Base Load Power Hub (BLPH)

OTP – BESS Battery Energy Storage System

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Table of Contents

1 INTRODUCTION 6
1.1 Project Overview 6
1.2 Project Location 6
1.3 Project Concept 7
2 DOCUMENT SCOPE 8
3 OTP SUMMARY 9
3.1 Test Objective 9
3.2 System Boundary Limits 10
3.3 Test and System Description 11
3.4 Safety Devices 11
3.5 HSE Management 11
3.6 Acceptance Criteria 12
4 DOCUMENTS REFERENCES AND ABBREVIATIONS 14
4.1 Reference Documents 14
4.1.1 Company Documents and Standards 14
4.1.2 Project Documents 14
4.1.3 Vendor Documents 16
4.2 Acronyms and Abbreviations 16
5 OTP AT ONSHORE WORKSITE 17
5.1 Planning and Manpower 17
5.1.1 Planned tasks with estimated manpower 17
5.1.2 Test duration estimate 17
5.1.3 Vendor Assistance 17
5.1.4 Items Postponed to C&E OTP. 17
5.1.5 Summary of items HARDWIRED to be tested: - 17
5.1.6 Summary of items HARDWIRED and PROFINET to be tested: - 17
5.2 OTP Test Requirements – Onshore WORKSITE 18
5.2.1 Pre-Commissioning Achievement 18
5.2.2 Commissioning Achievement 18
5.2.3 Status of Required Associated Subsystems 18
5.2.4 Special Tools & Test Equipment 19
5.2.5 Consumable List 19
5.2.6 Commissioning Spare Parts 19
5.2.7 Temporary Facilities 19

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Once printed shall be considered as "NOT CONTROLLED" copy.
File: 123A90-PML-COM-PRO-03063

5.3 OTP Description – Onshore WORKSITE 19
5.3.1 OTP Test Preparation 19
5.3.2 Electrical Preparation 20
5.3.3 Mechanical Preparation 21
5.3.4 Instrument Preparation 21
5.3.5 Piping Preparation 21
5.3.6 Additional Discipline Preparation 21
5.4 OTP Test Steps – Onshore WORKSITE - PHASES 1 & 2 21
5.4.1 OTP Steps WORKSITE - PHASE 3 21
5.4.2 OTP Steps WORKSITE - PHASE 4 22
5.4.2.1 BESS Integrated Testing ONSHORE 22
5.4.2.2 BESS Integrated Testing ONSHORE Notes and Remarks 25
5.4.2.3 BESS Integrated Testing ONSHORE - Certifying Authority Table of Attendances 26
5.4.2.4 BESS Integrated Testing ONSHORE - Final Signatures and Company Acceptance 26
5.5 Post-test Conditions 27
5.6 Reinstatement and Preservation Tasks 27
6 OTP AT SITE 28
6.1 Planning and Manpower 28
6.1.1 Offshore Site overview 28
6.1.2 Planned tasks with estimated manpower 28
6.1.3 Test duration estimate 28
6.1.4 Vendor Assistance 28
6.1.5 Items Postponed to C&E OTP 28
6.1.6 HOLDS 28
6.2 OTP Test Requirements – Offshore SITE 28
6.2.1 Pre-Commissioning Achievement 28
6.2.2 Commissioning Achievement 28
6.2.3 Status of Required Associated Subsystems 29
6.2.4 Special Tools & Test Equipment 29
6.2.5 Consumable List 29
6.2.6 Commissioning Spare Parts 29
6.2.7 Temporary Facilities 29
6.3 OTP Description – SITE 29
6.3.1 OTP Test Preparation 30
6.3.2 Electrical Preparation 31
6.3.3 Mechanical Preparation 31
6.3.4 Instrument Preparation 31

This document undergoes an issuance cycle within EDMS "FusionLive". Its distribution is electronically controlled.
Once printed shall be considered as "NOT CONTROLLED" copy.
File: 123A90-PML-COM-PRO-03063

6.3.5 Piping Preparation 31
6.3.6 Additional Discipline Preparation 31
6.4 OTP Test Steps – Offshore PHASE 5 31
6.4.1.1 BESS Integrated Testing OFFSHORE 31
6.4.1.2 BESS Integrated Testing OFFSHORE Notes and Remarks 34
6.4.1.3 BESS Integrated Testing OFFSHORE - Certifying Authority Table of Attendances 35
6.4.1.4 BESS Integrated Testing OFFSHORE - Final Signatures and Company Acceptance 35
6.5 Post-test Conditions 36
6.6 Reinstatement tasks 36
7 APPENDICES 37
7.1 Vendor SAT Procedure 38
7.2 Proverlis Summary System Reports 39
7.3 Equipment Related Technical Queries 40
7.4 As Built Documentation 41
7.5 Management of Change – Summary Table of Tasks and Details of Affected Related Documentation 42

List of Figures

Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map 6
Figure 2 - Wind Park Details 7
Figure 3 – BLPH Concept 8
Figure 4 – OTP System Boundary Limits 10

List of tables

Table 1: Reference Project Deliverables 15
Table 2: Vendor Reference Documentation 16
Table 3: Acronyms and Abbreviations 16
Table 4: Items HARDWIRED and MODBUS to be tested 17

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.

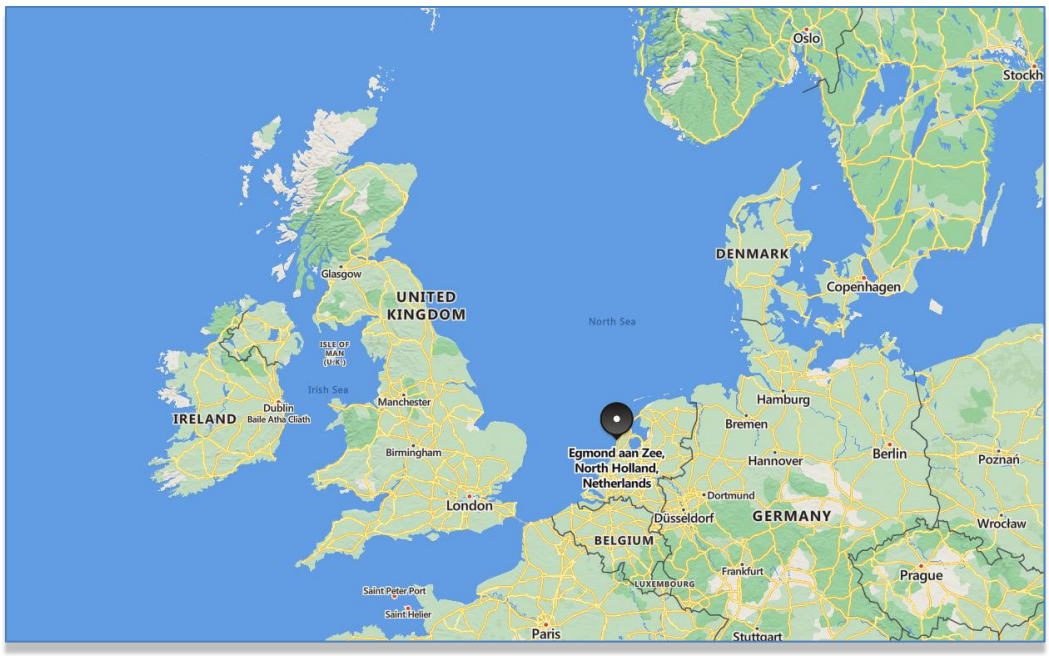


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

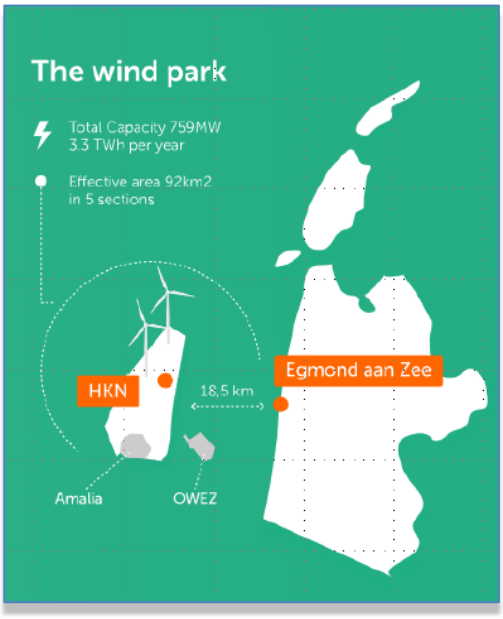


Figure 2 - Wind Park Details

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.

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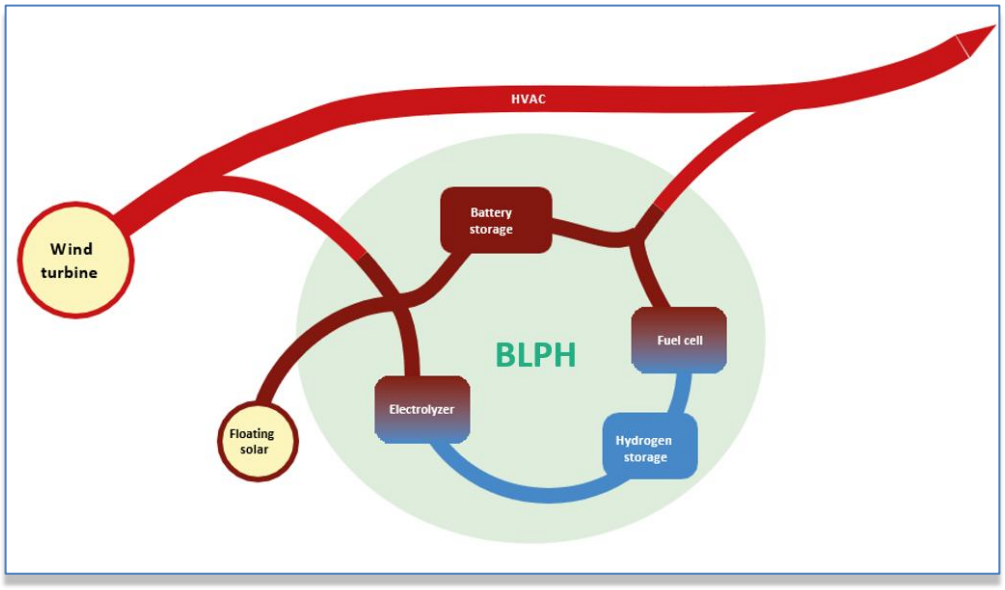


Figure 3 – BLPH Concept

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 dedicated Commissioning procedure together with the detailed test steps to be implemented for the preparation and execution of the operation testing of the BESS Package.

The document will cover all related test steps to be performed at both the onshore Worksite construction yard and the offshore SITE.

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3 OTP SUMMARY

3.1 Test Objective

The operating test of the BESS 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.

Aim of this document is to provide the sequence and appropriate actions to test the power connections (400VAC and 6.6kVAC) and main operations of the BESS package.

Please note that Pre-commissioning activities are described in detail in the SAT. For the sake of completeness, these activities will be mentioned here (Phases 1 & 2) as part of necessary steps but will not be part of the OTP.

Activities shall be developed as follows:

- Onshore pre-commissioning and commissioning activities at Contractor site (WORKSITE)
  - PHASE 1: PCS and BESS containers AUX with power supply from temporary 400V Diesel Generator (from yard 400V supply)/ Energized from TR-200DE1 and 6.6kV Switchboard SG-100D1 via 6,6 kV temporary yard facilities.
  - PHASE 2: Test BESS system communication with EMCS system.
  - PHASE 3: Complete BESS system connected to 6.6kVAC via 18T1.
  - PHASE 4: Integrated function test of BESS package (ONSHORE)

- Offshore commissioning (SITE)
  - PHASE 5: Integrated function test of BESS package (OFFSHORE).

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3.2 System Boundary Limits

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

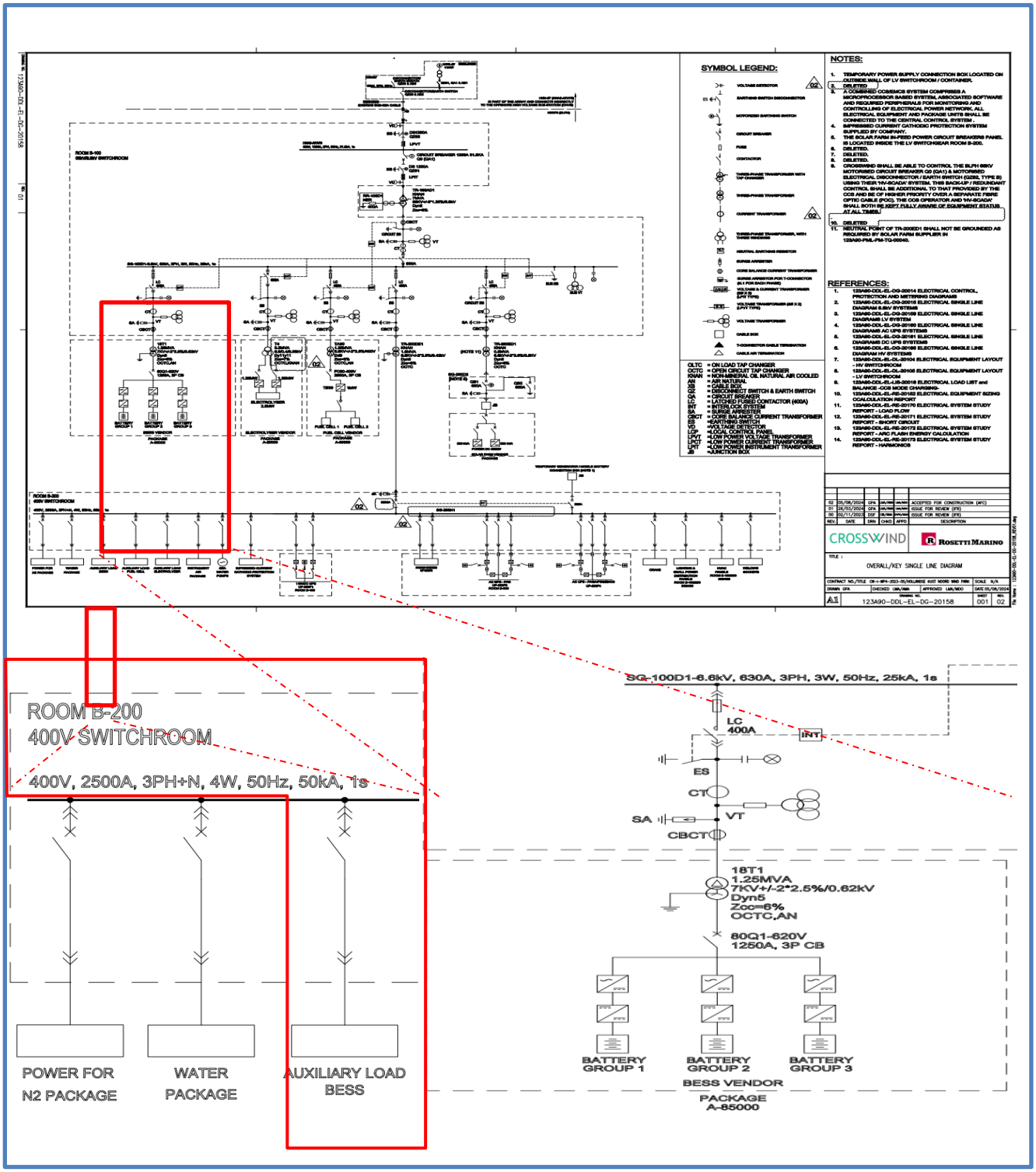


Figure 4 – OTP System Boundary Limits

3.3 Test and System Description

This document is specifically related to the following system:

- 85-00: Battery Energy and Storage System

All equipment must be properly installed in accordance with the following vendor documents:

- K559-2254-CWIWP4202201-E01-001 - Interconnection Diagram
- K559-2254-CWIWP4202201-E03-001 - Panel Cabinet Layout
- K559-2254-CWIWP4202201-E04-001 - Terminal Block Diagrams
- K559-2254-CWIWP4202201-E06-001 - Computer System Documentation
- K559-2254-CWIWP4202201-E07-001 - Control Diagrams
- K559-2254-CWIWP4202201-E08-001 - Electrical Termination & Hook Up Details
- K559-2254-CWIWP4202201-C10-001 - Electrical Schematics
- K559-2254-CWIWP4202201-B01-001 - General Arrangements
- K559-2254-CWIWP4202201-F01-001 - Detail Drawings (all equipment items)

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

Main components of the package:

- PCS (Converter System)
- BESS Container 1
- BESS Container 2

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.
- For entry into the PCS container under full load, Arc Flash Risk Category 2 PPE must be worn. This consists of:
    - Arc Rated clothing (AR long sleeve shirt with AR trousers or AR coveralls, AR hood/face shield/balaclava.
    - Hearing protection with inserts.
    - Heavy duty leather gloves.
    - Leather footwear

  This is in addition to all normal PPE in line with 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 - – Refer to SAT chapters 4.3, 4.4, 4.5, 4.6, 5.3, 5.4.
Apply padlocks on all feeder Breakers, the incomer breakers and on auxiliary MCB as per LOTO Procedure.

Applicable panels:

- 400 V Switchboard & Connection Box (SG-200N1)
- BESS package PCS Ctrl1, Ctrl2 & Converter
- Battery cabinets 1-11 in BESS1 and BESS2 containers

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 correct: (not part of OTP Scope)

- Energization of the AUX circuits is successful; all the subsystems are working according to specification.
- All necessary Software updates are performed and the package internal communication within the BMS is proven successful.
- The safety critical functions integrated in the BESS package are working according to specification.

Phase 2 will prove correct: (not part of OTP scope)

- The communication with the EMCS.

Phase 3 will prove correct:

- Functionality of power converters units.
- BESS package operability and response to commands (Charge/Discharge).

Phase 4 will prove correct:

- Functionality of the BESS package in coordination with the other packages on BLPH.

Phase 5 will prove correct:

- Functionality of the BESS package in coordination with the other packages on BLPH (OFFSHORE).

Performing the steps in this OTP as per engineering documents is crucial to ensure that the equipment is operating correctly and that it meets the desired design specifications. Observing the results will help identify any issues that may arise during the operation.

Overall, following these steps shall provide a comprehensive and effective way to verify the equipment installation and functionality.

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4 DOCUMENTS REFERENCES AND ABBREVIATIONS

4.1 Reference Documents

4.1.1 Company Documents and Standards

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

Table 1: Company Documents and Standards

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

Document ID	Document Title
[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-PML-COM-PRO-03041	OTP - Hydrogen Storage & Venting Systems
[26]123A90-PML-COM-PRO-03042	OTP - Sea Water Intake & Fresh Water Treatment Systems
[27]123A90-PML-COM-PRO-03043	OTP - Instrument Air System
[28]123A90-PML-COM-PRO-03055	OTP - Nitrogen Generation System
[29]123A90-PML-COM-PRO-03044	OTP - HVAC Systems
[30]123A90-PML-COM-PRO-03045	OTP - HV Switchgear & 66 kV Transformer Systems
[31]123A90-PML-COM-PRO-03046	OTP - 6.6 kV Switchgear & Transformer Systems
[32]123A90-PML-COM-PRO-03047	OTP - LV Switch Boards & LV Distribution Board Systems
[33]123A90-PML-COM-PRO-03048	OTP - Lighting & Small Power Systems
[34]123A90-PML-COM-PRO-03049	OTP - Electrical Heat Tracing Systems
[35]123A90-PML-COM-PRO-03050	OTP - UPS Systems
[36]123A90-PML-COM-PRO-03051	OTP - Data Network Systems
[37]123A90-PML-COM-PRO-03052	OTP - Telecom & Surveillance Systems
[38]123A90-PML-COM-PRO-03053	OTP - Navaid System
[39]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-DDL-IN-RE-40095	Process Control Logics Description

Table 1: Reference Project Deliverables

4.1.3 Vendor Documents

Document ID	Document Title
[1] 10354_23A2007_CAE_Statron_Shell Crosswind BESS FQ 1MW 5MWh	Overall Schematics
[2] 23A2007 BLPH BESS complete system	GA drawing as build
[3] 10354_23A2007_240911	Operating and maintenance manual
[4] 23A2007_240708_FAT_BESS_Converter_EN_v2.0_Signed	FAT report
[5] 23A2007_240628_PROFINET_Register BESS_V1_0_0_3	Profinet interface list
[6] 23A2007_241030_SAT_BESS_EN_v2.0	SAT protocol

Table 2: Vendor Reference Documentation

4.2 Acronyms and Abbreviations

Acronyms / Abbreviations	Description
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
CO	Carbon monoxide
EMCS	Electrical Monitoring & Control System
ESD	Emergency Stop Devices
FAT	Factory Acceptance Test
F&G	Fire and Gas
FTE	Full Time Employees
ITR	Inspection & Test Record
LOTO	Lock Out Tag Out
PCS	Power Conversion System
OTP	Operational Test Procedure
PPE	Personal Protective Equipment
SAT	Site Acceptance Test
SOC	State Of Charge

Table 3: Acronyms and Abbreviations

5 OTP AT ONSHORE WORKSITE

This chapter refer to the activities on the Contractor worksite (construction yard).

5.1 Planning and Manpower

5.1.1 Planned tasks with estimated manpower

Estimated manpower for the different phases of the OTP are:

- 2 Vendor FTE.
- 1 Commissioning Supervisor from Company
- 1 Commissioning Supervisor from Contractor
- 1 Operator from EMCS vendor
- 1 Operations Engineer from Company.

5.1.2 Test duration estimate

The test duration should be as follows:

- 3 days approx.

5.1.3 Vendor Assistance

Vendor Freqcon GmbH will lead and/or supervise the onshore commissioning activities. For offshore commissioning Freqcon GmbH will provide remote support.

5.1.4 Items Postponed to C&E OTP.

- *Not Applicable.*

5.1.5 Summary of items HARDWIRED to be tested: -

- *Not Applicable*

5.1.6 Summary of items HARDWIRED and PROFINET to be tested: -

Signal Tag:	*Signal Description:*
85-XA-001	*Confirmed gas (H2 Detection in BESS)*
85-XA-002	*Confirmed Smoke (Smoke detection in PCS)*
85-XA-003	*PLC fault*
85-XA-004	*Confirmed Thermal Runaway (temperature, CO, Smoke detection in BESS)*
85-XS-001	*Shut down to BESS*
HW SIGNAL 1	*Grid status island condition (HV C/B OPEN)*
HW SIGNAL 2	*Permissive – allow incoming 6.6kV C/B to Close*
HW SIGNAL 3	*6.6kV Grid phase voltage (PTT stotz QV2)*
HW SIGNAL 4	*6.6kV Bus phase voltage (PTT stotz QV4)*
HW SIGNAL 5	*Permissive – BESS to switch to grid forming mode*
MODBUS	*Refer to MODBUS interface list (23A2007_240628_PROFINET_Register BESS_V1_0_0_3)*

Table 4: Items HARDWIRED and MODBUS to be tested

5.2 OTP Test Requirements – Onshore WORKSITE

5.2.1 Pre-Commissioning Achievement

Prior to commencement of commissioning activities, the relevant pre-commissioning SAT steps should be fully signed i.e. Phases 1-3 as described earlier in section 3.1)

5.2.2 Commissioning Achievement

The commissioning achievement will be the full successful operation, functionality and integration of the BESS package installed on BLPH.

- 82-10 Power Transformer 1.25 MVA (1BT1 BESS)
- 85-00 BESS Package (A-85000

5.2.3 Status of Required Associated Subsystems

- PHASE 3

Subsystems required RFC for Commissioning of BESS Package

- 83-00 400V Switchboard SG200N1
- 83-00 Auxiliary power supply
- 83-20 Distribution board
- 88-00: Earthing System
- 83-99: Temporary Yard 400/230V Main and auxiliary power supplies
- 82-00: MV 6.6 kV Switchboard (SG-100D1)
- 82-10: Power Transformer 1.25 MVA
- 82-99: MV 6.6 kV Temporary Yard Supply Integrated Test

- PHASE 4

Subsystems required RFC for Commissioning of BESS Package

- 83-00 400V Switchboard SG200N1
- 83-00 Auxiliary power supply
- 83-20 Distribution board
- 88-00: Earthing System
- 83-99: Temporary Yard 400/230V Main and auxiliary power supplies
- 87-00: EMCS
- 87-10: PCS
- 82-00: MV 6.6 kV Switchboard (SG-100D1)
- 82-10: Power Transformer 1.25 MVA
- 82-99: MV 6.6 kV Temporary Yard Supply Integrated Test
- 70-00: F&G Control System

- PHASE 5

Subsystems required RFC for OFFSHORE Commissioning of BESS Package

- 83-00 400V Switchboard SG200N1
- 83-00 Auxiliary power supply
- 83-20 Distribution board
- 88-00: Earthing System
- 87-00: EMCS
- 87-10: PCS
- 82-00: MV 6.6 kV Switchboard (SG-100D1)

- 82-10: Power Transformer 1.25 MVA
- 70-00: F&G Control System
- 81-20: Power Transformer 7 MVA (TR-100AD1)
- 81-10: GIS 66 kV (HNA6-AFA70)
- 81-00: 66 kV Subsea Cable

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)
- Service Laptop for remote connection to UCP (monitoring & control)
- Test gas/smoke spray for CO, H2 & smoke
- LOTO Equipment

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

5.2.5 Consumable List

- Not Applicable.

5.2.6 Commissioning Spare Parts

5 spare battery modules will be available during the ONSHORE commissioning activities for quick replacement if required.
Note – check to confirm their availability required.

5.2.7 Temporary Facilities

Phase 4: Temporary emergency stop and/or fire and gas detection may be required if deemed necessary after suitable risk assessment. This will depend on the availability of interacting sub-systems.

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. 23A2007_240708_FAT_BESS_Converter_EN_v2.0_Signed)			
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 spares as per section 5.2.			
10	With reference to Commissioning Temporary equipment & Facilities (refer on Doc. 123A90-PML-COM-SP-03014), check that power is available to any temporary equipment or test equipment (if any).			
11	System(s) isolations as per LOTO procedure defined within HSSE Permits to Work and Commissioning procedures duly prepared and approved			
12	All yard personnel have been duly notified by dedicated LUN (Livening Up Notification) that the system(s) is ready for commissioning.			

5.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
2	Verify that all relevant associated systems / subsystems are completed.			
3	Check that grounding and bonding are in accordance with applicable documents.			
4	Verify and confirm the correct circuit breaker protection settings according to latest protection study revision.			

Step	Description	Result	Verified by	Date
5	Verify and confirm the completion of the final connections between the LV 400V Switchboard and the BESS, the MV 6.6kV and BESS and the EMCS.			
6	Assess the need for additional temporary F&G or E-Stop protection during ONSHORE phases and implement necessary changes.			

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	Verify availability of test equipment as per section 5.2.4.			

5.3.5 Piping Preparation

- Not applicable

5.3.6 Additional Discipline Preparation

- Not applicable.

5.4 OTP Test Steps – Onshore WORKSITE - PHASES 1 & 2

The previous chapters must be successfully performed prior to commissioning of the BESS Battery Energy Storage System Package.

Please refer to SAT document 23A2007_241030_SAT_BESS_EN_v2.0 ***sections 1 to 6*** for Phase 1 & 2 pre-commissioning Onshore activities.

5.4.1 OTP Steps WORKSITE - PHASE 3

It is foreseen that previous sections are successfully performed.

Please refer to SAT document 23A2007_241030_SAT_BESS_EN_v2.0 ***section 7*** for Phase 3 commissioning Onshore activities.

5.4.2 OTP Steps WORKSITE - PHASE 4

It is foreseen that previous sections are successfully performed.

In the following steps the functionality of the BESS package shall be tested for operation in all BLPH operating modes.

5.4.2.1 BESS Integrated Testing ONSHORE

Step	Description	Result	Verified by	Date
BESS operating modes to be controlled from PCS via ECMS.				
1	Ensure that EMCS parameter **Available Energy for charging**, tag *Profile_converter_status_3, charge_energy*, is set at the minimum allowable range of 54kW.			
2	Confirm on PCS that CCS operating mode is in "IDLE". Confirm BESS Package is charging at 54kW.			
3	Adjust EMCS parameter **Available Energy for charging**, tag *Profile_converter_status_3, charge_energy,* to the following values: a. 200 kW b. 400 kW c. 600 kW d. 800 kW e. 1 MW At each value confirm that BESS charges correspondingly.			
4	On PCS, change CCS operating mode to "IMPORT". Confirm no change at BESS.			
5	On PCS, change CCS operating mode to "HOT STANDBY". Confirm BESS is now Ready to Operate.			
6	Ensure that EMCS parameter **Available Energy for discharging**, tag *Profile_converter_status_3, discharge_energy*, is set at the minimum allowable range of 54kW.			

Step	Description	Result	Verified by	Date
7	On PCS, change CCS operating mode to "EXPORT". Confirm BESS commences discharge of power at 54kW			
8	Adjust EMCS parameter **Available Energy for discharging**, tag *Profile_converter_status_3, discharge_energy,* to the following values: a. 200 kW b. 400 kW c. 600 kW d. 800 kW e. 1 MW At each value confirm that BESS discharges correspondingly.			
9	On PCS, change CCS operating mode to "COLD STANDBY". Confirm BESS ceases discharge of power.			
10	On PCS, change CCS operating mode to "EMERGENCY (Island Mode)". Confirm BESS recommences discharge of power.			
11	On PCS, change CCS operating mode to "MAINTENANCE". Confirm BESS can only be operated locally.			
12	On PCS, return CCS operating mode to "EXPORT". Initiate BESS F&G event via agreed method and confirm successful shutdown of system.			
BESS operations while in "EMERGENCY (Island Mode)".				
13	While in "EMERGENCY (Island Mode)" BESS shall support all ongoing operation. The electrical protections shall be tested to ensure they are able to clear any fault. Platform side A second set of configurations have been selected for Emergency mode and tested during controller FAT. The thresholds are identified in the attachment B of the coordination study (doc v 123A90-DDL-EL-RE-20168)			

Step	Description	Result	Verified by	Date
	BESS side 1. Configure the current limit of BESS converter, to a current that can be driven during OTP Phase 4. This current can and will be lower than the rated current (suggested 200A – depends on load bank). 2. Configure the Time after the converter shall trip (suggested 250ms). 3. Bring the system to Emergency (island) mode 4. Increase the load until the specified current (limit) is reached and the converter is starting to limit the current. 5. When current limit is reached after nominated time period, confirm the Converter is switched off and the CB is tripped. The test is passed if the converter trips after the specified time.			

Full details of the EMCS HMI control graphics can be found in Document Number: **123A90-DDL-EL-SP-20039 Functional and Technical Design Specification, IDS and DDS for Electrical Monitoring and Control System (EMCS)**

5.4.2.2 BESS Integrated Testing ONSHORE Notes and Remarks

5.4.2.3 BESS Integrated Testing ONSHORE - Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.2.4 BESS Integrated Testing ONSHORE - Final Signatures and Company Acceptance

Name and Surname	Company Representative	Position	Signature

5.5 Post-test Conditions

Throughout Phase 1 to 4, AUX power shall be maintained active to ensure monitoring of the package and functionality of its safety features.
All other sub-systems shall be de-energized and, if deemed necessary, LOTO.
Between Phase 4 and 5, battery modules shall be kept at circa 30% SOC to ensure safe transport between the onshore and offshore site.
No AUX power will be provided during sea transport.

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

6 OTP AT SITE

6.1 Planning and Manpower

6.1.1 Offshore Site overview

It is expected that all precommissioning 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. No additional test steps will be required on these items of equipment, correct operation and functioning will be verified.

6.1.2 Planned tasks with estimated manpower

Estimated manpower for the entire duration of the Test:

- 1 Commissioning Supervisor from Contractor
- 1 Commissioning Supervisor from Company
- 1 Operator from EMCS vendor
- 1 Operations Engineer from Company.

6.1.3 Test duration estimate

The test duration should be as follows:

- 3 days approx.

6.1.4 Vendor Assistance

- For offshore commissioning Freqcon GmbH will provide remote support.

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 full successful operation, functionality and integration of the BESS package installed on BLPH.

The successful commissioning result, achieved during the WORKSITE commissioning phase for the functionality and safeguard of the BESS Battery Energy Storage System, will allow for a smoother commissioning phase of the offshore SITE.

6.2.3 Status of Required Associated Subsystems

The systems and subsystems involved:

- 83-00 400V Switchboard SG200N1
- 83-00 Auxiliary power supply
- 83-20 Distribution board
- 88-00: Earthing System
- 87-00: EMCS
- 87-10: PCS
- 82-00: MV 6.6 kV Switchboard (SG-100D1)
- 82-10: Power Transformer 1.25 MVA
- 70-00: F&G Control System
- 81-20: Power Transformer 7 MVA (TR-100AD1)
- 81-10: GIS 66 kV (HNA6-AFA70)
- 81-00: 66 kV Subsea Cable

6.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment may be required

- Voltage, frequency, continuity tester (Multimeter)
- Service Laptop for remote connection to UCP (monitoring & control)
- Test gas/smoke spray for CO, H2 & smoke

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

6.2.5 Consumable List

- Not applicable

6.2.6 Commissioning Spare Parts

A number of spare battery modules will be made available during the OFFSHORE commissioning activities for quick replacement if required.
Note – check to confirm their availability if required.

6.2.7 Temporary Facilities

- Not applicable

6.3 OTP Description – SITE

The SITE test will consist of a repeat of the onshore integration testing with the BLPH now installed situ to it's permanent connections. In the following steps the functionality of the BESS package shall be tested for operation in all BLPH operating modes.

6.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1	System Ready for Operation ((RFO) from ONSHORE) 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.			
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	All personnel have been duly notified during dedicated daily SIMOPS meetings that the system(s) is ready for operation.			

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6.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1	No blocking punch list items are outstanding against the system to be commissioned.			
2	Review and confirm no changes are required to be performed on existing protection settings.			
3	Verify that all relevant associated systems / subsystems are ready			

6.3.3 Mechanical Preparation

- Not applicable.

6.3.4 Instrument Preparation

- Not applicable.

6.3.5 Piping Preparation

- Not applicable

6.3.6 Additional Discipline Preparation

- Not applicable.

6.4 OTP Test Steps – Offshore PHASE 5

The previous chapters must be successfully performed prior to final operational test of the BESS Battery Energy Storage System

6.4.1.1 BESS Integrated Testing OFFSHORE

Step	Description	Result	Verified by	Date
	BESS operating modes to be controlled from PCS via ECMS.			
1	Ensure that EMCS parameter **Available Energy for charging**, tag *Profile_converter_status_3, charge_energy*, is set at the minimum allowable range of 54kW.			
2	Confirm on PCS that CCS operating mode is in "IDLE". Confirm BESS Package is charging at 54kW.			

3	Adjust EMCS parameter **Available Energy for charging**, tag *Profile_converter_status_3, charge_energy,* to the following values: a. 200 kW b. 400 kW c. 600 kW d. 800 kW e. 1 MW At each value confirm that BESS charges correspondingly.			
4	On PCS, change CCS operating mode to "IMPORT". Confirm no change at BESS.			
5	On PCS, change CCS operating mode to "HOT STANDBY". Confirm BESS is now Ready to Operate.			
6	Ensure that EMCS parameter **Available Energy for discharging**, tag *Profile_converter_status_3, discharge_energy*, is set at the minimum allowable range of 54kW.			
7	On PCS, change CCS operating mode to "EXPORT". Confirm BESS commences discharge of power at 54kW			
8	Adjust EMCS parameter **Available Energy for discharging**, tag *Profile_converter_status_3, discharge_energy,* to the following values: a. 200 kW b. 400 kW c. 600 kW d. 800 kW e. 1 MW At each value confirm that BESS discharges correspondingly.			
9	On PCS, change CCS operating mode to "COLD STANDBY". Confirm BESS ceases discharge of power.			
10	On PCS, change CCS operating mode to "EMERGENCY (Island Mode)". Confirm BESS recommences discharge of power.			
11	On PCS, change CCS operating mode to "MAINTENANCE". Confirm BESS can only be operated locally.			
12	On PCS, return CCS operating mode to "EXPORT". Initiate BESS F&G event via agreed method and confirm successful shutdown of system.			

Full details of the EMCS HMI control graphics can be found in Document Number: 123A90-DDL-EL-SP-20039 Functional and Technical Design Specification, IDS and DDS for Electrical Monitoring and Control System (EMCS)

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6.4.1.2 BESS Integrated Testing OFFSHORE Notes and Remarks

6.4.1.3 BESS Integrated Testing OFFSHORE - Certifying Authority Table of Attendances

Name and Surename	Certifying Authority	Position	Signature

6.4.1.4 BESS Integrated Testing OFFSHORE - Final Signatures and Company Acceptance

Name and Surname	Company Representative	Position	Signature
Name and Surename	**Certifying Authority**	**Position**	**Signature**

6.5 Post-test Conditions

After functional tests have been completed, system / sub-systems are left in healthy and safety condition and 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.

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7 APPENDICES

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7.1 Vendor SAT Procedure

Please refer to 23A2007_241030_SAT_BESS_EN_v2.1

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7.2 Proverlis Summary System Reports

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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