFF1140 PV Commissioning																				NA
COMM-OFF1190 Fuel Cell Offshore re-test (H2 Produced by Electrolizer)																				
COMM-OFF2100 Offshore Integrated Test Completed																				

ATTACHMENT 3 – SIMOPS FOR OFF-SHORE COMMISSIONIG ACTIVITIES

Study	Base load Power Hub (BLPH)
Client	Rosetti Marino / Crosswind
Unit	MOPO - OFF-SHORE activities
Session n° / data	1 06/09/2024
Leader- Scribe	Manning / Baldassarri
Note	

ROSETTI MARINO
CROSSWIND

#	Activity	Interfering with	Conflict	Potential risk	Existing Safety measures	SIMOPS Mitigative action	Rif.	Note
	COMM-OFF1020 FO Cable Termination	COMM-OF1080 PV Power Cable Termination	P					
	COMM-OFF1020 FO Cable Termination	COMM-OFF1090 Sea Water Pump & Caisson HU	N					