Base Load Power Hub (BLPH)

SAFOP Close Out Report

Document Number: 123A90-DDL-EL-RE-20179

Document Class: 2

Rev.	Date	Description	Prepared	Reviewed	Approved
02	19/09/2025	Approved for Construction (AFC)	V. Ramponi	A. Madaschi	C. Giunchi
01	24/02/2025	Approved for Construction (AFC)	A. Madaschi	C. Giunchi	D. Lo Sterzo
00	04/10/2024	Issue for Approval (IFA)	A. Madaschi	C. Giunchi	D. Lo Sterzo

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Revision / Change Log

Rev.	Description
00	Issue for Approval (IFA)
01	Approved for Construction (AFC)
02	Approved for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

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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.

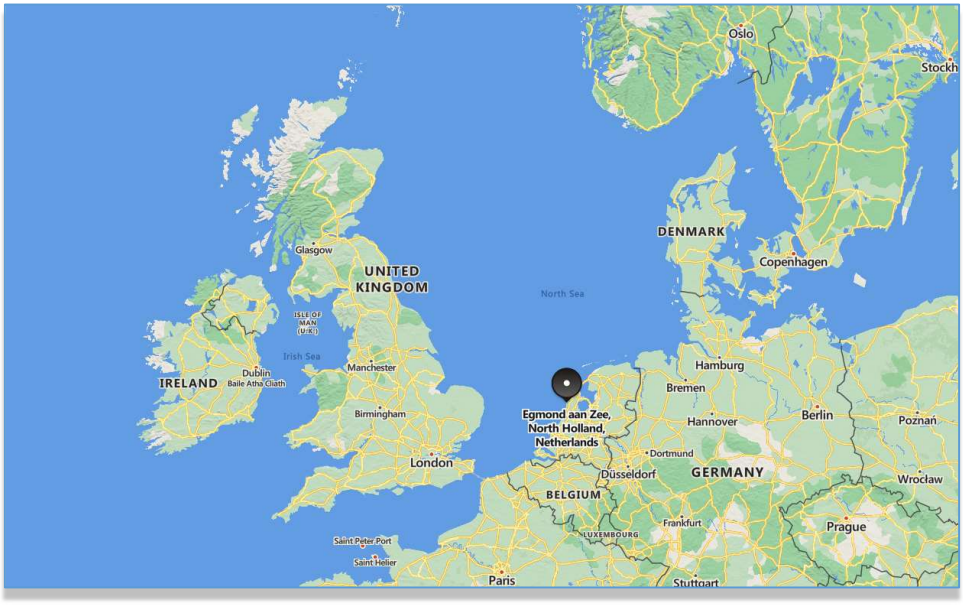


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

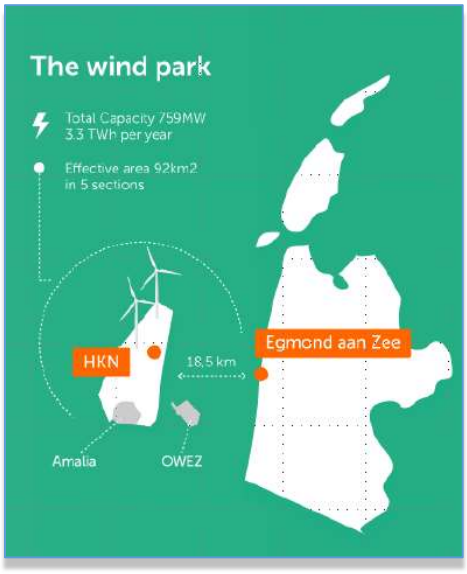


Figure 2 - Wind Park Details

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 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.

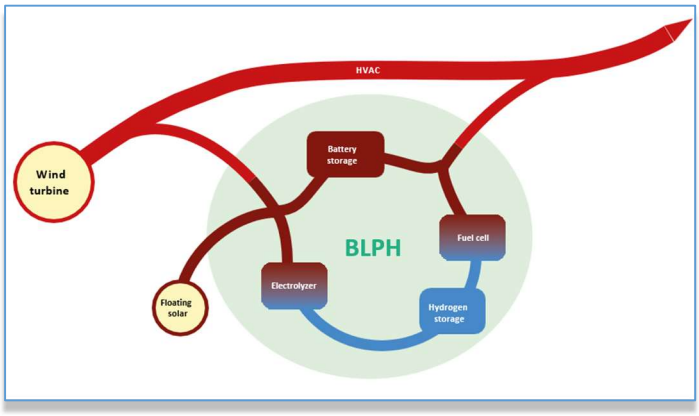


Figure 3 – BLPH Concept

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 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.

2 DOCUMENT SCOPE

The objective of the present document is to provide a formal close out record for all actions that have been responded to. This includes both FEED Deferred Actions (i.e., all the actions that have not been closed out in that Project Phase) and EPC Actions.

The SAFOP Close Out Report has been implemented on the Project to ensure that all actions raised from formal SAFOP workshop are managed and tracked.

Actions raised from other sources are not recorded in this document.

2.1 REFERENCES

Doc. No.	Description
[1] 123A90-DDL-EL-RE-20178	SAFOP Report

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

Table 2 – Definitions

3 SAFOP CLOSE OUT REPORT

3.1 ACTION STATUS DEFINITION

The action status may be defined as listed below:

- Open – Actions for which any form of response has yet to be submitted.
- Ongoing - The proposed response is considered approved by Contractor and the Action is under implementation in the engineering document.
- For Approval – The proposed response is considered approved and closed by Contractor and the Action is in the approval process by Client.
- Closed – Responses that have been approved as incorporated in the design (or otherwise closed) at EPC. Approval given by Contractor and Client.

3.2 ACTION STATUS

The following sections show the status of actions as a total and by Action Source (i.e., study).

3.3 FEED SAFOP ACTIONS

FEED SAFOP Actions

Status	Totals	%
Open	0	0
Ongoing	0	0
For Approval	0	0
Closed	18	100
TOTAL	**18**	**100**

3.4 EPC SAFOP ACTIONS

EPC SAFOP Actions

Status	Totals	%
Open	0	0
Ongoing	0	0
For Approval	0	0
Closed	37	100
TOTAL	**37**	**100**

3.5 Appendix 1 – FEED SAFOP ACTIONS

From the FEED SAFOP action list – Feb 2023.

Appendix 1 – FEED SAFOP ACTIONS *From the FEED SAFOP action list – Feb 2023.*

Sr. No.	Item	Description	Recommendation	RM Response	Comment – Execute SAFOP	Discipline	Action Response	Date	Action Status
1	Remote Operation	Remote monitoring and control not working properly. Sluggish control. Difficult to access large data remotely	Standardized remote monitoring for package vendors (Data Tunnel) à copy Siemens WTG method, if possible. Redundant fiber connection from Off to On-shore	Redundant fiber connection from Off to On-shore	**CW** to define data steam and to allow or not remote access and to what extent (High cybersecurity risk) Service network is in place. Missing "rules" for access to non-operators. Ensure suitable equipment to provide full data connection capacity.	**CW**	CWD REMOTE ACCESS SOLUTION: CWD to extend the Wind Farm solution to BLPH control room as soon as Yokogawa panels will be submitted. VENDORs REMOTE ACCESS SOLUTION: CWD and RM agreed on Remote Solution process and procedure has been issued from RM. CPI remote access list has been shared with RM and accepted.	19/11/2024	Closed
					YOKOGAWA will program data stream dedicated to alarm communication to ensure fast communication	**YOKO**	Form ITER to OER there will be a dedicated redundant FO link, which is part of PIN network. This link will transfer only traffic related to Yokogawa systems (SCADA and IT infrastructure). For this reason, we don't foresee any problem related to bandwidth and latency of this network. This is also one of the reasons why service network uses different FO links.	25/092024	Closed
					Each vendor shall provide alarm categorization (as per DEP) of their own alarm.	**CPI**	CW shared with RM the list of alarm of each Vendor; Alarm shared is included into the data base.	19/09/2025	**Closed**
2	Permit to operate	No permit to operate	Not meeting the TSO's connection requirements (Tennet) Unclear responsibilities regarding PCC. Effect of BLPH on PCC to be investigated / communicated with TENNET Both CW and BLPH teams to align towards Tennet.	CW to reply	There is no influence in terms of harmonics and BLPH is compliant to Tennet/grid regulation (ENSOL report). There could be interaction with the grid when full WT string is not producing and only BLPH is operating. Issue for this scenario will be investigated. **CW** (ENSOL) will take care of compliancy by extending the model to cover multiple scenarios for connection requirements – report ongoing (Saran Ganesh might support)	**CW**	ENSOL model study will not take place	19/09/2024	Closed
3	Grid-forming	Energizing transformers not working due to insufficient capacity (Q) of inverters to overcome the energization inrush of transformers.	During island operation the network short circuit capacity is too low to energize power transformers resulting in inverter trip. Re-consider the need for grid-forming operations.	CW to reply	There is a Black start scenario procedure being produced now. Current strategy is to use a temporary 200kW diesel generator to energize DC power and recharge the UPS to be hoisted on BLPH. For initial installation and commissioning is facilitated by the presence of the crane for BLPH installation. For other operations a vessel will have to bring a generator (can't keep it full with Diesel on the platform) **RM + CW** to explore Alternative by using 66kV breaker re-close discussed and will be considered – Please check **123A90-DDL-EL-SP-20141** for detailed description.	**CW**	The alternative have been explored and black start from grid is possible. Decision shall be made by RM and write the operational procedures **RM reply:** here the possible solution investigated: 1) Plant restart with DC and AC UPS enough residual battery energy 2) Portable temporary DC and AC UPS to allow plant restart 3) Portable small generator (in the range of 50 kVA) 4) Temporary generator 5) Permanent generator on platform Decision shall be made by CW and official TQ will be sent to ROS	02/10/2024	Closed
4	Non-standard	Switchgear room allows for a fire&gas sensors leading to tripping the platform.	Consider installing smoke and heat detectors and hook them up to a centralized system for alarm purpose only. E-room should be free from any combustible materials! Note: Electrical switchgear systems have their own protection barriers which will avoid sustained fires.	F&G detectors installed in each room	H2 and smoke detectors are installed. Signal to the offshore control room. Smoke detectors on air ingress (2/3) will trip ESD1D (we do not want smoke inside containers). Same as Smoke in UPS rooms. Smoke in other electrical rooms only de-energization. **RM** Consider guidelines from DEP and consequences from both wanted and unwanted shutdown.	**CW**	DEP guidelines are followed (see doc.: Design HSSE Plan *123A90-DDL-SAF-RE-30002)* , the result of actions are detailed in doc.: Fire & Gas Cause & Effect Matrix 123A90-DDL-IN-CE-40002.	25/09/2024	Closed
					Crosswind recommendations				
5	New design	Explosion and or fire	System to be transported, filled with H2 and charged batteries Review the details of the (im)possibilities of transporting the module charged or discharged and create a transportation philosophy document	BLPH will be transported without H2, since explosion risk is elevated and BESS battery charged less than 30%.	Transport has been discussed – No transport philosophy doc –SoC for BESS (~30%) **RM** Generate sea transportation philosophy document of BLPH	**MNG + T&I**	Document with the information for BLPH transport will be in ROAD MAP file present in document 123A90-DDL-TI-RE-99012: TOPSIDE YARD CHECKLIST	19/11/2024	Closed
6	Operational error	Wrong circuit breaker being switched or maintained, due to 66 and 6.6 kV look alike	Blackout and or wrong selection of panel to maintain Make use of colors and clear text to avoid mistake	Mistakes not possible due to proper tagging of cables and equipment	The item was referring to SCADA HMI interface not to physical tagging. Completely different physical spaces – to be addressed in SCADA – 2 step confirmation (?) **RM** Make Yokogawa aware for SCADA HMI design	**YOKO**	The HMI will show the TAG of each SWG nearest to the bus-bar and each page of feeder will show the same SWG's TAG se doc.: 1724000594-IN-DD-00028_HMI screens print out	01/10/2024	Closed
7	Standardization with Crosswind	Operators being confronted with different systems leading to confusion	Mishap in switching Ask Crosswind to share the standardized interlocking scheme for the 66 kV ring main unit Ask Crosswind to share the make and model from a WTG RMU and use at BLPH	Mitigation and recommendation taken	CW couldn't cooperate with Siemens, Hyosung provider (identical SLDs) **CW:** follow up with Hyosung to ensure coordinated operations for different system sections	**CW**	Different operational team for WTG and BLPH	19/09/2024	Closed
8	Electrical safety rules	Different contractors and package vendors will be working under different safety rules and Permit to Work systems	Come to a minimum safety standard that is valid for all working on BLPH during the commissioning phase	HSSE plan for on-shore and off-shore will be present. SIMOPS workshop will be organized.	HSSE always under control – **RM** Electrical safety operation doc to be shared with CW team before commissioning **RM** organize SIMOPS workshop	**HSE COMM**	SIMOPS workshop has been done at present of: CW representative, ROS Commissioning and Safety manager, see doc.: IMOP-MOPO report 123A90-DDL-SAF-RE-30038 for details.	25/09/2024	Closed
9	Interfacing	Incomplete understanding of system	Confusion Show TENNET 66 kV substation on SLD and interfacing signals (maybe via note) to/from BLPH	CW to reply.	Control will not receive messages from Tennet. Information can be requested to HV-SCADA on status of complete grid. In previous SW list of available messages has been provided and **CW** will update the strategy document to include BLPH with those messages.	**CW**	CWD sent the signals list to RM in October 2024	19/11/2024	Closed
					RM: Provide operations document		**RM:** Signal exchanged between HV-SCADA and BLPH through OPC-UA communication will be present int the 1724000594-IN-LIS-00005_ EMCS IO List (HW and SW)	01/10/2024	Closed

Sr. No.	Item	Description	Recommendation	RM Response	Comment – Execute SAFOP	Discipline	Action Response	Date	Action Status
					Crosswind recommendations				
10	New design	New control system covering ENMCS as well as process control functionality (DCS) and packages control. Control system not working as needed/expected leading to unreliable/unsafe situations	-Explore existing ENMC systems early to copy functionality into new system -Explore package control functionality early -Start development of overall control system early	PCS and SIS systems are designed in fail safe mode, so that in case of overall failure commands will be in safe condition.	**CW:** to check. Assessed – logic control of 6.6kV SWG is under review currently – remote control is avail.	**CW**	The logic control of 6.6kV SWG are defined and can be found in docs.: 1724000594-IN-SP-00019 1723002197-EL-DG-00023/25/26/27/28/29	01/10/2024	Closed
11	Fault finding	Clock of different systems not synchronized. Can't put the events that have been recorded by the different systems/packages in sequence	-Define synchronization of time/signal/power for integration of packages in BLPH and Crosswind for event sequencing	NTP server is present in BLPH for synchronizing the packages.	**CW:** to check Assessed during Control Workshop (Oct 23) – Ongoing	**CW**	NTP server is present in BLPH for synchronizing the packages, see doc.: 1724000594-IN-DD-00015_	01/10/2024	Closed
12	Isolation	Isolation of package / transformer omitted Fault not fully isolated due to LV and HV power sources	-Ensure implementation of inter-trips to isolate packages and transformers -Make use of protection DEP 33.64.10.17-Gen	Electrical intertrips have not been requested for packages (CPIs included) Intertrip signals are managed by serial connection to each CPI. To be noted that reported DEP is not contractual.	**CW:** to check Use of individual package intertrips – details to be finalized	**CW**	All intertrip via serial trip	19/09/2024	Closed
13	Freeze protection	Heat-tracing not operational when BLPH is isolated from the grid Damage to equipment	-This could be a reason to have a grid-forming capability. Understand the risk of freezing and decide if mitigation is required. -Consider Heat-tracing breakers (contactors?) with remote control. -Consider heat-tracing EF protection with high threshold	Heat tracing will be powered through DP-200N1 and have a general contactor commanded by ambient thermostat (NO remote control) 30mA RCD are provided according to project requirements	**CW:** to check No grid forming from blackstart available – Heat tracing have been discussed – to be checked	**CW**	Blackstart operations will be initiated only when weather/ambient conditions are suitable for not requiring Heat Tracing. HT is no vital load. To insert this condition on blackstart operation requirements Vital load are provided and HT was not part of it - need confirmation from RM to acknowledge it **RM reply:** confirms that HT is not part of vital loads	26/09/2024	Closed
14	Integration	Lose components not interfacing with digital protection relay. Operator confusion when system trips with no information on what caused the trip	Consider including the protection functions 86 and 87 as well as 94 into the digital protection relay	See ELECTRICAL CONTROL, PROTECTION & METERING DIAGRAMS	**CW:** to check	**CW**	All protection provided by RM is confirmed/revied see doc.: 123A90-DDL-EL-SP-20166_Electrical Protection Philosophy	01/10/2024	Closed
15	Arc flash	Switching in front of the 66 kV, 6.6 kV and 400 V switchboard due to absence of control station. Short circuit and arc flash incidents leading to trauma.	Provide a possibility to remote switch the main breakers on BLPH, with a possible safe location in the Plant Instrument Room.	CCS HMI is accessible on BLPH from the sliding monitor installed in the Server panel	**CW:** to check general rule no switching in the room – level 2 PPE required	**CW**	PPE level confirmed	19/09/2024	Closed

3.6 Appendix 2 – EPC SAFOP ACTIONS

From Execute Phase SAFOP June 12th – 13th

Appendix 2 – EPC SAFOP ACTIONS *From Execute Phase SAFOP June 12th – 13th*

Sr. No	Item	Description	Recommendation	Responsible	Actions	Discipline	Action Response	Date	Action Status
16	Document	CPI SAFOP Reports	-	CW	Share CPI SAFOP Reports with RM	**CW**	Shared	01/10/2024	Closed
17	Earthing management during island	In case of earth fault during island mode the 6.6kV bus will move from TN to IT network.	The strategy is to sequentially open the 6.6kV breakers to exclude packages/lines. Max time limit of ~8h not to generate dangerous voltages, procedures on BLPH might take ~1min.	RM	**RM**: Check voltage specs with CT, VT and switchgear manufacturers.	**RM**	**RM:** As per test report : - CTs are tested at 20 kV 50 Hz, 60 s - VTs are tested at 20 kV, 100 Hz, 60 s - the entire switchgear is fully tested at 20 kV, 50 Hz, 60 s Testing voltage is well above the maximum voltage (11.43 kV) during a phase to ground failure in case of IT operation. Moreover, protection tripping time is lower than 2 s. *(see all certification attached to IR-IME-2197-01)*	25/09/2024	Closed
					RM: Share previous experiences with 59(N) protection for IT earth faults.		**RM:** Examples from previous projects have been shown during a dedicated meeting done after SAFOP workshop.	13/06/2024	Closed
					RM: Check internally with specialist on ferro-resonance and possible addition to the model		**RM:** Considerations relevant to the ferro resonance have been shared via mail, clarifying that this problem is not expected on the project due to the limited extension of the 6.6 kV network.	10/07/2024	Closed
				CW	**CW**: Share paper on phenomenon of ferro-resonance	**CW**	**CW** shared the ferro resonance paper.	10/07/2024	Closed
18	Protection during island	Protection of BLPH during island → low SC current	ENSOL will be developing a model for load flow and SC analysis - RM checked on load flow and SC but ONLY for BLPH not for anything 'above' the interface.	CW	Engage with ENSOL for model developing	**CW**	ENSOL model study will not take place	19/09/2024	Closed
19	Protection coordination relay BLPH	-	Protection specialist is working on it this week, next week will be available for review.	RM	Share protection coordination study for review	**ELE**	Please refer to the document 123A90-DDL-EL-RE-20168 - Electrical Protection Relay Selectivity Study Repor.	25/09/2024	Closed
20	EMCS & Alarm management	Alarm management philosophy is a project requirement but it has not been developed fully yet. There is one for process control. Electrical is still missing.	Will there be 24/7 monitoring? All alarms are collected and communicated to CCS but currently there is not yet a defined strategy on how to distribute it to "outside world" ERP - Emergency response plan will be available for BLPH	CW (CPI)	**CW:** Provide alarm lists with "priority" and expected operator follow-up reaction.	**CW**	Overall BLPH Alarms are listed in the Master Alarm Database (123A90-DDL-IN-LIS-40027 - Master Alarm Database); Elogen alarm list ELO-INN-BPH-OTH-00007 **RM** share the document 1724000594-IN-LIS-00004 for CrossWind use.	19/11/2024	Closed
				RM	**RM:** Develop electrical alarm management philosophy .	**ELE**	Electrical alarm managment philosphy is present in doc.: 123A90-DDL-EL-LIS-20156		Closed
21	Alarm management	Batteries and UPS will be in the same room	Tripping strategy for smoke detection in UPS room	CW/RM	Pending on the assessment of the risk of having a sustained fire in the UPS room, determine if tripping on smoke detection is a requirement.	**HSE + INS**	The risk analysis (Electrical/Iter Containers – Fire duration calculation 123A90-DDL-SAF-CA-30047) was done demonstrate no escalation from internal to external of containers is credible. Relating the B-300 (UPS container) anyhow the platform abandon will be started to avoid operation without vital system according to HSE Design Philosophy 123A90-DDL-SAF-RE-30046 and Fire & Gas Cause & Effect Matrix 123A90-DDL-IN-CE-40002.	01/10/2024	Closed Closed
22	Commissioning	Commissioning of BLPH done in steps	Precom: IO list, checking all the switchgears and boards 1st step: connecting 400V aux from external source 2nd step: connecting after transformer on 6.6kV energize aux transformer, close aux circuit breaker.	RM	Share the commissioning schedule and activity plan	**COMM**	OTP's detailing the commissioning activities planned for the 400V Switchboard SG-200N1 and 6,6kV Switchgear SG-100D1 prepared and issued to CW. Ref. 123A90-PML-COM-PRO-03047 _ OTP - LV Switch Boards and LV Distribution Board Systems and 123A90-PML-COM-PRO-03046 _ OTP - 6.6 kV Switchgear & Transformer Systems. The schedule for all activities is detailed on project baseline schedule with breakdown by respective sub-systems.	01/10/2024	Closed
23	Commissioning	66kV cable termination	What tests will be performed on the cable connection between TP and 66kV switchgear? Company terminating and connecting cable to supply required qualifications. Cable connecting the SWG and the connection point with the subsea cable (stored in TP during transport) should be IEC tested in the yard, to avoid re-test offshore. Note: monopile has the 66 kV cable installed with surplus length. Verify if it can be routed directly to the 66 kV switchgear.	RM	Provide test results Supervise tests of connection cable	**CONSTR/QUA**	Test results will be included into the doc.: 123A90-PML-QHSE-RE-00115 - Mechanical Completion Final Dossier (ITR A). RM confirms the supervision of tests. Detail of location and regulations is present in the doc.: 123A90-DDL-EL-TBE-20055, according to Vendor procedure	07/01/2024	Closed
24	Commissioning	Yard commissioning	For the integrating testing 5MVA across 4 generators in parallel with 2 step-up transformers and load bank 1MW Procurement is ongoing. Planning is finalizing to generate a contract in few weeks. BESS powers won't be able to be given back to the grid. Synchronization will be done via generators.	RM	Finalize and share plan for yard commissioning (generators, load bank procurement)	**COMM**	RM commissioning and CW share the information and data relating the Temporary equipment and Facilities.	19/09/2025	**Closed**
25	Commissioning	Yard commissioning – H2 operation	Expectation is to finalize all the packages installation before introducing H2 in the system. Generally, sensors are tested with actual calibrated H2 or CH4 to ensure proper reading.	RM	Define H2 operations for commissioning in the yard and offshore.	**COMM**	RM confirm that before start the CPIs and move the H2 in the BLPH, sensors are tested according to Vendor procedure and the central system will work correctly upon receipt of the "anomaly".	19/09/2025	**Closed**
26	Commissioning	Preparation for sailing/transport	Sail away plan will be developed. UPS will be fully charged. H2 storage fully discharged and fully inerted. BESS should be around 30% SOC. There will be no power during transport. -> blind transport Every requirement from CPI or other packages is expected. NAVAID battery will be fully charged.	RM CW	Sail away plan development Share sail away/transport requirement of CPIs	**LOGISTIC**	Document with the information is ROAD MAP file present in document 123A90-DDL-TI-RE-99012 _ TOPSIDE YARD CHECKLIST	01/10/2024	Closed
27	66kV -GIS	It will be partially commissioned in the Yard. Canister with filling gas will be provided by supplier for partial refill.	Recommended to have it fully tested before sail away. CW representative to witness FAT.	RM	Prepare a table listing risks of commissioning activities to be repeated offshore – All the offshore tests will be performed without power on the GIS	**COMM**	All onshore and offshore commissioning activities will be detailed within dedicated OTP, doc. N. 123A90-PML-COM-PRO-03045 _ OTP - HV Switchgear and 66 kV Transformer Systems. Yard activities also defined within vendor SAT doc. N. 1723001595-QC-PRO-00028 _ Site acceptance test (SAT) procedure.	01/10/2024	Closed
28	Metering	Smart metering for BLPH	Smart/fiscal metering was not considered for the platform. Existing protection and control relay (REX640 and REF615) has embedded functions for monitoring power and energy exchanged.					12/08/2024	Closed

Sr. No	Item	Description	Recommendation	Responsible	Actions	Discipline	Action Response	Date	Action Status
29	CPI control	Control strategy for power request	Currently discussion was always on providing “>1MW” 99% of the time. However, control EMCS should take into consideration both P (kW) and Q (kVAR) to be communicated to CPIs (BESS in particular)	RM	**RM**: Define the setpoint given to CPIs based on information exchange with WTG.	**ELE**	V and Q is not controlled when the BLPH is connected to the Wind Farm; only P setpoint will be passed to each CPI. V control is active only in Emergency Mode through the BESS control system (not managed by BLPH). Q value will be shown on HMI. See doc.: 1724000594-IN-SP-00019 _EMCS Software Functional Design Specification (FDS-SW).	01/10/2024	Closed
				CW	More definition needed on control strategy for V, P & Q. **CW**: define what is WTG contribution to Q		Control Strategy Power Request – as discussed with e Crosswind Windfarm team, the BLPH EMCS only needs to consider P (kW) – the windfarm looks after Q (kVAr). When the BLPH is in “island Mode”, the BESS will need to consider Q for running Aux. loads on the platform.	19/11/2024	Closed
30	Hotspot measurement	6.6kV SWG has hotspot measurement in each of the SWG columns	There are multiple sensors located in the best spots (according to manufacturer) The connected reaction is a simple alarm and not a trip. These devices are generally used to predict long term maintenance (20+ yrs) Suggested to exclude it from future project unless strictly necessary for economical purposes AND to have it installed but not connected in the current layout to avoid additional commissioning and maintenance.		Decision on hotspot measurements use and commissioning.	**CW**	Use hot spot measurement as pure monitoring system no action linked to them	19/09/2024	Closed
31	6.6kV SWG	Lock out relays reset management	The relay is able to reset from shore - After a 3ph fault the system CAN be reset remotely.	RM	Define control philosophy and operators access management.	**CW**	RM confirms the possibility to reset from shore the 6.6kV relays, from HMI (password protected); HMI access shall be granted via MFA.	01/10/2024	Closed
			The logic and philosophy documents will be specifying on operators actions.	CW			Lock out relays – reset management – as described in the Electrical Protection Philosophy (doc. No. 123A90-DDL-EL-SP-20166) - Tripping Requirements (86). Protection trips shall be via local or remote reset, lockout relay functions (86). All alarms should be able to be reset/acknowledged remotely. One lockout relay shall lock out the primary switching device and the other lockout relay shall lockout the secondary switching device. The associated Logic Diagrams for SG-100D1 6.6kV Switchgear show the rest interface logic	19/11/2024	Closed
			SUGGESTION to have some sort of 'barrier' to ensure only dedicated operators can reset it. SCADA from Yokogawa is password protected and one can choose the access level.						
32	Solar Feeder	Specs and ratings of connections equipment	Due to IT management of network on solar farm, in case of earth faults the voltage would rise from 800VAC to 1385VAC. Can the switchboard withstand the voltage (SG-200D2) – rated for 3kV but what is the operating voltage? ABB seems to be rated for 690VAC with max voltage 1000VAC.	RM	To check on devices/ratings.	**ELE**	The EMAX version (Sace EMAX 2/E9) installed in the switchgear SG-200D2 has a rated voltage of 900 V. CW confirms that earth fault detection and command are present in Solar Farm package. Waiting for confirmation of OoE design.	01/10/2024	Closed
			Strongly recommended to trip the system on detection of earth fault to limit damages.	CW/OoE		**CW**	Point considered superseded	19/09/2025	**Closed**
			Need to be checked with OOE for ability to trip low voltage when they have fault.	OoE		**CW**	Point considered superseded	19/09/2025	**Closed**
33	Solar interface	Subsea cable might not have circular external profile	Define the interface to properly design junction box on BLPH for cable entry, cable glands.	RM/CW	Coordinate with OOE with the support of CW	**ELE + CW**	The connection between the Solar Farm Subsea cable and platform cable will be done trought Junction Box, only the power conductors (round shape) will be entering in the junction box. For detail see TDS cable 240213_RJIT-O 18_3 (36) kV NKT.	01/10/2024	Closed
34	AUX	5x3x(1x300)+3x(1x300) cables lay-down	Ensure clear instructions are given to installers for trefoil configuration of phases (L1,L2,L3)	RM	Provide clear instruction for cable layout	**COSTR**	See doc.:123A90-DDL-EL-DD-20092 - Electrical Typical Installation Details - Power System and Cable Installation Ref. Code C05A and C06 (sheet 9 and 10) and according to cable ladder section view (L-750-101-LVT-001) on sheet 07of18 doc.: 123A90-DDL-EL-DL-20108 - Electrical Cable Routing Layout Lower deck.	01/10/2024	Closed
35	Fire safety	No paper allowed in LV and MV switchgear rooms	To avoid spreading/generation of fires no combustibles (including paper documents/ schematics) should be present in the containers. Operators to ensure removing them after maintenance operations.	RM	Ensure correct procedure/check in place to avoid combustible materials in switchgear rooms.	**MNG**	Recommendation will be present in the platform operating manual doc.: 123A90-DDL-PR-MAN-80001 _ Operations and Maintenance Manuals	12/02/2025	Closed
36	Fuse – Contactor combo for protection		Check design of fuse + contactor (curves intercepts) considering the SC levels to minimize the risk of accidental fuse trip and ensure correct selectivity. Is the contactor’s rating Fault-making or -breaking?	RM	Check design and selectivity	**ELE**	Fuses are properly selected and coordinated with the contactors, as per ABB instructions, to prevent contactor operation at too high currnets that could damage the contactor itslef. Contactor will open currents lower that the maximum admissible value. Refere to the document 123A90-DDL-EL-RE-20168 _ Electrical Protection Relay Selectivity Study Report.	01/10/2024	Closed
37	Fuel cell transformer interface		Clarify the interface with the incoming transformer MV cables – space requirements and connections	RM/CW/Ballard	Coordinate with Fuel Cell	**ELE/CW/Ballard**	Interface space on MV connection point is clarified according to attached document BALLARD - BLPH Project - Cable Transits Schedule - K559-2254-CWIWP4202202-E99-003Rev001 and as reported in the points 55/55a/55b in Electrical Weekly Meeting MoM.	19/09/2024	Closed
38	Electrolizer	Latest interface schematics and transformer connections	Review the latest drawings received from Fores. Review SAFOP open points with Fores to ensure implementation	CW	Review SAFOP open points with Fores to ensure implementation	**CW**	Refer to C63-ELE-002 Electrical Single Line Diagram Power distribution for overview, ELO-INN-BPH-PLN-00011 NIDEC_C63-NID-ELO-DED01_A.5 Detailed Electrical Drawing for Rectifier and Transformer detailed information and FORES-INN-BPH-DWG-00029 Power and Control Panel Layout & Single Line Diagram and FORES-INN-BPH-DWG-00028 LV Single Line Diagram for the complete wiring and SLD's.	21/01/2025	Closed
39	Electrolizer	Grounding of piping system	Due to floating system of stacks, necessity to ensure proper insulation of metal piping for gas and liquid from ground. Electrolizer should list requirements and RM should study solutions to accommodate	CW	Coordinate with electrolizer on requirements and solutions around piping grounding	**CW**	The Grounding system layout and details (C0063-FOR-LAY-EL-003) document created by Fores (with input of Elogen) describes the grounding/earthing philosophy for the Process piping. This documents proves all piping (for gas and liquid) are bonded and connected to earthing.	21/01/2025	Closed
40	BESS	Neutral connection to ground missing	Previous electrical system schematic showed direct connection between transformer 2nd start center with PE. On current design this connection is missing. Need explanation and strategy to manage faults. Need explanation on why connecting transformer star center to DC bus mid-point.	CW	Confirm neutral point connection and grounding strategy with BESS	**CW**	There was a mistake on drawings, PE and neutral Trafo are actually connected. See latest electrical drawings K559-2254-CWIWP4202201-C06-001	03/10/2024	Closed
41	Interfaces	SW interface with packages	Missing definition of SW interfaces and interactions between EMCS and packages.	RM	Define SW interfaces	**YOKO**	SW interfaces are developed and will be tested during Pre-Commissioning / Commissioning in Yard.	01/10/2024	Closed
42	Interfaces	Interface with WTGs, BLPH and TENNET	The interfaces were discussed as a reaction to opening of CBs located on different points on the 66kV network. Further discussion in dedicated coordination workshops will clarify what is the signal exchange between parties and what are the consequences on the different packages in case of a trip on the 66kV network.	RM/CW	Follow up during coordination workshops	**CW / ROS / YOKO**	BLPH doesn’t have any interface with TENNET. Communication between EMCS and HV-SCADA will be via OPC-UA protocol; list of signals already been agreed with CW and interface will be tested off-shore.	01/10/2024	Closed
43	Maintenance operations	Ordinary and extraordinary maintenance procedures	During planned maintenance electrolizer and fuel cell will be off and the H2 system will remain pressurized, creating exclusion zones. During unplanned maintenance activities, to ensure operators safety, BLPH will receive a ESD1D command (emergency stop with depressurization), the incoming breaker will open, so operators will be able to safely board the platform. Suggestion is to re-address this with the team (incl. HHSE) as this could lead to more risks rather than reduce them. Suggestion is to blow out the H2 from the equipment , excluding the H2 tanks, and keep the whole electrical distribution system live and have the possibility of remote monitoring.	RM	Reconsider the risks connected to the maintenance strategy and the need for complete ESD1D during extraordinary maintenance.	**PROCC / HSE / INS / ELE / MNG**	The maintenance strategy and the correlated risk was analyzed during the SCTA workshop (at present of CW, RM and external third parties) and the results are reported in doc.: Safety Critical Task Analyses Report 123A90-DDL-SAF-RE-30040.	01/10/2024	Closed

3.7 Attachment– SAFOP ACTIONS

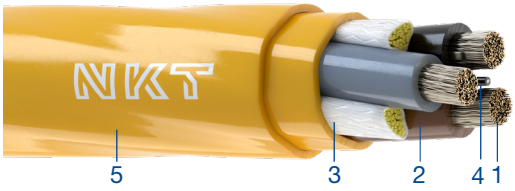
RJIT-O 1,8/3 (3,6) kV

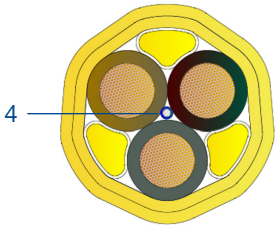
Dynamisk kraftkabel

Dynamic power cable

Standard: IEC 60502-1 i tillämpliga delar

Standard: IEC 60502-1 in applicable parts





Konstruktion:

Construction:

1 Ledare: Flertrådig glödgad förtent koppar enligt IEC 60228 klass 5: Rund.
Conductor: Annealed and tinned copper according to IEC 60228 class 5: Round.

2 Isolering: Termoplastisk polyester elastomer
Partfärger:
3-ledare: Brun, svart, grå.
Insulation: Thermoplastic polyester elastomer
Colour identification:
3-core: Brown, black, grey.

3 Inre fyllnad: Aramidgarn.
Inner filler: Aramid yarn.

4 Nanokabel (12 fiber).
Nano cable (12 fibers).

5 Mantel: Gul polyuretan
Märkning exempel: RJIT-O 3x50 1,8/3 (3,6) kV samt metermärkning.
Sheath: Yellow polyurethane
Example of marking: RJIT-O 3x50 1,8/3 (3,6) kV and meter marking.

Användning:

Application:

Kablar enligt denna standard är avsedda för förläggning i vatten. Kablarna är flexibla vilket gör dem användbara i tillämpningar med rörliga stationer/platformar, även i havsvatten.

Cables according to this standard are intended for permanent installation in water. The cables are flexible which makes them suitable for applications with moving stations/platforms, also for offshore use.

Egenskaper:

Properties:

Spänning Rated voltage	1,8/3 (3,6) kV
Max. ledartemperatur Max. conductor temperature	90°C vid kont. drift 90°C continuous
Max. kortslutningstemperatur Max. short circuit temperature	250°C
Min. förläggningstemperatur Min. temperature for laying	-10°C
Högsta tillåtna dragkraft vid utdragning Maximum pulling force	30 N/mm^2
Min. lagringstemperatur Min. storage temperature	-40°C

Min. böjningsradie Min. bending radius	8xD
CPR brandklass CPR fire class	F_{ca}
RoHS	2011/65/EU
REACH	2006/121/EC

02/2024

Tekniska data
Technical data

Ledarantal och area No. of cores and cross-section (mm²)	**Förpackning/ lev.längd** Packaging, delivering length	**Ledare (diameter över)** Nominal Conductor diameter (mm)	**Isolering (diameter över)** Nominal insulation diameter (approx.) (mm)	**Yttre diameter (ca)** Outer diameter (approx.) (mm)	**Ca vikt** Cable mass approx. (kg/km)	**Resistans** Resistance (Ω/km)	**Kapacitans** Capacitance (µF/km)	**Nominellt strömvärde i luft** Nominal load current in air (A)
3x50	Trumma/drum 500 (K18)	9,5	14,5	40	2300	0,393	0,62	192
3x95	Trumma/drum 500 (K20)	12,8	17,8	47	3600	0,210	0,81	298
3x120	Trumma/drum 500 (K22)	14,1	19,1	50	4400	0,164	0,88	346
3x150	Trumma/drum 500 (K24/28)*	16,0	21,0	54	5300	0,132	0,98	399
3x185	Trumma/drum 500 (K24)	17,6	22,6	58	6300	0,108	1,07	437

(*)
600 m: K24 (kabelvikt~3700 kg & trumman klarar 5000 kg)
1400 m: K28 (kabelvikt~8200 kg & trumman klarar 12000 kg)
600 m: K24 (kabelmass~3700 kg & the drum handles 5000 kg)
1400 m: K28 (kabelmass~8200 kg & the drum handles 12000 kg)

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