Base Load Power Hub (BLPH)

SW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

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1 INTRODUCTION

1.1 GENERAL

The purpose of this document is to define the methods and documentation that will be used to carry out the Integration Factory Acceptance Test (FAT) using Virtual Machine (VM)/Remote Access on Yokogawa's Distributed Control System (PCS) CENTUM VP, ProSafe-RS (SIS and FGS), SCADA (CI Servers) and EMCS. The FAT is performed to ensure that the system is properly configured, assembled and functional in accordance with the intended design as specified in the approved documents. The objective of FAT is to demonstrate to Crosswind that the system hardware and software is built in accordance to requirements as specified in the approved documents. Crosswind and Rosetti Marino (RM) would witness to verify the test. Upon successful completion of the test, a FAT Test Certificate and Shipping Release Notice would be signed by both Yokogawa as MAC and Crosswind/RM to signify the acceptance of the test and approval of shipment of the equipment.

1.2 SCOPE AND OBJECTIVE

The Factory Acceptance Test referred to as FAT applies to the PCS, SIS , FGS and EMCS Software supplied by Yokogawa . The objective of the FAT is to verify the conformance of the system against the approved specifications and FAT procedure before delivery to site. The FAT shall be conducted to test and verify the main items listed below:

- System Software

PCS- CentumVP Version R6 Software
SIS and FGS - Prosafe-RS Version R4 Software
SCADA – Collaborative Information (CI) Server R1

- Operator Station Application Software

SCADA – Collaborative Information (CI) Server R1

- Control Station Application Software

PCS, SIS, FGS and EMCS

- Alarm Management

SCADA – Collaborative Information (CI) Server R1

<u>Exclusion of test during this FAT</u>

- 3rd Party Package Communication Testing, EMCS integration test with CI-Server and PCS

2 REFERENCES

2.1.1 Project Reference Documents

Doc. No.	*Description*
123A90-DDL-IN-DD-40019 Rev.00	Data Network Architecture Drawings
123A90-DDL-EL-DG-20041 Rev.00	Block Diagram (EMCS)
123A90-PML-PM-TQ-00050 Rev.01	Reactive power control requirement for BLPH
123A90-DDL-EL-DS-20040 Rev.00	TDS - Electrical Monitoring and Control System (EMCS)
123A90-PML-PM-TQ-00052 Rev.00	Interface with Electrolyzer
123A90-PML-PM-TQ-00053 Rev.00	Interface with BESS
123A90-PML-PM-TQ-00054 Rev.00	Interface with WINDFARM and WTG-57
123A90-PML-PM-TQ-00055 Rev.01	Interface with SOLAR FARM
123A90-PML-QHSE-PRO-00113 Rev.01	Vendor final document requirements and management
123A90-PML-PM-RE-00038 Rev.01	PROJECT CODES AND STANDARDS REPORT
123A90-DDL-TL-SP-45007 Rev.02	Telecom System Philosophy and Specifications
123A90-DDL-SAF-DL-30027 Rev.00	FandG detection Layout - lower and upper deck
123A90-DDL-SAF-DL-30028 Rev.00	FandG detection Layout - Below Lower deck
123A90-DDL-PR-UFD-80006 Rev.01	BLPH UTILITY FLOW DIAGRAM WATER TREATMENT PLANT
123A90-DDL-PR-UFD-80007 Rev.01	BLPH UTILITY FLOW DIAGRAM INSTRUMENT AIR AND NITROGEN SYSTEMS
123A90-DDL-PR-UFD-80008 Rev.01	BLPH UTILITY FLOW DIAGRAM VENT SYSTEMS
123A90-DDL-IN-SP-40018 Rev. 00	Data Network Design Specification
123A90-DDL-IN-SP-40094 Rev. 00	Instrumentation for Package Unit Specification
123A90-DDL-IN-SP-40097 Rev.00	System Specification for Main Automation Contractor
123A90-DDL-IN-SP-40098 Rev.00	Control System (PCS) Specification
123A90-DDL-IN-SP-40100 Rev.00	Safety System (ESD, Fire and Gas) Specification
123A90-DDL-IN-RE-40023 Rev. 00	Cyber Security Design Philosophy
123A90-DDL-IN-RE-40093 Rev. 00	Control System Philosophy
123A90-DDL-IN-DL-40013 Rev.00	Earthing layouts drawings (Onshore CCR, Offshore ITER)
123A90-DDL-IN-DD-40096 Rev.00	Control System Architecture Detailed Drawings
123A90-DDL-IN-DD-40029 Rev.00	Automation Detailed Design and Construction Package

Doc. No.	*Description*
123A90-DDL-EL-SP-20039 Rev.00	Functional and Technical Design Specification, IDS and DDS for EMCS
123A90-DDL-PR-DG-80000 Rev.01	Process Safety Cause and Effect Block Diagram
123A90-DDL-IN-MR-40103 Rev.01	MR - Process Automation System
123A90-DDL-IN-CE-40000 Rev.03	Process Safety Cause and Effect Matrix
123A90-DDL-IN-CE-40002 Rev.02	Fire and Gas Cause and Effect Matrix
123A90-DDL-PR-PID-80009 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM GENERAL NOTES
123A90-DDL-PR-PID-80010 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM PIPING SYMBOLOGY
123A90-DDL-PR-PID-80011 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM ELECTROLYSER PACKAGE
123A90-DDL-PR-PID-80012 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM FUEL CELL PACKAGE
123A90-DDL-PR-PID-80013 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSELS HEADER (INLET)
123A90-DDL-PR-PID-80014 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSELS HEADER (OUTLET)
123A90-DDL-PR-PID-80015 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL A
123A90-DDL-PR-PID-80016 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL B
123A90-DDL-PR-PID-80019 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL E
123A90-DDL-PR-PID-80017 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL C
123A90-DDL-PR-PID-80018 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL D
123A90-DDL-PR-PID-80020 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN STORAGE VESSEL F
123A90-DDL-PR-PID-80021 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM SEA-WATER INTAKE SYSTEM SHEET 1
123A90-DDL-PR-PID-80022 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM SEA-WATER INTAKE SYSTEM SHEET 2

Doc. No.	*Description*
123A90-DDL-PR-PID-80023 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER TREATMENT PLANT SHEET 1
123A90-DDL-PR-PID-80024 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER TREATMENT PLANT SHEET 2
123A90-DDL-PR-PID-80025 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER DISPOSAL SHEET 1
123A90-DDL-PR-PID-80026 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM WATER DISPOSAL SHEET 2
123A90-DDL-PR-PID-80027 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENT AIR PACKAGE
123A90-DDL-PR-PID-80029 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN VENT DRUM
123A90-DDL-PR-PID-80028 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM HYDROGEN VENT HEADER
123A90-DDL-PR-PID-80041 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM Instrument air distribution header
123A90-DDL-PR-PID-80042 Rev.02	BLPH PIPING AND INSTRUMENTATION DIAGRAM instrumentation SYMBOLOGY
123A90-DDL-PR-PID-80043 Rev.00	BLPH PIPING AND INSTRUMENTATION DIAGRAM - OPEN DRAIN SYSTEM
K559-2254-PM-PLN-003 Rev.02	BASIC DESIGN ENGINEERING PACKAGE
123A90-MOM-RM-OOE-CW-002 Rev.00	Solar Package – BLPH Network Redundancy discussion
CWHKN-INN-INP-SPC-00005 Rev.01	SCADA Functional Design Specification
Crosswind - System Security Requirements v1.0	SYSTEM SECURITY REQUIREMENTS
K559-2254-EL-PHI-002 Rev03	ELECTRICAL SYSTEM DESCRIPTION AND DESIGN PHILOSOPHY
K559-2254-IC-BLD-001 Rev.01	PRELIMINARY CONTROL SYSTEM ARCHITECTURE
K559-2254-IC-PHI-001 Rev.01	CONTROL SYSTEM PHILOSOPHY
K559-2254-IC-REP-003 Rev.00	CYBER SECURITY ASSESSMENT
K559-2254-IC-SPE-001 Rev.00	SYSTEM SPECIFICATION FOR MAIN AUTOMATION CONTRACTOR
K559-2254-PR-BLD-001 Rev.01	BLOCK FLOW DIAGRAM SYSTEM OVERVIEW

Doc. No.	*Description*
K559-2254-EL-LST-001 Rev.00	CONTROL ALARM AND MONITORING TABLE
123A90-DDL-IN-LIS-40027 Rev.01	Master Alarm Database
123A90-DDL-IN-RE-40026 Rev.00	Alarm Management Workshop Report
123A90-DDL-IN-RE-40095 Rev.01	Process Control Logics Description
123A90-DDL-IN-PRO-40010 Rev.01	Override Procedures for Process Safeguarding Systems
123A90-DDL-IN-RE-40025 Rev.01	Alarm Management Workshop Terms of Reference
123A90-DDL-IN-SP-40024_Rev.00	Alarm System Requirements Specification
123A90-DDL-PR-RE-80031 Rev.02	Process Control, Operation, Start-up and Shutdown Philosophy
123A90-DDL-EL-DG-20014 Rev 01	Electrical Control, Protection and Metering Diagrams
123A90-DDL-EL-DG-20158 Rev.02	Overall-Key Single Line Diagram
123A90-DDL-EL-RE-20170 Rev.01	Electrical System Study Report - Load Flow
123A90-DDL-EL-RE-20171 REV.01	Electrical System Study Report - Short Circuit
123A90-DDL-EL-RE-20175 Rev.01	Electrical System Study Report - Power Factor Compensation
123A90-DDL-EL-RE-20176 Rev.01	Electrical System Study Report - Transient In-Rush
123A90-DDL-EL-SP-20141 Rev.01	Electrical System Description and Design Philosophy
1723001595-EL-DG-00012 Rev.02	Functional logic diagram
1723001595-EL-DG-00013 Rev.03	BASE LOAD POWER HUB (BLPH) - 66kV Switchgear (GIS) - Single line diagram
1723001595-EL-DG-00017 Rev.01	Inter-panel logic diagram
1723001697-EL-DG-00010 Rev.03	TR-100AD1 Termination and Wiring Diagram
1723002197-EL-DG-00010 Rev. 04	SG-100D1 HV SWBD 6,6kV - ELECTRICAL SINGLE LINE DIAGRAM
1723002197-EL-DG-00011 Rev.04	SG-200N1 LV SWBD 400-230V ELECTRICAL SINGLE LINE DIAGRAM
1723002197-EL-DG-00012 Rev.04	SG-200D2-LV SWBD 800V-ELECTRICAL SINGLE LINE DIAGRAM
1723002197-EL-DG-00015 Rev.01	SG-100D1 MV SWBD 6,6kV - FUNCTIONAL DIAGRAM - INCOMING FEEDER
1723002197-EL-DG-00016 Rev.01	SG-100D1 MV SWBD 6,6kV - FUNCTIONAL DIAGRAM - BUS BAR METERING
1723002197-EL-DG-00017 Rev.01	SG-100D1 MV SWBD 6,6kV - FUNCTIONAL DIAGRAM BESS FEEDER A-8500

Doc. No.	*Description*
1723002197-EL-DG-00018 Rev.01	SG-100D1 MV SWBD 6,6kV - FUNCTIONAL DIAGRAM - ELECTROLYSER FEEDER A20000
1723002197-EL-DG-00019 Rev.03	SG-100D1 HV SWBD 6,6kV- FUNCTIONAL DIAGRAM - FUEL CELL FEEDER A-80000
1723002197-EL-DG-00020 Rev.03	SG-100D1 HV SWBD 6,6kV - FUNCTIONAL DIAGRAM - TRANSFORMER FEEDER TR200ED1
1723002197-EL-DG-00021 Rev.01	SG-100D1 MV SWBD 6,6kV - FUNCTIONAL DIAGRAM - TRANSFORMER FEEDER TR200DE1
1723002197-EL-DG-00022 Rev.01	SG-100D1 MV SWBD 6,6kV INTERCONNECTING
1723002197-EL-DG-00023 Rev.01	SG-100D1 MV SWBD 6,6kV-LOGIC DIAGRAM-INCOMING FEEDER TR-100AD1
1723002197-EL-DG-00025 Rev.01	SG-100D1 MV SWBD 6,6kV - LOGIC DIAGRAM - BESS FEEDER A-85000
1723002197-EL-DG-00026 Rev.01	SG-100D1 MV SWBD 6,6kV - LOGIC DIAGRAM - ELECTROLYSER FEEDER A20000
1723002197-EL-DG-00027 Rev.03	SG-100D1 HV SWBD 6,6kV - LOGIC DIAGRAM -FUEL CELL FEEDER A-80000
1723002197-EL-DG-00028 Rev.03	SG-100D1 HV SWBD 6,6kV - LOGIC DIAGRAM - TRANSFORMER FEEDER TR200ED1
1723002197-EL-DG-00029 Rev.03	SG-100D1 HV SWBD 6,6kV - LOGIC DIAGRAM - TRANSFORMER FEEDER TR200DE1
1723002197-EL-DG-00030 Rev.02	SG-200N1 LV SWBD 400-230V FUNCTIONAL DIAGRAMS - INCOMINGS AND INTERCONNECTING AND AUX DISTRIBUTION
1723002197-EL-DG-00031 Rev.02	SG-200N1 LV SWBD 400-230V - FUNCTIONAL DIAGRAMS - TYPICAL FEEDERS
1723002197-EL-DG-00032 Rev.01	SG-200D2 LV SWBD - ELECTRICAL FUNCTIONAL DIAGRAM
1724000428-IN-LIS-00016 Rev.03	IO LIST - INSTRUMENT AIR PACKAGE
1724000437-IN-LIS-00015 Rev.03	IO LIST - NITROGEN GENERATION PACKAGE U-64000
1724000372-EL-LIS-00014 Rev.02	IO LIST
1723002197-EL-LIS-00041 Rev.02	SG-100D1 IO LIST- Hv Switchgear
1723002197-EL-LIS-00042 Rev.02	SG-200N1 IO LIST - Lv Switchgear
1723002197-EL-LIS-00043 Rev.01	SG-200D2 IO LIST (HARDWARE -SOFTWARE)

Doc. No.	*Description*
1723001595-EL-LIS-00011 Rev.02	Switchgear IO list
1724000448-IN-LIS-00019 Rev.01	INPUT-OUTPUT LIST
123A90-DDL-EL-DG-20185 Rev.01	Electrical Single Line Diagram HV Systems
1724000372-EL-DG-00006 Rev.02	DC UPS - SINGLE LINE DIAGRAM and INTERCONNECTING DIAGRAM
1724000372-EL-DG-00007 Rev.02	AC UPS - SINGLE LINE DIAGRAM and INTERCONNECTING DIAGRAM
123A90-DDL-IN-LIS-40089 Rev.03	Instrument I-O List
123A90-DDL-EL-DL-20100 Rev 01	Base Load Power Hub - Electrical Equipment Layout - Top Deck
123A90-DDL-EL-DL-20101 Rev 01	BASE LOAD POWER HUB (BLPH) - Electrical Equipment Layout - Lower Deck
123A90-DDL-EL-DL-20104 Rev.02	Base Load Power Hub (BLPH) - Electrical Equipment Layout - HV Switch room
123A90-DDL-EL-DL-20105 Rev.02	Electrical Equipment Layout - LV Switch room
123A90-DDL-EL-DL-20106 Rev.01	Base Load Power Hub (BLPH) - Electrical Equipment Layout - UPSs & Batteries Switch room
123A90-DDL-IN-DL-40012_Rev.03	BASE LOAD POWER HUB - OFFSHORE ITER - EQUIPMENT LAYOUT
1724000049-HV-PID-00039.Rev.00	B-100 PID - E&I SHELTERS
1724000049-HV-PID-00040.Rev.00	B-200 PID - E&I SHELTERS
1724000049-HV-PID-00041.Rev.00	B-300 PID - E&I SHELTERS
1724000049-HV-PID-00042.Rev.00	B-400 PID - E&I SHELTERS
1724000428-PR-PID-00019 Rev.02	PACKAGE PID - INSTRUMENT AIR PACKAGE
1724000437-PR-PID-00018 Rev.02	PACKAGE PID - NITROGEN GENERATION PACKAGE
1724000448-PR-PID-00013_Rev.01	WATER TREATMENT PACKAGE-PID DIAGRAM
HKN1-04-DWG-312 RevD	HKN1-04-DWG-312 Power Export System Single Line Diagram
K559-2254-CWIWP4202201-C06-001 Rev.01	Electrical Single Line Diagrams
K559-2254-CWIWP4202202-C03-001 Rev.05	BALLARD - BLPH Project - P&IDs
C63-PID-001_Rev.07	ELOGEN BLPH Project - Process and Instrumentation Diagrams
123A90-DDL-IN-CE-40000 Rev.03	Process Safety Cause and Effect Matrix

Doc. No.	*Description*
123A90-DDL-IN-CE-40002 Rev.02	Fire and Gas Cause and Effect Matrix

Table 1 – Project Reference Documents

2.1.2 Yokogawa Project Document

Doc. No.	Description
1724000594-IN-RE-00041 Rev00	Cybersecurity Workshop Preparation
1724000594-QC-ITP-00002 Rev01	INSPECTION AND TEST PLAN
1724000594-QC-PRO-00031 Rev00	SW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE
1724000594-IN-SP-00018 Rev02	PCS and SAFETY SYSTEMS Software Functional Design Specification (FDS-SW)
1724000594-QC-DB-00033 Rev00	MANUFACTURERS RECORD BOOK (FINAL DOSSIER)
1724000594-IN-LIS-00040 Rev00	VENDOR ASSET AND TAG REGISTER
1724000594-IN-DG-00023 Rev01	NETWORK AND SERVER CABINETS IN OER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-MD-LIS-00001 Rev03	SUPPLIER MASTER INDEX REGISTER (SMIR)
1724000594-IN-MAN-00038 Rev00	Instructions for Operation and Maintenance for ProSafe-RS
1724000594-IN-DA-00009 Rev01	PCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-QC-PRO-00030 Rev01	HW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE
1724000594-IN-RE-00008 Rev01	Safety Controller loading estimation
1724000594-IN-DD-00028 Rev01	HMI screens print out
1724000594-COM-LIS-00039 Rev01	SPARE PART INDEX REGISTER (COMMISSIONING AND 2-YEARs OPERATION)
1724000594-IN-PL-00029 Rev00	Safety Validation Plan (SVP)
1724000594-IN-CA-00006 Rev01	Power Consumption and Heat Dissipation
1724000594-IN-LIS-00005 Rev00	EMCS IO List (HW and SW)
1724000594-IN-RE-00035 Rev01	Cyber Security Risk Assessment REPORT
1724000594-IN-RE-00043 Rev00	CYBER SECURITY SETTINGS
1724000594-IN-DG-00021 Rev01	SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DA-00010 Rev01	SAFETY SYSTEMS CABINETS (SIS AND FGS) GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-LIS-00036 Rev01	ATEX REGISTER

1724000594-IN-DA-00011 Rev02	NETWORK AND SERVER CABINETS IN ITER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-SP-00019 Rev02	EMCS Software Functional Design Specification (FDS-SW)
1724000594-QC-LIS-00034 Rev00	MANUFACTURERS RECORD BOOK (FINAL DOSSIER) - INDEX
1724000594-IN-DA-00012 Rev01	NETWORK AND SERVER CABINETS IN OER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-QC-PRO-00042 Rev00	THIRD PARTY COMMUNICATION TEST PROCEDURE
1724000594-IN-DD-00015 Rev03	System Architecture
1724000594-IN-LIS-00004 Rev03	PCS and Safety System IO List (HW and SW)
1724000594-IN-DG-00022 Rev01	NETWORK AND SERVER CABINETS IN ITER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00016 Rev01	Network Connection Diagram
1724000594-IN-LIS-00007 Rev01	Systems Cables List
1724000594-IN-SP-00017 Rev01	PAS Hardware Functional Design Specification (FDS-HW)
1724000594-IN-DG-00024 Rev01	EMCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DA-00013 Rev01	EMCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT

Table 2 – Yokogawa Reference Documents.

2.2 DEFINITIONS AND ABBREVIATIONS

ALE	Yokogawa Ethernet Communication Module
AMS	Alarm Management System
BLPH	Base Load Power Hub
CAP	Critical Action Panel
Centum VP	Yokogawa's DCS Product
PCS	Process Control System
CI	Collaborative Information
COMPANY	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
DCS	Distributed Control System
DEP	Design and Engineering Practice
DOCUMENT NAME	Document Title
EMCS	Electrical Monitoring and Control System
EPC	Engineering, Procurement Construction

EWS	Engineering Workstation
FCS	Field Control Station
FGS	Fire & Gas System
GSD	General Station Description
HART	Highway Addressable Remote Transducer
HKN	Hollandse Kust Noord
HMI	Human Machine Interface
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HV-SCADA	The given name for the COMPANY's control system for the HKN wind farm infrastructure. BLPH's control system shall operate autonomously but will interface with HV-SCADA.
IAMS	Instrument Asset Management System
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITER	Instrument & Telecoms Equipment Room
ITP	Inspection and Test Plan
MAC	Main Automation Contractor
MCC	Motor Control Centre
NA	Not Applicable
OER	Onshore Equipment Room
OPC	OLE (Object Linking Embedded) for Process Control
P&ID	Piping and Instrument Diagram
PCS	Process Control System
PIN	Plant Information Network
PRM	Plant Resource Manager
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
SCADA	Supervisory Control and Data Acquisition
SHALL	An absolute requirement.
SHOULD	This word indicates a recommendation that whilst preferred may not be implemented provided some equivalent is proposed and agreed by COMPANY. The full implications must be understood and carefully weighed before choosing a different course.
SIF	Safety Instrumented Function

SIL	Safety Instrumented Level
SIS	Safety Instrumented System
TCP/IP	Transmission Control Protocol/Internet Protocol
Vnet/IP	Yokogawa Virtual Network
WSUS	Window Security Update Services

Table 3 – Definitions and Abbreviations

2.3 APPLICABLE DESIGN ENGINEERING PRACTICES

Design Engineering Practices (DEP) have a limited rollout on BLPH.

2.3.1 Fully Applicable DEP

The following DEP are identified as being fully applicable to the project.

Document Name	Document Title
DEP 32.01.20.12	Industrial Automation and Control Systems (IACS) Security
DEP 30.00.60.15	Humans Factors Engineering – Control Room Design
DEP 33.64.10.32	Electrical Network Monitoring and Control System for Global Application
DEP 37.76.10.10	HVAC for Offshore Installations (Amendments/Supplements to ISO 15138)

Table 4 – Applicable DEPs

DEP 32.01.20.12 shall be applied to the project in full, in conjunction with IEC 62443, for the cybersecurity design.

2.3.2 DEM-1 Process Safety Only DEP

The following DEPs shall have the DEM-1 'Process Safety' requirements applied to the project.

Document Name	Document Title
DEP 32.30.20.11	Fire, Gas and Smoke Detections
DEP 32.80.10.10	Safety Instrumented Systems
DEP 32.80.10.14	Alarm Management (Amendment/Supplements to IEC 62682)
DEP 62.10.08.11	Inspection and Function Testing of Instruments

Table 5 – Applicable DEPs

2.4 INDUSTRY STANDARDS

Document Name	Document Title
IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61511	Functional Safety – Safety Instrumented Systems for the Process Industry Sector – Framework, Definitions, System, Hardware, and Application Programming Requirements
IEC 61850	Communication Networks and Systems for Power Utility Automation

IEC 62443	Cyber Security for Industrial Automation and Control Systems
IEC 62682	Management of Alarm Systems for the Process Industries
ISO 9001	Certifications of Quality Management System

Table 6 – Industry Standards

3 RESPONSIBILITY

Responsibilities for each party involved in the FAT are defined here-under to ensure that the FAT is carried out in accordance with an agreed procedure. It also ensures that there shall be authorized personnel(s) from Crosswind, RM and YOKOGAWA to facilitate any decisions and schedule changes resulted from the FAT as per ITP.

3.1 CROSSWIND

The full participation of Crosswind in the FAT is essential. Crosswind shall appoint an Inspector cum Test Approver to witness the FAT. The Test Approver would have the authority to sign-off upon the successful completion of all tests. Once signed off, the test will be deemed accepted and the decision will be final. The Inspector shall participate in the test and observe the test results on daily basis. The Test Approver shall approve the inspection items based on the approved specification and the test results recorded.

3.2 ROSETTI MARINO (RM)

RM shall appoint a FAT Manager for the FAT. The FAT Manager representing RM shall coordinate with Crosswind and YOKOGAWA FAT Managers and to facilitate the smooth implementation of the FAT activities and schedule. The role of the FAT Manager is also to resolve FAT issues on a regular basis. RM representatives will participate in the FAT for the complex controls, sequences and logics. For PCS controlled equipment packages containing complex controls, sequences and logics, RM at their discretion, may invite their package equipment supplier representatives to participate in the testing.

3.3 MAC SUPPLIER

YOKOGAWA as MAC shall appoint a Test Conductor to organize and manage all aspects of the FAT. YOKOGAWA shall carry out the testing and record the test results daily basis together with Crosswind Inspector and RM representative. The Project Manager representing YOKOGAWA shall be the FAT Manager. The FAT Manager shall coordinate with RM's FAT Manager and shall amend the test schedule whenever necessary to ensure the smooth running of the FAT. The FAT Manager shall also ensure that all tests are conducted in accordance with the approved FAT documents. If changes/modifications are required in the implementation, the FAT Managers of YOKOGAWA and RM shall discuss and arrive at the action plan.

4 GENERAL ADMINISTRATION

4.1 FAT VENUE

Remote FAT shall be carried out using Virtual Machine (VM)/Remote Access on Yokogawa's Distributed Control System (PCS) CENTUM VP HMI, Controller, EMCS, Prosafe-RS (SIS and FGS) and SCADA (CI Servers) OWS, CI Servers.

4.2 ORGANIZATION CHART

A specific detailed Organization Chart shall be issued for each project, with all positions and names filled in. In addition, a FAT roster of the participants shall be issued, with the following details for each person; full name, company, responsibility, samples of the signature and initials, actual start and finish date of participation in the FAT. The FAT Manager will be responsible for maintaining the roster and keeping it updated.

4.3 KICK-OFF MEETING

An initial kick-off meeting will be held prior to starting the FAT to brief the participants, confirm the organization and responsibilities, and review the FAT schedule. At the same time, HSE briefing for all participants will be provided by YOKOGAWA. YOKOGAWA FAT Manager will prepare the presentation and explain the organization and work practices. All FAT documentation prepared by YOKOGAWA prior to FAT will be inspected for completeness.

4.4 DAILY WORKING SCHEDULE

The FAT will be conducted using Virtual Machine (VM)/Remote Access from YOKOGAWA premises from Monday to Friday (working days).

The following timing (CET) is recommended for the testing:

0900 to 1230 hrs	Inspection and test
1230 to 1330 hrs	Lunch
1330 to 1530 hrs	Inspection and test
1530 to 1600 hrs	Daily review meeting including next day's schedule planning

4.5 DAILY REVIEW MEETING

YOKOGAWA FAT Manager shall conduct a daily review meeting at the end of each FAT day. The meeting will involve all the parties taking part in the FAT. The purpose of this review meeting is to update all parties the progress and status of the FAT. The punch list will be reviewed during the daily meeting and the action to be taken will be discussed and finalized. If the recovery work involved is minor (identified in the daily meeting) and agreed by all parties, the work will be carried out on the same day and will be verified the following day by all the concerned parties and signed off in the punch list. If the recovery work involves major change/modification, The FAT Manager will advise the schedule for retesting.
Refer to section 5.4 for details in punch record.
The FAT Manager should also ensure that PCS, SIS, FGS, SCADA and EMCS Engineers make a backup of the application program to an external storage & other PC every day after the daily review meeting, so that old backups can be retrieved, if necessary.
White board will be provided to record progress & pending item.

4.6 WEEKLY PROGRESS MEETING

YOKOGAWA FAT Managers shall conduct weekly progress meeting every Friday. The purpose of the weekly meeting is to report the progress of the FAT in the same week and planned activity the following week. It shall also be the forum for resolving any issue arises from punch list. In the weekly progress meeting, The FAT Manager will present detailed weekly progress report, containing details of activities and achievements for the week, plan for the next week, area of concern, and detailed formal overall progress assessment. The format and content details of the weekly progress report and the underlining planning, progress monitoring and measurement methodology shall be in accordance with the FAT planning, Progress Monitoring Report. After the joint review in the weekly progress meeting and any necessary amendments, The FAT Manager will issue the weekly progress report.

4.7 FAT WRAP-UP MEETING

At the completion of the FAT, a final wrap-up meeting will be held. The overall status of the FAT shall be reported. Upon all parties' agreement that the FAT is completed satisfactorily, the FAT Completion Certificate and Shipping Release Notes shall be signed off by Crosswind/RM.

5 FAT DOCUMENTATION

The Factory Acceptance Test (FAT) shall be conducted in accordance with the test procedures detailed in this document. The test results shall be recorded in the check sheet. To prevent from any check sheet getting lost, each Check sheet shall be given a unique reference number.

5.1 FAT WRAP-UP MEETING

All FAT documentation shall be prepared by YOKOGAWA prior to the start of the FAT. All forms, check sheets, sign-off sheets, drawings, etc. as listed in this procedure shall be organized in indexed binders. A master index for the FAT will be provided and maintained by YOKOGAWA FAT Manager.
The documentation for software checks shall be organized by individual process units in indexed binders. The documentation for graphics checks shall also be organized, separately by individual process units in indexed binders.
All FAT reference documents (latest issue) as listed in this procedure originated by other parties (Crosswind, RM), which were issued formally to YOKOGAWA will form a part of the FAT documentation and shall be printed out and organized in indexed binders by YOKOGAWA.
All FAT reference documents as mentioned above shall be stamped "FAT MASTER" on every page/sheet. Any additional documents that may be necessary and generated later during FAT shall also be stamped, and indexes amended accordingly.

5.2 INTERNAL TEST/PRE-FAT WRAP

Prior to the FAT, YOKOGAWA shall conduct internal test (Pre-FAT) to verify the system and application software.

PCS Complex control loops, specialized sequential controls and batch control applications shall also be completely tested during Pre-FAT using Simulation Software (Test Function) in VMs.

The entire SIS, FGS application software will also be completely tested during Pre-FAT using Simulation Software (Test function) in VMs.

The result of the test shall be recorded and made available for reference before or during FAT. As a part of the pre-FAT, the project team consisting of application engineers from YOKOGAWA, RM and Crosswind conduct electronic (paper) check using the PCS tag/tuning report generated from the system.

During this paper check Pre-FAT, Crosswind/RM will verify the configuration parameters by using engineering documents. This will enable the FAT crew to concentrate on the control functions and Graphic functionality during the actual FAT and will also help in reducing the duration of the FAT.

Refer to PCS, SIS, FGS and SCADA application software sections for detailed procedure on paper check. It is also preferred that Crosswind and RM representatives participate in the pre-FAT for complex controls, sequences and logics checks, especially in projects that has multiple equipment's with identical control strategy, to facilitate smooth execution of the FAT.

5.3 METHOD OF TESTING

Detailed test procedure for each test item is described in this document. Check sheet shall be provided, listing the equipment to be tested. All test results shall be recorded in the Check sheets. The following color codes shall be used in the testing:

a) Yellow marker/highlighter – Items that were checked and cleared

b) Pink marker/highlighter – Items that were having problems.

c) Green marker/highlighter – Items that were checked after completion of recovery.

The color marking on the printouts or pdf file highlighting shall be done on the control drawings, graphics and supporting design documents such as P&IDs, narratives, etc.

During PRE-FAT/FAT sample check of SIS, FGS Logics can be demonstrated with target hardware. Complete software and Hardware Integration Test shall be performed during SAT.

PCS/SIS/FGS/EMCS Software Function Test will be conducted using Test Function tool/applicable simulation software's, without connection to any physical I/O. Simulation Software (PCS/SIS/FGS/SCADA Specific) will be used to simulate process input, digital signal and alarms to FCS/SCS so that typical loops, logic sequence blocks can be tested without connecting to physical input and output devices. Dynamic graphics check shall be a part of the PCS/SIS/FGS/SCADA Software function test. In case of EMCS application simulations shall be done to demonstrate the functionality.

5.4 PUNCH RECORD

All shortcomings found during the test shall be noted in the FAT Punch Record. Each punch Record shall cover one punch item/fault. A Punch Record Ledger shall be used to summarize all the punch records. Punch record items shall be classified as follows:

M = Modification, item is to be modified, deleted, added due to design input changes.

C = Correction, item is to be corrected by YOKOGAWA.

If the recovery work involves change/modification, it is to be recorded on the punch record and the recovery undertaken as soon as possible after the agreement of both the FAT Managers after signing of the punch record. YOKOGAWA shall clear all correction items (Code-C) at factory before shipment. For recovery work that involves modification (Code-M), it will be regularly jointly reviewed by all parties on at least weekly basis and resolved whether to be implemented during FAT or later, depending on complexity and potential schedule and/or cost impact. After verification, the same will be signed off by all concerned parties in the punch record.

Each Punch Record Shall include the expected completion Date within which the punch shall be implemented and ready for re-testing.

-Each "Code-M" punch requiring a minor or negligible effort to be cleared and shall be considered as included in lump-sum.

-Each" Code-M" punch deemed not included in lump-sum Yokogawa scope shall be subject to preliminary agreement between the parties before proceeding for implementation.

-Such Classification of "Code-M" punches shall be reflected either in FAT punch record sheets or in FAT punch ledger/SIS Punch Record Summary.

5.5 FAT COMPLETION CERTIFICATE & SHIPPING RELEASE NOTE

Upon completion of the FAT, FAT Completion Certificate and Shipping Release Note will be signed by Crosswind, Rosetti Marino and YOKOGAWA. The purpose of these two documents is to certify that the FAT has been completed and accepted by Rosetti Marino . Both Rosetti Marino and YOKOGAWA agree that the system is in order and can be released for software to site. The software will be accepted and released by Rosetti Marino. In any case, the release note will be issued by Rosetti Marino using its own template .

5.6 TEST EQUIPMENT

For SW FAT Virtual Machines with required software shall be used to demonstrate software applications configured using screen sharing and audio. Hence no dedicated measuring/Calibrating Test equipment shall be used.

6 PCS APPLICATION SOFTWARE

6.1 PROJECT OVERALL FUNCTION

6.1.1 Project Common Setting Check

Outline	Application inspection of project overall function include verifying project common configuration like plant hierarchy, alarm table, operation mark, and FCS properties/constants.
Objective	- Verify that the project overall function of CENTUM VP project is defined according to the FDS requirements.
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00018- PCS and SAFETY SYSTEMS Software FDS-SW - CENTUMVP system view - 123A90-DDL-IN-SP-40097 Rev.00 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Rev.00 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Rev. 00 Control System Philosophy - 123A90-DDL-IN-DD-40096 Rev.00 Control System Architecture Detailed Drawings - K559-2254-IC-SPE-001 Rev.00 SYSTEM SPECIFICATION FOR MAIN AUTOMATION CONTRACTOR - K559-2254-PR-BLD-001 Rev.01 BLOCK FLOW DIAGRAM SYSTEM OVERVIEW - K559-2254-EL-LST-001 Rev.00 CONTROL ALARM AND MONITORING TABLE - 123A90-DDL-IN-SP-40024_Rev.00 Alarm System Requirements Specification - 123A90-DDL-IN-DD-40019 Rev.00 Data Network Architecture Drawings
Procedure	Verify following CENTUM VP configuration files as a part of paper check during pre-FAT; • Plant hierarchy • Alarm table • Operation mark • FCS properties/constants
Criteria	Plant hierarchy, alarm table, operation mark, and FCS properties/constants are configured according to the FDS.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

6.2 FCS FUNCTION

6.2.1 Application Software Test for Typical Loops

Outline	This application inspection includes typical loops such as simple indicators, simple control loops, manual loader, etc. Therefore, the accuracy of the PCS configuration relies on the accuracy of the data entry in the database.
Objective	- Verify that that regulatory control loops are configured according to the database and FDS requirements.
Reference	Functional Specifications like; - 1724000594-IN-SP-00018- PCS and SAFETY SYSTEMS Software FDS-SW - 1724000594-IN-LIS-00004- PCS and Safety System IO List (HW and SW) Refer to Documents - 123A90-DDL-IN-LIS-40089 Instrument IO List - P&IDs of Process and third-party communication packages (WTP, HVAC, LV SWGR, UPS) - 123A90-DDL-IN-RE-40095 Process Control Logic Description - 123A90-DDL-IN-CE-40000 ESD/PSD Cause and Effect Diagram - 123A90-DDL-IN-LIS-40027 Master Alarm Database PCS I/O Database - 123A90-DDL-IN-RE-40093 Rev. 00 Control System Philosophy
Procedure	1. Identify each type of application module from P&IDs and FDS. 2. If necessary, perform function test for selected application modules. 3. Verify configuration data for application, by reviewing CENTUM VP system view. Sample tags checked during FAT shall be logged for test record. The accuracy of the PCS configuration relies on the accuracy of the data in the I/O List.
Criteria	Each loop in control drawing should be configured in accordance to the functional specifications, control narrative, P&IDs, and PCS I/O Database.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

6.2.2 Application Software Test for Complex Loops

Outline	PCS application test involves functionality check for all complex loops that is described in the functional specification, control narratives and P&IDs.
Objective	Verify that the complex control configuration functions as defined in the approved functional specifications.
Reference	Functional Specifications like; - 1724000594-IN-SP-00018 PCS and SAFETY SYSTEMS Software FDS-SW - 1724000594-IN-LIS-00004 PCS and Safety System IO List (HW and SW) Refer to Documents - 123A90-DDL-IN-LIS-40089 Instrument IO List - P&IDs of Process and third-party communication packages (WTP, - HVAC, LV SWGR, UPS) - 123A90-DDL-IN-RE-40095 Process Control Logic Description - 123A90-DDL-IN-CE-40000 ESD/PSD Cause and Effect Diagram - 123A90-DDL-IN-LIS-40027 Master Alarm Database
Procedure	1. Using Test function tool, simulate process input signals to check control loop functions. 2. Check following applicable control functions for each complex loop. • Control Action • Bumpless transfer • Tracking functions • Ratio/Calculations • Annunciator message output • Data quality Propagation • ESD/PSD Interlock Shutdown Controller action • Operational Interlock Controller action • Initial functional status of loops on FCS startup • Operator Graphical Interface • Alarm & Trip settings • Other specific functional requirements according to complex loop description
Criteria	Complex loops in control drawing should be configured in accordance to the functional specifications, control narrative, P&IDs, C&E and PCS I/O Database.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

6.2.3 Application Software Test for Sequence and Logic

Outline	FCS sequence control functions include sequence table, logic chart or SEBOL (Sequence and Batch Oriented Language) configuration. These are configured in accordance with plant logic requirements as described in the FDS, control narrative and any sequence/logic diagrams. Sequence control functions are checked by simulating field inputs using the test function software tool and confirming the corresponding expected outputs.
Objective	Verify that the specified functions perform control as defined in the approved functional specifications.
Reference	Functional Specifications like; - 1724000594-IN-SP-00018 PCS and SAFETY SYSTEMS Software FDS-SW - 1724000594-IN-LIS-00004 PCS and Safety System IO List (HW and SW) Refer to Documents - 123A90-DDL-IN-LIS-40089 Instrument IO List - P&IDs of Process and third-party communication packages (WTP, HVAC, LV SWGR, UPS) - 123A90-DDL-IN-RE-40095 Process Control Logic Description - 123A90-DDL-IN-CE-40000 ESD/PSD Cause and Effect Diagram
Procedure	1. Using Test function tool, simulate process input signals to check logic/sequence configuration. 2. Check that the sequence/logic performs correctly, and the correct digital outputs are set. 3. Check valves open/shut, pumps start/stop, appropriate alarm message display etc. 4. Check the initial functional status of sequence logics on FCS start-up. 5. For each sequence/logic, check operator interface Graphic functions. Detail checklists are described on the Check sheet.
Criteria	Sequence and logic should be configured in accordance to the functional specifications, Control/Logic narrative, P&IDs, SLDs, C&E and PCS I/O Database and any sequence or logic diagram.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

6.2.4 Application Software Test for non-Typical Loops

Outline	This application inspection includes non-typical loops such as control loops, etc. that are generated. Non-Typical loops can be simple Analog outputs, Value comparison, average, deviation alarm or process alarm based on analog values etc.
Objective	- Verify that that regulatory control loops are configured according to the FDS requirements.
Reference	Functional Specifications like; - 1724000594-IN-SP-00018 PCS and SAFETY SYSTEMS Software FDS-SW - 1724000594-IN-LIS-00004 PCS and Safety System IO List (HW and SW) Refer to Documents Refer to Documents - 123A90-DDL-IN-LIS-40089 Instrument IO List - P&IDs of Process and third-party communication packages (WTP, HVAC, LV SWGR, UPS) - 123A90-DDL-IN-RE-40095 Process Control Logic Description - 123A90-DDL-IN-CE-40000 ESD/PSD Cause and Effect Diagram
Procedure	1. Identify each type of Typical from P&IDs and FDS. 2. If necessary, perform function test for selected loops. Detail checklists are described on the check sheet. Sample tags checked during FAT shall be logged in this check sheet for test record. The check sheet used for this test shall be from the Excel spreadsheet as the test record. Non-Typical loop Pre-FAT paper check will be sufficient to test all the application loops. The accuracy of the PCS configuration relies on the accuracy of the data in the I/O List. Detail checklists are described on the Check sheet.
Criteria	Each loop in control drawing should be configured in accordance to the functional specifications, control narrative, P&IDs, and PCS I/O Database.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

6.2.5 Alarm and Trip Setpoints

Outline	This application inspection includes non-typical loops such as control loops, etc. that are generated.
Objective	- Verify that alarm and setpoints are as per Alarm/Trip Setpoints.
Reference	Functional Specifications like - 1724000594-IN-SP-00018- PCS and SAFETY SYSTEMS Software FDS-SW - CENTUMVP system view - 123A90-DDL-IN-SP-40097 Rev.00 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Rev.00 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Rev. 00 Control System Philosophy - K559-2254-IC-SPE-001 Rev.00 SYSTEM SPECIFICATION FOR MAIN AUTOMATION CONTRACTOR - K559-2254-PR-BLD-001 Rev.01 BLOCK FLOW DIAGRAM SYSTEM OVERVIEW - K559-2254-EL-LST-001 Rev.00 CONTROL ALARM AND MONITORING TABLE Refer to Documents - 123A90-DDL-IN-SP-40024_Rev.00 Alarm System Requirements Specification - 123A90-DDL-IN-LIS-40089 Instrument IO List - 123A90-DDL-IN-LIS-40027 Master Alarm Database
Procedure	1. Identify each Alarm/trip for each required Tag. 2. Simulate the value to create alarm 3. Verify the alarm/trip setpoints on the check sheet. Detail checklists are described on the check sheet.
Criteria	Each loop in control drawing should be configured in accordance to the functional specifications, control narrative, P&IDs, and PCS I/O Database.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

7 CI SERVER CONFIGURATION

7.1 NAMING CONVENTION

Outline	To verify the agreed naming conventions are implemented
Objective	To confirm that the naming conventions is correctly implemented for the following: ▪ Plant hierarchy ▪ Item names ▪ Displays ▪ Symbols (static and dynamic)
Reference	Functional Specifications - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00018- PCS and SAFETY SYSTEMS Software FDS-SW - CENTUMVP system view - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-DD-40096 Control System Architecture Detailed Drawings - K559-2254-IC-SPE-001 SYSTEM SPECIFICATION FOR MAIN AUTOMATION CONTRACTOR - K559-2254-PR-BLD-001 BLOCK FLOW DIAGRAM SYSTEM OVERVIEW - K559-2254-EL-LST-001 CONTROL ALARM AND MONITORING TABLE - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-IN-DD-40019 Data Network Architecture Drawings System Architecture Drawing Refer documents - 1724000594-IN-LIS-00003 Bill Of Material - Section 8.3,9, 24, 28.5.2, 28.10.1 of Reference PCS and SAFETY SYSTEMS Software Functional Design Specification (FDS-SW) 1724000594-IN-SP-00018 - Instrument IO list 1724000594-IN-LIS-00004
Procedure	Check the naming conventions for the following are in accordance with the FDS: ▪ Plant hierarchy – check the section naming and structure under the node in CI Server Engineering module and confirm that it conforms to the FDS plant hierarchy convention. ▪ Items – review the item names under the sections and confirm that the naming conforms to the FCS tag naming convention (e.g.: A, SH, SL). ▪ Displays – check the graphic names in the Edit Module and confirm that they conform to the FDS graphic naming convention. The display name shall be followed as per the P&ID/SLDs.

	▪ Static and dynamic symbols – check the symbol names in the Edit Module and confirm that they conform to the FDS graphics naming convention.
Criteria	The naming conventions match the customer convention requirements
Test Record Reference	HMI Screen and Engineering Module Printout

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

7.2 AUDIT TRAIL

Outline	The generated events are recorded and can be traced
Objective	To verify the event generated by the operator can be traced
Reference	Functional Specifications - Section 14.8, 28.5.7 of Reference PCS and SAFETY SYSTEMS Software Functional Design Specification (FDS-SW) 1724000594-IN-SP-00018 Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-SP-40100 Safety System (ESD, Fire and Gas) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-PR-RE-80031 Process Control, Operation, Start-up and Shutdown Philosophy
Procedure	Generate some events which have to be recorded in the audit trail window in the operator interface.
Criteria	The generated events are logged in the respective display.
Test Record Reference	Audit Trail Window printout

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

7.3 HISTORISATION

Outline	History data is acquired for applications like reporting, alarm pages and trending and therefore the correct configuration is very important to trace significant events in the past.
Objective	To verify the history configuration meets the customer requirements.
Reference	Functional Specifications - Section 28.5.1 of Reference PCS and SAFETY SYSTEMS Software Functional Design Doc.No. 1724000594-IN-SP-00018 - History Storage calculation sheet Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-SP-40100 Safety System (ESD, Fire and Gas) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-PR-RE-80031 Process Control, Operation, Start-up and Shutdown Philosophy
Procedure	▪ Verify the history storage path ▪ Check the lifetime for the following history groups: - Item storage groups: SCAN/ITEM EVENT/EVENT EVENT/ITEM Generate randomly events for items in each storage groups to verify the timestamp of the generated events.
Criteria	The storage drive has enough space to match the size of the total history lifetime. This could be verified by using a history calculation sheet. The lifetime of the history groups is correctly implemented. Generated events could be observed using reports or trend displays.
Test Record Reference	Trend Display printout and generated csv report file

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

7.4 AUTHORIZATION

Outline	The level of authorization for the typical is verified in typical FAT prior to the FAT. E.g., the operator can modify a setpoint but is not able to set the tag in calibration mode. In this test case the general CI Server configuration part will be tested which is the framework for the application typical.
Objective	Verify if all authorization groups and users are configured according to the design documentation
Reference	Functional Specifications - Section 28.8 of Reference PCS and SAFETY SYSTEMS Software Functional Design Doc.No. 1724000594-IN-SP-00018 Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-SP-40100 Safety System (ESD, Fire and Gas) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-PR-RE-80031 Process Control, Operation, Start-up and Shutdown Philosophy
Procedure	▪ Authorization groups are configured correctly. ▪ All the required users are added in CI Server with the proper authorization groups. ▪ Users are authorized to modify items within their process area (e.g., acknowledge, value) ▪ Users are authorized to open displays within their process area
Criteria	All Authorization levels are configured properly. All required users are configured properly. Users have (only) access to their process area
Test Record Reference	NA

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

8 GRAPHICAL USER INTERFACE

8.1 GENERAL LAYOUT AND NAVIGATION

Outline	CI Server graphics are used as the Human-Machine Interface for operating the plant. The live status of the plant can be observed on the graphics and these data are obtained from the Centum VP and SIS controller.
Objective	The purpose of this test is to confirm that the frames of the general layout are configured according to the design specification.
Reference	Functional Specifications - Section 30 of Reference PCS and SAFETY SYSTEMS Software Functional Design Doc. No. 1724000594-IN-SP-00018 Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-IN-DD-40096 Rev.00 Control System Architecture Detailed Drawings - 123A90-DDL-IN-DD-40029 Rev.00 Automation Detailed Design and Construction Package - P&IDs and Single line diagrams
Procedure	Verify the general layout of the display area: ▪ Windows heading ▪ Menu area ▪ Toolbar area ▪ Display area ▪ Display Navigation Verify the display navigation is in accordance with the design document.
Criteria	Graphics layout, display navigation are according to what was approved and correctly displayed as specified in the reference document.
Test Record Reference	Graphic printouts.

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

8.2 PROCESS DISPLAYS

Outline	CI Server graphics are used as the Human-Machine Interface for operating the plant. The live status of the plant can be observed on the graphics and these data are obtained from the CENTUM VP and SIS controller. All dynamic process data and alarms shall be simulated from the test panels or from software (forcing).
Objective	The purpose of this test is to confirm that: ▪ Correct process flow is shown on the process displays and popups. ▪ Correct process data is shown on the process displays and popups.
Reference	Functional Specifications - Reference PCS and SAFETY SYSTEMS Software Functional Design 1724000594-IN-SP-00018 - Reference Instrument IO List 1724000594-IN-LIS-00004 - Reference HMI screens print out 1724000594-QC-PRO-00032 - P&IDs & SLDs. Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-IN-DD-40096 Rev.00 Control System Architecture Detailed Drawings - 123A90-DDL-IN-DD-40029 Rev.00 Automation Detailed Design and Construction Package - P&IDs and Single line diagrams
Procedure	The test environment shall include Test Function FCSs with project configuration to provide data to the tags on each display. Check the following for the process display: ▪ Correct representation of the process flow ▪ Correct representation of the process data points. ▪ Dynamic data and element modifiers by simulating process data.
Criteria	All process displays and popups are according to what was approved and correctly implemented as specified in the reference document(s).
Test Record Reference	Graphic printouts.

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative	:	_____	Date:	_____
Rosetti Marino Representative	:	_____	Date:	_____
Crosswind Representative	:	_____	Date:	_____

8.3 SYMBOLS AND FACEPLATES

Outline	CI Server graphics are used as the Human-Machine Interface for operating the plant. The live status of the plant can be observed on the graphics and these data are obtained from the CENTUM VP controller. All dynamic process data and alarms shall be simulated from the test panels or from software (forcing).
Objective	The purpose of this test is to confirm that: ▪ Symbols, faceplates, and tuning panels are generated and functioning according to specifications.
Reference	Functional Specifications - Reference PCS and SAFETY SYSTEMS Software Functional Design Doc. No. 1724000594-IN-SP-00018 Refer Documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-RE-40093 Control System Philosophy - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-IN-DD-40096 Rev.00 Control System Architecture Detailed Drawings - 123A90-DDL-IN-DD-40029 Rev.00 Automation Detailed Design and Construction Package - P&IDs and Single line diagrams
Procedure	The test environment shall include Test Function FCSs with project configuration to provide data to the tags on each display. Check the following for the symbols and faceplates: ▪ The sizes, colours, lines, fonts and shapes for the symbols, faceplates. ▪ Process Value and Engineering unit. ▪ Forcing the value from HMI, by changing the operation Modes. ▪ Alarm and status indication.
Criteria	All static and dynamic symbols and related faceplates are according to what was approved and correctly implemented as specified in the reference document.
Test Record Reference	Graphic printouts.

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative	:	_____	Date:	_____
Rosetti Marino Representative	:	_____	Date:	_____
Crosswind Representative	:	_____	Date:	_____

8.4 ALARMS PAGES

Outline	CI Server graphics are used as the Human-Machine Interface for operating the plant. The related graphics shall show the generated alarm, time-stamp, Alarm text and Priority upon forcing the values from test panels.
Objective	The purpose of this test is to confirm that: ▪ The layout and function of the alarm pages is according to specifications.
Reference	Functional Specifications: - - 1724000594-IN-SP-00018 PCS and SAFETY SYSTEMS Software Functional Design. Section 28.6 - 1724000594-IN-LIS-00004 - Reference Instrument IO List Input documents - 123A90-DDL-IN-SP-40097 Reference Documents - 123A90-DDL-IN-SP-40098 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40024 Control System (PCS) Specification - 123A90-DDL-IN-LIS-40027 Alarm System Requirements Specification - 1724000594-IN-LIS-00004 Reference Instrument IO List - Section Master Alarm Database 123A90-DDL-IN-LIS-40027 - P&IDs & SLDs
Procedure	Check the following for the process display: ▪ Layout ▪ Colours and priorities ▪ Alarm sorting ▪ Available columns ▪ Column width ▪ Alarm time format ▪ Available filters (fixed or changeable) ▪ Alarm line layout (for different state transitions) ▪ Alarm Description
Criteria	The alarm overview displays are according to what was approved and correctly implemented as specified in the reference document(s).
Test Record Reference	Graphic printouts.

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

8.5 ALARM FUNCTION

Outline	All the alarm functions within CI Server and the related project specific configuration are implemented.
Objective	To verify all the alarm requirements are correctly implemented.
Reference	Functional Specifications: - 1724000594-IN-SP-00018 PCS and SAFETY SYSTEMS Software - Functional Design. Section 30.2.5 - 1724000594-IN-LIS-00004 Reference Instrument IO List Refer documents - 123A90-DDL-IN-SP-40097 System Specification for Main Automation Contractor - 123A90-DDL-IN-SP-40098 Control System (PCS) Specification - 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification - 123A90-DDL-IN-LIS-40027 Master Alarm Database
Procedure	Verify the following is implemented correctly: ▪ Acknowledgement types ▪ Alarm collection behaviour ▪ First-out group behaviour ▪ Alarm group behaviour ▪ Alarm Selection area ▪ Areas of interest ▪ Alarm priority ▪ Alarm destinations e.g., audible alarm annunciation, alarm notification SMTP, alarm pages, alarm printers, … ▪ Historical alarm lifetime
Criteria	The alarm portion within CI Server is configured in accordance with the reference document
Test Record Reference	Graphic printouts.

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

8.6 TREND FUNCTION

Outline	All the trend functions within CI Server and the related project specific configuration are implemented.
Objective	To verify all the Trend Group requirements are correctly implemented. ▪ Group ▪ Label ▪ Description ▪ Sampling Time ▪ Duration ▪ Pen assignment
Reference	Functional Specifications: ▪ Section 30.2.5 of Reference PCS and SAFETY SYSTEMS Software Functional Design Doc.No. 1724000594-IN-SP-00018 ▪ Reference Instrument IO List 1724000594-IN-LIS-00004 Refer documents ▪ System Specification for Main Automation Contractor 123A90-DDL-IN-SP-40097 ▪ 123A90-DDL-IN-SP-40098 Control System (PCS) Specification ▪ 123A90-DDL-IN-SP-40024 Alarm System Requirements Specification ▪ 123A90-DDL-IN-LIS-40027 Master Alarm Database
Procedure	Verify the following is implemented correctly as per the "Trend Group" in latest Project database Tag List Reference Document. The trend group shall be as per the P&ID ▪ Trend generation for over a period by selecting the date and time range.
Criteria	The trend groups within CI Server are implemented in accordance with the reference document.
Test Record Reference	Graphic Printout

The above checks are conducted and witnessed by the following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

9 SIS AND FGS APPLICATION SOFTWARE

9.1 SCS PROJECT OVERALL FUNCTION

Outline	Application inspection of project overall function include verifying SCS Resource Properties, SCS Project Properties and SCS Constants Builder.
Objective	To verify that the project overall function of SCS project is defined according to the FDS requirements.
Reference	1. SW Functional Design Specifications 2. ProSafe-RS system print out (Self documentation)
Procedure	Verify ProSafe-RS Project configuration files for SCS Resource properties, SCS Project Properties, and SCS Constants Builder as a part of paper check during pre-FAT. Refer to detail checklists are in Check sheet Appendix-10.5
Criteria (Expected Result)	The SCS Resource Properties, SCS Project Properties and SCS Constants Builder are defined according to the FDS. Refer attached highlighted printout.
Test Record Reference	Appendix-10.5 Application Software Test Case & Record (Project Overall Check)

The above check will be conducted for all SCSs and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

9.2 SCS FUNCTION

9.2.1 Application Software Test for Typical Logics

Outline	Typical logic functions are those which are defined under software Typicals such as MOS logic, Reset logic, AI blocks, Voted input blocks, Gas detector typical logic etc. as listed in the software typical design specification document. These are checked by selecting a sample loop and simulating inputs using the test panel (and/or software simulation tool as option) and observing the behavior of the logic / outputs.
Objective	To verify that the software typical logic functions are configured according to the project requirement.
Reference	1. Software Functional Design Specifications 2. Instrument I/O List 123A90-DDL-IN-LIS-40089 3. P&IDs
Procedure	1. Verify the latest Typicals are used by document check. 2. Simulate input signals to check software typical logic function. 3. Check other related functions: • Trips • Communication signals to PCS. • First Up Alarm, Process Alarms / Annunciator messages on HIS • SOE output • IOP (Bad Status) 4. Check other specific functions, if any. Detail checklists are described on the Check sheet Appendix-10.5
Criteria (Expected Result)	The logic functionalities are achieved in accordance to Typical Software Design Specifications. Refer attached highlighted logic printout.
Test Record Reference	Appendix-10.5 Application Software Test Case & Record (Typical Logic Check)

The above check will be conducted for all Typical logics and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

9.2.2 Application Software Test for Logics

Outline	SCS Application Logic functions are implemented using the FBD (Functional Block Diagram) language. These are configured in accordance with plant logic requirements as described in the C&E (Cause & Effect) Matrix prepared by the RM. Logic functions are checked by simulating field inputs using the test panel (and/or software simulation tool as option) and confirming the logic functions together with expected outputs.
Objective	To verify that the application logic functions are configured according to C&E Matrix and/or Safeguarding narratives.
Reference	1. Cause & Effect Matrix 2. Safety validation Plan 3. Software Functional Specification.
Procedure	1. Check the initial functional status of logic upon SCS startup. 2. Normalize all inputs with simulation signals by the test panel (and/or software simulation tool as option) and reset logic to energize output(s) in the case of De-energize to trip logic. (In case of Energize to trip logic, the outputs are de-energized when normalized) 3. Simulate trip condition for a trip input signal using the test panel (and/or software simulation tool as option). 4. Check output trip status, appropriate alarm messages, etc. 5. Normalize and Repeat test for all trip inputs one after another. 6. Check Bypass functions and abnormal situations (Fault conditions). 7. Check the status on Interlock and/or Cause & Effects Graphics 8. Voted logic configuration is as per identified Safety Analysis Function Evaluation (SAFE) charts as per requirements in SVP. Note: For Projects using T/C and/or RTD input modules, the field signals shall be simulated using software simulation for logic test. If the logic test is done using hardwired test panel, the SIS will run in simulation mode with T/C and/or RTD input modules disconnected to facilitate software simulation and rest of the IO modules connected for simulation from test panel. Detail checklists are described on the Check sheet Appendix-10.5
Criteria (Expected Results)	1. Logic functions is functioning correctly according to Cause & Effects. Refer attached highlighted logic printout
Test Record Reference	Appendix-10.5 Application Software Test Case & Record (Safety Logic check)

The above check will be conducted for all Safety Logics/Interlocks

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

9.2.3 Application Software Test for Non-Safety Logics

Outline	The IEC standards 61508 and 61511 require ensuring that program logic has been programmed in a safe way. Checks below are additional tests to the build-in checks in the ProSafe-RS workbench.
Objective	To verify that the application logic functions are configured according to C&E Matrix.
Reference	Cause & Effect Matrix
Procedure	1. Check if any inverter blocks are used and if any check the logic is programmed fail-safe. 2. Check if DIV blocks are not or cannot be divided by zero (0). Variables used should not be allowed to get to zero (0) 3. Check if SR and RS blocks are chosen correctly. The trip condition should always have a higher priority than the reset of that trip. 4. Check on F_TRIG and R_TRIG blocks in trip functions that trips are latched or extended by a timer function. 5. Safety communication blocks or field input channels should not be configured to go to "HOLD" in case of a failure. 6. Structured text, preferably avoided, and if used well documented and preferably only in non-safety related applications. 7. Has diagnostic information from logic solver, sensors, inputs, outputs and final elements been followed-up with alarming to the operator, sequence of event recording or a system trip? 8. The results of the Cross-reference check should be checked for secondary write actions on variables. Detail checklists are described on the Check sheet Appendix-10.5
Criteria (Expected Results)	Logic functions is functioning correctly according to Cause & Effects. Refer attached highlighted logic printout
Test Record Reference	Appendix-10.5 Application Software Test Case & Record (Non – Safety Logic Check)

The above check will be conducted for all Non Safety Logics

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

Rosetti Marino Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

9.2.4 Inter-SCS Safety Communication and Interference-free Communication between SCS & FCS

Outline	For some applications, the Safety Instrumented Function may include I/Os from different SCS and the logic may extend from one SCS to another SCS. In such cases, safety data need to be exchanged between different SCSs while maintaining the SIL as part of the Safety Loop. This can be achieved via SCS Link Transmission function within domain. Such safety communication is TÜV certified up to SIL3. For other applications, non-safety related data may be required to be exchanged between SCS and FCS. In this case, the SCS Global Switch Communication and the External Communication Function Blocks can also be used for interference-free Communications.
Objective	To verify that both the Inter-SCS Safety Communication and Interference-free Communication function properly and the associated logic is executed as desired.
Reference	1. ProSafe-RS Instruction Manual (Safety Manual, Safety Control Station and Engineering Reference) 2. Cause & Effect Matrix 3. SW FDS 4. ProSafe-RS system print out
Procedure	1. From SENG/HIS, monitor the "NORMAL" state of logic for which trip inputs/outputs comprise of Inter-SCS Safety Communication. 2. Trigger the logic / value changes on the Sending Side either through direct IO injection or forcing to simulate a 'Trip' condition. 3. From SENG/HIS, monitor the "TRIP" state of logic on the receiver side of the Destination SCS 4. Repeat the same steps above for SCS with Redundant CPUs while one CPU is in 'STOP' mode. (Both CPUs to be tested alternately). 5. From HIS logic chart or sequence table display, monitor the Normal state of a Trip bit of an SCS Interlock that is referenced in an FCS. 6. By using SENG IO force function, force the Interlock Trip bit to "Trip" state and verify that the FCS reads the Trip bit status change and execute the desired logic. 7. Fail both the redundant V net or Vnet/IP buses and test the Safety Communication Timeout/Delay and Failsafe Value settings to examine safe state is achieved. Detail checklists are described on the Check sheet Appendix-10.5
Criteria (Expected Results)	1. The Inter-SCS Safety / Interference-free Communications are configured and executed as per application requirement. 2. Failsafe values are output on failure of both buses of V net or Vnet/IP
Test Record Reference	Appendix-10.5 Application Software Test Case & Record (Inter-SCS, SCS_FCS Comm. Check)

The above check will be conducted for all applicable Safety Logics/Interlocks and witnessed by the following representatives:

TEST RESULT: PASS / FAIL

YOKOGAWA
Representative : _____ Date: _____

Rosetti Marino
Representative : _____ Date: _____

Crosswind
Representative : _____ Date: _____

9.3 APPLICATION REVISION CHECK

Outline	Register the revision of the safety application at the end of internal FAT and End of FAT.
Objective	Register final application revision at end of FAT. Register FAT starting application revision
Reference	n/a
Procedure	1. In the workbench open the revision control sheet of the controller and update the revision 2. Open Database validity check tool and record the CRC. 3. Record the application revision in Appendix- 10.4 Application revision Record.
Criteria (Expected Results)	End of Internal-FAT revision and CRC will be used to verify at start of FAT. End of FAT revision and CRC will be used to verify at start of SAT. Refer attached highlighted printout (Revision control and database validity tool result).

The above check will be conducted for all the controllers and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YOKOGAWA Representative : _____ Date: _____

Rosetti Marino Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

10 EMCS APPLICATION SOFTWARE

10.1 PROJECT OVERALL FUNCTION

10.1.1 Project Common Setting Check

Outline	Inspection of project overall function include verifying project common configuration like OPC UA interface Signals, Data exchange/Receive from OPC UA server to CCS SCADA, Transition of Modes, and Configuration of parameters.
Objective	- Verify that the project overall SW function of RTAC is defined according to the EMCS FDS-SW requirements.
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW - 1724000594-IN-LIS-00005_R00- EMCS_IO_List
Procedure	Verify following configuration as a part of paper check during FAT: • Software Test for OPC UA interface Signals • Software Test for Data exchange/Receive from OPC UA server to CCS SCADA Operation mark • Software Test for Transition of Modes Sequence & Logic • Software Test for Configuration of Parameters
Criteria	OPC UA interface Signals, Data exchange/Receive from OPC UA server to CCS SCADA, Transition of Modes, and Configuration test of parameters are configured according to the EMCS FDS-SW.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

10.2 EMCS FUNCTION

10.2.1 Software Test for OPC UA Interface Signals

Outline	OPC UA interface signals match the signals that have been identified in the EMCS IO list.
Objective	- Visualize and compare the matching signals in the OPC UA server address space
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW - 1724000594-IN-LIS-00005_R00- EMCS_IO_List
Procedure	By browsing the OPC UA server address space, it is possible to visualize all the available signals of the EMCS and compare them with the signals defined in the EMCS IO list.
Criteria	The signals in the OPC UA address space are the same as those defined in the EMCS IO list

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

10.2.2 Software Test for Data Exchanged from OPC UA server to CCS SCADA

Outline	EMCS has an OPC UA server that provides data to the CCS SCADA and receives commands from the CCS SCADA. A test dashboard, developed on purpose, will be connected to the OPC UA server. The test dashboard tool is intended to be used only for FAT and IFAT.
Objective	Verify that the complex control configuration functions work as defined in the approved functional specifications.
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW - 1724000594-IN-LIS-00005_R00- EMCS_IO_List
Procedure	Visualize the test dashboard and simulate the change of the process variables using the GUI. Follow the change of the EMCS state machine, and verify the actuations performed in each company provided package. Visualize each package in terms of setpoints and measurements.
Criteria	The modes and status of the EMCS match what is mentioned in the EMCS FDS-SW

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

10.2.3 Software Test for Transition of Modes Sequence & Logic

Outline	Transitions in the modes of the EMCS software logic, both Automatic and Manual, change the status of the current mode following the transition in each package.
Objective	Performing the TEST to verify the logic for the transition from EMCS Automatic to EMCS Manual (Maintenance & Research)
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW - 1724000594-IN-LIS-00005_R00- EMCS_IO_List
Procedure	- Using the test GUI, change the EMCS mode from automatic to manual (Maintenance & Research) and verify the correctness of the reached mode.
Criteria	The modes and status of the EMCS match what is mentioned in the EMCS FDS-SW

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

10.2.4 Software Test for Configuration of Parameters

Outline	The configuration test of the EMCS parameters.
Objective	- Verify the configuration test of the EMCS parameters identifying that EMCS can be configured via the OPC UA interface
Reference	- Functional Specifications like; - 1724000594-IN-DD-00015- System Architecture Drawing - 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW - 1724000594-IN-LIS-00005_R00- EMCS_IO_List
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

11 APPENDICES

11.1 Fat Organization Chart

11.2 Fat Schedule

11.3 Fat Punch Record Form

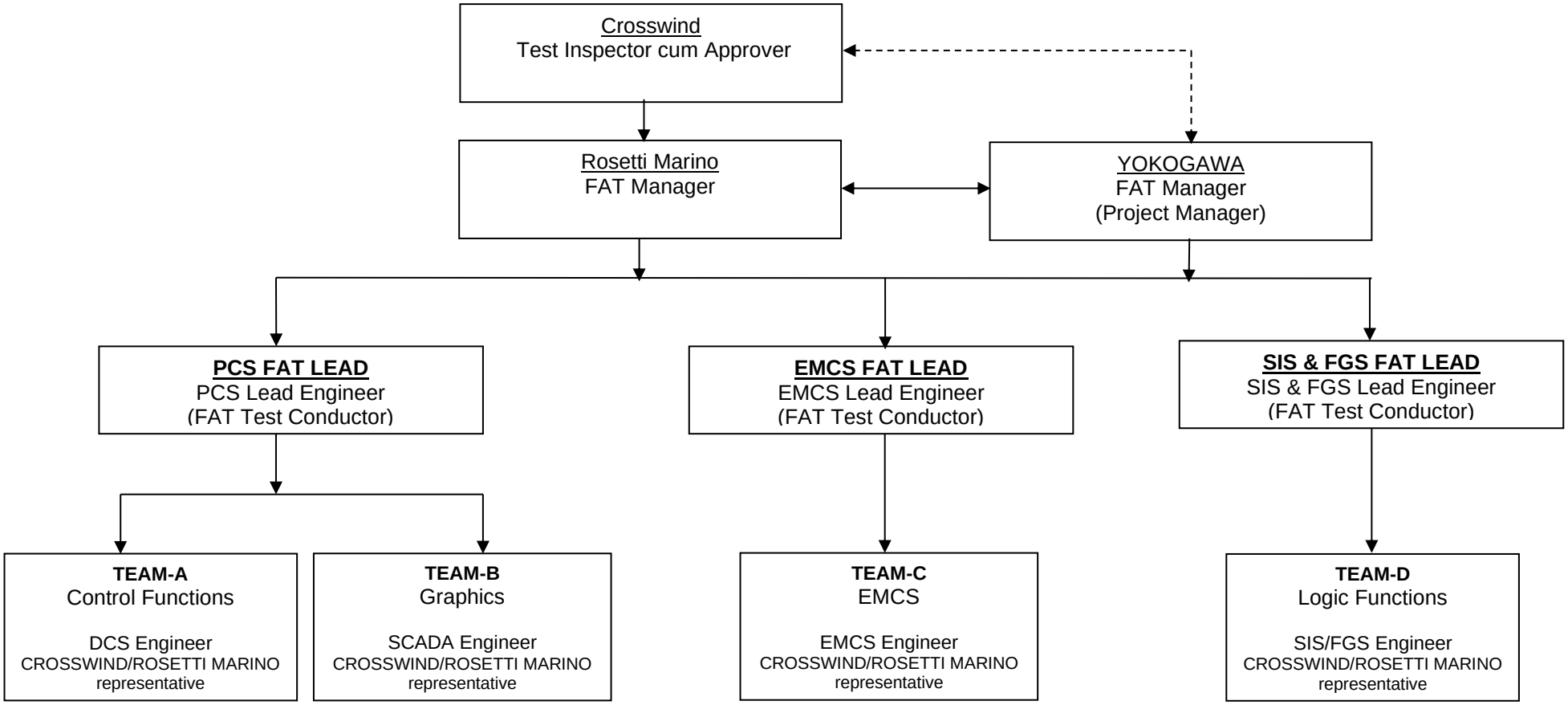
11.4 Application Revision Record

11.5 Application Software Test Case And Record

11.6 Fat Completion Certificate

11.7 EMCS Software FAT Procedure

FAT ORGANIZATION



Note: Team A, B, C & D shall conduct Software FAT

PSC, SIS and FGS FAT Schedule

Task Name	Duration	Start	Finish
FAT HW	1wk	09/20/24	09/27/24
Integrated FAT	4 wk	09/18/24	10/15/24
FAT SW	9 wk	10/23/24	12/24/24

Note:- Post 5th week planned, no full day activity planned.

FAT PUNCH RECORD	Punch Record No.	Date
Process Area:	**System:**	

Please enter all fields or indicate 'Not Applicable' where appropriate

Test reference / item:	**Classification :** **Correction (Code C)** ☐ **Modification (Code M)** ☐

Punch Item description: **(Attach Separate sheets/attachments, if necessary)**

Related to: **Hardware** ☐ **Software** ☐ **Documentation** ☐

Details of change required: **(Attach Separate sheets/attachments, if necessary)**

Tester (Name)	**Signature**	**Date**
Witness (Name)	**Signature**	**Date**

Repeat the test? : **YES** ☐ **NO** ☐

If NO, reason: _____

Resolution: **(Attach Separate sheets/attachments, if necessary)**

FAT CLOSURE APPROVAL SIGNATORIES BY :

	Names	Company	Signatures	Date
Prepared By		YOKOGAWA		
Witnessed By		ROSETTI MARINO		
Approved By		CROSSWIND		

SAMPLE

FAT PUNCH LEDGER

Customer : _____
Project: _____
Record Date: _____

Recorded By: _____
Witnessed By: _____

Punch Record No.	Punch Description	Cause (C/M)	Initiated by	Action By	Date	Re-test By (MAC)	Witnessed by (EPC/End-User)	Punch Closed Date

Legend for cause column:
C = Correction, items is to be corrected by YOKOGAWA
M = Modification, items is to be modified, deleted or added due to design input changes

YOKOGAWA	Appendix 11.3 C - FAT Punch Record (SIS AND FGS) SIS/FGS Punch Record	Ref. No.

Project No.		Project Name	
Contractor			
EPC Subcontractor			
Employer			
System		Proc.Area/Unit	
Stage		Controller No.	

Punch Description

Noted By		Approved By		Date		Category	
Proposed/Agreed Solution						Action By	

Impact Analysis

Impacted Aspects	☐ Hardware	☐ Software	☐ Documentation	☐ Graphics	☐ Other Non-Safety Items	☐ No Impact

Safety Related		Re-Test Required?		Impact Analysis By	

Impacted Documents and Revision Details

Punch Record Status

Status			
Implemented By		Verified/Tested By	
Implemented Version (VC)			

Yokogawa	Sign		Rosemetti Marino	Sign		Crosswind	Sign	
	Name			Name			Name	
	Date			Date			Date	

Notes:
1) Safety Impact defined by any hardware or software change in the safety path of the applicable SIF.
2) Detailed Impact analysis shall be elaborated in Impact analysis section including Impacted Documents with Revision Details.
3) Punch Description should include summary of the issue including deviations to project specifications - if any.

YOKOGAWA

SIS/FGS Punch Record Summary

Project No.		**Project Name**	
Contractor		**EMPLOYER**	

Sl. No.	Punch Record Reference No	Date	Stage	System	Punch Description	Category	Recorded by	Action By	Safety Related	Proposed / Agreed Solution	Punch Status	Punch Closed Date

Yokogawa **Rosematti Marino** **Crosswind**

Reference No: ____________________

Application Revision Record Sheet Start FAT

No.	Controller	Revision	CRC (Attached Database Validity Tool result)	NA	Checked		Remarks / Punch No.
					Pass	Fail	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

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Reference No: ____________________

Application Revision Record Sheet End FAT

No.	Controller	Revision	CRC (Attached Database Validity Tool result)	NA	Checked		Remarks / Punch No.
					Pass	Fail	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

Responsible Party	Representative	Date:	Signature
YOKOGAWA			
ROSETTI MARINO			
CROSSWIND			

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Project: _____ **Area:** _____

Project Overall Check

* All the check item must have highlighted copy as a test proof

No.	Item	Chk Req.	Results	Remark
1	SCS Resource Properties	X		
2	SCS Project Propeties	X		
3	SCS Constants Builder	X		
4		X		
5		X		
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Responsible party	Representative	Signature	Date
YOKOGAWA			
Rosetti Marino			
Crosswind			

Note:
1. "X" mark means checking is required
2. Highlight the "X" mark after checking
3. Comment shall be recorded in punch sheet and reference number shall be filled in punch reference column.

Project: _____ **Area:** _____

Typical Logic Check

* All the check item must have highlighted copy as a test proof

Typical Type:

No.	Item	Typical Rev	Chk Req.	Results	Remark
1	Project to list typical logics.				
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

Responsible party	Representative	Signature	Date
YOKOGAWA			
Rosetti Marino			
Crosswind			

Note:
1. "X" mark means checking is required
2. Highlight the "X" mark after checking
3. Comment shall be recorded in punch sheet and reference number shall be filled in punch reference column.

Project: _____ **Area:** _____

Safety Logic Check

* All the check item must have highlighted copy as a test proof

Logic Function

No.	Item	Chk Req.	Results	Remark
1	Project to list all Interlocks			
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Responsible party	Representative	Signature	Date
YOKOGAWA			
Rosetti Marino			
Crosswind			

Note:
1. "X" mark means checking is required
2. Highlight the "X" mark after checking
3. Comment shall be recorded in punch sheet and reference number shall be filled in punch reference column.

Project: _____ **Area:** _____

Non Safety Logic Check

* All the check item must have highlighted copy as a test proof

Logic Function

No.	Item	Chk Req.	Results	Remark
1	Project to list all Non Safety Logics			
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
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22				
23				
24				

Responsible party	Representative	Signature	Date
YOKOGAWA			
Rosetti Marino			
Crosswind			

Note:
1. "X" mark means checking is required
2. Highlight the "X" mark after checking
3. Comment shall be recorded in punch sheet and reference number shall be filled in punch reference column.

Project: _____ **Area:** _____

Inter-SCS Safety Communication and Interference-free Communication between SCS and FCS

* All the check item must have highlighted copy as a test proof

No.	Item	Criteria	Chk Req.	Results	Remark
1	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'NORMAL' State	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'NORMAL' state is maintained.			
2	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'TRIP' State	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is achieved.			
3	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'NORMAL' State, CPU-L Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'NORMAL' state is maintained.			
4	SCS-SCS Safety Inter-Comm. SCS0110 & SCS0120) – 'TRIP' State, CPU-L Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is achieved.			
5	SCS-SCS Safety Inter-Comm. SCS0110 & SCS0120) – 'NORMAL' State, CPU-R Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'NORMAL' state is maintained.			
6	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'TRIP' State, CPU-R Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is achieved.			
7	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'NORMAL' State, Bus1 Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'NORMAL' state is maintained.			
8	SCS-SCS Safety Inter-Comm. SCS0110 & SCS0120) – 'TRIP' State, Bus1 Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is achieved.			
9	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'NORMAL' State, Bus2 Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'NORMAL' state is maintained.			
10	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'TRIP' State, Bus2 Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is achieved.			
11	SCS-SCS Safety Inter-Comm. (SCS0110 & SCS0120) – 'TRIP' State, Bus1 & Bus2 Fail	Safety Communucation between the SCSs involved is functioning properly and associated logic in 'TRIP' state is observed after expected timeout and safe state is achieved.			
12	SCS-FCS Interference-Free Communication (SCS0110 & FCS0101) – Logic / Value Changes	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
13	SCS-FCS Interference-Free Communication (SCS0110 & FCS0101) – Logic / Value Changes, CPU-L Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
14	SCS-FCS Interference-Free Communication (SCS0110 & FCS0101) – Logic / Value Changes, CPU-R Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
15	SCS-FCS Interference-Free Communication (SCS0110 & FCS0101) – Logic / Value Changes, Bus1 Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
16	SCS-FCS Interference-Free Communication (SCS0110 & FCS0101) – Logic / Value Changes, Bus2 Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
17	SCS-FCS Interference-Free Communication (SCS0120 & FCS0101) – Logic / Value Changes	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
18	SCS-FCS Interference-Free Communication (SCS0120 & FCS0101) – Logic / Value Changes, CPU-L Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
19	SCS-FCS Interference-Free Communication (SCS0120 & FCS0101) – Logic / Value Changes, CPU-R Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
20	SCS-FCS Interference-Free Communication (SCS0120 & FCS0101) – Logic / Value Changes, Bus1 Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			
21	SCS-FCS Interference-Free Communication (SCS0120 & FCS0101) – Logic / Value Changes, Bus2 Fail	Interference-Free Communucation between the SCS & FCS involved is functioning properly and associated logic states / value changes is observed.			

Responsible party	Representative	Signature	Date
YOKOGAWA			
Rosetti Marino			
Crosswind			

Note:
1. "X" mark means checking is required
2. Highlight the "X" mark after checking
3. Comment shall be recorded in punch sheet and reference number shall be filled in punch reference column.

FACTORY ACCEPTANCE TEST COMPLETION CERTIFICATE

JOB NAME	:	BASE LOAD POWER HUB
END USER	:	CROSSWIND
CUSTOMER	:	ROSETTI MARINO
PLANT	:	OFFSHORE HKN WIND FARM
SYSTEM DESCRIPTION	:	PCS/SIS/FGS/EMCS INTEGRATED WITH CI SERVER

This is to certify that it is mutually agreed by all parties that the Factory Acceptance Test for PCS/SIS/FGS/EMCS [Software] has been completed to the satisfaction of all parties concerned.

[Remarks]

_____

_____

_____

Signed in agreement by;

YOKOGAWA : _____ Date: _____

ROSETTI MARINO : _____ Date: _____

CROSSWIND : _____ Date: _____

APPENDIX 11.7

EMCS SOFTWARE FAT PROCEDURE

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

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EMCS APPLICATION SOFTWARE

1.1 PROJECT OVERALL FUNCTION

1.1.1 Project Common Setting Check

Outline	Inspection of project overall function include verifying project common configuration like OPC UA interface Signals, Data exchange/Receive from OPC UA server to CCS SCADA, Transition of Modes, and Configuration of parameters.
Objective	- Verify that the project overall SW function of RTAC is defined according to the EMCS FDS-SW requirements.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Verify following configuration as a part of paper check during FAT: • Software Test for OPC UA interface Signals • Software Test for Data exchange/Receive from OPC UA server to CCS SCADA Operation mark • Software Test for Transition of Modes Sequence & Logic • Software Test for Configuration of Parameters
Criteria	OPC UA interface Signals, Data exchange/Receive from OPC UA server to CCS SCADA, Transition of Modes, and Configuration test of parameters are configured according to the EMCS FDS-SW.

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

The above checks are conducted and witnessed by following representatives

TEST RESULT	PASS/FAIL		
YEF-I Representative	:	Date:	
RM Representative	:	Date:	
Crosswind Representative	:	Date:	

.

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1.2 EMCS FUNCTION

1.2.1 Software Test for OPC UA Interface Signals

Outline	OPC UA interface signals match the signals that have been identified in the EMCS IO list.
Objective	- Visualize and compare the matching signals in the OPC UA server address space
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	By browsing the OPC UA server address space, it is possible to visualize all the available signals of the EMCS and compare them with the signals defined in the EMCS IO list.
Criteria	The signals in the OPC UA address space are the same as those defined in the EMCS IO list

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.2 Software Test for Data Exchanged from OPC UA server to CCS SCADA

Outline	EMCS has an OPC UA server that provides data to the CCS SCADA and receives commands from the CCS SCADA. A test dashboard, developed on purpose, will be connected to the OPC UA server. The test dashboard tool is intended to be used only for FAT and IFAT.
Objective	Verify that the complex control configuration functions work as defined in the approved functional specifications.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Visualize the test dashboard and simulate the change of the process variables using the GUI. Follow the change of the EMCS state machine, and verify the actuations performed in each company provided package. Visualize each package in terms of setpoints and measurements.
Criteria	The modes and status of the EMCS match what is mentioned in the EMCS FDS- SW

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.3 Software Test for Transition of Modes Sequence & Logic

Outline	Transitions in the modes of the EMCS software logic, both Automatic and Manual, change the status of the current mode following the transition in each package.
Objective	Performing the TEST to verify the logic for the transition from EMCS Automatic to EMCS Manual (Maintenance & Research)
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	- Using the test GUI, change the EMCS mode from automatic to manual (Maintenance & Research) and verify the correctness of the reached mode.
Criteria	The modes and status of the EMCS match what is mentioned in the EMCS FDS- SW

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date: _____ _____

RM Representative : Date: _____ _____

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.4 Software Test for Configuration of Parameters

Outline	The configuration test of the EMCS parameters.
Objective	- Verify the configuration test of the EMCS parameters identifying that EMCS can be configured via the OPC UA interface
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.5 Software Test for Configuration of Electrolyzer State Machine

Outline	The configuration test of the Electrolyzer Package State Machine.
Objective	- Verify the configuration test of the Electrolyzer State Machine identifying that State Machine is configured as per transitions between these states based on conditions like running duration and PCS permission.(For Example: the system will transition to Stop state if PCS permission is revoked (i.e., Tanks are full).
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic, The BLPH State Machine will correspond with Electrolyzer State Machine, to do the following: • EMCS requires permissive signal from PCS to start the Electrolyzer. (i.e. PCS.PermToStartEL). • EMCS shall not partialize the Electrolyzer, requiring it either to not produce or to produce at full power (EL_MAX_SET_POINT). • If the PCS.PermToStartEL is not fulfilled the Electrolyzer will be stopped by EMCS.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.6.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.6 Software Test for Configuration of Fuel Cell State Machine

Outline	The configuration test of the Fuel Cell Package State Machine.
Objective	- Verify the configuration test of the Fuel Cell State Machine identifying that State Machine is configured as per transitions between these states including Running, Stoppable, Unstoppable, Start-able, Unstart-able, and Stop. Transitions are dictated by conditions such as PCS permission (i.e., hydrogen level). The Fuel Cell can start if the PCS permission is granted, while the system will stop if PCS permission is revoked.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic, The BLPH State Machine will correspond with Fuel Cell State Machine.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.7 Software Test for Configuration of BESS State Machine

Outline	The configuration test of the BESS Package State Machine.
Objective	- Verify the configuration test of the BESS State Machine identifying that State Machine is configured as per transitions between these States include Charging, Discharging, and Idle, influenced by the State of Charge (SoC) and PCS permissions via EMCS. The system will charge if the SoC is below the maximum threshold and PCS permission is granted via EMCS, and it will discharge if the SoC is above the minimum threshold and PCS permission is granted via EMCS. The system transitions to Idle if PCS permission is revoked via EMCS.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic, The BLPH State Machine will correspond with BESS State Machine to do the following: • Charge Transition • Discharge Transition • Stop Transition
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.8.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.8 Software Test for Configuration of Solar Farm State Machine

Outline	The configuration test of the Solar Farm Package State Machine.
Objective	- Verify the configuration test of the Solar Farm State Machine identifying that State Machine is configured as per transitions between these States include transitions between "Started" and "Stopped" states within the broader context of "Operating." The "Started" state the system is actively managing or generating energy, whereas the "Stopped" state signifies that the system is not operating and has been shut down. the "Started" state, there is a loop indicating the "Curtail" action (EMERGENCY MODE only),
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic, The BLPH State Machine will correspond with Solar Farm State Machine.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.9.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.9 Software Test for Configuration of BLPH MODE 0 = IDLE (Power Import Only)

Outline	The configuration test of the BLPH MODE 0 = IDLE (Power Import Only)
Objective	- Verify the configuration test of the MODE 0 = IDLE, BLPH shall enter in the IDLE MODE if: • It is Grid Tied • Supply Guarantee is Active • HNA5 is unable to produce power
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to IDLE MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.1.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.10 Software Test for Configuration of BLPH MODE 1 = IMPORT

Outline	The configuration test of the BLPH MODE 1 = IMPORT
Objective	- Verify the configuration test of the MODE 1 = IMPORT, BLPH shall enter in the IMPORT MODE if: • It is Grid Tied • Supply Guarantee is Active • HNA5 is produce more than 1 MW for one minute • Check the BESS is NOT fully charged or NOT PCS:ProcessFullyCharge (H2 vessels not full)
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to IMPORT MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.2.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.11 Software Test for Configuration of BLPH MODE 1A = IMPORT (Charging)

Outline	The configuration test of the BLPH MODE 1A = IMPORT (Charging)
Objective	- Verify the configuration test of MODE 1A = IMPORT (Charging), BLPH shall enter in the IMPORT MODE 1A if: • HNA5.P > 2 MW for one minute (Power Surplus)
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to IMPORT (Charging) MODE 1A.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.3.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.12 Software Test for Configuration of BLPH MODE 1B = IMPORT (Not Able to Charge)

Outline	The configuration test of the BLPH MODE 1B = IMPORT (Not Able to Charge)
Objective	- Verify the configuration test of MODE 1B = IMPORT(Not Able to Charge), BLPH shall enter in the IMPORT MODE 1B if: • HNA5.P <= 2 MW for one minute (Power Deficit).
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to IMPORT MODE 1B.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.4.

The above checks are conducted and witnessed by following representatives.

TEST RESULT: PASS / FAIL

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

YEF-I Representative : _____ Date: _____

RM Representative : _____ Date: _____

Crosswind Representative : _____ Date: _____

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.13 Software Test for Configuration of BLPH MODE 2 = HOT STANDBY (Ready to Export)

Outline	The configuration test of the BLPH MODE 2 = HOT STANDBY (Ready to Export)
Objective	- Verify the configuration test of the MODE 2 = HOT STANDBY (Ready to Export), BLPH shall enter in the IMPORT MODE 2 if: • It is Grid Tied • Supply Guarantee is Active • HNA5 is produce more than 1 MW for one minute • Check the BESS is fully charged and PCS:ProcessFullyCharge (H2 vessels full)
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to HOT STANDBY MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.5.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.14 Software Test for Configuration of BLPH MODE 3 = EXPORT MODE (DISCHARGING)

Outline	The configuration test of the BLPH MODE 3 = EXPORT MODE (Discharging)
Objective	- Verify the configuration test of the MODE 3 = EXPORT, BLPH shall enter in the EXPORT MODE if: • It is Grid Tied • Supply Guarantee is Active • HNA5 is produce less than 1 MW for one minute • BESS is Healthy
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to EXPORT MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.6.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.15 Software Test for Configuration of BLPH MODE 4 = COLD STANDBY (Not Able to Export)

Outline	The configuration test of the BLPH MODE 4 = COLD STANDBY
Objective	- Verify the configuration test of the MODE 4 = COLD STANDBY, BLPH shall enter in the COLD STANDBY MODE if: • It is Grid Tied • Supply Guarantee is Active • HNA5 is produce less than 1 MW for one minute • BESS is NOT able to operate in Export (BESS Fault)
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to COLD STANDBY MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.7.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.16 Software Test for Configuration of BLPH MODE 4A = EMERGENCY (ISLAND)

Outline	The configuration test of the BLPH MODE 4A = EMERGENCY (ISLAND)
Objective	- Verify the configuration test of the MODE 4A = EMERGENCY, BLPH shall enter in the EMERGENCY MODE if: • It is Islanded (off-gid) • BESS is Healthy (NO Fault) • The BESS charge level is above the BESS-MINIMUM-OPERATING- RESERVE threshold.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to EMERGENCY MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.8.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.17 Software Test for Configuration of BLPH MODE 5 = POWER OUT (Black Out)

Outline	The configuration test of the BLPH MODE 5 = POWER OUT (Black Out)
Objective	- Verify the configuration test of the MODE 5 = POWER OUT, BLPH shall enter in the POWER OUT MODE if: • It is Islanded (off grid) • Either the BESS charge level is below the BESS-MINIMUM- OPERATING-RESERVE threshold (BESS FAULT) or the SG-100D1 voltage measure on the BLPH 6.6kV distribution bus is absent. • EMCS is informed of ESD-1D activation (reference doc. "Process Safety Cause & Effect Matrix"). • BESS is NOT Healthy.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to POWER OUT MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.9.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.18 Software Test for Configuration of BLPH MODE 6 = MAINTENANCE

Outline	The configuration test of the BLPH MODE 6 = MAINTENANCE
Objective	- Verify the configuration test of the MODE 6 = MAINTENANCE, BLPH shall enter and remain in this MODE if receives the request to enter from CCS SCADA. The BLPH shall exit from the MAINTENANCE MODE if, and only if, the EMCS receives the request to return in automatic identification of the MODE from the data interface of the CCS SCADA through a software exit button. In MAINTENANCE MODE the EMCS shall not dispatch any command required by any automatic logic in the EMCS, including any open/close command, load shedding command, change in power setpoint. - Transition Conditions: Entrance on a command to get in the MANTENANCE MODE, Exit on a command to return in automation identification of the MODE.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to MAINTENANCE MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.10.

The above checks are conducted and witnessed by following representatives.

TEST RESULT	PASS/FAIL		
YEF-I Representative	:	Date:	
RM Representative	:	Date:	
Crosswind Representative	:	Date:	

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.19 Software Test for Configuration of BLPH MODE 7 = RESEARCH

Outline	The configuration test of the BLPH MODE 7 = RESEARCH
Objective	- Verify the configuration test of the MODE 7 = RESEARCH, BLPH shall enter and remain in the RESEARCH MODE, if the EMCS receives the request to enter in this MODE from the data interface of the CCS SCADA (protected under password). BLPH will ignore the power output of the HNA5 wind turbine. - The BLPH shall exit from the RESEARCH MODE if, and only if, the EMCS receives the request to return in automatic identification of the MODE from the data interface of the CCS SCADA through an exit button.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to RESEARCH MODE.
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.7.11.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.20 Software Test for Configuration of OPC-UA Communication Loss Between HV- SCADA & EMCS

Outline	The configuration test for the loss of OPC-UA communication between HV-SCADA & EMCS
Objective	- Verify the configuration test of the EMCS, in case of OPC-UA communication between the HV-SCADA and EMCS is lost, the EMCS does not take any automatic action on 66kV GIS. In conjunction with this communication loss, the EMCS will immediately command the platform in IDLE MODE "PCS.EnterMode(IDLE)"
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly interrupting an OPC-UA client communication, change the parameters of the EMCS. The parameter change directly affects the control logic and transit to IDLE MODE with "PCS.EnterMode(IDLE)".
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.4.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.21 Software Test for Configuration of 66kV GIS

Outline	The configuration test for the status of signals & electrical sequence to manage the closing of GIS on BLPH.
Objective	- Verify the configuration test of the EMCS, to manage the closing of GIS on BLPH, Wind Farm will have a direct connection to the BLPH 66 kV GIS CB for control & monitoring, the electrical sequence is as follows: • Q0(QA1) "CB Open" command, directly to the BLPH GIS from HV- SCADA • Q0(QA1) "Ready to close" permissive to EMCS from HV-SCADA • Full control of QZ92 line and earthing switches from HV-SCADA (not controlled by EMCS) BLPH Q0(QA1) "CB Close" command and "CB Open" commands will also be available to BLPH GIS by the EMCS.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.5.

The above checks are conducted and witnessed by following representatives.

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.22 Software Test for Configuration of Transformer OLTC/AVR

Outline	The configuration test for the AVR the set-point voltage reference for the secondary winding (the 6.6 kV side)
Objective	- Verify the configuration test of the EMCS, to manage the closing of GIS on BLPH, Wind Farm will have a direct connection to the BLPH 66 kV GIS CB for control & monitoring, the electrical sequence is as follows: • Q0(QA1) "CB Open" command, directly to the BLPH GIS from HV- SCADA • Q0(QA1) "Ready to close" permissive to EMCS from HV-SCADA • Full control of QZ92 line and earthing switches from HV-SCADA (not controlled by EMCS) BLPH Q0(QA1) "CB Close" command and "CB Open" commands will also be available to BLPH GIS by the EMCS.
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.5.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.23 Software Test for Configuration Coordination Between PCS & EMCS

Outline	The configuration to test the Coordination between PCS & EMCS .
Objective	- Verify the configuration test of the EMCS, as follows: • PCS communicates with EMCS through serial internal communication and the necessary signals(commands, statuses and permissive) will be exchanged between two systems • EMCS requires PCS to enter in IDLE MODE with "PCS.EnterMode(IDLE)" • EMCS requires PCS to enter in IMPORT MODE with "PCS.EnterMode(IMPORT)". • EMCS requires PCS to enter in HOT STANDBY MODE with "PCS.EnterMode(HOT STANDBY)". • EMCS requires PCS to enter in EXPORT MODE with "PCS.EnterMode(EXPORT)". • EMCS requires PCS to enter in COLD STANDBY MODE with "PCS.EnterMode(STANDBY)". • EMCS requires PCS to enter in EMERGENCY MODE with "PCS.EnterMode(EMERGENCY)". • EMCS requires PCS to enter in RESEARCH MODE with "PCS.EnterMode(RESEARCH)". • The EMCS shall not run (i.e. not starting and stop if running) the BESS without a positive permissive signal from the PCS. • EMCS informs PCS for "Start Request" for Electrolyzer Package with "PermToStartEL" • EMCS requires PCS the "Permissive to start" for Fuel Cell Package with "PermToStartFC" • EMCS sends to PCS the "Command to Load shedding 1" – "Cmd.To.LoadShed" All the above control signals (status & commands) will be exchanged with BLPH control system (PCS) through a Modbus TCP communication

Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark
	• BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.5.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.

1.2.24 Software Test for Configuration on the Energy Management Policy

Outline	The configuration to test the BLPH Energy Management Policy
Objective	- Verify the exposure of EMCS to CCS SCADA the following parameters: • EXPORT_POWER_SUPPLY_THRESHOLD (Default 1 MW) • IMPORT_POWER_SURPLUS_THRESHOLD (Default 2 MW) • POWER_SURPLUS_TIME_DURATION_IMPORT (Default 1 minute). • POWER_DEFICIT_TIME_DURATION_IMPORT (Default 1 minute). All the above control signals (status & commands) will be exchanged with BLPH control system (PCS) through a Modbus TCP communication
Reference	- Functional Specifications like; • 1724000594-IN-DD-00015- System Architecture Drawing • 1724000594-IN-SP-00019- EMCS Software Functional Design Specification FDS-SW • 1724000594-IN-LIS-00005_R00- EMCS_IO_List • 123A90-DDL-IN-RE-40095 Process Control Logics Description • 1724000594-IN-DD-00028 HMI screen print out • 1723002197-EL-LIS-00043 - SG-200D2 I/O List Lv Switchgear • 23A2007_240628_PROFINET_Register BESS_V1_0_0_3 • 1723002197-EL-LIS-00041 - SG-100D1 I/O LIST HV Switchgear • 1723002197-EL-LIS-00042 - SG-200N1 I/O LIST Lv Switchgear • 1724000372-EL-LIS-00014 - I/O LIST • C63-AUT-002_03_Communication table • Crosswind Modbus Table - Main PLC - External Cut v3_comTest_Denmark • BAL_8249889_001_00_1_EN • EMCS-HNA5-SignalList-20240906
Procedure	Using the GUI, or directly an OPC-UA client, change the parameters of the EMCS. The parameter change directly affects the control logic
Criteria	Verify that the changed parameters will affect the control logic accordingly the EMCS FDS reference 4.2.1.10.

The above checks are conducted and witnessed by following representatives.

TEST RESULT PASS/FAIL

YEF-I Representative : Date:

RM Representative : Date:

Crosswind Representative : Date:

TLP:AMBER - Limited disclosure, restricted to participants' organizations.