Base Load Power Hub (BLPH)

OTP: 6.6 kV Switchgear & Transformer Systems

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Revision / Change Log

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1 INTRODUCTION

1.1 Project Overview

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.2 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

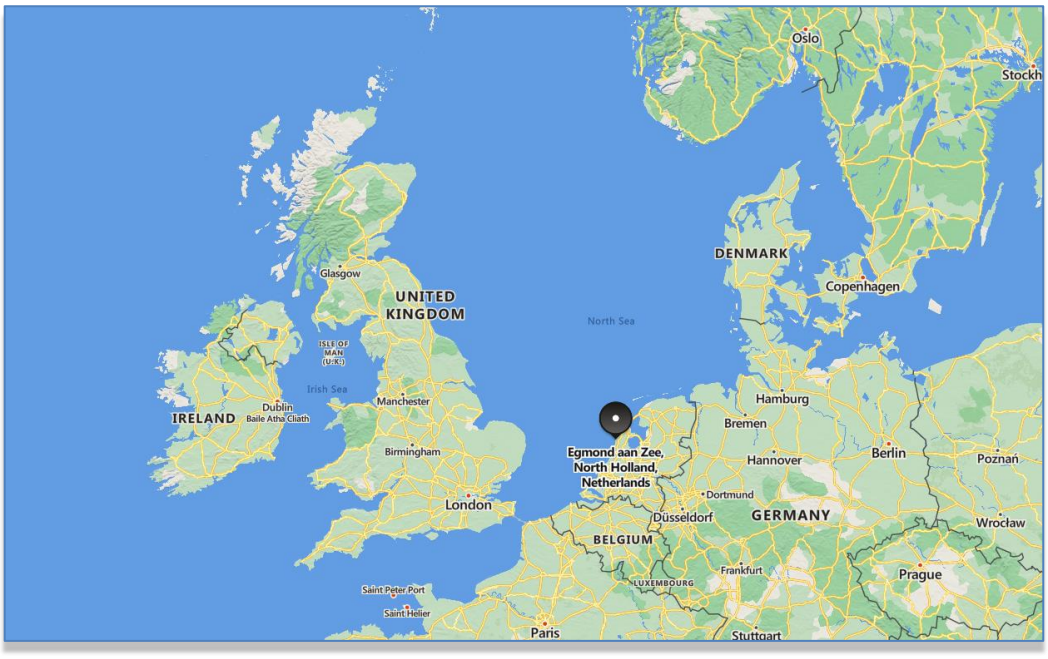


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

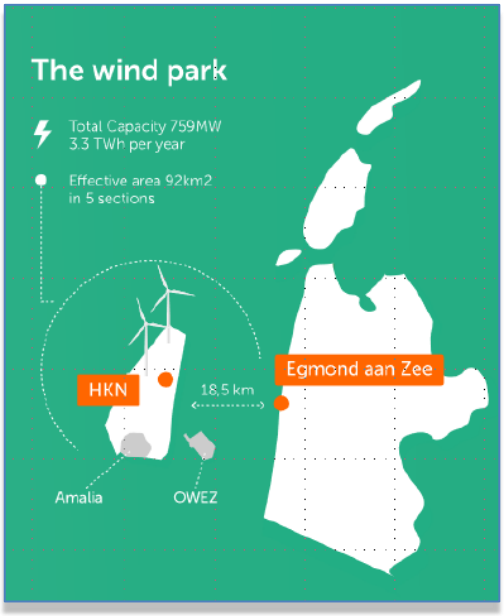


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile is located on coordinates E 590719.1, N 5841602.3 and is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.3 Project Concept

All components included in the BLPH will be integrated onshore on a topside and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

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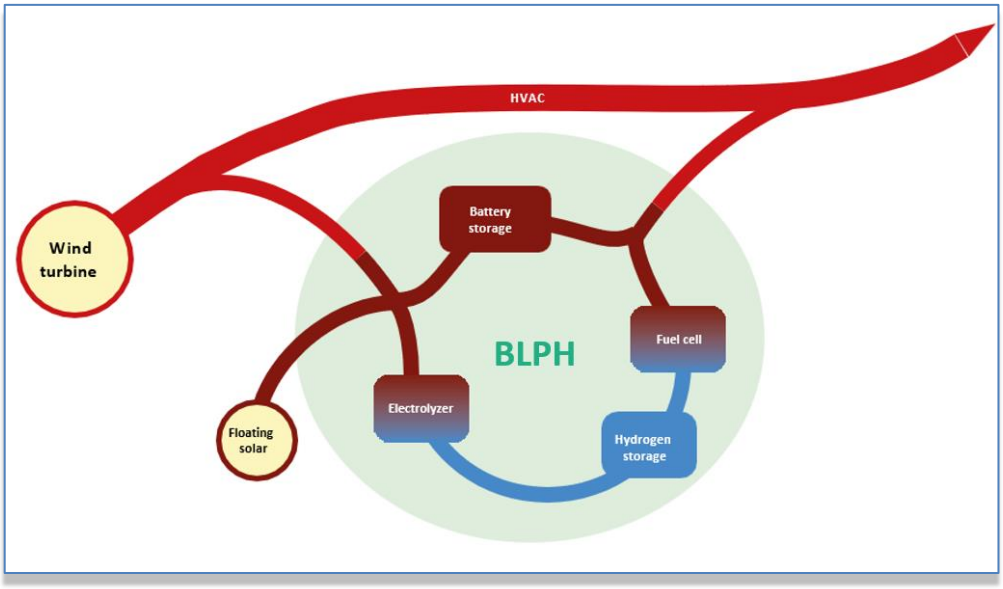


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH is to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2 DOCUMENT SCOPE

The purpose of this document is to describe the methodology and the planned actions to be implemented for the preparation and execution of Mechanical Completion, Pre-commissioning, Commissioning & Start-Up activities to be performed on the PLANT, including COMPANY PROVIDED ITEMS, at the onshore premises of CONTRACTOR located in Milan (Italy) offices and Piomboni yard - Marina di Ravenna (Italy).

CONTRACTOR, pursuant to CONTRACT and PROJECT requirements, shall implement an exacting methodology, complete with a distinct set of tools and documentation to meet the following key objectives:

Perform the Mechanical Completion, Pre-commissioning and Commissioning on the WORKSITE to the maximum extent possible so as to minimise the commissioning operations on SITE;

- Ensure safety for the people, environment and facilities during the execution of the Commissioning activities at WORKSITE,
- Ensure integrity and operation of the equipment for their lifetime in accordance with PROJECT design and specifications,

- Plan a smooth and flawless execution of the Commissioning activities avoiding unforeseen downtimes and delays.

Achievement of the above objectives shall be obtained by:

- Defining and prioritizing a predetermined sequence of the Mechanical Completion checks, Pre-commissioning and Commissioning tests and tasks,
- Checking, testing systematically and exhaustively all the components of PLANT in compliance with PROJECT approved procedures and CONTRACT terms, managed by a dedicated team of inspectors, technicians and field engineers who will perform the Mechanical Completion, Pre-commissioning, Commissioning and Start-Up tasks and subsequently record the results via discipline specific check, inspection and test sheets (ITR's) & where applicable via discrete Operational Test Procedures (OTP's).
- Ensuring full traceability of the performed checks and tests, through implementation of a dedicated Project Completions Management System (CMS) containing individual references to all tagged items.

3 OTP SUMMARY

3.1 Test Objective

The operating test of the 6.6KV Power Distribution switchboard system is executed to ensure that the system is started up in a safe and controlled manner and to verify the correct operation according to the project requirements.

Aim of this document is to provide the sequence and appropriate actions to test the 6.6KV Power Distribution Switchboard SG-100D1.

Commissioning activities shall be developed as follows:

- Onshore pre-commissioning and commissioning activities at Contractor site (WORKSITE)
- PHASE 1: SWBD SG-100D1 With only Auxiliary power supplies energized
- PHASE 2: SWBD SG-100D1 With main 6,6kV power supply energized
- PHASE 3: SWBD SG-100D1 feeder n.A4 to LV SWBD "SB-200N1" will be energized
- PHASE 4: SWBD SG-100D1 feeder n.A3 to "BESS" will be energized
- PHASE 5: SWBD SG-100D1 feeder n.A7 to "FUEL CELL" will be energized
- PHASE 6: SWBD SG-100D1 feeder n.A1 to "ELECTROLYSER" will be energized
- PHASE 7: SWBD SG-100D1 feeder n.A2 to "SOLAR Transformer TR-200-ED1" will be energized
- OFFSHORE PHASE commissioning activities at SITE

3.2 System Boundary Limits

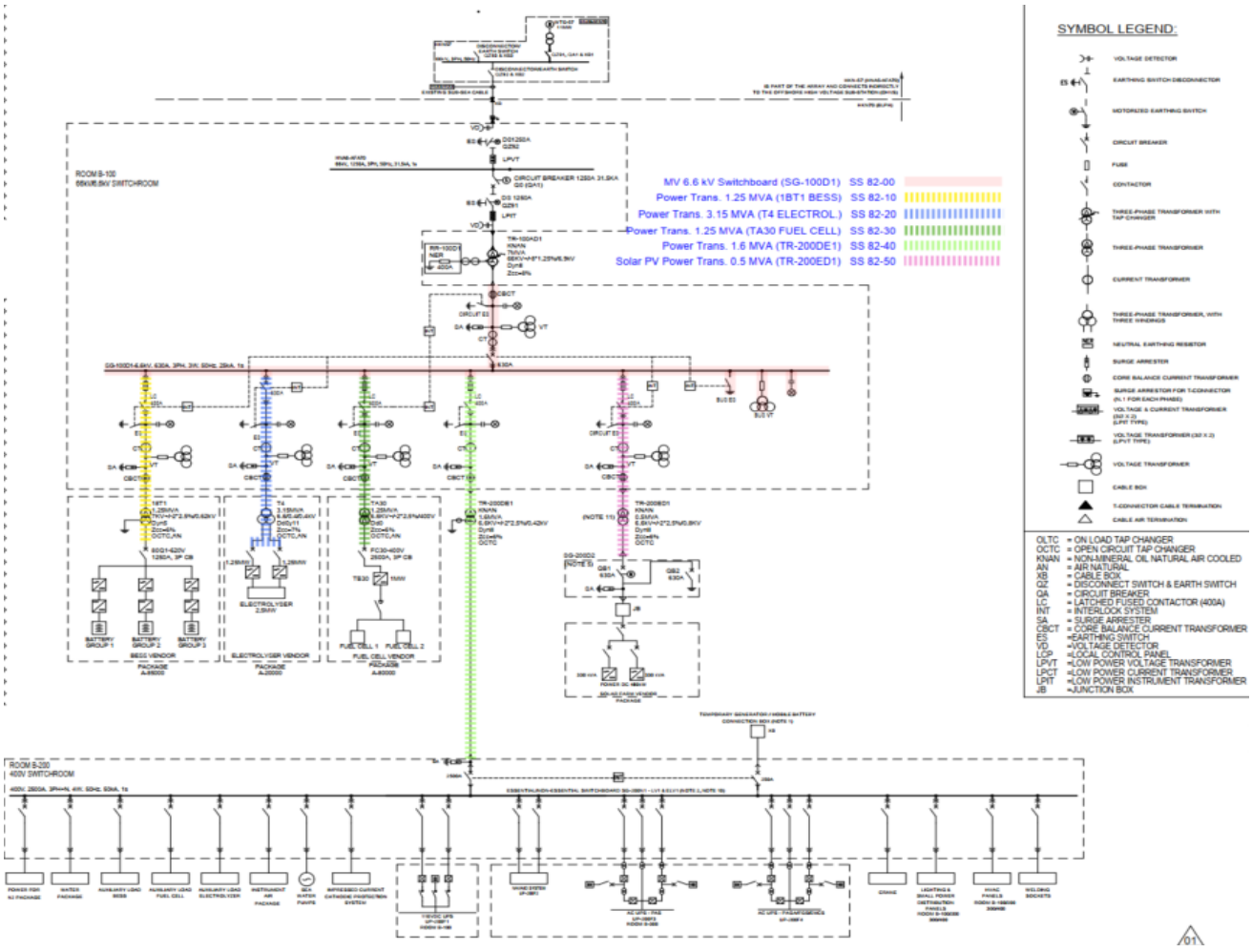


Figure 4 – OTP System Boundary Limits

This picture is extracted from the document n° 123A90-EL-DG-20158 "OVERALL/SINGLE LINE".

3.3 Test and System Description

This document is related to the following systems/ subsystems:

- 82-00: 6,6 kV Switchboard SG-100D1

All equipment is installed inside Technical Room B-100.

System boundary limits are defined in OVERALL SINGLE LINE DIAGRAM Doc. 123A90-DDL-EL-DG-20158.

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

The 6.6KV switchboards are metal enclosed prefabricated self-supporting type, for floor installation in compliance to the requirements of IEC 61439 1&2.

The 6.6KV switchboard (SWBD) main data are the following:

GENERAL CHARACTERISTICS CLIMATIC CONDITION:

- Installation: Marine Offshore-Indoor
- Design Ambient Temperature: -8,4+40°C
- Rel. Humidity average 95%

ENCLOSURES:

- Type: Floor Standing
- Finish Colour: RAL 7035

CONNECTIONS:

- Cable Compartment Access: From the TOP (Incoming & Outgoing)
- Accessibility: Front and Rear

POWER SUPPLY:

- Rated Service Voltage: 6,6kV
- Rated insulation Voltage: 7,2kV
- Rated frequency: 50 Hz
- Rated Power-Frequency with Stands Voltage: 20 kV
- Switchboard Rated Current: 630A
- Rated Peak Withstand Current (Ik): 25kA/1s
- Internal Arc Classification: 25kA x1s
- Neutral operation: TN-S (Neutral not distributed)

BUSBARS:

- Busbars: 3P
- Material: Electrolytic Copper
- Maximum Operating Temperature: 70°C
- Protection: Internal IP20/External IP 30

There are two Aux power supply (230VAC, 110VDC).

- 110VDC A/B From UPS UP-200F1 MCB Q12, Q13.
    - Supply motor spring charger
    - Command circuits (feeders)
- 230V from DP-200N1 MCB Q38
    - Space heaters and internal lighting

The basic Single Line Diagram of the switchboards and relevant connections is illustrated in the document 123A90-DDL-EL-DG-20158 “Overall/Key Single Line Electrical Diagram”.

3.4 Safety Devices

- Appropriate Personnel Protective Equipment (PPE) and safety equipment e.g., safety shoes, hand gloves, helmet, earplugs etc. are available and must be used in line with the site requirements.
- For Arc Flash Risk Category to be consider, without maintenance switch ON, for SG-200D1 PPE Level 1 online Side Fault and Level 1 for Bus Side Fault, as per Arc Flash Energy Calculation 123A90-DDL-EL-RE-20172, section 3.7 and attachment 2.
- Will be used the ARC FLASH appropriate PPE.
- Warning safety signs are to be posted with restricted access to essential personnel only.
- Adequate firefighting equipment.

3.5 HSE Management

All necessary safety precautions must be taken to avoid any risk for personnel injury.

- All personnel involved in this operational test shall be competent for the tasks they will be required to undertake
- Place safety / warning signs and segregate the entire area with barrier tapes (safety barriers) of a colour distinguished (blue and white) from those used for construction activities
- Restrict access into area only to authorized personnel
- Conduct "Toolbox Talk" with all personnel prior to starting test work
- Appropriate Personnel Protective Equipment (PPE) and safety equipment e.g. safety shoes, safety glasses, hand gloves, helmet, earplugs etc. are available and must be used in line with the site requirements
- All activities carried out on the project shall be performed in accordance with the "Permit to Work" system Doc. PRO-HSE-23
- Additional reference corporate safety documentation to be observed and adhered to; PRO-HSE-30 Working with Electricity, PRO-HSE-25 Simultaneous Operations (SIMOPS) and PRO-HSE-07 HAZID.
- Electrical and mechanical isolations are to be assured as per Doc. PRO-HSE-08 and "Commissioning and start-up operation" procedure.
- Observe and enforce all international codes and regulations to safeguard personnel, plant and environment.
- Ensure that the working area is clean, tidy, well illuminated and that access and escape routes are free from obstructions.

Before starting work on any of the activities in this OTP it is the responsibility of the persons performing the work to:

- Familiarize themselves with the plant/equipment to be worked on
- Ensure they are aware of all other work activities that are taking place, or due to take place
- If necessary, re-plan any situation/activity
- Ensure proper communications between parties involved in the execution of the OTP
- Read the relevant Vendor documentation for the equipment covered by this OTP and observe any special requirements and limitations recommended or imposed by Vendor
- Verify that all personnel involved in the implementation of this procedure are familiar with its content as well as the associated safety requirements (Toolbox Talk)

3.6 Acceptance Criteria

Before Power ON:

Visual inspection and verification are a crucial step to identify any obvious issues with the installation, such as loose connections, missing components, or damage to the equipment.

Crosschecking the installation with engineering documentation ensures that the installation is done correctly and according to the manufacturer's guidelines. These steps can help identify any missing or incorrect components, and wrong connections.

All protection relays must be set and compliance with the Electrical Protection Relay Selectivity Study Report 123A90-DDL-EL-RE-20168.

Check the protection setting on related check sheet (ITR-B) for each protection.

Applicable panels:

- SS82-00: SG-100D1

Refer Overall SLD with Marked Sub-systems.

The 6.6kV switchboard and its outgoings must be isolated with circuits breakers and contactor extracted and opened and earthing switches closed to ensure safety conditions.

After Power ON:

Powering ON the units (before auxiliary and after main supply) circuits are an essential step to verify that the equipment is functioning correctly. Observing if everything is OK and any alarm will help detect possible errors or malfunctions.

Phase 1 It will be only auxiliary power to each unit, systems/devices that will be available at this stage.

Phase 1 will prove correct:

- Verify the correct extract position of the circuit breaker.
- Verify the correct service position of the circuit breaker (with bypass)
- Verify electrical interlocks
- Verify mechanical interlocks with the key system

Phase 2 will be powered with 6,6 kV to test Unit A6 Main Incomer and A5 Measuring Unit as per design and with other systems connected to distribution board.

Phase 2 will prove correct:

- Test and validation of safety interlock between 6.6kV and low voltage SWBDs
- Verify phase sequence, frequency, voltage and current
- Verify the incomer, Measuring, feeder 6.6KV A6 column, EMCS

If available, it will be used ESD (SIS) operation through the related cabinet

Phase 3 will be powered with 6,6 kV to test 6.6/0.4kV transformer TR-200DE1 feeder A4 as per design and with other systems connected to distribution board.

Phase 4 will be powered with 6,6 kV to test BESS incomer A3 of SG-100D1

Phase 5 will be powered with 6,6 kV to test FUEL CELL incomer A7 of SG-100D1

Phase 6 will be powered with 6,6 kV, to test Electrolyser feeder A1 of SG-100D1

Phase 7 will be powered with 6,6 kV, to test Solar TR100-ED1 incomer A2 of SG-100D1

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

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

4 DOCUMENTS REFERENCES AND ABBREVIATIONS

4.1 Reference Documents

4.1.1 Company Documents and Standards

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

Table 1: Company Key Reference Documentation

These documents were produced in FEED and made available to RM for info. They have subsequently been superseded by Detailed Design, similar or same deliverables.

4.1.2 Project Documents

Document ID	Document Title
[1] 123A90-PML-PM-LIS-01001	Master Document Register
[2] 123A90-PML-PM-PL-00001	Project Execution Plan
[3] 123A90-PML-QHSE-PL-00001	Project HSE Plan
[4] 123A90-PRO-HSE-23	RM Yard Permit To Work Procedure
[5] 123A90-PML-COM-PL-03002	Mechanical Completion & Commissioning Execution Plan
[6] 123A90-PML-COM-PRO-03007	Commissioning Strategy
[7] 123A90-PML-COM-LIS-03011	System/Sub-Systems List
[8] 123A90-PML-COM-LIS-03012	System/Sub-System Boundary Limit Diagrams
[9] 123A90-PML-COM-PRO-03038	Leak Test Procedure
[10] 123A90-PML-COM-SP-03032	Pre-Commissioning Functional Test Sheet Template Collection (ITR-B)
[11] 123A90-PML-COM-SP-03014	Commissioning TDS - Temporary Equipment & Facilities
[12] 123A90-PML-COM-PRO-03019	OTP – Onshore Performance & Integrated Test Procedure
[13] 123A90-PML-COM-LIS-03034	Inhibit-Override Register
[14] 123A90-PML-COM-LIS-03035	PSV Calibration Register
[15] 123A90-PML-COM-PRO-03036	OTP - Black Start Procedure
[16] 123A90-PML-COM-LIS-03024	Commissioning Spare Parts and Consumables List
[17] 123A90-PML-COM-PRO-03022	Initial offshore START-UP procedures
[18] 123A90-PML-COM-SP-03057	Worksite WEF (Work Execution Flow Scheme)
[19] 123A90-PML-COM-SP-03058	Site WEF (Work Execution Flow Scheme)
[20] 123A90-PML-COM-RE-03001	Commissioning Final Dossier (ITR-B)
[21] 123A90-PML-QHSE-PRO-00116	Flushing and Cleaning Procedures

Document ID	Document Title
[22] 123A90-PML-QHSE-SP-00118	Mechanical Completion Check Sheet Template Collection (ITR-A)
[23] 123A90-PML-QHSE-RE-00115	Mechanical Completion Final Dossier (ITR-A)
[24] 123A90-PML-QHSE-PRO-00117	Punch list Management Procedure
[25] 123A90- 123A90-PML-COM-PRO-03041	OTP - Hydrogen Storage & Venting Systems
[26] 123A90- 123A90-PML-COM-PRO-03042	OTP - Sea Water Intake & Fresh Water Treatment Systems
[27] 123A90- 123A90-PML-COM-PRO-03043	OTP - Instrument Air System
[28] 123A90- 123A90-PML-COM-PRO-03055	OTP - Nitrogen Generation System
[29] 123A90- 123A90-PML-COM-PRO-03044	OTP - HVAC Systems
[30] 123A90- 123A90-PML-COM-PRO-03045	OTP - HV Switchgear & 66 kV Transformer Systems
[31] 123A90- 123A90-PML-COM-PRO-03046	OTP - 6.6 kV Switchgear & Transformer Systems
[32] 123A90- 123A90-PML-COM-PRO-03047	OTP - LV Switch Boards & LV Distribution Board Systems
[33] 123A90- 123A90-PML-COM-PRO-03048	OTP - Lighting & Small Power Systems
[34] 123A90- 123A90-PML-COM-PRO-03049	OTP - Electrical Heat Tracing Systems
[35] 123A90- 123A90-PML-COM-PRO-03050	OTP - DC UPS System 10kVA UP-200F1
[36] 123A90- 123A90-PML-COM-PRO-03051	OTP - Data Network Systems
[37] 123A90- 123A90-PML-COM-PRO-03052	OTP - Telecom & Surveillance Systems
[38] 123A90- 123A90-PML-COM-PRO-03053	OTP - Navaid System
[39] 123A90- 123A90-PML-COM-PRO-03054	OTP - F&G and ESD C&E Logics
[40] 123A90-PML-QHSE-PRO-00120	Proverlis Management Procedure
[41] 123A90-PML-COM-PRO-03056	OTP – Document Template
[42] 123A90-PML-COM-PRO-03059	OTP - AC UPS System 35kVA UP-200F3
[43] 123A90-PML-COM-PRO-03060	OTP - AC UPS System 15kVA UP-200F4

Table 2: Reference Project Deliverables

4.1.3 Vendor Documents

Document ID	Document Title
[1] 1723002197-COM-LIS-00052	SPARE PART INDEX REGISTER (COMMISSIONING AND OPERATION)
[2] 1723002197-EL-CAL-00049	HEAT DISSIPATION CALCULATIONS
[3] 1723002197-EL-DA-00006	SG-200D1 HV SWBD 6,6kV - GENERAL ARRANGEMENTS DWG
[4] 1723002197-EL-DG-00010	SG-200D1 HV SWBD 6,6kV ELECTRICAL SINGLE LINE DIAGRAM
[5] 1723002197-EL-DG-00022	SG-200N1 LV SWBD 6,6kV INTERCONNECTING AND AUX DISTRIBUTION
[6] 1723002197-EL-DG-00018	SG-200D1 HV SWBD 6,6kV (UNIT A1) - FUNCTIONAL DIAGRAM ELECTROLYSER FEEDER A-20000
[7] 1723002197-EL-DG-00020	SG-200D1 HV SWBD 6,6 kV (UNIT A2) - FUNCTIONAL DIAGRAM TRASNFORMER FEEDER TR-200ED1
[8] 1723002197-EL-DG-00017	SG-200D1 HV SWBD 6,6 kV (UNIT A3) - FUNCTIONAL DIAGRAM BESS FEEDER A-85000
[9] 1723002197-EL-DG-00021	SG-200D1 HV SWBD 6,6 kV (UNIT A4) - FUNCTIONAL DIAGRAM TRASNFORMER FEEDER TR200DE1
[10] 1723002197-EL-DG-00016	SG-200D1 HV SWBD 6,6 kV (UNIT A5) - FUNCTIONAL DIAGRAM BUS BAR METERING
[11] 1723002197-EL-DG-00015	SG-200D1 HV SWBD 6,6 kV (UNIT A6) - FUNCTIONAL DIAGRAM INCOMING FEEDER
[12] 1723002197-EL-DG-00019	SG-200D1 HV SWBD 6,6 kV (UNIT A7) - FUNCTIONAL DIAGRAM FEEDER A-80000
[13] 1723002197-EL-LIS-00041	IO LIST HV SWITCHGEAR
[14] 1723002197-EL-LIS-00050	CONSUMPTION LIST
[15] 1723002197-EL-LIS-00051	DATA TABLE
[16] 1723002197-EL-LIS-00053	SPECIAL TOOLS LIST
[17] 1723002197-EL-MAN-00054	INSTALLATION OPERATING AND MAINTENANCE MANUAL
[18] 1723002197-EL-REP-00038	PROTECTION SETTING REPORT

Document ID	Document Title
[19] 1723002197-EL-SO-00039	SG-100D1 PROTECTION CONFIGURATION (INCLUDING I/O CONFIGURATION) (CID File and PCM600)
[20] 1723002197-MAT-PRO-00004	MV-LV SWG PAINTING PROCEDURE
[21] 1723002197-MD-LIS-00001	SUPPLIER MASTER INDEX REGISTER (SMIR)
[22] 1723002197-QC-DB-00048	EQUIPMENT MANUFACTURERS RECORD BOOK
[23] 1723002197-QC-ITP-00003	INSPECTION AND TEST PLAN - LV Switchgear
[24] 1723002197-QC-LIS-00005	EQUIPMENT MANUFACTURER RECORD BOOK (FINAL DOSSIER) - INDEX
[25] 1723002197-QC-PRO-00044	FACTORY ACCEPTANCE TEST PROCEDURE - HV Switchgear
[26] 1723002197-QC-PRO-00046	SITE ACCEPTANCE TEST PROCEDURE - HV Switchgear
[27] 1723002197-QC-PRO-00055	PACKING, SHIPPING, HANDLING AND STORAGE PROCEDURES

Table 3: Vendor Reference Documentation

4.2 Acronyms and Abbreviations

Acronyms and Abbreviations	Descriptions
AIS	Automatic Identification System
AHU	Air Handling Unit
AOC	Achievement of Commissioning
C&E	Cause & Effects
CCS	Central Control System
CCTV	Closed Circuit Television
CMS	Completions Management System
CPI	Company Provided Item
CRS	Comments Response Sheet
CSU	Commissioning & Start-Up

Acronyms and Abbreviations	Descriptions
E&I	Electrical & Instrumentation
EMCS	Electrical Monitoring & Control System
ESD	Emergency Shut Down
FAT	Factory Acceptance Test
FT	Functional Test
F&G	Fire & Gas
GALT	Gross Air Leak Test
HAZID	Hazard Identification Studies
HAZOP	Hazard and Operability Studies
HKN	Hollandse Kust Noord
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
HSE	Health, Safety, & Environment
ICSS	Integrated Control and Safety System
ITR	Inspection & Test Record
LC	Locked Closed
LO	Locked Open
LoSH	Limits of System Handover
LOTO	Lock-Out / Tag-Out
LV	Low Voltage
MC	Mechanical Completion
MDR	Master Document Register
MOC	Management of Change

Acronyms and Abbreviations	Descriptions
NUI	Normally Unmanned Installation
OEM	Original Equipment Manufacturer
OMAR	Operating Modes Assurance Review
OTP	Operational Test Procedure (Commissioning)
OR	Operations Readiness
ORR	Operations Readiness Review
PACO	Process Automation, Control and Optimisation
PCS	Process Control System
PID (P&ID)	Piping and Instrumentation Diagram
PSV	Pressure Safety Valve
PTW	Permit to Work
PVP	Piping and Vessels Preparation
PC&C	Pre-Commissioning & Commissioning
PSUA	Pre Start-Up Audit
PSSR	Pre Start-up Safety Review
RFC	Ready for Commissioning
RFO	Ready for Operation
RFSA	Ready For Sail Away
RFSU	Ready For Start-Up
SAT	Site Acceptance test
SECE	Safety Environmental Critical Element
SIF	Safety Instrumentation Function
SIL	Safety Integrity Level

Acronyms and Abbreviations	Descriptions
SIMOPS	Simultaneous Operations & Maintenance
SIS	Safety Instrumented System
SLD	Single Line Diagram
SoF	Statement of Fitness
TA	Technical Authority
TQ	Technical Query
TIV	Technical Integrity verification
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal

Table 4: Acronyms and Abbreviations

5 OTP AT WORKSITE

This section refers to the activities on the Contractor worksite (construction yard).

5.1 PLANNING AND MANPOWER

5.1.1 Planned tasks with estimated manpower

Estimated manpower for the entire duration of the Test:

- 1 E&I commissioning superintendent
- 1 E&I commissioning supervisor from Contractor
- 1 E&I commissioning technicians from Contractor
- 1 Vendor technician
- 1 PCS/ESD Operator workstation specialist (phase 2,3,4,5,6,7)

5.1.2 Test duration estimate

The test duration should be as follows:

- 8 days approx.

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

5.1.3 Vendor Assistance

Vendor IMESA S.p.A. will provide a qualified specialist to assist with all aspects of commissioning of the 6.6KV SWBD.

5.1.4 Items Postponed to C&E OTP (IEC61850 ETHERNET PHASE 2,3,4,5,6,7)

These following signals are implemented into protocol IEC61850 and will be implemented into cause effect & diagram of EMCS.

Signal tag:	Signal description:
X120-4	LOCKOUT RELAY FROM MVS UNIT 4 (IEC 61850)
X120-3	C.B. OPENED OR ISOLATED FROM MVS UNIT 4 (IEC61850)
	GOOSE FROM INCOMINGS UNIT A6: TRIPPED ARC PROTECTION FROM 100-AD1 TRANSFORMER & - ARC MAIN BUS BAR BB SG-100D1 - ARC CONTACTOR COMPART "CB" SG-100D1 - ARC "CABLE COMPARTMENT "CC" SG-100D1

5.1.5 HOLDS

Not applicable

5.2 OTP Test Requirements

First, confirm that the following equipment are installed and operational in technical room B-100:

- HVAC system
- Substation lifesaving & Intervention Kit
- Toolbox and service trolley for switchgear
- Lighting & Fire and Gas system

5.2.1 Pre-Commissioning Achievement

Prior the commissioning operation starts, the relevant pre-commissioning ITRs should be fully signed.

5.2.2 Commissioning Achievement

The commissioning achievement will be the successful operation, functionality and safeguarding test of 6.6KV Power distribution System, installed and put in operation during the WORKSITE phase:

- 82-00: 6,6kV Switchboard SG-100D1

5.2.3 Status of Required Associated Subsystems

PHASE 1 – Test without 6,6kV Main Power Supply, with present only auxiliary supply only to each Unit of switchboard.

Subsystems required RFC for Commissioning of 6,6kV Switchboard

- 82-00: 6,6 kV Switchboard (SG-100D1)
- 83:99: Low Voltage 400V Temporary Yard Power Supply
- 88-00: Earthing System
- 84-00: UPS System UP-200F1

PHASE 2 – Test with 6,6kV Main Power Supply of Incomer Unit A6 and Measuring Unit A5

Subsystems required RFC for Commissioning of 6,6kV Switchboard :

- 88-00: Earthing System
- 82-00: 6.6 kV Switchboard (SG-100D1)
- 84-00: UPS System UP-200F1
- 82-99: 6.6kV power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 86-00: IEC61850 Ethernet Communication Network
- 86-00: MODBUS RTU Communication Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

PHASE 3 - Test with 6,6kV Main Power Supply of Feeder for TR-200E1 6.6/0.4kV transformer Unit A4

Subsystems required RFC for Commissioning of 6,6kV Switchboard :

- 88-00: Earthing System
- 82-00: HV 6.6 kV Switchboard (SG-100D1)
- 82-40: Transformer 1,6 MVA TR-200DE1
- 84-00: UPS System UP-200F1
- 82-99: power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 86-00: IEC61850 Ethernet Communication Medium and Low Voltage Network
- 86-00: MODBUS RTU Switchboard 6.6kV Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

PHASE 4 – Test with 6,6kV Main Power Supply of Feeder for BESS PACKAGE Unit A3

Subsystems required RFC for Commissioning of 6,6kV Switchboard :

- 88-00: Earthing System
- 82-00: 6.6 kV Switchboard (SG-100D1)
- 82-40: Transformer 1,6 MVA TR-200DE1
- 82-10: 6.6kV Bess Package Unit A3
- 82-99: 6.6kV power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 83-00: 400V Switchboard SG-200N1
- 79-00: SIS Safety Instrumented System (ESD)
- 86-00: IEC61850 Ethernet Communication Network
- 86-00: MODBUS RTU Communication Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

PHASE 5 - Test with 6,6kV Main Power Supply of Feeder for FUEL CELL PACKAGE Unit A7

Subsystems required RFC for Commissioning of 6,6kV Switchboard :

- 88-00: Earthing System
- 82-00: SG-100D1 6.6kV SWBD Unit A7 6,6 kV
- 82-40: Transformer 1,6 MVA TR-200DE1
- 82-99: 6.6kV power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 83-00: 400V Switchboard SG-200N1
- 79-00: SIS Safety Instrumented System (ESD)
- 86-00: IEC61850 Ethernet Communication Network
- 86-00: MODBUS RTU Communication Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

PHASE 6 - Test with 6,6kV Main Power Supply of Feeder for ELECTROLIZER PACKAGE Unit A1

Subsystems required RFC for Commissioning of 6,6kV Switchboard:

- 88-00: Earthing System
- 82-00: SG-100D1 6.6kV SWBD Unit A6 6,6 kV
- 82-40: Transformer 1,6 MVA TR-200DE1
- 82-99: 6.6kV power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 83-00: 400V Switchboard SG-200N1
- 79-00: SIS Safety Instrumented System (ESD)
- 86-00: IEC61850 Ethernet Communication Network
- 86-00: MODBUS RTU Communication Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

PHASE 7 - Test with 6,6kV Main Power Supply of Feeder for SOLAR PACKAGE Unit A2

Subsystems required RFC for Commissioning of 6,6kV Switchboard:

- 88-00: Earthing System
- 82-00: SG-100D1 6.6kV SWBD Unit A6 6,6 kV
- 82-40: Transformer 1,6 MVA TR-200DE1
- 82-99: 6.6kV power supply from temporary 6,6 kV Diesel Generator Yard facilities
- 83-00: 400V Switchboard SG-200N1
- 79-00: SIS Safety Instrumented System (ESD)
- 86-00: IEC61850 Ethernet Communication Network
- 86-00: MODBUS RTU Communication Network
- 87-00: Electrical Monitoring & Control System (EMCS)
- 87-10: Process Control System (PCS)

5.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required:

- Voltage, frequency, continuity tester (Multimeter)
- Phases sequence tester
- Extracting tool & transportation trolley
- Portable radios (3 pcs + 1 per Technical Room)
- 230Vac/24VDC temporary stabilized power supply converter
- OMICRON secondary injection test kit

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

5.2.5 Consumable List

Not applicable

5.2.6 Commissioning Spare Parts

Reference is made to IMESA Spare Part List 1723002197-COM-LIS-00052 regarding the 6.6kV SWBD spare parts.

5.2.7 Temporary Facilities

Not applicable

5.3 OTP DESCRIPTION - WORKSITE

5.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1	System Ready for Commissioning Certificate (RFC) is issued and approved. N.B. RFC certificates for all associated connected downstream transformers will also be required prior to energisation.			
2	No Mechanical Completion or Pre-commissioning punch list 'A' items are outstanding against the system to be commissioned.			
3	Factory Acceptance Test Procedure has been carried out successfully (refer to Doc. 1723002197-QC-PRO-00044)			

Step	Description	Result	Verified by	Date
4	All personnel involved in the implementation of this procedure are familiar with its content as well as with associated safety requirements (Toolbox Talk to be conducted before initiation of activities).			
5	A final walkdown of the system has been completed, to ensure that the system and the area are ready for commissioning.			
6	Check that areas are free for work and escape routes are clear of any obstructions.			
7	All safety barriers and warning signs have been installed.			
8	Ensure that proper communications have been established between parties involved in the implementation of the procedure.			
9	Verify availability of test equipment and consumables as per section 5.2.4.			
10	With reference to Commissioning Temporary equipment & Facilities (refer on Doc. 123A90-PML-COM-SP-03014), check that power is available to any temporary equipment or test equipment (if any).			
11	System(s) isolations as per LOTO procedure defined within HSSE Permits to Work and Commissioning procedures duly prepared and approved			
12	All yard personnel have been duly notified by dedicated LUN (Livening Up Notification) that the system(s) is ready for commissioning.			

5.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
13	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
14	Verify that all relevant associated systems / subsystems are completed.			
15	Check that grounding and bonding are in accordance with applicable documents.			
16	Review and confirm protection settings on up-stream power supply (temporary 6,6 kV yard supply)			
17	Verify finalization of SG-100D1 6.6KV Switchboard Units internal power and auxiliary circuit connections in accordance with manufacturers documentation.			
18	Verify and confirm completion and availability of associated systems and subsystems (PHASE 2 and 3,4,5,6)			

5.3.3 Mechanical Preparation

Not applicable.

5.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
19	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
20	Verify that all relevant associated systems / subsystems are ready to work.			
21	Check Inhibit and Override register has been prepared and validated.			

Step	Description	Result	Verified by	Date
22	Verify that relevant equipment/ components are available and in operation for start of commissioning activities.			

5.3.5 Piping Preparation

Not applicable

5.3.6 Additional Discipline Preparation

Not applicable.

5.4 OTP Steps WORKSITE

5.4.1 PHASE 1 – Test without 6,6kV Main Power Supply, with auxiliary supply only to each Unit of switchboard

The previous sections must be successfully performed prior to commissioning of the 6.6KV Switchboard without power supply 6,6 KV.

In PHASE 1 Temporary Yard Auxiliaries Power supply will be connected as 110 V and 230 V without 6,6 kV main power supply.

In the following steps the functionality of the 6.6KV Switchboards shall be tested:

- SS 82-00: 6,6kV Switchboard "SG-100D1"

5.4.1.1 Test Preparation

Need to Verify:

- Auxiliary power supplies are available 230V DP-200N1 (Internal Heaters & Lights)
- Auxiliary power supplies are available 110 V A/B UPS UP-200F1
- Phase1 400V Temporary Yard power supply is available SG-200N1 (A2/+08)

All systems and subsystems involved in this procedure must be ready for commissioning and available.

5.4.1.2 Auxiliary Supply SG-100D1 6.6kV switchboard

Step	Description	Result	Verified by	Date
Auxiliaries Energization of 6.6kV SWBD SG-100D1				
23	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
24	Verify that all relevant associated systems / subsystems are completed.			
25	Check that grounding and bonding are in accordance with applicable documents			
26	Review and confirm protection settings on up-stream 6.6KV Switchboards feeder power supply circuit breakers.			
27	Verify and confirm the power by UPS supply A&B 110V on Column A5 With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 11 - Supply A XM 1-2..... Vdc - Supply B XM 3-4..... Vdc - Close MCB QD01 - Close MCB QD02			
28	Verify and confirm the power supply 110V on Column A1 With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 11 - Supply XC 1-3..... Vdc - Close MCB QD01 - Close MCB QD02.			
29	Verify and confirm the power supply 110V on Column A2			

Step	Description	Result	Verified by	Date
	With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 11 - Supply XC 1-3 ..... Vdc - Close MCB QD01 - Close MCB QD02			
30	Verify and confirm the power supply 110V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 11 - Supply XC 1-3 ..... Vdc - Close MCB QD01 - Close MCB QD02.			
31	Verify and confirm the power supply 110V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 10 - Supply XC 1-3 ..... Vdc - Close MCB QD01 - Close MCB QD02			
32	Verify and confirm the power supply 110V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 11 - Supply XC 1-3 ..... Vdc - Close MCB QD01 - Close MCB QD02			
33	Verify and confirm the power supply 110V on Column A7 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 11			

Step	Description	Result	Verified by	Date
	- Supply XC 1-3 ..... Vdc - Close MCB QD01 - Close MCB QD02			
34	Verify and confirm the power supply 24V on Column A5 With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 13 - Supply XC 5-7 ..... Vdc - Switch on MCB QD5 - Switch on MCB QD6 - Verify the led on ethernet switch A - Verify the led on ethernet switch B - Verify the led on ethernet switch C			
35	Verify and confirm the power supply 24V on Column A1 With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 11 - Supply XC 5-7 ..... Vdc - Close MCB QD4			
36	Verify and confirm the power supply 24V on Column A2 With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 11 - Supply XC 5-7 ..... Vdc - Close MCB QD4			
37	Verify and confirm the power supply 24V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 11 - Supply XC 5-7 ..... Vdc - Close MCB QD4			

Step	Description	Result	Verified by	Date
38	Verify and confirm the power supply 24V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 11 - Supply XC 5-7 ..... Vdc - Close MCB QD4			
39	Verify and confirm the power supply 24V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 11 - Supply XC: 5-7 ..... Vdc - Close MCB QD4			
40	Verify and confirm the power supply 24V on Column A7 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 11 - Supply XC: 5-7 ..... Vdc - Close MCB QD4			
41	Verify and confirm the power supply 230V on Column A5 With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 10 - Supply XM 5-7 .....Vac - Close MCB QA1 - Close MCB QA2 - Supply XC 9-11 .....Vac - Supply XC 10-12 .....Vac			
42	Verify and confirm the power supply 230V on Column A1			

Step	Description	Result	Verified by	Date
	With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 13 - Supply XC 9-11.....Vac			
43	Verify and confirm the power supply 230V on Column A2 With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 13 - Supply XC 9-11.....Vac			
44	Verify and confirm the power supply 230V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 13 - Supply XC 9-11.....Vac			
45	Verify and confirm the power supply 230V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 13 - Supply XC 9-11.....Vac			
46	Verify and confirm the power supply 230V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 13 - Supply XC 9-11.....Vac			
47	Verify and confirm the power supply 230V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 13 - Supply XC 9-11.....Vac			

Step	Description	Result	Verified by	Date
48	With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 8,9 Close the following MCBs - QV1 ..... ☐ - QV2 ..... ☐ - QV3 ..... ☐ - QV4 ..... ☐			

5.4.1.3 Command and Feedback Verification in Test Position

Step	Description	Result	Verified by	Date
VERIFICATION OF COMMAND IN TEST POSITION				
49	Unit A1-Feeder Electrolyser Rack in Circuit Breaker QM in Test Position and verify the functionality starting from isolated condition, QM is in extract position and Earthing Switch BGE is closed; - Open earthing Switch BGE - Remove the KEY G3477 which is now free - Insert the key G3477 on breaker rack in/rack out system - Rack in Breaker QM in test position - Verify Breaker status on HMI: Test position and Open - Place the Selector SA1 in Local Position - Press PUSH Button SC1 to close the Breaker QM - Verify Breaker status on HMI: Test position and Closed - Open Breaker and Rack Out to extract position.			

Step	Description	Result	Verified by	Date
	- Verify Breaker status on HMI: Extract position and Opened			
50	Unit A2 - Feeder Solar Package Rack in Contactor K1 in Test Position and verify the functionality starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed; - Open earthing Switch BGE - Remove the KEY-3 G3476 which is now free - Insert the KEY-3 G3476 on Contactor rack in/rack out system - Rack in Contactor K1 in test position - Verify Contactor status on HMI: Test position and Open - Place the Selector SA1 in Local Position - Press PUSH Button SC1 to close the Contactor K1 - Verify Contactor status on HMI: Test position and Closed - Open Contactor K1 and Rack Out to extract position. - Verify Contactor status on HMI: Extract position and opened			
51	Unit A3 - Feeder BESS Package Rack in Contactor K1 in Test Position and verify the functionality starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed. - Open earthing Switch BGE - Remove the KEY-3 G3095 which is now free - Insert the KEY-2 19834 (KEY 2 should be free from LoTo procedure) on Contactor rack in/rack out system			

Step	Description	Result	Verified by	Date
	- Rack in Contactor K1 in test position - Verify Contactor status on HMI: Test position and Open - Place the Selector SA1 in Local Position - Press PUSH Button SC1 to close the Contactor K1 - Verify Contactor status on HMI: Test position and Closed - Open Contactor K1 and Rack Out to extract position. - Verify Contactor status on HMI: Extract position and Opened			
52	Unit A4 - Feeder TRANSFORMER TR-200DE1 Rack in Contactor K1 in Test Position and verify the functionality starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed; - Open earthing Switch BGE - Remove the KEY-3 G3398 which is now free - Insert the KEY-2 19465 (KEY 2 should be free from LoTo procedure) on Contactor rack in/rack out system - Rack in Contactor K1 in test position - Verify Contactor status on HMI: Test position and Open - Place the Selector SA1 in Local Position - Press PUSH Button SC1 to close the Contactor K1 - Verify Contactor status on HMI: Test position and Closed - Open Contactor K1 and Rack Out to extract position.			

Step	Description	Result	Verified by	Date
	- Verify Contactor status on HMI: Extract position and Opened			
53	Unit A7 - Feeder FUEL CELL Package Rack in Contactor K1 in Test Position and verify the functionality starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed; - Open earthing Switch BGE - Remove the KEY-3 G3223 which is now free - Insert the KEY-2 19163 (KEY 2 should be free from LoTo procedure) on Contactor rack in/rack out system - Rack in Contactor K1 in test position - Verify Contactor status on HMI: Test position and Open - Place the Selector SA1 in Local Position - Press PUSH Button SC1 to close the Contactor K1 - Verify Contactor status on HMI: Test position and Closed - Open Contactor K1 and Rack Out to extract position. - Verify Contactor status on HMI: Extract position and opened			

The electrical interlocks are between Medium Voltage and Low Voltage and High Voltage

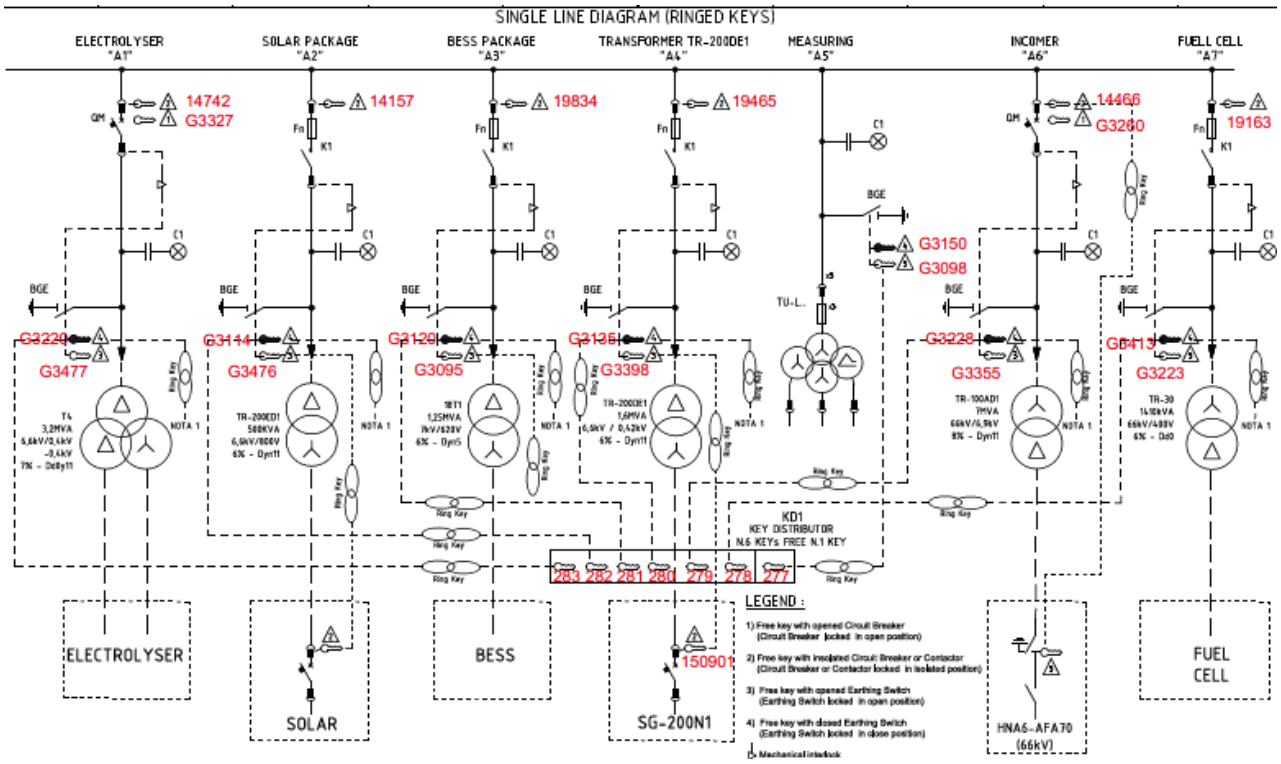
5.4.1.4

5.4.1.4 SG-100D1 Interlocks & Key Interlocks

See below the key interlocks between units earthing switches /breakers (contactors) of 6.6kV SWBD and their downstream devices.

Step	Description	Result	Verified by	Date
KEY Interlocks of 6.6kV SWBD SG-100D1				

KD1: KEY Distributor



KEY 283: KEY ringed with KEY4 G3220 SG-100D1 UNIT A1

KEY 282: KEY ringed with KEY4 G3114 SG-100D1 UNIT A2

KEY 281: KEY ringed with KEY4 G3120 SG-100D1 UNIT A3

KEY 280: KEY ringed with KEY4 G3135 SG-100D1 UNIT A4

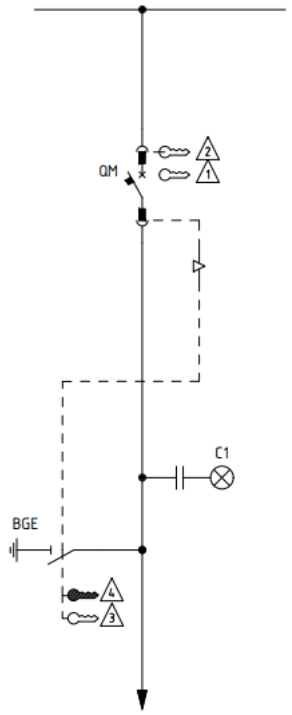
KEY 279: KEY ringed with KEY4 G3228 SG-100D1 UNIT A6

KEY 278: KEY ringed with KEY4 G3413 SG-100D1 UNIT A7

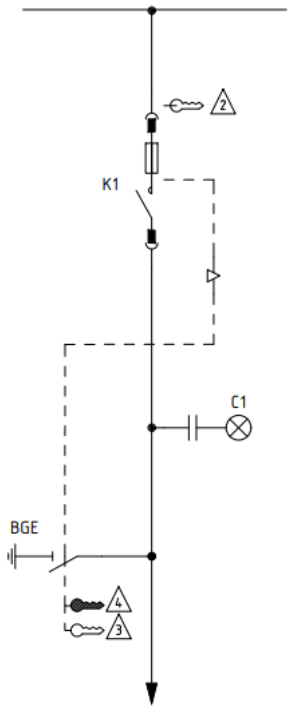
KEY 277: KEY ringed with KEY3 G3098 SG-100D1 UNIT A5

KD1: KEY DISTRIBUTOR

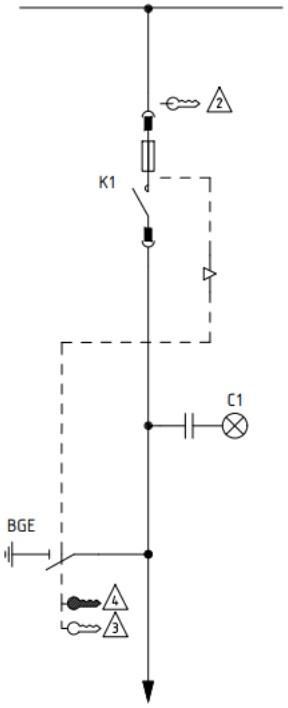
KEY277 is free with all keys on key distributor

Step	Description	Result	Verified by	Date
54	The key distributor KD1 is a key interlock device to ensure the correct and safety action during manoeuvres on the earthing switches and circuit breakers /contactors on the 6.6kV switchboard SG-100D1. The key 277 will be freed when all KEY-4 of earthing switches (keys number 283, 282, 281, 280, 279, 278) are all inserted on the KD1. Extracting key 277 all keys will be locked on KD1.			
	<u>Unit A1 Column Electrolyser – Typical single line diagram</u> 1 Free key with opened Circuit Breaker (Circuit Breaker locked in open position) 2 Free key with insolated Circuit Breaker (Circuit Breaker locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
55	<u>Unit A1-Feeder Electrolyser</u> Verify functionality key interlock starting from isolated condition, QM is in extract position and Earthing Switch BGE is closed. Internal Unit Interlock: - QM Rack in /rack out system is interlocked with earthing switch BGE opened			

Step	Description	Result	Verified by	Date
	- Earthing switch opened: QM rack in/rack out system is unlocked. It's possible to move the breaker in test or service position - Earthing switch closed: QM rack in/rack out system is locked. It's not possible to rack-in the breaker. - QM Racked in: BGE earthing switch is locked. It's not possible to close the earthing switch. - QM Racked out: BGE earthing switch is unlocked. It is possible to close the earthing switch. Key external Interlock: - KEY-1 Free key with opened circuit breaker, locked in open position. Available for use with LOTO procedure. - KEY-2 Free key with racked out circuit breaker, locked in extract position (isolated). Available for use with LOTO procedure. - KEY-3 Free key with opened earthing switch BGE. Earthing switch locked in open position. This key is mechanically coupled (ringed) with the Incomer downstream device. The incomer downstream device is unlocked and is free to close. Once the Incomer downstream device is closed, KEY3 is locked on it. To release the KEY-3 open the downstream device. - KEY-4 Free key with closed earthing switch. Earthing switch is locked in closed position (downstream isolated). This is mechanically coupled (ringed) with the key distributor DP1 and with downstream devices (e.g. transformer and enclosure door). Once downstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To release KEY-4 reinstate downstream normal condition.			

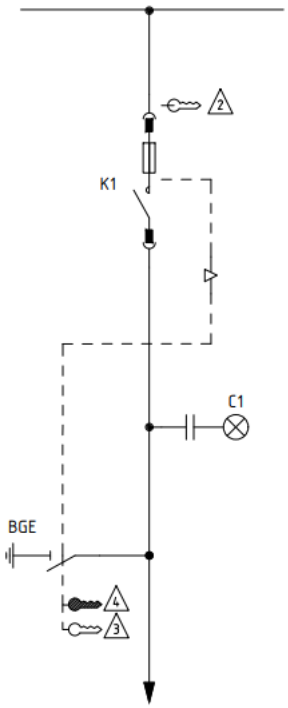
Step	Description	Result	Verified by	Date
	Unit A2 Column Transformer feeder TR-200ED1 – Typical single line diagram 2 Free key with insolated Contactor (Contactor locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
56	Unit A2-SOLAR PACKAGE FEEDER Verify functionality key interlock starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed. Internal Unit Interlock: - QM Rack in /rack out system is interlocked with earthing switch BGE opened - Earthing switch opened: K1 rack in/rack out system is unlocked. It's possible to move the contactor in test or service position - Earthing switch closed: K1 rack in/rack out system is locked. It's not possible to rack-in the breaker. - Contactor K1 is Racked in: BGE earthing switch is locked. It's not possible to close the earthing switch.			

Step	Description	Result	Verified by	Date
	- Contactor K1 is Racked out: BGE earthing switch is unlocked. It is possible to close the earthing switch. Key external Interlock: - KEY-2 Free key with racked out contactor, locked in extract position (isolated). Free to use in LOTO procedure or something similar - KEY-3 Free key with opened earthing switch BGE. Earthing switch locked in open position. This key is mechanically coupled with the contactor downstream device. The incomer downstream device is unlocked and is free to close. Once the Incomer downstream device is closed, KEY3 is locked on it. To unlock the KEY-3 open the downstream device. - KEY-4 Free key is free with closed earthing switch. Earthing switch is locked in closed position (downstream isolated). This is mechanically coupled with the key distributor DP1 and with downstream devices (e.g. transformer unit door). Once downstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate downstream normal condition.			

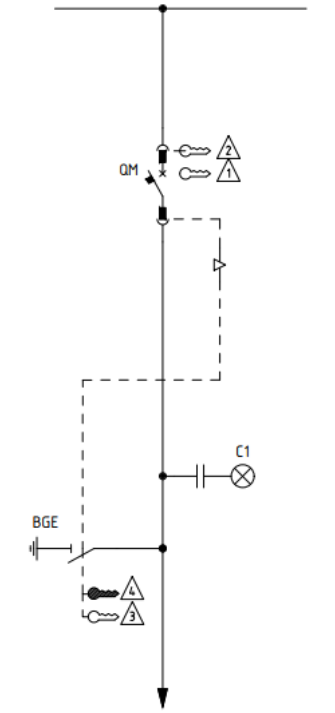
Step	Description	Result	Verified by	Date
	Unit A3 Column "BESS PACKAGE FEEDER" – Typical single line diagram 2 Free key with insolated Contactor (Contactor locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
57	Unit A3-BESS PACKAGE FEEDER Verify functionality key interlock starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed. Internal Unit Interlock: - Contactor K1 Rack in /rack out system is interlocked with earthing switch BGE opened - Earthing switch opened: QM rack in/rack out system is unlocked. It's possible to move the breaker in test or service position - Earthing switch closed: QM rack in/rack out system is locked. It's not possible to rack-in the breaker. - Contactor K1 is Racked in: BGE earthing switch is locked. It's not possible to close the earthing switch. - Contactor K1 is Racked out: BGE earthing switch is unlocked. It is possible to close the earthing switch.			

Step	Description	Result	Verified by	Date
	Key external Interlock: - KEY-2 Free key with racked out contactor, locked in extract position (isolated). Free to use in LOTO procedure or something similar - KEY-3 Free key with opened earthing switch BGE. Earthing switch locked in open position. This key is mechanically coupled with the Incomer downstream device. The incomer downstream device is unlocked and is free to close. Once the Incomer downstream device is closed, KEY3 is locked on it. To unlock the KEY-3 open the downstream device. - KEY-4 Free key is free with closed earthing switch. Earthing switch is locked in closed position (downstream isolated). This is mechanically coupled with the key distributor DP1 and with downstream devices (e.g. transformer unit door). Once downstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate downstream normal condition.			

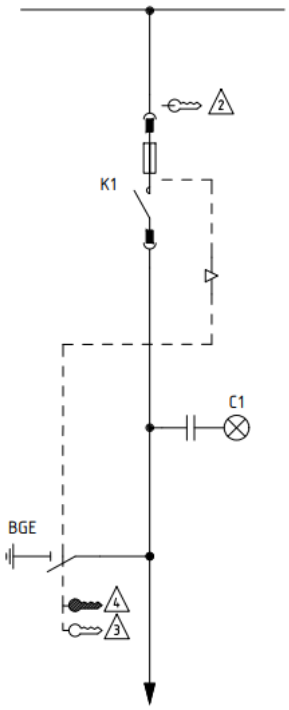
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Step	Description	Result	Verified by	Date
	Unit A4 TRANSFORMER TR-200DE1 FEEDER – Typical single line diagram 2 Free key with insolated Contactor (Contactor locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
58	Unit A4-TRANSFORMER TR-200DE1 FEEDER Verify functionality key interlock starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed. Internal Unit Interlock: - Contactor K1 Rack in /rack out system is interlocked with earthing switch BGE opened - Earthing switch opened: Contactor K1 rack in/rack out system is unlocked. It's possible to move the breaker in test or service position - Earthing switch closed: Contactor K1 rack in/rack out system is locked. It's not possible to rack-in the breaker. - K1 Contactor Racked in: BGE earthing switch is locked. It's not possible to close the earthing switch.			

Step	Description	Result	Verified by	Date
	- K1 Contactor Racked out: BGE earthing switch is unlocked. It is possible to close the earthing switch. Key external Interlock: - KEY-2 Free key with racked out contactor, locked in extract position (isolated). Free to use in LOTO procedure or something similar - KEY-3 Free key with opened earthing switch BGE. Earthing switch locked in open position. This key is mechanically coupled with the Incomer downstream device. The incomer downstream device is unlocked and is free to close. Once the Incomer downstream device is closed, KEY3 is locked on it. To unlock the KEY-3 open the downstream device. - KEY-4 Free key is free with closed earthing switch. Earthing switch is locked in closed position (downstream isolated). This is mechanically coupled with the key distributor DP1 and with downstream devices (e.g. transformer unit door). Once downstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate downstream normal condition.			

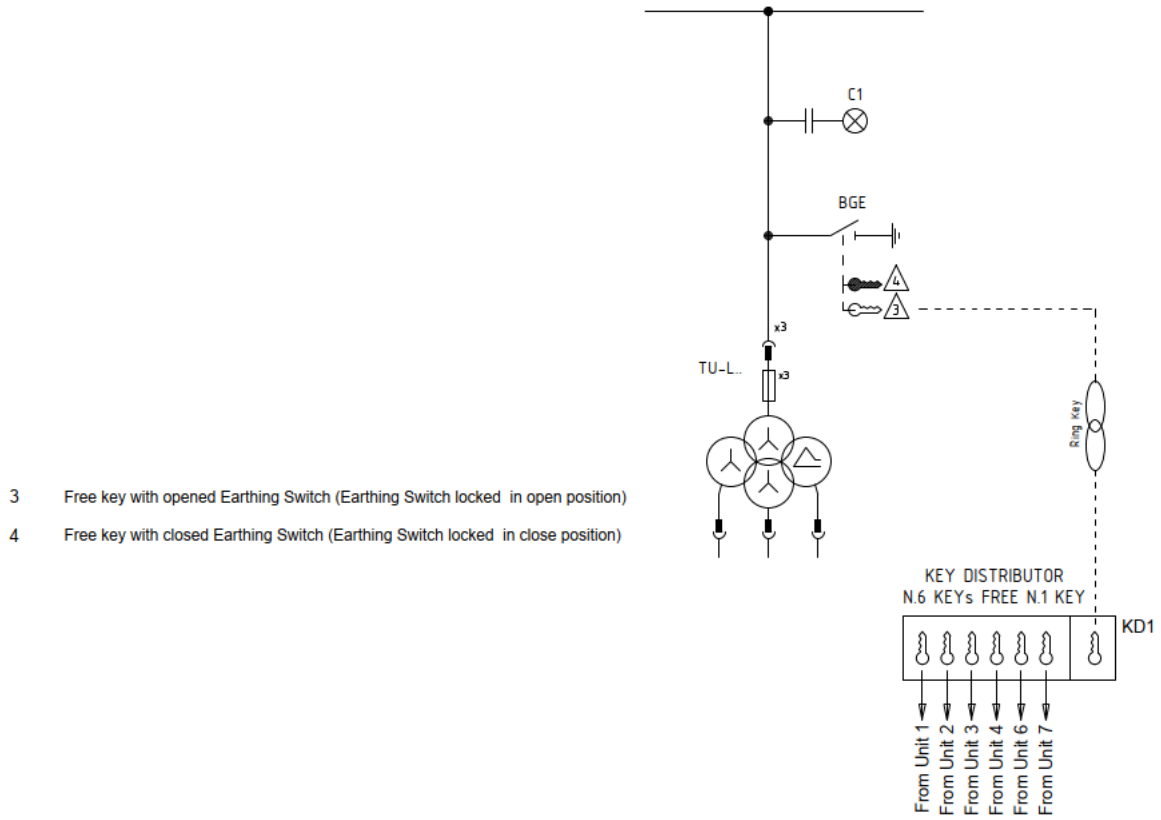
Step	Description	Result	Verified by	Date
	Unit A6 INCOMING CIRCUIT BREAKER – Typical single line diagram 1 Free key with opened Circuit Breaker (Circuit Breaker locked in open position) 2 Free key with insolated Circuit Breaker (Circuit Breaker locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
59	Unit A6-INCOMING CIRCUIT BREAKER Verify functionality key interlock starting from isolated condition, QM is in extract position and Earthing Switch BGE is closed. Internal Unit Interlock: - QM Rack in /rack out system is interlocked with earthing switch BGE opened - Earthing switch opened: QM rack in/rack out system is unlocked. It's possible to move the breaker in test or service position - Earthing switch closed: QM rack in/rack out system is locked. It's not possible to rack-in the breaker. - QM Racked in: BGE earthing switch is locked. It's not possible to close the earthing switch.			

Step	Description	Result	Verified by	Date
	- QM Racked out: BGE earthing switch is unlocked. It is possible to close the earthing switch. Key external Interlock: - KEY-1 is free with Opened Circuit Breaker. Circuit Breaker Locked in Open Position. It is usable in LOTO procedure. - Lock the circuit breaker in extracted position by means of KEY-2 "14742" - KEY-2 is free with the Circuit Breaker in Extract Position and Open. Circuit Breaker locked in isolated position. It is used mechanically locked (ringed) with the upstream Earthing Switch locked in open position. - KEY-3 is free with Opened earthing switch locked in open position. It can use ringed with upstream devices. - KEY-4 is free with closed Earthing switch locked in closed position. This is mechanically coupled with the key distributor DP1 and with upstream devices (e.g. transformer unit door). Once upstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate upstream normal condition. - KD1 KEY DISTRIBUTOR: With the key that is released from KD1 Key distributor, unlock the opening position of the earthing switch.			

Step	Description	Result	Verified by	Date
	Unit A7 Column FUEL CELL FEEDER– Typical single line diagram 2 Free key with insolated Contactor (Contactor locked in isolated position) 3 Free key with opened Earthing Switch (Earthing Switch locked in open position) 4 Free key with closed Earthing Switch (Earthing Switch locked in close position) 			
60	Unit A7-FUEL CELL FEEDER Verify functionality key interlock starting from isolated condition, K1 is in extract position and Earthing Switch BGE is closed. Key external Interlock: - KEY-2 Free key with racked out Contactor, locked in extract position (isolated). Free to use in LOTO procedure or something similar - KEY-3 Free key with opened earthing switch BGE. Earthing switch locked in open position. This key is mechanically coupled with the Incomer downstream device. The incomer downstream device is unlocked and is free to close. Once the Incomer downstream device is closed, KEY3 is locked on it. To unlock the KEY-3 open the downstream device.			

Step	Description	Result	Verified by	Date
	- KEY-4 Free key is free with closed earthing switch. Earthing switch is locked in closed position (downstream isolated) . This is mechanically coupled with the key distributor DP1 and with downstream devices (e.g. transformer unit door). Once downstream device (or key distributor DP1) keeps KEY-4locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate downstream normal condition			

Unit A5 MEASURING and BUS BAR - Typical single line diagram



3 Free key with opened Earthing Switch (Earthing Switch locked in open position)

4 Free key with closed Earthing Switch (Earthing Switch locked in close position)

Step	Description	Result	Verified by	Date
61	- KEY-3 is free with Opened earthing switch locked in open position. It can use ringed with upstream devices. - KEY-4 is free with closed Earthing switch locked in closed position. This is mechanically coupled with the key distributor DP1 and with upstream devices (e.g. transformer unit door). Once upstream device (or key distributor DP1) keeps KEY-4 locked, it's not possible to open the earthing switch. To unlock KEY-4 reinstate upstream normal condition. - KD1 KEY DISTRIBUTOR: With the key that is released from KD1 Key distributor, unlock the opening position of the earthing switch.			

5.4.1.5 OTP Worksite PHASE 1 - Test Notes and Remarks

5.4.1.6 OTP Worksite PHASE 1 - Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.1.7 OTP Worksite PHASE 1 - Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.2 PHASE 2 – Test with 6,6kV Main Power Supply of Incomer Unit A6 and Measuring Unit A5

It is foreseen that previous sections are successfully performed.

All auxiliary circuits are powered ON, the breakers of voltage references are switched on for FP1 Protection Relay.

In this PHASE will be tested the SWBD Incomer Unit A6 and Measuring Unit A5. Tests will be performed successfully and accepted to proceed in the next phases.

After this PHASE all systems will be fed from SWBD SG-100D1 that will be available without pending point, ready to work and powered ON ready to next phases.

In the following steps will be performed the first energization of the Incomer Unit (A6) and related measuring unit (A5), that they will be ready for commissioning.

Will be performed the unit functionality tests and will be tested all provided I/O lists for these units, referring to vendor document 1723002197-EL-LIS-00041 of the 6.6KV Switchboards.

Shall be tested the following systems and subsystems:

- SS 83-00: 6,6 kV Switchboard
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-10: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System

5.4.2.1 Test Preparation

Verification of systems and subsystems of 6.6KV Switchboards, feeding main busbar and without loads connected.

The Incomer Unit A6 and Measuring Unit A5 involved in this procedure must be ready for commissioning and available.

The Unit A5 and A6 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

The CBs for voltage measuring and reference are already closed in PHASE 1

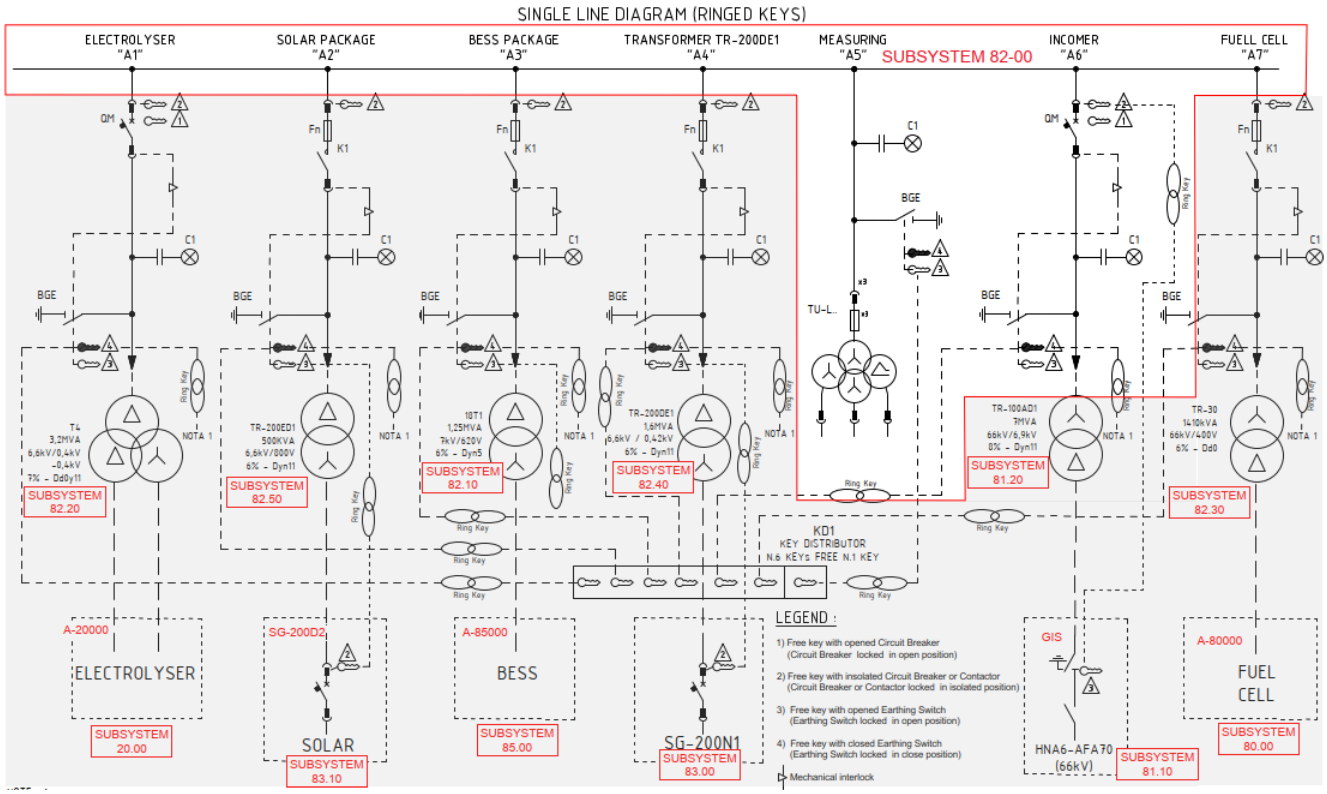
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A5, A6 UNIT and main busbar

Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the upstream is not powered, Measuring Unit A5 has its Earthing Switch (BGE) Closed and Incomer Unit A6 has its Earthing Switch (BGE) Closed and Its Main Breaker QM in extract position and opened.

The main 6,6kV supply will be provided from 6,6kV Temporary Yard Power Supply system and will be provided only after the following safety checks.

Step	Description	Result	Verified by	Date

See the Measuring Unit A5 operating sequences to put the unit *out of service* or *in service*

OPERATING SEQUENCE

MEASURING AND BUS BAR OPERATING SEQUENCE

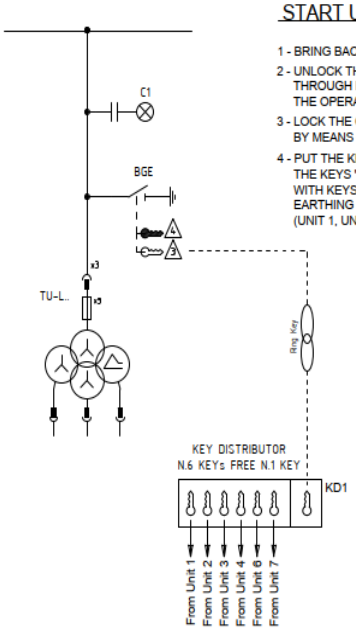
PUTTING OUT OF SERVICE

1 - OPEN AND CARRY IN ISOLATED POSITION ALL CIRCUIT BREAKERS AND CONTACTORS AND THEN CLOSE THE EARTHING SWITCH FOR THE FOLLOWING UNITS: (UNIT 1, UNIT 2, UNIT 3, UNIT 4, UNIT 6, UNIT 7). LOCK THE EARTHING SWITCH IN CLOSE POSITION BY MEANS OF THE RESPECTIVE KEYS (4).

2 - PUT THE KEYS "4" OF THE EARTHING SWITCHES IN THE KEYS-DISTRIBUTOR 'KD1'. WITH THE KEY THAT IS RELEASED FROM THE "KD1" KEY DISTRIBUTOR, UNLOCK THE OPENING POSITION OF THE EARTHING SWITCH

3 - OPEN THE COVER OF THE EARTHING SWITCH OPERATING SEAT BY TURNING THE ACTUATOR ANTICLOCKWISE, CLOSE EARTHING SWITCH BY TURNING THE OPERATING LEVER CLOCKWISE

5 - LOCK THE CLOSED POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY "4".



START UP

1 - BRING BACK THE KEY "4".

2 - UNLOCK THE EARTHING SWITCH CLOSE POSITION THROUGH KEY "4". OPEN EARTHING SWITCH BY TURNING THE OPERATING LEVER ANTICLOCKWISE

3 - LOCK THE OPEN POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY "3".

4 - PUT THE KEY "3" IN THE KEYS-DISTRIBUTOR "KD1", WILL BE RELEASE THE KEYS "4" OF ALL EARTHING SWITCHES . WITH KEYS "4" WILL BE POSSIBLE UNLOCKING THE CLOSE POSITION OF THE EARTHING SWITCHES OF THE FOLLOWING UNITS: (UNIT 1, UNIT 2, UNIT 3, UNIT 4, UNIT 6, UNIT 7) .

3 Free key with opened Earthing Switch (Earthing Switch locked in open position)

4 Free key with closed Earthing Switch (Earthing Switch locked in close position)

WARNING DO NOT REMOVE OR MODIFY THE SAFETY INTERLOCKS WITHOUT PRIOR AUTHORISATION

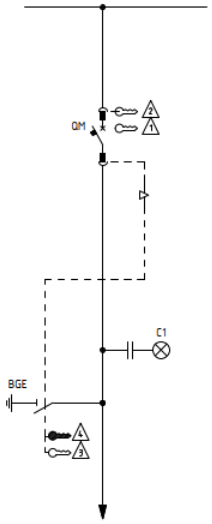
Step	Description	Result	Verified by	Date
	See the Incomer Unit A6 operating sequences to put the unit *out of service* or *in service*			
62	Verify and confirm that **Unit A6** is in safety status with following checks: - BGE Earthing Switch is locked in closed position. **KEY-4 G3228/279** is locked on KD1 device. **KEY-3 G3355** is locked on BGE Earthing Switch closed ..... ☐ - QM Main Breaker is locked in extract position and opened. **KEY-2 14466** is locked on 66kV **upstream** safety isolation device. ..... ☐ Note: see the detail of upstream safety isolation device (e.g. 66kV Earthing Switch) on 66kV OTP procedure			

OPERATING SEQUENCE

GENERAL CIRCUIT BREAKER OPERATING SEQUENCE

PUTTING OUT OF SERVICE

1 - OPEN THE CIRCUIT BREAKER.
2 - PRESS THE PUSH-BUTTON -P1 AND CARRY CIRCUIT BREAKER IN ISOLATED POSITION.
3 - LOCK THE CIRCUIT BREAKER IN EXTRACTED POSITION BY MEANS OF KEY "2".
4 - TO ACCESS THE CIRCUIT BREAKER COMPARTMENT PRESS THE -P1 PUSH-BUTTON AND OPEN THE DOOR.
5 - UNLOCK THE EARTHING SWITCH OPEN POSITION THROUGH KEY (3).
6 - OPEN THE SHUTTER OF THE EARTHING SWITCH TURNING THE ACTUATOR ANTICLOCKWISE.
7 - PRESS THE PUSH-BUTTON -P1. CLOSE EARTHING SWITCH BY TURNING THE OPERATING LEVER CLOCKWISE.
8 - LOCK THE CLOSED POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY (4)
9 - IT IS POSSIBLE TO ACCESS THE CABLE COMPARTEMENT ON THE BACK BY UNSCREWING THE BOLTS AND REMOVING THE REAR PANEL.



START UP

1 - CLOSE THE CABLE COMPARTMENT BY SCREWING THE REAR PANEL WITH THE BOLTS
2 - BRING BACK THE KEY (4)
3 - UNLOCK THE EARTHING SWITCH CLOSE POSITION THROUGH KEY (4) . PRESS THE PUSH-BUTTON -P1 OPEN EARTHING SWITCH BY TURNING THE OPERATING LEVER ANTICLOCKWISE.
4 -CLOSE THE EARTHING SWITCH COMMAND SHUTTER, TURN THE ACTUATOR CLOCKWISE.
5 - LOCK THE OPEN POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY (3)
6 - PRESS TIMING PUSH-BUTTON -P1 AND CLOSE THE DOOR OF THE CIRCUIT BREAKER.
7 - RECOVER THE KEY (2) AND UNLOCK THE ISOLATED POSITION OF THE CIRCUIT BREAKER.
8 - PRESS TIMING PUSH-BUTTON -P1 AND TO INSERT THE CIRCUIT BREAKER, CARRY IT IN THE CONNECT POSITION THROUGH THE OPERATING LEVER .
9 - CLOSE THE CIRCUIT BREAKER.

1 Free key with opened Circuit Breaker (Circuit Breaker locked in open position)
2 Free key with insolated Circuit Breaker (Circuit Breaker locked in isolated position)
3 Free key with opened Earthing Switch (Earthing Switch locked in open position)
4 Free key with closed Earthing Switch (Earthing Switch locked in close position)

WARNING DO NOT REMOVE OR MODIFY THE SAFETY INTERLOCKS WITHOUT PRIOR AUTHORISATION

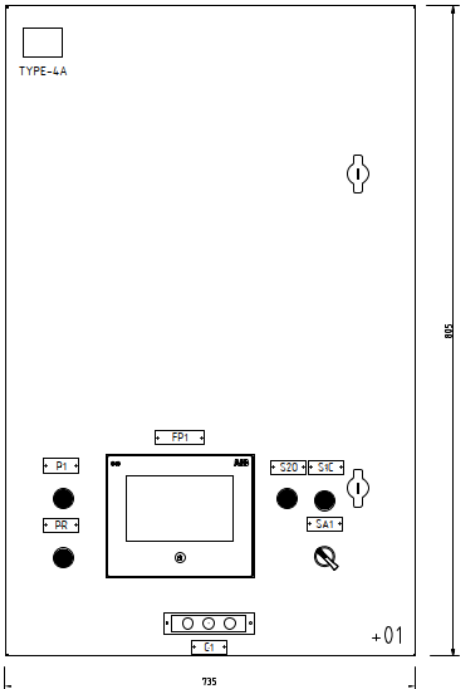
Step	Description	Result	Verified by	Date
63	Verify and confirm that Unit A5 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-3 G3098/277 is locked on KD1 device. ..... ☐ - KEY-4 G3150 is unlocked and available to use in the LoTo Procedure..... ☐			
Switchboard preparation to receive 6,6kV Temporary Yard Power Supply on Incomer Unit A6				
64	The keys 278, 279, 280, 281, 282, 283 are interlocked on KD1. On Unit A5 - Take KEY-4 G3150 insert it on BGE and open Earthing Switch .....☐ - KEY-3 G3098/277 is now available, withdraw it and insert in keys Interlock device KD1 ..... ☐			
65	To unlock Incomer Unit A6 BGE Earthing Switch - QM main Breaker is locked in extract position ..... ☐ - KEY-1 G3260 is locked on LoTo procedure to keep breaker isolated in compliance with project PTW Procedure.....☐ - KEY-2 14466 is locked on 66kV upstream safety isolation device ...☐ - KEY-3 G3355 is used and locked on PTW procedure. Once it is available insert it on BGE Earthing Switch to allow opening switch procedure.. ☐ - KEY-4 G3228 has been released from KD1. Insert KEY-4 G3228 on BGE and open it.....☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 will turn to green.....☐			

Step	Description	Result	Verified by	Date
	- Remove the safety isolation device, extract KEY-2 14466 and place it on rack in/out system to unlock the QM main breaker.....☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green.....☐ - Rack in QM Main Breaker in TEST position .....☐			

Test the Unit A6 Incomer Breaker Functionality with "commissioning bypass" activated simulating the QM Breaker in "service position" (N.B.: *breaker kept in test position but with full functionality of service position).*

With reference Vendor doc. N° 1723002197-EL-DG-00015)

Note: *See next section 5.4.2.3/4/5 EMCS IEC61850 and MODBUS TCP-IP – A6 Unit I/O list*



DOOR LAY-OUT

DEVICES name plate

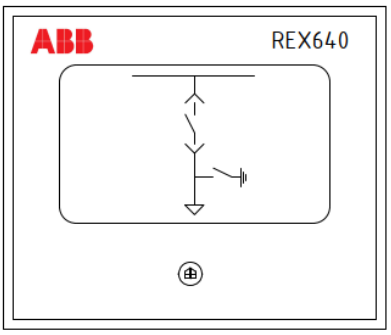
ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2.0	PUSH BUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1C	PUSH BUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUSH BUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

66	Hardwired I/O signals between Unit A6 and 66kV switchboard:			

Step	Description	Result	Verified by	Date
	Arc Flash cable Compartment Tripped, Sheet 27 Confirm open contact without alarm - XM 63-64 .....☐ C.B. connected in service position and opened, sheet 27 Confirm close contact with breaker in service position (with "commissioning bypass") and opened - XM 65-66 .....☐ Earthing Switch BGE opened Confirm close contact with Earthing Switch opened - XM 67-68 .....☐ - XM 73-74 .....☐ Transformer TD-100AD1 General Trip Signal to 66kV Switchboard Confirm Open contact with no Trip Signal - Trip XM 79-80 .....☐ Circuit Breaker Opened Confirm close contact with C.B. opened - XM 89-90 .....☐ - XM 91-92 .....☐			
67	Hardwired I/O signals between 66kV switchboard and Unit A6: From 66kV C.B. opened (opening command) Confirm open contact with 66kV C.B. Closed - XM 43-44 .....☐ - XM 81-82 .....☐ - XM 83-84 .....☐ Confirm close contact with 66kV lockout relay healthy - XM 25-26 .....☐			

Step	Description	Result	Verified by	Date
	Confirm open contact with 66kV lockout relay healthy (opening command) - XM 11-12 .....☐			
68	Hardwired I/O signals from TR-100AD1 (66/6,6 kV) Transformer to Unit A6: Alarm and Trip I/O Signals from Transformer TR-100AD1 to Unit A6 Confirm open contact with No Alarm or No Trip status Relay Buchholz - Trip XM 27-28 (97T).....☐ - Alarm XM 61-62 (97T) .....☐ Transformer oil temperature - Trip XM 29-30 (26OT) .....☐ - Alarm XM 47-48 (26OT).....☐ Transformer Pressure Relay - Trip XM 31-32 (63T).....☐ Transformer windings temperature - Trip XM 33-34 (49T).....☐ - Alarm XM 53-54 (49T) .....☐ Transformer OLTC Oil Level Indicator - Trip XM 35-36 (71OOLTC).....☐ - Alarm XM 55-56 (71OOLTC) .....☐ Transformer OLTC Protection Relay - Trip XM 37-38 (97OLTC) .....☐ Transformer Protection Oil Level - Trip XM 39-40 (71OT) .....☐ - Alarm XM 49-50 (71OT).....☐ Transformer self-dehydrating breather			

Step	Description	Result	Verified by	Date
	- Alarm XM 51-52 (89T.2).....☐ Transformer Membrane Control - Alarm XM 45-46 (89T.1).....☐ TR-100AD1 General Alarm - Alarm XM 57-58 .....☐ General Alarm from RR-100D1 NER - Alarm XM 85-86 .....☐			
69	Hardwired I/O Signals From / To Incomer Unit A6 – Other Devices Signal From Unit A6 to BESS PACKAGE 66kV C.B. open & QM Incomer C.B. Open or in Test Position Confirm Closed Contact with 66kV C.B. open & QM Incomer C.B. Open or in Test Position - XM 87-88 (C.B. Isolated).....☐ Synchronization Closing Command Signal from BESS PACKAGE Confirm open Contact with Normal condition (No Synchro). Connect a temporary jumper between terminals and confirm QM Breaker Closed (with bypass) - XM 59-60.....☐			
	HMI of FP1 Protection Relay and its LEDs signalling			

Step	Description	Result	Verified by	Date
	PROTECTION DISPLAY  LHMI - TOUCH DISPLAY - COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED - PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED			
70	The QM Breaker is in test position. Closing and opening QM Breaker command, simulating (C.B. in) service position with "commissioning bypass" Close QM Incoming Breaker - Place the selector SA1 in Local Position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. .....☐ - Close QM Breaker by pressing push button S1C .....☐ - Verify and confirm the breaker status closed via on board mechanical red signal .....☐			

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 - VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 - TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 - TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIG (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐ Open QM Incoming Breaker - Open QM Breaker by pressing push button S2O .....☐ - Verify and confirm the breaker status open via on board mechanical green signal.....☐ - See on FP1 Protection Relay Display if Breaker Opened is confirmed on REX640 HMI.....☐			
71	Rack in QM Main Breaker in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the following tests to be performed in the final operational configuration.			
72	Confirm availability of the 6,6kV Main Temporary Yard Power Supply and prepare to energize. To allow closing QM breaker: Keep open contact disconnecting cables on following terminal: - XM 11-12.....☐ - XM 43-44.....☐ - XM 81-82.....☐ - XM 83-84.....☐ Ensure close contact connecting a jumper between terminals: - XM 25-26.....☐ When the power supply is available confirm the following: - On Unit A6 the voltage presence lamps C1 are ON .....☐			

Step	Description	Result	Verified by	Date
	- Led-2 "BREAKER READY (TCS)" on protection relay REX640 will turn to green.....☐			
73	A6 Unit – Incoming Breaker – **Local** command Close QM Incoming Breaker, feeding 6,6kV SWBD SG-100D1 main busbar - Place the selector SA1 in Local position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF.....☐ o LED-2 must be GREEN .....☐ o LED-3 must be GREEN .....☐ o LED-4 must be GREEN .....☐ o LED-5 must be OFF.....☐ o LED-6 must be OFF.....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN .....☐ o LED-9 must be OFF.....☐ o LED-10 must be OFF .....☐ o LED-11 must be OFF .....☐ - Close QM Breaker by pressing push button S1C.....☐ - Verify and confirm the breaker status closed via on board mechanical red signal .....☐ - On Unit A5 the busbar voltage presence lamps C1 are ON.....☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐			

Step	Description	Result	Verified by	Date
74	A6 Unit – Incoming Breaker – **Remote** command from Close QM Incoming Breaker, feeding 6,6kV SWBD SG-100D1 main busbar - Place the selector SA1 in Remote position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF.....☐ o LED-2 must be GREEN .....☐ o LED-3 must be GREEN .....☐ o LED-4 must be GREEN .....☐ o LED-5 must be OFF.....☐ o LED-6 must be OFF.....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN .....☐ o LED-9 must be OFF.....☐ o LED-10 must be OFF .....☐ o LED-11 must be OFF .....☐ - Close QM Breaker from EMCS System .....☐ - Verify and confirm the breaker status closed via on board mechanical red signal .....☐ - On Unit A5 the busbar voltage presence lamps C1 are ON.....☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐ - Open QM Breaker from EMCS System .....☐ - Verify and confirm the breaker status opened via on board mechanical green signal.....☐			

Step	Description	Result	Verified by	Date
	- On Unit A5 the busbar voltage presence lamps C1 are OFF .....☐			

5.4.2.2 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
INCOMER UNIT A6				
75	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
76	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			
77	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			
78	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			

Step	Description	Result	Verified by	Date
79	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			
MEASURING UNIT A5				
80	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XM 5-6 (230V)..... V - XC 9-11 (230V)..... V - XC 10-12 (230V)..... V			
81	Power up 230Vac auxiliary circuits. - Close MCB QA1 .....☐ Verify and confirm voltage presence on terminals: - XC 9-11 (230V)..... V - XC 10-12 (230V)..... V 230Vac Auxiliary Healthy relay is on - Verify and confirm .....☐ Verify and confirm close contact between terminals XC 47-48 .....☐			
82	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			
83	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			

Step	Description	Result	Verified by	Date
84	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
85	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.2.3 EMCS EC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6.6kV Switchboard SG-100D1: In detail it will be tested the functionalities provided on I/O lists, refer to vendor document 1723002197-EL-LIS-00041 with the A6 Unit INCOMER.

5.4.2.4 EMCS IEC61850 – A6 Unit I/O list

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS REX640.

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
INCOMING FEEDER TR-100AD1 "A6"		
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
SYNCHRO "OK"	DIGITAL	LD0.LEDGGIO1.ST.Ind3.stVal
PROTECTION TRIPPED "59N-1"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "59N-2"	DIGITAL	LD0.ROVPTOV2.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "27-2"	DIGITAL	LD0.PHPTUV2.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
PROTECTION TRIPPED "59-2"	DIGITAL	LD0.PHPTOV2.ST.Op.general
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSFORMER PROTECTION TRIPPED "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind9.stVal

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SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
TRANSFORMER PROTECTION ALARM "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind8.stVal
TRANSFORMER PROTECTION TRIPPED "OIL PRESSURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind12.stVal
TRANSF. PROT. SELF DEHYDRATING BREATHER ALARM	DIGITAL	LD0.SCBIGGIO1.ST.Ind11.stVal
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
TRANSFORMER PROTECTION ALARM BUCHHOLZ	DIGITAL	LD0.SDBIGGIO1.ST.Ind7.stVal
TRANSFORMER PROTECTION TRIPPED BUCHHOLZ	DIGITAL	LD0.SDBIGGIO1.ST.Ind9.stVal
TRANSFORMER OLTC PROTECTION RELAY	DIGITAL	LD0.SBBIGGIO1.ST.Ind9.stVal
TRANSFORMER PROTECTION ALARM LEVEL OIL	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
TRANSFORMER PROTECTION TRIPPED LEVEL OIL	DIGITAL	LD0.SCBIGGIO1.ST.Ind7.stVal
TRANSFORMER PROTECTION ALARM OIL LEVEL INDICATOR	DIGITAL	LD0.SDBIGGIO1.ST.Ind3.stVal
TRANSF. OLTC PROTECTION TRIPPED OIL LEVEL INDICATOR	DIGITAL	LD0.SCBIGGIO1.ST.Ind1.stVal
TRANSFORMER PROTECTION ALARM MEMBRANE CONTROL	DIGITAL	LD0.SCBIGGIO1.ST.Ind6.stVal
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
V.T. HEALTLY CIRCUIT	DIGITAL	LD0.SCBIGGIO1.ST.Ind2.stVal
INTERTRIP SEND TO 66kV SWITCHB.	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal

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SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
C.B. CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
C.B. OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO5.stVal
C.B. READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
C.B. READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
LIVE VOLTAGE 6.6kV ON THE MAIN BUS-BARS	DIGITAL	LD0.VMMXU2.ST.HiWrn.stVal
TRIPPED ARC CABLE COMPARTEMENT	DIGITAL	LD0.SCBOGGIO1.ST.SPCSO2.stVal
TR-100AD1 GENERAL ALAM	DIGITAL	LD0.SDBIGGIO1.ST.Ind4.stVal
RR-100D1 NER GENERAL ALARM	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal

Step	Description	Result	Verified by	Date
86	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results..... ☐		

5.4.2.5 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

SIGNAL_DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
INCOMING FEEDER TR-100AD1 "A6"			
Phase L1 - Temperature Detection - cable Compart.	15	40146	ΔT
Phase L2 - Temperature Detection - cable Compart.	15	40147	ΔT
Phase L3 - Temperature Detection - cable Compart.	15	40148	ΔT
Phase L1 - Temperature Detection - C.B. Compart.	15	40149	ΔT
Phase L2 - Temperature Detection - C.B. Compart.	15	40150	ΔT
Phase L3 - Temperature Detection - C.B. Compart.	15	40151	ΔT
Phase L1 - Temperature Detection - Main Bus Bar	15	40152	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	15	40153	ΔT

Step	Description	Result	Verified by	Date
87	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

N.B.: Following PHASE 2 we will consider the SWBD Incomer Unit (A6) and Measuring Unit (A5) tested, available, and continually energized ready for operation.

5.4.2.6 OTP Worksite PHASE 2 - Test Notes and Remarks

5.4.2.7 OTP Worksite PHASE 2 - Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.2.8 OTP Worksite PHASE 2 - Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.3 PHASE 3 - Test with 6,6kV Main Power Supply of Unit A4 Feeder for TR-200E1 6.6/0.4kV Transformer

5.4.3.1 OTP Steps WORKSITE - PHASE 3

It is foreseen that previous PHASE 2 is successfully performed. 6.6KV Switchboard is working in normal operation and no alarm pending.

In this Phase will be tested the Unit A4 Feeder for TR-200E1 6.6/0.4kV Transformer with 6,6 kV from main busbar

After this PHASE all systems will be fed from SWBD SG-200N1 that will be available without pending point, ready to work and powered ON ready to next phases.

In the following steps the functionality of the 6.6KV Switchboard shall be tested for:

- SS 82-00: 6,6 kV 6.6kV SG-100D1 SWBD.
- SS 83-00: 400/230V Low Voltage SG-200N1 SWBD.
- SS 83-20: 400/230V Distribution Board DP-200N1.
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-10: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System

5.4.3.2 Test Preparation

Verification of system and subsystem 6.6KV Power Distribution Switchboards Unit A4 is completed without punch lists or pending point that limit the power up.

Verify that Unit A4 Feeder for TR-200E1 6.6/0.4kV Transformer is available.

Auxiliary power supplies in SG-100D1 are available from:

- UPS AC/DC 110V UP-200F1
- DISTRIBUTION BOARD AC 230V DP-200N1
- 24Vdc From MEASURING UNIT A5

The list electrical hardwired interlocks are between K1 Contactor of Unit A4 and LV SWBD SG-200N1 Incomer.

The Unit A4 Feeder for TR-200E1 6.6/0.4kV Transformer involved in this procedure must be available and ready for commissioning.

The test of all internal interconnections between units of 6.6KV Switchboard SG-100D1 are tested on Vendor SAT procedure 1723002197-QC-PRO-00046

The Unit A4 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

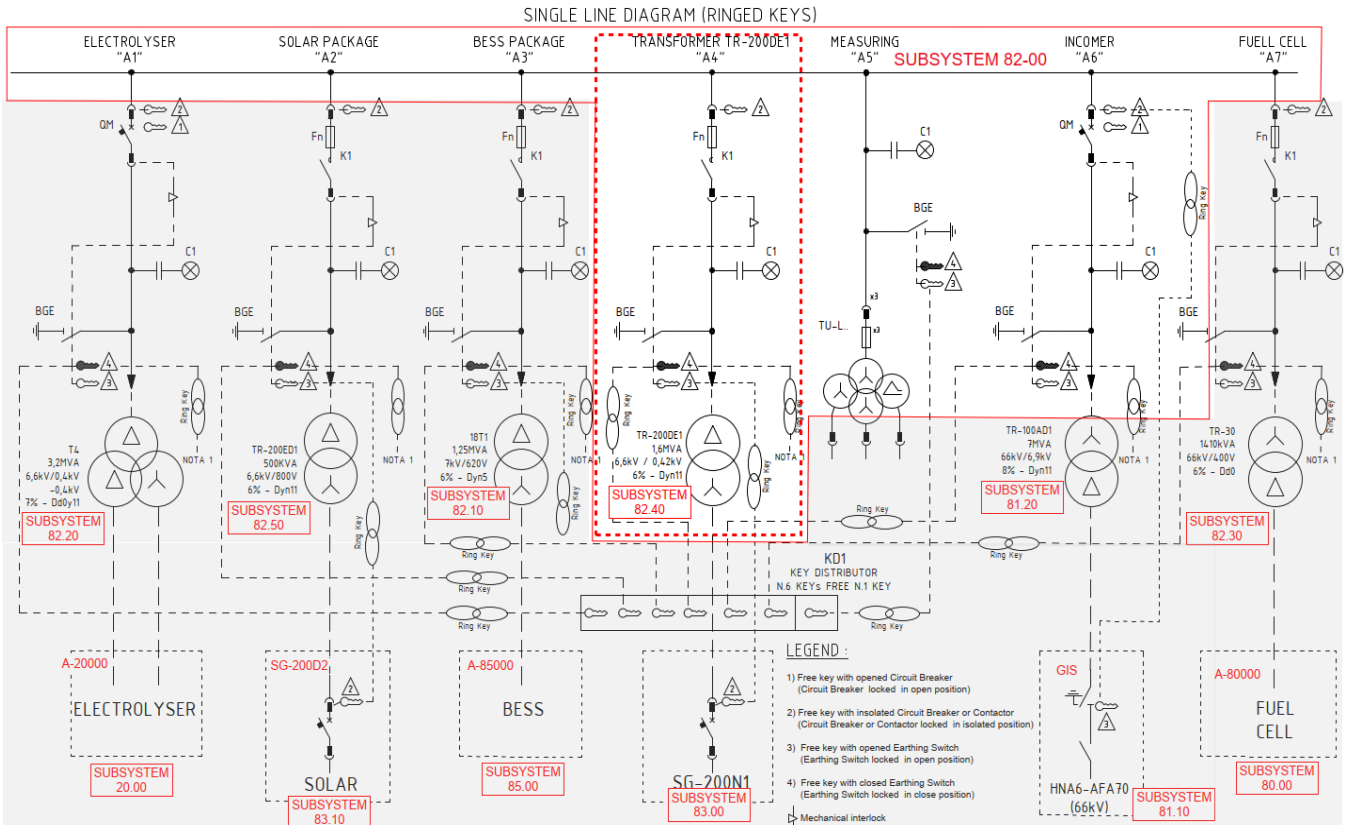
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A4 UNIT Feeder for TR-200E1 6.6/0.4kV Transformer

Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the main busbars are powered on, Unit A4 has its Earthing Switch (BGE) Closed and Its Contactor K1 is in extract position and opened, it is isolated status.

The 6,6kV supply is provided from main busbar will be possible to change isolated status, only after the following safety checks.

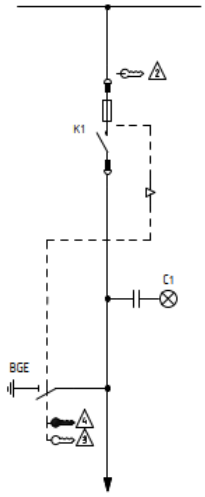
Step	Description	Result	Verified by	Date
	See the Feeder Unit A4 operating sequences to put the unit *out of service* or *in service*			
88	Verify and confirm that Unit A4 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-4 G3135/280 is on KD1 device. KEY-3 G3398, that is mechanically coupled (ringed) with KEY-2 150901 of SG-200N1 main Incomer, it is locked on BGE Earthing Switch closed ...☐			

OPERATING SEQUENCE

GENERAL CONTACTOR OPERATING SEQUENCE

PUTTING OUT OF SERVICE

1 - OPEN THE CONTACTOR.
2 - PRESS THE PUSH-BUTTON -P1 AND CARRY CONTACTOR IN ISOLATED POSITION.
3 - LOCK THE CONTACTOR IN EXTRACTED POSITION BY MEANS OF KEY "2".
4 - TO ACCESS THE CONTACTOR COMPARTMENT PRESS THE -P1 PUSH-BUTTON AND OPEN THE DOOR.
5 - UNLOCK THE EARTHING SWITCH OPEN POSITION THROUGH KEY (3).
6 - OPEN THE SHUTTER OF THE EARTHING SWITCH TURNING THE ACTUATOR ANTICLOCKWISE.
7 - PRESS THE PUSH-BUTTON -P1. CLOSE EARTHING SWITCH BY TURNING THE OPERATING LEVER CLOCKWISE.
8 - LOCK THE CLOSED POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY (4)
9 - IT IS POSSIBLE TO ACCESS THE CABLE COMPARTEMENT ON THE BACK BY UNSCREWING THE BOLTS AND REMOVING THE REAR PANEL.



START UP

1 - CLOSE THE CABLE COMPARTMENT BY SCREWING THE REAR PANEL WITH THE BOLTS
2 - BRING BACK THE KEY (4)
3 - UNLOCK THE EARTHING SWITCH CLOSE POSITION THROUGH KEY (4) . PRESS THE PUSH-BUTTON -P1 OPEN EARTHING SWITCH BY TURNING THE OPERATING LEVER ANTICLOCKWISE.
4 -CLOSE THE EARTHING SWITCH COMMAND SHUTTER, TURN THE ACTUATOR CLOCKWISE.
5 - LOCK THE OPEN POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY (3)
6 - PRESS TIMING PUSH-BUTTON -P1 AND CLOSE THE DOOR OF THE CONTACTOR.
7 - RECOVER THE KEY (2) AND UNLOCK THE ISOLATED POSITION OF THE CONTACTOR.
8 - PRESS TIMING PUSH-BUTTON -P1 AND TO INSERT THE CONTACTOR, CARRY IT IN THE CONNECT POSITION THROUGH THE OPERATING LEVER .
9 - CLOSE THE CONTACTOR.

2 Free key with insolated Contactor (Contactor locked in isolated position)
3 Free key with opened Earthing Switch (Earthing Switch locked in open position)
4 Free key with closed Earthing Switch (Earthing Switch locked in close position)

WARNING DO NOT REMOVE OR MODIFY THE SAFETY INTERLOCKS WITHOUT PRIOR AUTHORISATION

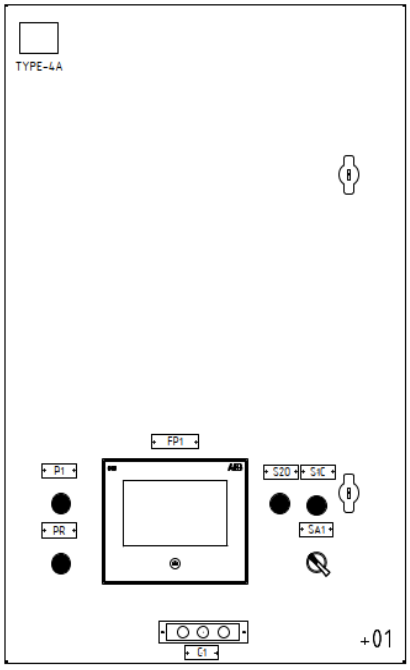
Step	Description	Result	Verified by	Date
	- K1 Contactor is locked in extract position and opened. KEY-2 19465 is locked on the LoTo Procedure .....☐ *N.B.: See the Key interlocks details on section 5.4.1.4 SG-100D1 Interlocks & Key Interlocks*			
Unit preparation to receive 6,6kV from main busbar on Feeder Unit A4				
89	Ensure voltage reference on REX640 Protection relay: - Close MCB QV4 ..... ☐ - Close MCB QV5 ..... ☐ The protection relay is now available and ready to operate			
90	The KEY-4 3135/280 is in KD1 device and it is withdrawable On Unit A4 - Take KEY-4 G3135/280 insert it on BGE and open Earthing Switch.....☐ - KEY-3 G3398/277 is now unlocked and withdrawable to use it on SG-200N1 SWBD Incomer ..... ☐			
91	To unlock Incomer Breaker of Unit A4 - K1 main contactor is locked in extract position ..... ☐ - KEY-2 19465 is locked on LoTo procedure to keep breaker isolated in compliance with project PTW Procedure ..... ☐ - KEY-3 G3398/277 is unlocked with BGE opened. - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 HMI will turn to green ☐			

Step	Description	Result	Verified by	Date
	- The internal Interlock is unlocking Rack in/out Contactor system. The KEY-2 19465 has been freed from PTW procedure, insert it on Rack in/out system and bring contactor in test position..... ☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green..... ☐			

Test the Unit A4 Feeder for TR-200E1 6.6/0.4kV Transformer contactor Functionality with "commissioning bypass" activated simulating the K1 contactor in "service position" (N.B.: *contactor kept in test position but with full functionality of service position).*

With reference Vendor doc. N° 1723002197-EL-DG-00021)

Note: *See next sections 5.4.3.5/6/7 EMCS IEC61850 AND MODBUS TCP-IP – A4 Unit I/O list*



DOOR LAY-OUT

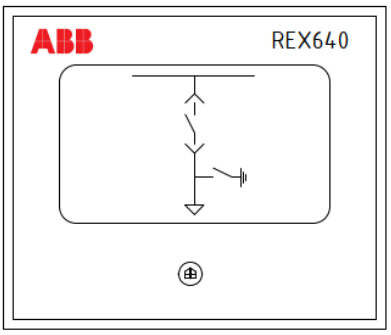
DEVICES name plate

ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2.0	PUCHBUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1.C	PUCHBUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUCHBUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

92	Hardwired I/O signals between Unit A4 and TR-200DE1 Transformer 6,6/0,42 kV:			

Step	Description	Result	Verified by	Date
	Confirm open contact with No Alarm or No Trip status (sheets 22-24) Relay Buchholz - Trip XM 17-18 (97T) ..... ☐ - Alarm XM 29-30 (97T)..... ☐ Transformer oil temperature - Trip XM 19-20 (26OT)..... ☐ - Alarm XM 31-32 (26OT) ..... ☐ Transformer Pressure Relay - Trip XM 21-22 (63T) ..... ☐ Transformer windings temperature - Trip XM 23-24 (49T) ..... ☐ - Alarm XM 37-38 (49T)..... ☐ Transformer Protection Oil Level - Alarm XM 33-34 (71OT) ..... ☐			
93	Hardwired I/O signals between Unit A4 and SG-200N1 LV Switchboard From LV SWBD SG-200N1 To 6.6KV SWBD SG-100D1 (sheets 25-26) Incomer C.B. QF1 (on SG-200N1) is in test position Confirm QF1 in Test Position Confirm close contact between terminals on SG-100D1: - XM 39-40..... ☐ Confirm QF1 not tripped Confirm open contact between terminals: - XM 41-42..... ☐ Incomer C.B. QF1 (on SG-200N1) opened (closing Interlock)			

Step	Description	Result	Verified by	Date
	Confirm closing contact with QF1 opened between terminals on SG-100D1 - XM 27-28..... ☐ From 6.6KV SWBD SG-100D1 To LV SWBD SG-200N1 Opening (on SG-200N1) LV QF1 Incomer Breaker command signal Confirm close contact with K1 contactor status opened or in test position: - XM 49-50..... ☐ Confirm open contact with K86 (on SG-100D1) lock out relay healthy: - XM 51-52 (opening command) ..... ☐ - XM 69-70 (closing command) ☐ Closing (on SG-200N1) LV QF1 command permissive signal – Contactor status closed + contactor in service position + Earthing switch opened Confirm close contact with K1 contactor in service position (with "commissioning bypass") and Closed and BGE Earthing Switch opened - XM 53-54..... ☐			
	HMI of FP1 Protection Relay and its LEDs signalling			

Step	Description	Result	Verified by	Date
	PROTECTION DISPLAY  LHMI – TOUCH DISPLAY - COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED - PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED			
94	The K1 Contactor is in test position. Closing and opening K1 Contactor command, simulating (K1 in) service position with "commissioning bypass" Close K1 Contactor feeder - Place the selector SA1 in Local Position ..... ☐ - All permissive interlock signals are authorizing the contactor closing. ..... ☐ - Close K1 Contactor by pressing push button S1C ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐			

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 - VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 - TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 - TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIG (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ..... ☐ Open K1 Contactor feeder - Open K1 Contactor by pressing push button S2O ..... ☐ - Verify and confirm the Contactor status open via on board mechanical green signal..... ☐ - See on FP1 Protection Relay Display if Contactor Opened is confirmed on REX640 HMI ..... ☐			
95	Before to close the K1 Contactor ensure and confirm that the TRANSFORMER FEEDER TR-200DE1 has Ready for Commissioning Certificate and it is available to receive the 6,6kV Power Supply			
96	Rack in K1 Contactor in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the following tests to be performed in the final operational configuration.			
97	A4 Unit – Feeder for TR-200E1 6.6/0.4kV Transformer Confirm the conditions to close the K1 Contactor following: - On Unit A5 the voltage presence lamps C1 are ON ..... ☐ - Led-2 "BREAKER READY (TCS)" on Unit A4 protection relay REX640 is green..... ☐ Close K1 Contactor, feeding downstream TR-200DE1 6.6/0.4kV Transformer - Local command - Place the selector SA1 in Local position ..... ☐			

Step	Description	Result	Verified by	Date
	- All permissive interlock signals are authorizing the Contactor closing command. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00021 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close K1 Contactor by pressing push button S1C ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐ - On Unit A4 the downstream voltage presence lamps C1 are ON ..... ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ..... ☐			
98	A4 Unit – Feeder for TR-200E1 6.6/0.4kV Transformer - **Remote** command Close K1 Contactor, feeding downstream TR-200E1 6.6/0.4kV Transformer - Place the selector SA1 in Remote position ..... ☐			

Step	Description	Result	Verified by	Date
	- All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close QM Breaker from EMCS System ..... ☐ - Verify and confirm the breaker status closed via on board mechanical red signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON ..... ☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI ..... ☐ - Open QM Breaker from EMCS System ..... ☐ - Verify and confirm the breaker status opened via on board mechanical green signal..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are OFF ..... ☐			

5.4.3.3 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
UNIT A4 - TRANSFORMER TR-200DE1 FEEDER				
99	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
100	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			
101	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			
102	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
103	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.3.4 SIS Safety Instrumented System

Not applicable

5.4.3.5 EMCS EC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6,6kV SWBD: In detail it will be tested the functionalities provided on I/O lists vendor document 1723002197-EL-LIS-00041 with the A4 Unit TRANSFORMER FEEDER TR-200DE1.

5.4.3.6 EMCS IEC61850 - A4 Unit I/O List

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS Relay REX640.

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
TRANSFORMER FEEDER TR-200DE1 "A4		
PROTECTION TRIPPED "50"	DIGITAL	LD0.PHHPTOC2.ST.Op.general
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHHPTOC1.ST.Op.general
PROTECTION TRIPPED "50-2"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51"	DIGITAL	LD0.PHLPTOC2.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general
PROTECTION TRIPPED "51G"	DIGITAL	LD0.EFHPTOC1.ST.Op.general
PROTECTION TRIPPED "59N-1"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "59N-2"	DIGITAL	LD0.ROVPTOV2.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSFORMER PROTECTION TRIPPED "BUCHHOLZ"	DIGITAL	LD0.SCBIGGIO1.ST.Ind7.stVal
TRANSFORMER PROTECTION ALARM "BUCHHOLZ"	DIGITAL	LD0.SCBIGGIO1.ST.Ind6.stVal
TRANSFORMER PROTECTION TRIPPED "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind9.stVal
TRANSFORMER PROTECTION ALARM "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind8.stVal
PROTECTION TRIPPED ALARM "OIL LEVEL"	DIGITAL	LD0.SCBIGGIO1.ST.Ind10.stVal
TRANSFORMER PROTECTION TRIPPED "OIL PRESSURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind12.stVal
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
TRANSF. OIL LEVEL VERY LOW ALARM	DIGITAL	LD0.SCBIGGIO1.ST.Ind11.stVal
TRANSFORMER GENERAL ALARM	DIGITAL	LD0.SDBIGGIO1.ST.Ind7.stVal

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	IEC61850 ITEM TAG
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
INTERTRIP SEND TO L.V. SWITCHBOARD	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal
Contactor CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
Contactor OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO3.stVal
Contactor READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
Contactor READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
PROTECTION RELAY UNIT 3 HEALTHY	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal
SELECTOR SWITCH OF OVERRIDE (SIL ENABLED)	DIGITAL	LD0.SDBIGGIO1.ST.Ind9.stVal

Step	Description	Result	Verified by	Date
104	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

5.4.3.7 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

SIGNAL_DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
TRANSFORMER FEEDER TR-200DE1 "A4"			
Phase L1 - Temperature Detection - cable Compart.	13	40133	ΔT
Phase L2 - Temperature Detection - cable Compart.	13	40134	ΔT
Phase L3 - Temperature Detection - cable Compart.	13	40135	ΔT
Phase L1 - Temperature Detection - Contactor Compart.	13	40136	ΔT
Phase L2 - Temperature Detection - Contactor Compart.	13	40137	ΔT
Phase L3 - Temperature Detection - Contactor Compart.	13	40138	ΔT
Phase L1 - Temperature Detection - Main Bus Bar	13	40139	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	13	40140	ΔT

Step	Description	Result	Verified by	Date
105	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

5.4.3.8 OTP Worksite PHASE 3 Test Notes and Remarks

5.4.3.9 OTP Worksite PHASE 3 Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.3.10 OTP Worksite PHASE 3 Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.4 PHASE 4 - Test with 6,6kV Main Power Supply of Unit A3 Feeder for BESS PACKAGE A-85000

5.4.4.1 OTP Steps WORKSITE - PHASE 4

It is foreseen that previous PHASE 2 is successfully performed. 6.6KV Switchboard is working in normal operation and no alarm pending.

In this Phase will be tested the Unit A3 Feeder for BESS PACKAGE with 6,6 kV from main busbar

In the following steps will be tested the energization of the BESS PACKAGE feeder, that it will be ready for commissioning. The test will be performed with load connected

- SS 83-00: 6,6 kV Switchboard
- SS 82-10: Power Transformer 1.25 MVA (1BT1 BESS)
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-00: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System
- SS 85-00: BESS Package (A-85000)

5.4.4.2 Test Preparation

Verification of system and subsystem 6.6KV Power Distribution Switchboards Unit A3 is completed without punch lists or pending point that limit the power up.

Verify that Unit A3 Feeder for BESS PACKAGE is available.

Auxiliary power supplies in SG-100D1 are available from:

- UPS AC/DC 110V UP-200F1
- DISTRIBUTION BOARD AC 230V DP-200N1
- 24Vdc From MEASURING UNIT A5

The list electrical hardwired interlocks are between K1 Contactor of Unit A3 and other devices.

The Unit A3 Feeder for BESS PACKAGE involved in this procedure must be available and ready for commissioning.

The test of all internal interconnections between units of 6.6KV Switchboard SG-100D1 are tested on Vendor SAT procedure 1723002197-QC-PRO-00046

The Unit A3 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

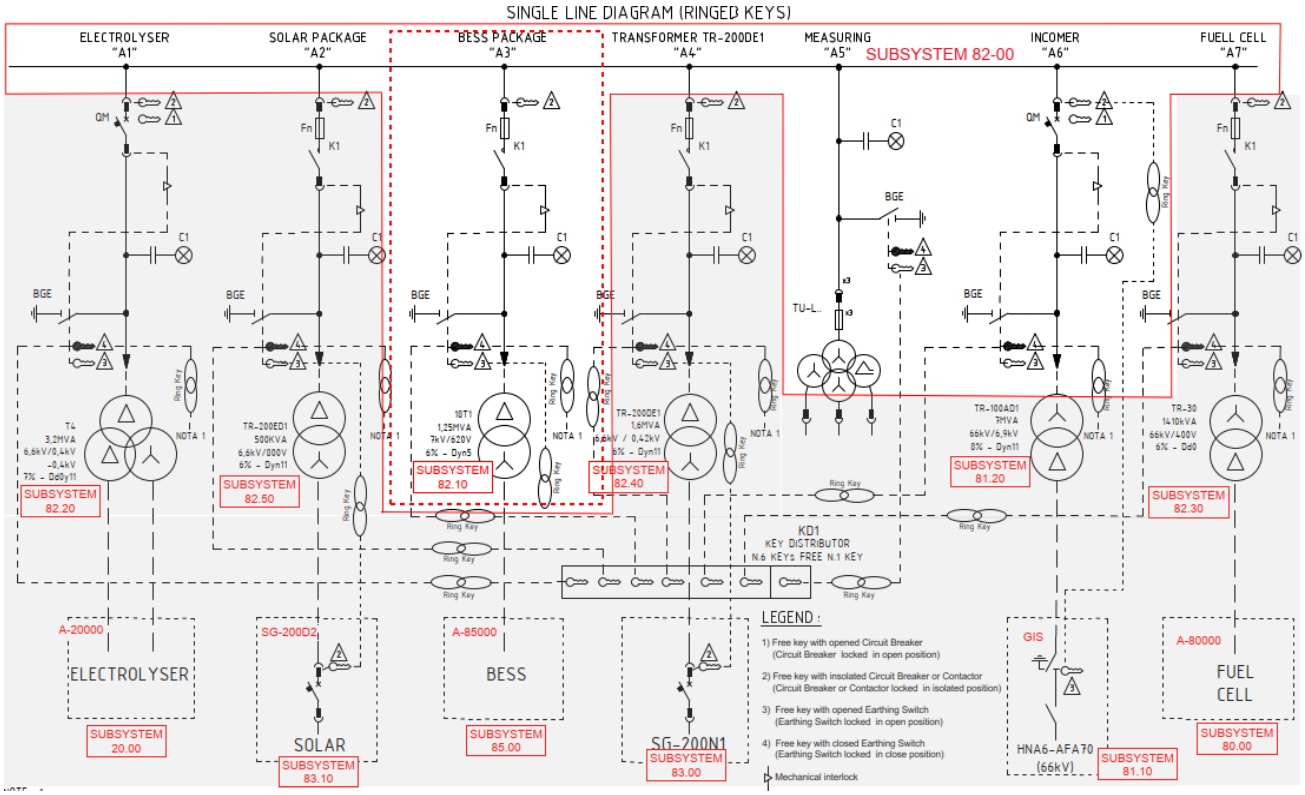
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A3 UNIT Feeder for BESS PACKAGE

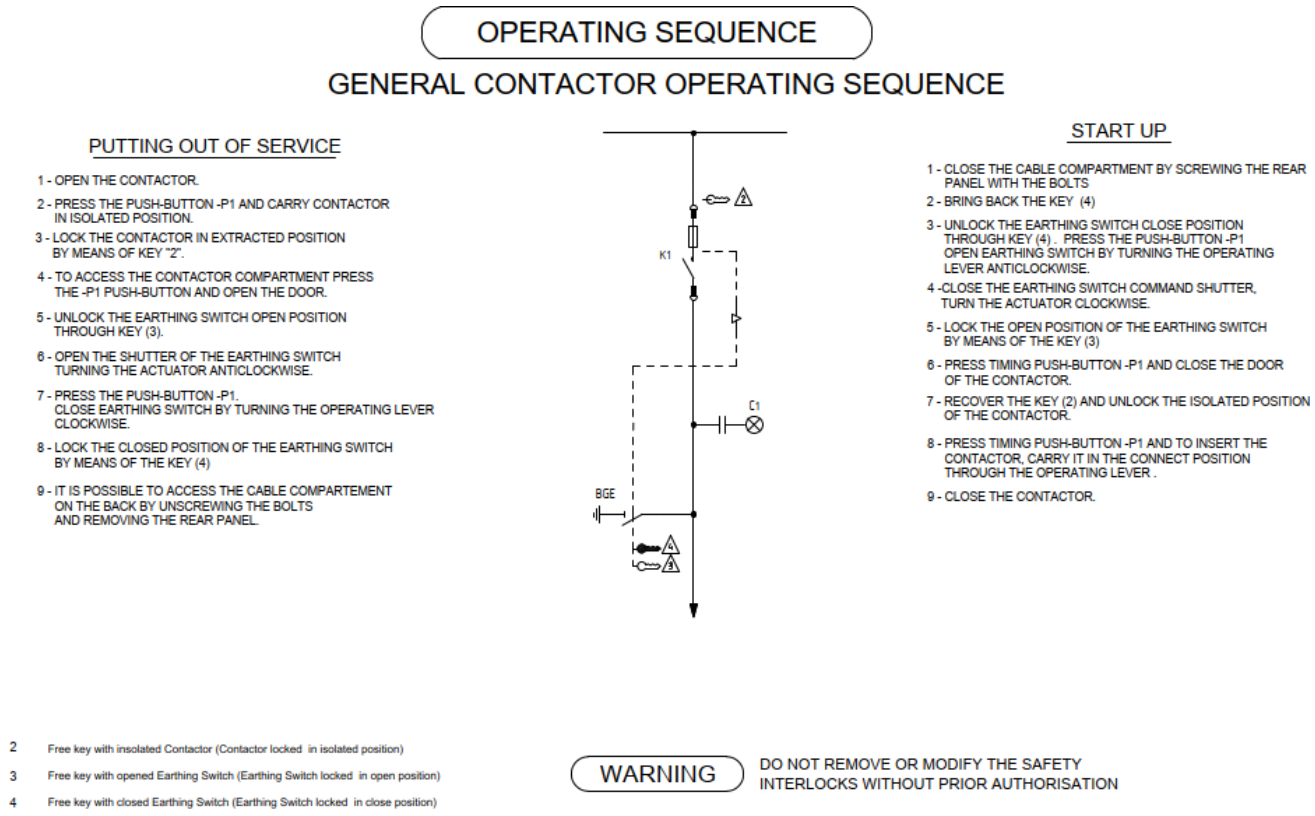
Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the main busbars are powered on, Unit A3 has its Earthing Switch (BGE) Closed and Its Contactor K1 is in extract position and opened, it is in isolated status.

The 6,6kV supply is provided from main busbar will be possible to change isolated status, only after the following safety checks.

Step	Description	Result	Verified by	Date
	See the Feeder Unit A3 operating sequences to put the unit *out of service* or *in service*			
106	Verify and confirm that Unit A3 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-4 G3120/281 is on KD1 device. KEY-3 G3095, that is mechanically coupled (ringed) with safety device of BESS PACKAGE, it is locked on BGE Earthing Switch closed ..... ☐ - K1 Contactor is locked in extract position and opened. KEY-2 19834 is locked on the LoTo Procedure ☐			



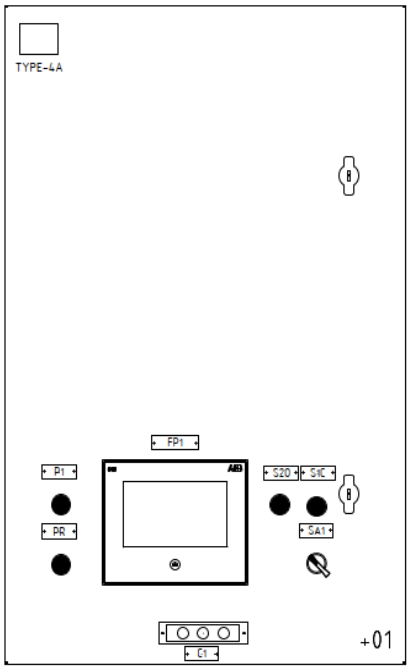
Step	Description	Result	Verified by	Date
	N.B.: See the Key interlocks details on section 5.4.1.4 SG-100D1 Interlocks & Key Interlocks			
Unit preparation to receive 6,6kV from main busbar on Feeder Unit A3				
107	Ensure voltage reference on REX640 Protection relay: - Close MCB QV4..... ☐ - Close MCB QV5..... ☐ The protection relay is now available and ready to operate			
108	ESD Signal Healthy from SIS Ensure that the ESD signal from SIS is healthy (24Vdc), the KSIL (safety SIL relay) is ON . Measure between terminals: - XM 43-44 (24Vdc)..... ☐ If SIS cabinet is not available apply the override to bypass the ESD signal: - Place in Override position (ON) the SA2 selector Now is possible to proceed with Unit tests *N.B.:* XM 43-44=24Vdc ESD is Healthy and KSIL is ON XM 43-44=0Vdc ESD is Tripped and KSIL is OFF			
109	The KEY-4 3120/281 is in KD1 device and it is withdrawable On Unit A3 - Take KEY-4 G3120/281 insert it on BGE and open Earthing Switch ....☐ - KEY-3 G3095 is now unlocked and withdrawable to use it on BESS PACKAGE ..... ☐			
110	To unlock Contactor Feeder of Unit A3			

Step	Description	Result	Verified by	Date
	- K1 main contactor is locked in extract position ..... ☐ - KEY-2 19834 is locked on LoTo procedure to keep breaker isolated in compliance with project PTW Procedure ..... ☐ - KEY-4 G3120 is locked on BGE Earthing Switch ..... ☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 HMI will turn to green ..... ☐ - The internal Interlock is unlocking Rack in/out Contactor system. The KEY-2 19834 has been freed from PTW procedure, insert it on Rack in/out system and bring contactor in test position..... ☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green ..... ☐ -			

Test the Unit A3 Feeder for BESS PACKAGE contactor Functionality with "commissioning bypass" activated simulating the K1 contactor in "service position" (N.B.: *contactor kept in test position but with full functionality of service position).*

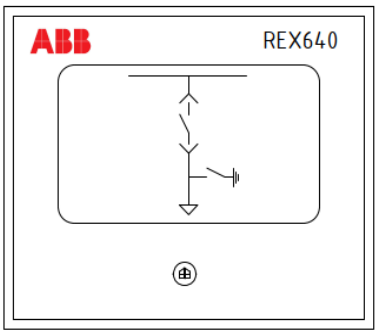
With reference Vendor doc. N° 1723002197-EL-DG-00017)

Note: *See next section 5.4.4.5/6/7 EMCS IEC61850 – A3 Unit I/O list*

Step	Description	Result	Verified by	Date
	DOOR LAY-OUT  DEVICES name plate ITEM / COMPONENT / DESCRIPTION 1 / DESCRIPTION 2 / NOTE FP1 / PROTECTION RELAY / PROTECTION RELAY / / TYPE-1A S2O / PUSHBUTTON / OPEN COMMAND / CONTACTOR / TYPE-2A S1C / PUSHBUTTON / CLOSE COMMAND / CONTACTOR / TYPE-2A SA1 / SELECTOR SWITCH / LOCAL / REMOTE / / TYPE-2A PR / LIGHT PUSH BUTTON / RESET LOCK-OUT / TRIP LOCK-OUT / TYPE-2A C1 / PILOT LIGHT / VOLTAGE / PRESENCE / P1 / PUSHBUTTON / TRUCK-DOOR-E.SWITCH / ENABLING / TYPE-2A			
111	Hardwired I/O signals between Unit A3 and BESS PACKAGE There are not hardwired connections between Unit A3 and BESS PACKAGE. There are the predispositions for some future signals. See following Available Opening Command Verify and confirm open contact between terminals - XM 9-10..... ☐ - XM 11-12..... ☐ - XM 13-14..... ☐ Available trip contact on lockout relay (K86) circuits Verify and confirm open contact between terminals			

Step	Description	Result	Verified by	Date
	- XM 15-16..... ☐ - XM 17-18..... ☐ Available "transformer trip winding temperature" Verify and confirm open contact between terminals - XM 65-66..... ☐ Available "transformer alarm winding temperature" Verify and confirm open contact between terminals - XM 33-34..... ☐ Available external closing interlock Verify and confirm close contact between terminals - XM 21-22 (there is a jumper)..... ☐ - XM 23-24 (make a jumper) ..... ☐ Available from LV SWBD – C.B. TEST POSITION Verify and confirm open contact between terminals - XM 35-36..... ☐ Available from LV SWBD – TRIPPED Verify and confirm open contact between terminals - XM 37-38..... ☐ Available Remote Opening Command Verify and confirm open contact between terminals - XM 39-40..... ☐			

Step	Description	Result	Verified by	Date
	Available signal for Contactor opened and in test position Confirm close contact with K1 contactor status opened or in test position: - XM 45-46..... ☐ Available lock out relay K86 healthy + Arc detector Healthy (on Unit A3) to downstream device. Confirm open contact between terminals: - XM 47-48 ..... ☐ Available Closing LV SWBD command permissive signal – Contactor status closed + contactor in service position + Earthing switch opened to downstream device Confirm close contact with K1 contactor in service position (with "commissioning bypass") and Closed and BGE Earthing Switch opened XM 49-50..... ☐			
	HMI of FP1 Protection Relay and its LEDs signalling			

Step	Description	Result	Verified by	Date
	PROTECTION DISPLAY  LHMI - TOUCH DISPLAY - COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED - PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED	LEDs PAGE 1 Item / NAME PLATE / COLOUR (ALARM / OK) / Note LED-1 / 27-1/27-2/59-1/59-2 - VOLTAGE PROTECTION / RED / - / ALARM = OVER/UNDER VOLTAGE PROTECTION LED-2 / CONTACTOR READY (TCS) / - / GREEN / OK = TCS OK (CONTACTOR READY) LED-3 / SYNCHRO CHECK / / GREEN / OK = SYNCHRONISM LED-4 / CONTACTOR READY TO CLOSE / - / GREEN / OK = CONTACTOR READY TO CLOSE LED-5 / 50-1/51-1/67-1/67-2 - TRIPPED / RED / - / ALARM = OVERCURRENT PROTECTION TRIPPED LED-6 / 51N/59N-1/59N-2 - TRIPPED / RED / - / ALARM = EARTH PROTECTION TRIPPED LED-7 / EARTHING SWITCH UNLOCKED / - / GREEN / OK = EARTHING SWITCH UNLOCKED LED-8 / RACK-IN/OUT ENABLED / - / GREEN / OK = CONTACTOR TRUCK UNLOCKED LED-9 / ARC PROTECTION TRIPPED / RED / - / ALARM = TRIP ARC PROTECTION LED-10 / GOOSE ALARM / RED / - / ALARM = GOOSE FAULT LED-11 / EMERGENCY OPENING BY SIG (ESD) / RED / - / ALARM = ESD TRIPPED LEDs PAGE 2 Item / NAME PLATE / COLOUR (ALARM / OK) / Note LED-12 / SPACE HEATER "ON" / RED / - / ALARM = SPACE HEATER "ON" LED-13 LED-14 LED-15 LED-16 LED-17 LED-18 LED-19 LED-20 LED-21 LED-22		
112	The K1 Contactor is in test position. Closing and opening K1 Contactor command, simulating (K1 in) service position with "commissioning bypass" Close K1 Contactor feeder - Place the selector SA1 in Local Position ..... ☐ - All permissive interlock signals are authorizing the contactor closing. ☐ - Close K1 Contactor by pressing push button S1C ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ..... ☐			

Step	Description	Result	Verified by	Date
	Open K1 Contactor feeder - Open K1 Contactor by pressing push button S2O ..... ☐ - Verify and confirm the Contactor status open via on board mechanical green signal ..... ☐ - See on FP1 Protection Relay Display if Contactor Opened is confirmed on REX640 HMI..... ☐			
113	ESD Test Signal from SIS Functioning test of the ESD signal (82xS002) that comes from SIS Contactor must be in test position and Closed (with commissioning Bypass) and SA2 Selector must be in Healthy position (Not Override), SIS sends to KSIL Relay an healthy signal and KSIL Relay is ON Send a trip signal from SIS: - K1 Contactor goes OFF ..... ☐ - KSIL Relay is off ..... ☐ Reinstate the healthy condition of K1 and KSIL relay - Place the SA2 Selector in Override position (ON)..... ☐ Send a trip signal from SIS - K1 Contactor remain ON ..... ☐ - KSIL Relay is off ..... ☐			
114	Before to close the K1 Contactor ensure and confirm that the BESS PACKAGE has Ready for Commissioning Certificate and it is available to receive the 6,6kV Power Supply			
115	Rack in K1 Contactor in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the			

Step	Description	Result	Verified by	Date
	following tests to be performed in the **final operational configuration.**			
116	A3 Unit – Feeder for BESS PACKAGE Confirm the conditions to close the K1 Contactor following: - On Unit A5 the voltage presence lamps C1 are ON..... ☐ - Led-2 "CONTACTOR READY (TCS)" on Unit A3 protection relay REX640 is green..... ☐ Close K1 Contactor, feeding downstream BESS PACKAGE - Place the selector SA1 in Local position ..... ☐ - All permissive interlock signals are authorizing the Contactor closing command. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00017 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN..... ☐ o LED-3 must be GREEN..... ☐ o LED-4 must be GREEN..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF..... ☐ o LED-11 must be OFF..... ☐ - Close K1 Contactor by pressing push button S1C..... ☐			

Step	Description	Result	Verified by	Date
	- Verify and confirm the Contactor status closed via on board mechanical red signal..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON..... ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ..... ☐			
117	A3 Unit – Feeder for BESS PACKAGE - Remote command Close K1 Contactor, feeding downstream BESS PACKAGE - Place the selector SA1 in Remote position ..... ☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF..... ☐ o LED-6 must be OFF..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close QM Breaker from EMCS System ..... ☐			

Step	Description	Result	Verified by	Date
	- Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON ..... ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ..... ☐ - Open K1 Contactor from EMCS System ..... ☐ - Verify and confirm the Contactor status opened via on board mechanical green signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are OFF ..... ☐			

5.4.4.3 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
UNIT A4 - TRANSFORMER TR-200DE1 FEEDER				
118	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
119	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			

Step	Description	Result	Verified by	Date
120	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			
121	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
122	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.4.4 SIS Safety Instrumented System - I/O signal from SIS to SG-100D1 UNIT A3

The following I/O list represent the hardwired signals that are connected on Unit A3 and they come from the SIS (Emergency Shut Down).

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	ITEM TAG
BESS FEEDER A-85000 "A3"		
EMERGENCY OPEN BY SIS BESS FEEDER A-85000	DIGITAL	82XS0002

Step	Description	Result	Verified by	Date
123	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.4.5 EMCS IEC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6.6kV SWBD: In detail it will be tested the functionalities provided on I/O lists vendor document 1723002197-EL-LIS-00041 with the A3 Unit BESS PACKAGE.

5.4.4.6 EMCS IEC61850 – A3 Unit I/O List

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS Relay REX640

DESCRITPION	SIGNAL TYPE	TAG SIGNAL
BESS FEEDER A-85000 "A3"		
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general
SYNCHRO "OK"	DIGITAL	LD0.LEDGGIO1.ST.Ind3.stVal
PROTECTION TRIPPED "59N-1"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "59N-2"	DIGITAL	LD0.ROVPTOV2.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "27-2"	DIGITAL	LD0.PHPTUV2.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
PROTECTION TRIPPED "59-2"	DIGITAL	LD0.PHPTOV2.ST.Op.general
PROTECTION TRIPPED "67-1"	DIGITAL	LD0.DPHLPDOC1.ST.Op.general
PROTECTION TRIPPED "67-2"	DIGITAL	LD0.DPHLPDOC2.ST.Op.general

DESCRITPION	SIGNAL TYPE	TAG SIGNAL
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
V.T. HEALTLY CIRCUIT	DIGITAL	LD0.SCBIGGIO1.ST.Ind2.stVal
INTERTRIP SEND TO L.V. SWITCHBOARD	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal
Contactor CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
Contactor OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO3.stVal

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DESCRITPION	SIGNAL TYPE	TAG SIGNAL
Contactor READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
Contactor READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
PROTECTION RELAY UNIT 2 HEALTHY	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal
PROTECTION RELAY UNIT 4 HEALTHY	DIGITAL	LD0.SCBIGGIO1.ST.Ind6.stVal
SELECTOR SWITCH OF OVERRIDE (SIL ENABLED)	DIGITAL	LD0.SDBIGGIO1.ST.Ind9.stVal

Step	Description	Result	Verified by	Date
124	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

5.4.4.7 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
BESS FEEDER A-85000 "A3"			
Phase L1 - Temperature Detection - cable Compart.	12	40125	ΔT
Phase L2 - Temperature Detection - cable Compart.	12	40126	ΔT
Phase L3 - Temperature Detection - cable Compart.	12	40127	ΔT
Phase L1 - Temperature Detection - Contactor Compart.	12	40128	ΔT

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
Phase L2 - Temperature Detection - Contactor Compart.	12	40129	ΔT
Phase L3 - Temperature Detection - Contactor Compart.	12	40130	ΔT
Phase L1 - Temperature Detection - Main Bus Bar	12	40131	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	12	40132	ΔT

Step	Description	Result	Verified by	Date
125	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

5.4.4.8 OTP Worksite PHASE 4 Test Notes and Remarks

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5.4.4.9 OTP Worksite PHASE 4 Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.4.10 OTP Worksite PHASE 4 Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.5 PHASE 5 - Test with 6,6kV Main Power Supply of Unit A7 Feeder for FUEL CELL PACKAGE

5.4.5.1 OTP Steps WORKSITE - PHASE 5

It is foreseen that previous PHASE 2 is successfully performed. 6.6KV Switchboard is working in normal operation and no alarm pending.

In this Phase will be tested the Unit A7 Feeder for FUEL CELL PACKAGE with 6,6 kV from main busbar

In the following steps will be tested the energization of the FUEL CELL PACKAGE feeder, that it will be ready for commissioning. The test will be performed with load connected

- SS 83-00: 6,6 kV Switchboard
- SS 82-20: Power Transformer 1.25 MVA (TA30 FUEL CELL)
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-00: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System
- SS 80-00: Hydrogen Fuel Cell Package (A-80000)

5.4.5.2 Test Preparation

Verification of system and subsystem 6.6KV Power Distribution Switchboards Unit A7 is completed without punch lists or pending point that limit the power up.

Verify that Unit A7 Feeder for FUEL CELL PACKAGE is available.

Auxiliary power supplies in SG-100D1 are available from:

- UPS AC/DC 110V UP-200F1
- DISTRIBUTION BOARD AC 230V DP-200N1
- 24Vdc From MEASURING UNIT A5

The Unit A7 Feeder for FUEL CELL PACKAGE involved in this procedure must be available and ready for commissioning.

The test of all internal interconnections between units of 6.6KV Switchboard SG-100D1 are tested on Vendor SAT procedure 1723002197-QC-PRO-00046

The Unit A7 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

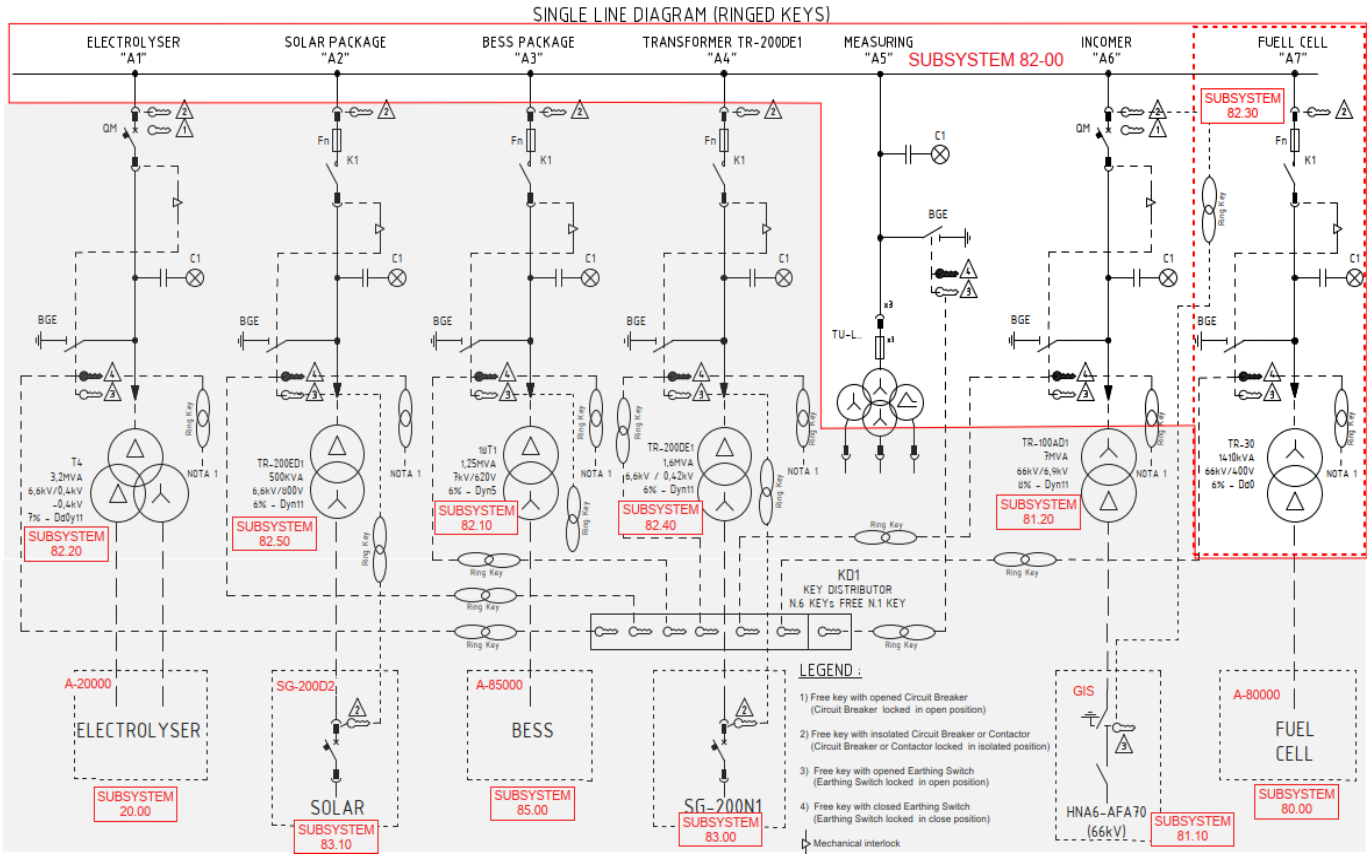
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A7 UNIT Feeder for FUEL CELL PACKAGE

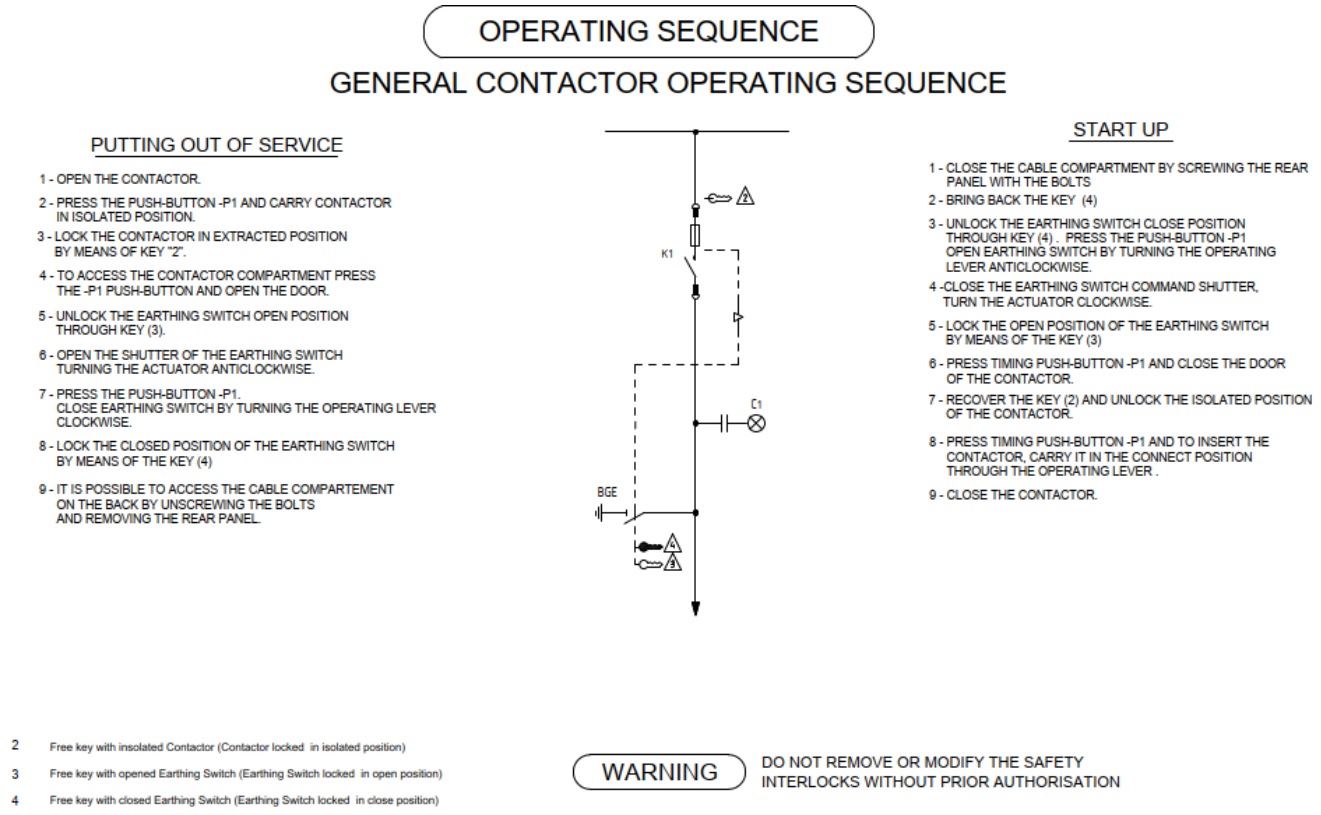
Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the main busbars are powered on, Unit A7 has its Earthing Switch (BGE) Closed and Its Contactor K1 is in extract position and opened, it is in isolated status.

The 6,6kV supply is provided from main busbar will be possible to change isolated status, only after the following safety checks.

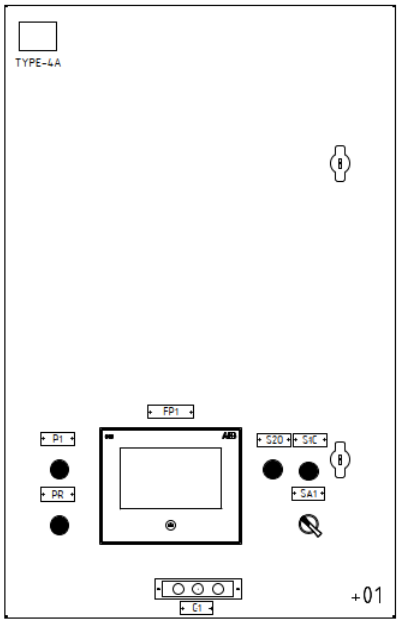
Step	Description	Result	Verified by	Date
	See the Feeder Unit A7 operating sequences to put the unit *out of service* or *in service*			
126	Verify and confirm that Unit A7 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-4 G3413/278 is on KD1 device. KEY-3 G3223, that is mechanically coupled (ringed) with safety device of FUEL CELL PACKAGE, it is locked on BGE Earthing Switch closed ..... ☐			



Step	Description	Result	Verified by	Date
	- K1 Contactor is locked in extract position and opened. KEY-2 19163 is locked on the LoTo Procedure..... ☐ *N.B.: See the Key interlocks details on section 5.4.1.4 SG-100D1 Interlocks & Key Interlocks*			
Unit preparation to receive 6,6kV from main busbar on Feeder Unit A7				
127	Ensure voltage reference on REX640 Protection relay: - Close MCB QV4 ..... ☐ - Close MCB QV5 ..... ☐ The protection relay is now available and ready to operate			
128	ESD Signal Healthy from SIS Ensure that the ESD signal from SIS is healthy (24Vdc), the KSIL (safety SIL relay) is ON. Measure between terminals: - XM 37-38 (24Vdc)..... ☐ *If SIS cabinet doesn't send the Healthy ESD signal, it needs to wait the availability of SIS system/Cabinet because the override is NOT present* *N.B.:* *XM 37-38=24Vdc ESD is Healthy and KSIL is ON* *XM 37-38=0Vdc ESD is Tripped and KSIL is OFF*			
129	The KEY-4 3413/281 is in KD1 device and it is withdrawable On Unit A7 - Take KEY-4 G3120/281 insert it on BGE and open Earthing Switch..... ☐ - KEY-3 G3223 is now unlocked and withdrawable to use it on FUEL CELL PACKAGE ..... ☐			
130	To unlock Contactor Feeder of Unit A7			

Step	Description	Result	Verified by	Date
	- K1 main Contactor is locked in extract position .....☐ - KEY-2 19163 is locked on LoTo procedure to keep Contactor isolated in compliance with project PTW Procedure .....☐ - KEY-4 G3413 is locked on BGE Earthing Switch .....☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 HMI will turn to green.....☐ - The internal Interlock is unlocking Rack in/out Contactor system. The KEY-2 19163 has been freed from PTW procedure, insert it on Rack in/out system and bring contactor in test position.....☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green .....☐			

Step	Description	Result	Verified by	Date
	Test the Unit A7 Feeder for FUEL CELL PACKAGE contactor Functionality with "commissioning bypass" activated simulating the K1 contactor in "service position" (N.B.: *contactor kept in test position but with full functionality of service position).* With reference Vendor doc. N° 1723002197-EL-DG-00019) Note: *See next section 5.4.4.5/6/7 EMCS IEC61850 – A7 Unit I/O list*			
131	Hardwired I/O signals between Unit A7 and FUEL CELL PACKAGE There are not hardwired connections between Unit A7 and FUEL CELL PACKAGE. There are the predispositions for some future signals. See following Available Opening Command Verify and confirm open contact between terminals - XM 9-10 ..... ☐ - XM 11-12 ..... ☐ - XM 13-14 ..... ☐			



DOOR LAY-OUT

DEVICES name plate

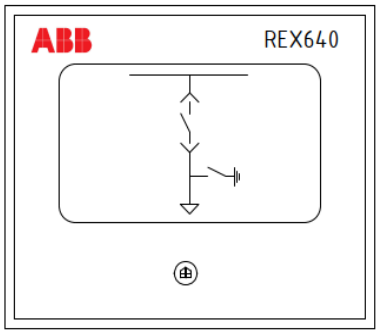
ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2O	PUSHBUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1C	PUSHBUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUSHBUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

Step	Description	Result	Verified by	Date
	Available trip contact on lockout relay (K86) circuits Verify and confirm open contact between terminals - XM 15-16.....☐ - XM 17-18.....☐ Available "transformer trip winding temperature" Verify and confirm open contact between terminals - XM 21-22.....☐ Available "transformer alarm winding temperature" Verify and confirm open contact between terminals - XM 27-28.....☐ Available external closing interlock Verify and confirm close contact between terminals - XM 23-24 (there is a jumper).....☐ - XM 25-26 (make a jumper).....☐ Available from LV SWBD – C.B. TEST POSITION Verify and confirm open contact between terminals - XM 29-30.....☐ Available from LV SWBD – TRIPPED Verify and confirm open contact between terminals - XM 31-32.....☐ Available Remote Opening Command			

Step	Description	Result	Verified by	Date
	Verify and confirm open contact between terminals - XM 33-34.....☐ Available signal for Contactor opened and in test position Confirm close contact with K1 contactor status opened or in test position: - XM 39-40.....☐ Available lock out relay K86 healthy (on Unit A7) to downstream device. Confirm open contact between terminals: - XM 41-42 .....☐ Available Closing LV SWBD command permissive signal – Contactor status closed + contactor in service position + Earthing switch opened to downstream device Confirm close contact with K1 contactor in service position (with "commissioning bypass") and Closed and BGE Earthing Switch opened - XM 43-44.....☐			

Step	Description	Result	Verified by	Date
	HMI of FP1 Protection Relay and its LEDs signalling			
132	The K1 Contactor is in test position. Closing and opening K1 Contactor command, simulating (K1 in) service position with "commissioning bypass" Close K1 Contactor feeder - Place the selector SA1 in Local Position ..... ☐ - All permissive interlock signals are authorizing the contactor closing. ..... ☐ - Close K1 Contactor by pressing push button S1C ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐			

PROTECTION DISPLAY



LHMI – TOUCH DISPLAY

- COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED
- PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 - VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 - TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 - TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIC (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI .....☐ Open K1 Contactor feeder - Open K1 Contactor by pressing push button S2O .....☐ - Verify and confirm the Contactor status open via on board mechanical green signal.....☐ - See on FP1 Protection Relay Display if Contactor Opened is confirmed on REX640 HMI .....☐			
133	ESD Test Signal from SIS Functioning test of the ESD signal (82xS003) that comes from SIS Contactor must be in test position and Closed (with commissioning Bypass), SIS sends to KSIL Relay an healthy signal and KSIL Relay is ON Send a trip signal from SIS: - K1 Contactor goes OFF .....☐ - KSIL Relay is off .....☐ Reinstate the healthy condition of K1 and KSIL relay			
134	Before to close the K1 Contactor ensure and confirm that the FUEL CELL PACKAGE has Ready for Commissioning Certificate and it is available to receive the 6,6kV Power Supply			
135	Rack in K1 Contactor in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the following tests to be performed in the final operational configuration.			
136	A7 Unit – Feeder for FUEL CELL PACKAGE			

Step	Description	Result	Verified by	Date
	Confirm the conditions to close the K1 Contactor following: - On Unit A5 the voltage presence lamps C1 are ON ..... ☐ - Led-2 "CONTACTOR READY (TCS)" on Unit A7 protection relay REX640 is green ..... ☐ Close K1 Contactor, feeding downstream FUEL CELL PACKAGE - Place the selector SA1 in Local position ..... ☐ - All permissive interlock signals are authorizing the Contactor closing command. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00019 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close K1 Contactor by pressing push button S1C ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON ..... ☐			

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI .....☐			
137	A7 Unit – Feeder for FUEL CELL PACKAGE - Remote command Close K1 Contactor, feeding downstream BESS PACKAGE - Place the selector SA1 in Remote position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF .....☐ o LED-2 must be GREEN.....☐ o LED-3 must be GREEN.....☐ o LED-4 must be GREEN.....☐ o LED-5 must be OFF .....☐ o LED-6 must be OFF .....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN.....☐ o LED-9 must be OFF .....☐ o LED-10 must be OFF.....☐ o LED-11 must be OFF.....☐ - Close QM Breaker from EMCS System .....☐ - Verify and confirm the Contactor status closed via on board mechanical red signal.....☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON.....☐			

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI .....☐ - Open K1 Contactor from EMCS System .....☐ - Verify and confirm the Contactor status opened via on board mechanical green signal .....☐ - Verify that the voltage presence lamps C1 on downstream busbar are OFF .....☐			

5.4.5.3 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
UNIT A4 - TRANSFORMER TR-200DE1 FEEDER				
138	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
139	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			
140	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			

Step	Description	Result	Verified by	Date
141	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
142	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.5.4 SIS Safety Instrumented System - I/O signal from SIS to SG-100D1 UNIT A7

The following I/O list represent the hardwired signals that are connected on Unit A7 and they come from the SIS (Emergency Shut Down).

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	ITEM TAG
FUELL CELL A-80000 "A7"		
EMERGENCY OPEN BY SIS FUEL CELL A-8000	DIGITAL	82XS0003

Step	Description	Result	Verified by	Date
143	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results..... ☐		

5.4.5.5 EMCS IEC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6.6kV SWBD: In detail it will be tested the functionalities provided on I/O lists vendor document 1723002197-EL-LIS-00041 with the A7 Unit FUEL CELL PACKAGE.

5.4.5.6 EMCS IEC61850 – A7 Unit I/O List

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS Relay REX640.

DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
FUELL CELL A-80000 "A7"		
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general
SYNCHRO "OK"	DIGITAL	LD0.LEDGGIO1.ST.Ind3.stVal
PROTECTION TRIPPED "59N-1"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "59N-2"	DIGITAL	LD0.ROVPTOV2.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "27-2"	DIGITAL	LD0.PHPTUV2.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
PROTECTION TRIPPED "59-2"	DIGITAL	LD0.PHPTOV2.ST.Op.general
PROTECTION TRIPPED "67-1"	DIGITAL	LD0.DPHLPDOC1.ST.Op.general

DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
PROTECTION TRIPPED "67-2"	DIGITAL	LD0.DPHLPDOC2.ST.Op.general
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
V.T. HEALTLY CIRCUIT	DIGITAL	LD0.SCBIGGIO1.ST.Ind2.stVal
INTERTRIP SEND TO L.V. SWITCHBOARD	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal
Contactor CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
Contactor OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal

DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO3.stVal
Contactor READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
Contactor READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
PROTECTION RELAY UNIT 6 HEALTHY	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal
AUXILIARY 230VAC HEALTHY (ALL SWITCHBOARD)	DIGITAL	LD0.SDBIGGIO1.ST.Ind7.stVal
TR-100AD1 GENERAL ALAM	DIGITAL	N.A.
MCB'S CLOSED (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind6.stVal
V.T. HEALTLY CIRCUIT (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind7.stVal
UPS 110VDC A SUPPLY "ON" (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind8.stVal
UPS 110VDC B SUPPLY "ON" (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind9.stVal
230VAC SUPPLY "ON" (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind10.stVal
24VDC SUPPLY "ON" (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind11.stVal
EARTHING SWITCH OPENED (FROM MEASURE UNIT A5)	DIGITAL	LD0.SCBIGGIO1.ST.Ind3.stVal

Step	Description	Result	Verified by	Date
144	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results .....☐		

5.4.5.7 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
FUELL CELL A-80000 "A7"			
Phase L1 - Temperature Detection - cable Compart.	15	40154	ΔT
Phase L2 - Temperature Detection - cable Compart.	15	40155	ΔT
Phase L3 - Temperature Detection - cable Compart.	15	40156	ΔT
Phase L1 - Temperature Detection - Contactor Compart.	15	40157	ΔT
Phase L2 - Temperature Detection - Contactor Compart.	15	40158	ΔT
Phase L3 - Temperature Detection - Contactor Compart.	15	40159	ΔT
Phase L1 - Temperature Detection - Main Bus Bar	15	40160	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	15	40161	ΔT

Step	Description	Result	Verified by	Date
145	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.5.8 OTP Worksite PHASE 5 Test Notes and Remarks

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Once printed shall be considered as "NOT CONTROLLED" copy.
File: 123A90-PML-COM-PRO-03046

5.4.5.9 OTP Worksite PHASE 5 Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.5.10 OTP Worksite PHASE 5 Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.6 PHASE 6 - Test with 6,6kV Main Power Supply of Unit A1 Feeder for ELECTROLYSER PACKAGE

5.4.6.1 OTP Steps WORKSITE - PHASE 6

It is foreseen that previous PHASE 2 is successfully performed. 6.6KV Switchboard is working in normal operation and no alarm pending.

In this Phase will be tested the Unit A1 Feeder for ELECTROLYSER TRANSFORMER PACKAGE with 6,6 kV from main busbar

In the following steps the functionality of the 6.6KV Switchboard shall be tested for:

- SS 83-00: 6,6 kV Switchboard
- SS 82-20: Power Transformer 3.15 MVA (T4 ELECTROLYSER)
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-00: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System
- SS 20-00: ELECTROLYSER

5.4.6.2 Test Preparation

Verification of system and subsystem 6.6KV Power Distribution Switchboards Unit A1 is completed without punch lists or pending point that limit the power up.

Verify that Unit A1 Feeder for ELECTROLYSER TRANSFORMER PACKAGE is available.

Auxiliary power supplies in SG-100D1 are available from:

- UPS AC/DC 110V UP-200F1
- DISTRIBUTION BOARD AC 230V DP-200N1
- 24Vdc From MEASURING UNIT A5

The list electrical hardwired interlocks are between QM Breaker of Unit A1 and LV SWBD SG-200N1 Incomer.

The Unit A1 Feeder for ELECTROLYSER TRANSFORMER PACKAGE involved in this procedure must be available and ready for commissioning.

The test of all internal interconnections between units of 6.6KV Switchboard SG-100D1 are tested on Vendor SAT procedure 1723002197-QC-PRO-00046

The Unit A4 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

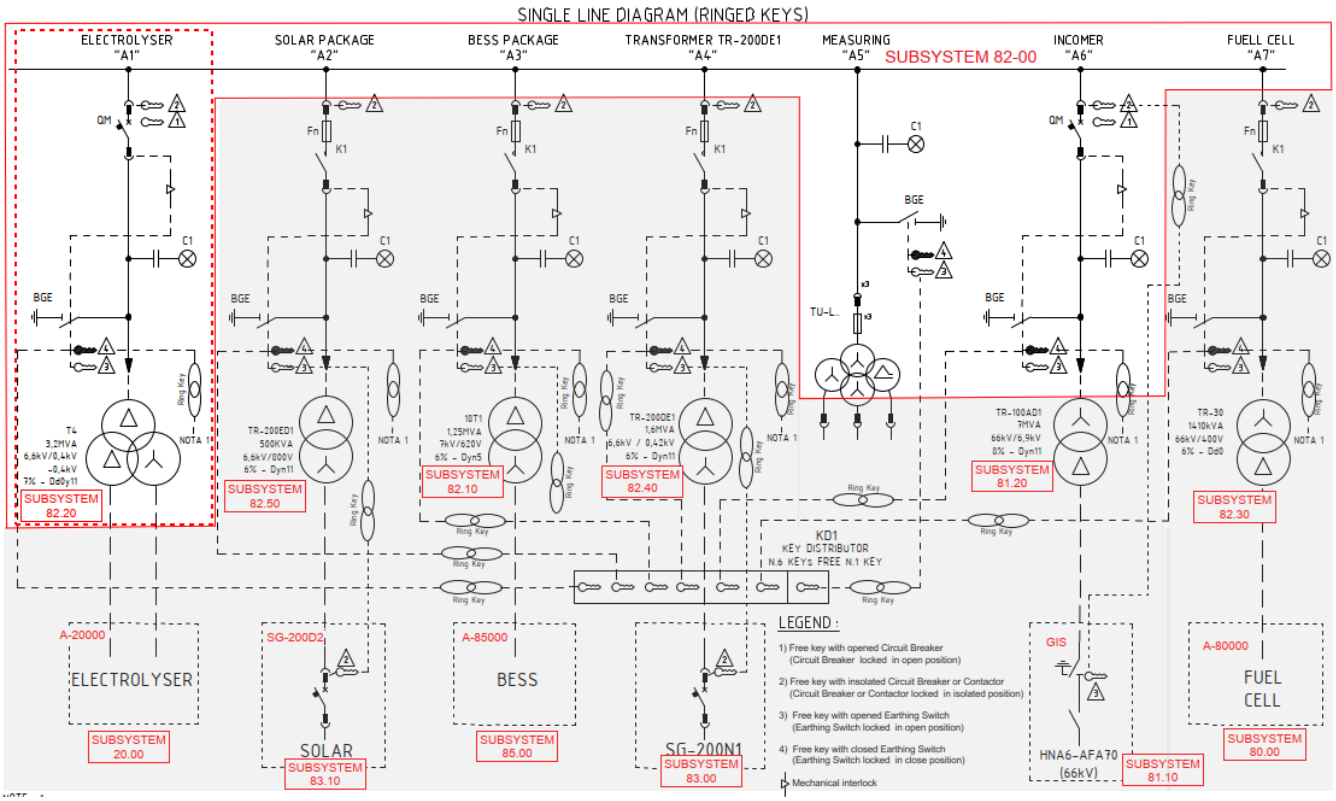
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A1 UNIT Feeder for ELECTROLYSER TRANSFORMER PACKAGE

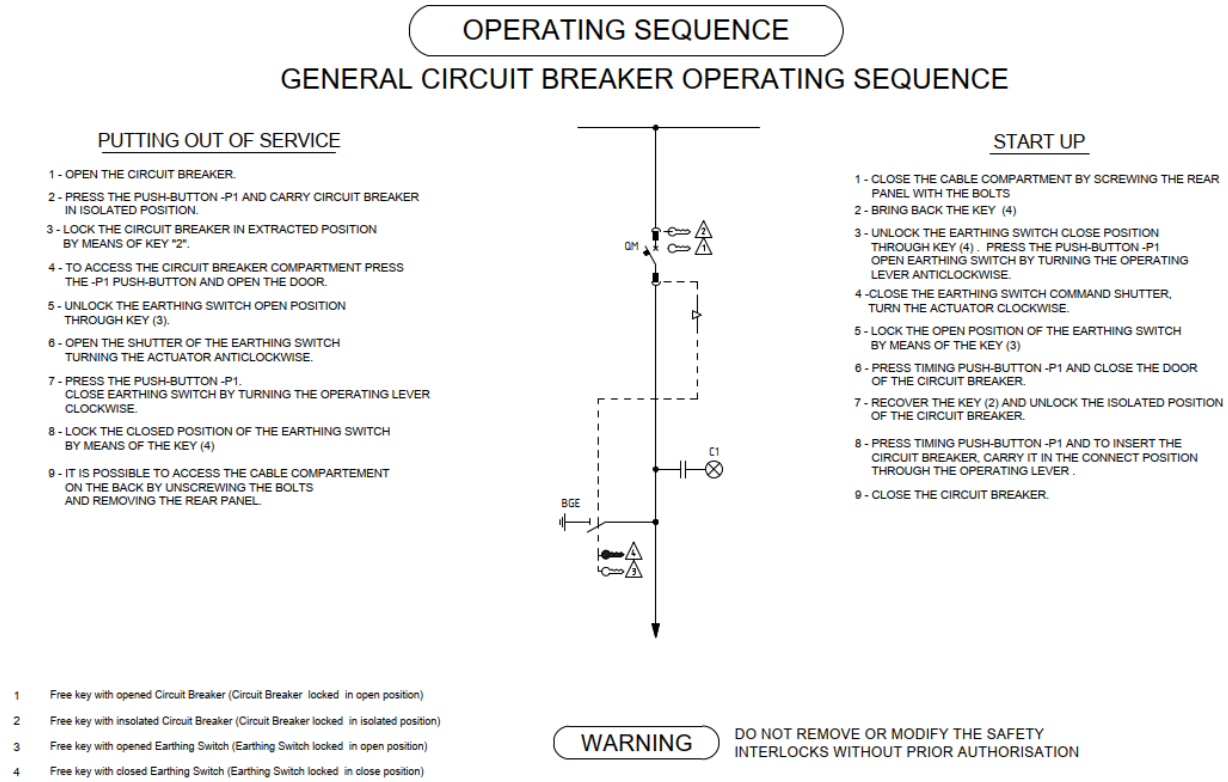
Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the main busbars are powered on, Unit A1 has its Earthing Switch (BGE) Closed and Its QM Breaker is in extract position and opened, it is in isolated status.

The 6,6kV supply is provided from main busbar will be possible to change isolated status, only after the following safety checks.

Step	Description	Result	Verified by	Date
	See the Feeder Unit A1 operating sequences to put the unit *out of service* or *in service*			
146	Verify and confirm that **Unit A1** is in safety status with following checks: - BGE Earthing Switch is locked in closed position. **KEY-4 G3220/283** is on KD1 device. **KEY-3 G3477**, that is mechanically coupled (ringed) with **safety device** of **ELECTROLYSER TRANSFORMER PACKAGE,** it is locked on BGE Earthing Switch closed ..... ☐ - QM Breaker is locked in extract position and opened. **KEY-2 14742** is locked on the LoTo Procedure . ☐			



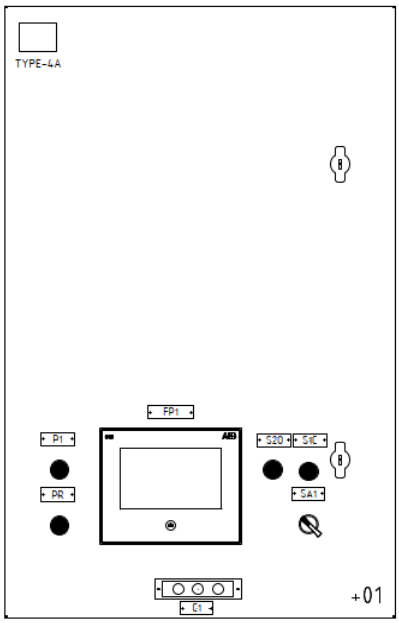
Step	Description	Result	Verified by	Date
	N.B.: See the Key interlocks details on section 5.4.1.4 SG-100D1 Interlocks & Key Interlocks			
Unit preparation to receive 6,6kV from main busbar on Feeder Unit A1				
147	Ensure voltage reference on REX640 Protection relay: - Close MCB QV4 .....☐ - Close MCB QV5 .....☐ The protection relay is now available and ready to operate			
148	The KEY-4 3413/281 is in KD1 device and it is withdrawable On Unit A7 - Take KEY-4 G3120/281 insert it on BGE and open Earthing Switch ....☐ - KEY-3 G3223 is now unlocked and withdrawable to use it on ELECTROLYSER TRANSFORMER PACKAGE .....☐			
149	To unlock Breaker Feeder of Unit A7 - QM main Breaker is locked in extract position .....☐ - KEY-2 14742 is locked on LoTo procedure to keep breaker isolated in compliance with project PTW Procedure .....☐ - KEY-4 G3413 is locked on BGE Earthing Switch .....☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 HMI will turn to green .....☐ - The internal Interlock is unlocking Rack in/out Breaker system. The KEY-2 19163 has been freed from PTW procedure, insert it on Rack in/out system and bring Breaker in test position .....☐			

Step	Description	Result	Verified by	Date
	- Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green .....☐			

Test the Unit A1 Feeder for ELECTROLYSER TRANSFORMER PACKAGE Breaker Functionality with "commissioning bypass" activated simulating the QM Breaker in "service position" (N.B.: *Breaker kept in test position but with full functionality of service position).*

With reference Vendor doc. N° 1723002197-EL-DG-00018)

Note: *See next section 5.4.4.5/6/7 EMCS IEC61850 – A1 Unit I/O list*



DOOR LAY-OUT

DEVICES name plate

ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2O	PUSHBUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1C	PUSHBUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUSHBUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

150	Hardwired I/O signals between Unit A1 and ELECTROLYSER TRANSFORMER PACKAGE There are not hardwired connections between Unit A1 and ELECTROLYSER TRANSFORMER PACKAGE There are the predispositions for some future signals. See following Available Opening Command Verify and confirm open contact between terminals			

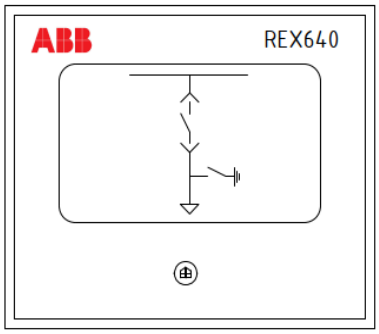
Step	Description	Result	Verified by	Date
	- XM 11-12.....☐ - XM 13-14.....☐ - XM 15-16.....☐ - XM 17-18.....☐ Available trip contact on lock out relay (K86) circuits Verify and confirm open contact between terminals - XM 19-20.....☐ - XM 21-22.....☐ Available "transformer trip winding temperature" Verify and confirm open contact between terminals - XM 29-30.....☐ Available "transformer alarm winding temperature" Verify and confirm open contact between terminals - XM 43-44.....☐ Available external closing interlock Verify and confirm close contact between terminals - XM 31-32 (there is a jumper) .....☐ - XM 33-34 (make a jumper).....☐ Available "transformer trip oil temperature" Verify and confirm open contact between terminals - XM 25-26.....☐			

Step	Description	Result	Verified by	Date
	Available "transformer alarm oil temperature" Verify and confirm open contact between terminals - XM 37-38.....☐ Available "transformer trip oil pressure relay" Verify and confirm open contact between terminals - XM 27-28.....☐ Available "transformer alarm oil pressure relay" Verify and confirm open contact between terminals - XM 41-42.....☐ Available from downstream SWBD – C.B. TEST POSITION Verify and confirm open contact between terminals - XM 45-46.....☐ Available from downstream SWBD – C.B. TRIPPED Verify and confirm open contact between terminals - XM 47-48.....☐ Available Remote Opening Command Verify and confirm open contact between terminals - XM 49-50.....☐ - XM 51-52.....☐			

Step	Description	Result	Verified by	Date
	Available signal for Breaker opened and in test position Confirm close contact with QM Breaker status opened or in test position: - XM 55-56.....☐ Available lock out relay K86 healthy (on Unit A7) to downstream device. Confirm open contact between terminals: - XM 57-58 .....☐ Available Closing command permissive signal – Breaker status closed + Breaker in service position + Earthing switch opened to downstream device Confirm close contact with QM Breaker in service position (with "commissioning bypass") and Closed and BGE Earthing Switch opened - XM 59-60.....☐			

Step	Description	Result	Verified by	Date
	HMI of FP1 Protection Relay and its LEDs signalling			
151	The QM Breaker is in test position. Closing and opening QM Breaker command, simulating (QM in) service position with "commissioning bypass" Close QM Breaker feeder - Place the selector SA1 in Local Position .....☐ - All permissive interlock signals are authorizing the Breaker closing..☐ - Close QM Breaker by pressing push button S1C.....☐ - Verify and confirm the Breaker status closed via on board mechanical red signal .....☐			

PROTECTION DISPLAY



LHMI – TOUCH DISPLAY

- COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED
- PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 - VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 - TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 - TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIG (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐ Open QM Breaker feeder - Open QM Breaker by pressing push button S2O .....☐ - Verify and confirm the Breaker status open via on board mechanical green signal.....☐ - See on FP1 Protection Relay Display if Breaker Opened is confirmed on REX640 HMI .....☐			
152	Before to close the QM Breaker ensure and confirm that the ELECTROLYSER TRANSFORMER PACKAGE has Ready for Commissioning Certificate and it is available to receive the 6,6kV Power Supply			
153	Rack in QM Breaker in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the following tests to be performed in the final operational configuration.			
154	A1 Unit – Feeder for ELECTROLYSER TRANSFORMER PACKAGE Confirm the conditions to close the QM Breaker following: - On Unit A5 the voltage presence lamps C1 are ON .....☐ - Led-2 "BREAKER READY (TCS)" on Unit A7 protection relay REX640 is green .....☐ Close QM Breaker, feeding downstream ELECTROLYSER TRANSFORMER PACKAGE - Place the selector SA1 in Local position .....☐			

Step	Description	Result	Verified by	Date
	- All permissive interlock signals are authorizing the Breaker closing command. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00019 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ..... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close QM Breaker by pressing push button S1C ..... ☐ - Verify and confirm the Breaker status closed via on board mechanical red signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON ..... ☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI ..... ☐			
155	A1 Unit – Feeder for ELECTROLYSER TRANSFORMER PACKAGE - **Remote** command Close QM Breaker, feeding downstream ELECTROLYSER TRANSFORMER PACKAGE - Place the selector SA1 in Remote position ..... ☐			

Step	Description	Result	Verified by	Date
	- All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF .....☐ o LED-2 must be GREEN.....☐ o LED-3 must be GREEN.....☐ o LED-4 must be GREEN.....☐ o LED-5 must be OFF .....☐ o LED-6 must be OFF .....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN.....☐ o LED-9 must be OFF .....☐ o LED-10 must be OFF.....☐ o LED-11 must be OFF.....☐ - Close QM Breaker from EMCS System .....☐ - Verify and confirm the Breaker status closed via on board mechanical red signal.....☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON.....☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐ - Open QM Breaker from EMCS System .....☐ - Verify and confirm the Breaker status opened via on board mechanical green signal .....☐ - Verify that the voltage presence lamps C1 on downstream busbar are OFF .....☐			

5.4.6.3 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
UNIT A1 - ELECTROLYSER TRANSFORMER PACKAGE FEEDER				
156	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
157	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			
158	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			
159	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
160	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.6.4 SIS Safety Instrumented System - I/O signal from SIS to SG-100D1 UNIT A1

Not applicable

5.4.6.5 EMCS IEC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6.6kV SWBD: In detail it will be tested the functionalities provided on I/O lists vendor document 1723002197-EL-LIS-00041 with the A7 Unit FUEL CELL PACKAGE.

5.4.6.6 EMCS IEC61850 – A1 Unit I/O List

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS Relay REX640

DESCRIPTION	SIGNAL TYPE	TAG SIGNAL
ELECTROLYSER FEEDER A-20000 "A1"		
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general
PROTECTION TRIPPED "59N"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f

DESCRIPTION	SIGNAL TYPE	TAG SIGNAL
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSFORMER PROTECTION TRIPPED "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind9.stVal
TRANSFORMER PROTECTION ALARM "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind8.stVal
TRANSFORMER PROTECTION TRIPPED "OIL PRESSURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind12.stVal
TRANSFORMER PROTECTION ALARM "OIL PRESSURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind11.stVal
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
V.T. HEALTLY CIRCUIT	DIGITAL	LD0.SCBIGGIO1.ST.Ind2.stVal
INTERTRIP SEND TO L.V. SWITCHBOARD	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal
C.B. CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
C.B. OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO3.stVal
C.B. READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
C.B. READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal

DESCRIPTION	SIGNAL TYPE	TAG SIGNAL
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
PROTECTION RELAY UNIT 7 HEALTHY	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal

Step	Description	Result	Verified by	Date
161	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.6.7 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
ELECTROLYSER FEEDER A-20000 "A1"			
Phase L1 - Temperature Detection - cable Compart.	10	40109	ΔT
Phase L2 - Temperature Detection - Câble Compart.	10	40110	ΔT
Phase L3 - Temperature Detection - cable Compart.	10	40111	ΔT
Phase L1 - Temperature Detection - C.B. Compart.	10	40112	ΔT
Phase L2 - Temperature Detection - C.B. Compart.	10	40113	ΔT
Phase L3 - Temperature Detection - C.B. Compart.	10	40114	ΔT

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
Phase L1 - Temperature Detection - Main Bus Bar	10	40115	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	10	40116	ΔT

Step	Description	Result	Verified by	Date
162	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.6.8 OTP Worksite PHASE 6 Test Notes and Remarks

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5.4.6.9 OTP Worksite PHASE 6 Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.6.10 OTP Worksite PHASE 6 Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.4.7 PHASE 7 - Test with 6,6kV Main Power Supply of Feeder for Solar PV Package Power Transformer TR-200ED1

5.4.7.1 OTP Steps WORKSITE - PHASE 7

It is foreseen that previous PHASE 2 is successfully performed. 6.6KV Switchboard is working in normal operation and no alarm pending.

In this Phase will be tested the Unit A2 Feeder for Solar PV Package Power Transformer TR-200ED1 with 6,6 kV from main busbar.

In the following steps will be tested the energization of the Solar PV Package Power Transformer TR-200ED1 feeder, that it will be ready for commissioning. The test will be performed with load connected

In the following steps the functionality of the 6.6KV Switchboard shall be tested for:

- SS 83-00: 6,6 kV Switchboard
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-00: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System
- SS 82-50: Solar PV Package Power Transformer 0.5 MVA (TR-200ED1)
- SS 83-10: 400 V Switchboard Solar (SG-200D2) – SOLAR PACKAGE

5.4.7.2 Test Preparation

Verification of system and subsystem 6.6KV Power Distribution Switchboards Unit A2 is completed without punch lists or pending point that limit the power up.

Verify that Unit A2 Feeder for Solar PV Package Power Transformer TR-200ED1 is available.

Auxiliary power supplies in SG-100D1 are available from:

- UPS AC/DC 110V UP-200F1
- DISTRIBUTION BOARD AC 230V DP-200N1
- 24Vdc From MEASURING UNIT A5

The Unit A2 Feeder for Solar PV Package Power Transformer TR-200ED1 involved in this procedure must be available and ready for commissioning.

The test of all internal interconnections between units of 6.6KV Switchboard SG-100D1 are tested on Vendor SAT procedure 1723002197-QC-PRO-00046

The Unit A2 auxiliary circuits are powered, protection relay and all internal devices are ready to work.

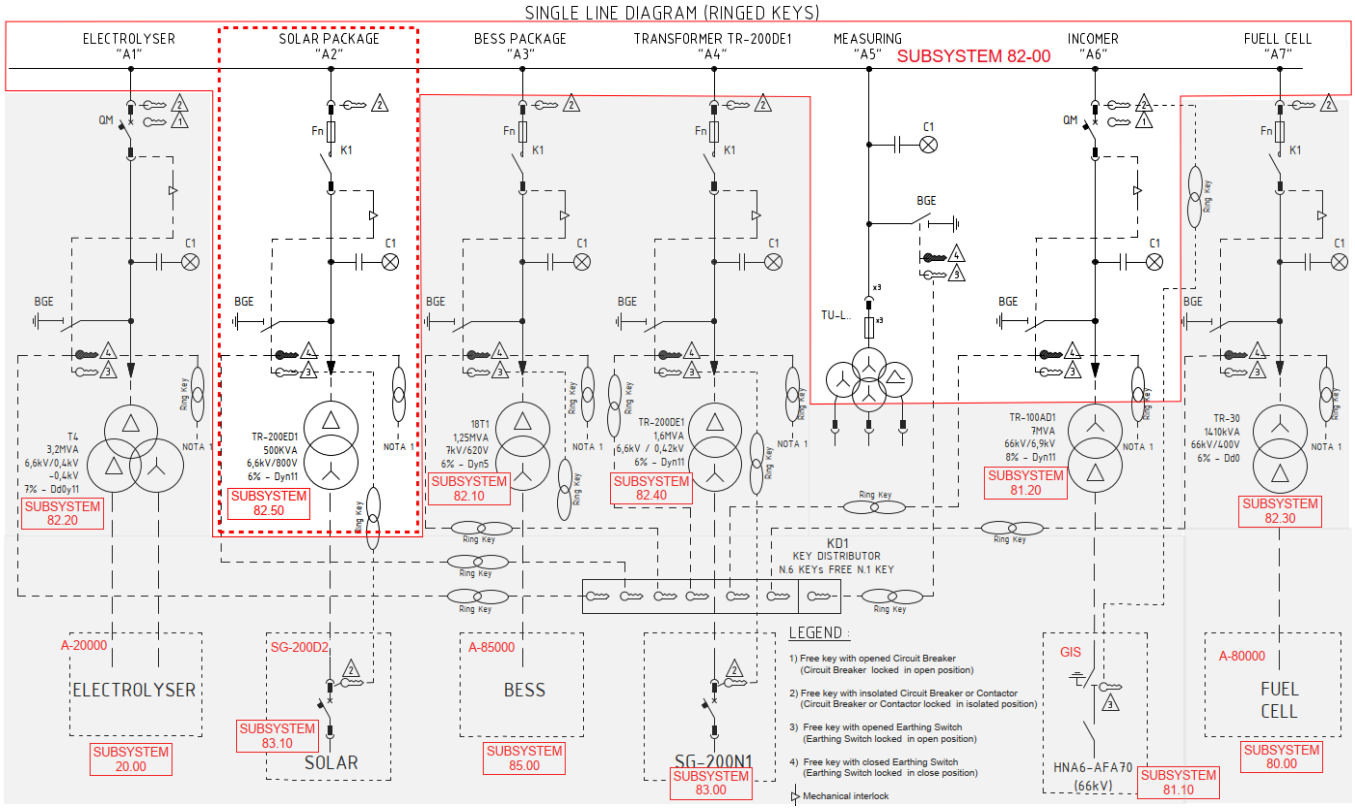
To perform the I/O signal tests is mandatory that the EMCS cabinet – IEC 61850 network system – Modbus TCP-IP network system - are already tested, available and ready to work.

To test all signals, refer to specific electrical pre-commissioning ITRs, they will be used to test the specific functioning of all I/O.

Step	Description	Result	Verified by	Date

SG-100D1 6.6KV Switchboard - Energization A2 UNIT Feeder for Solar PV Package Power Transformer TR-200ED1

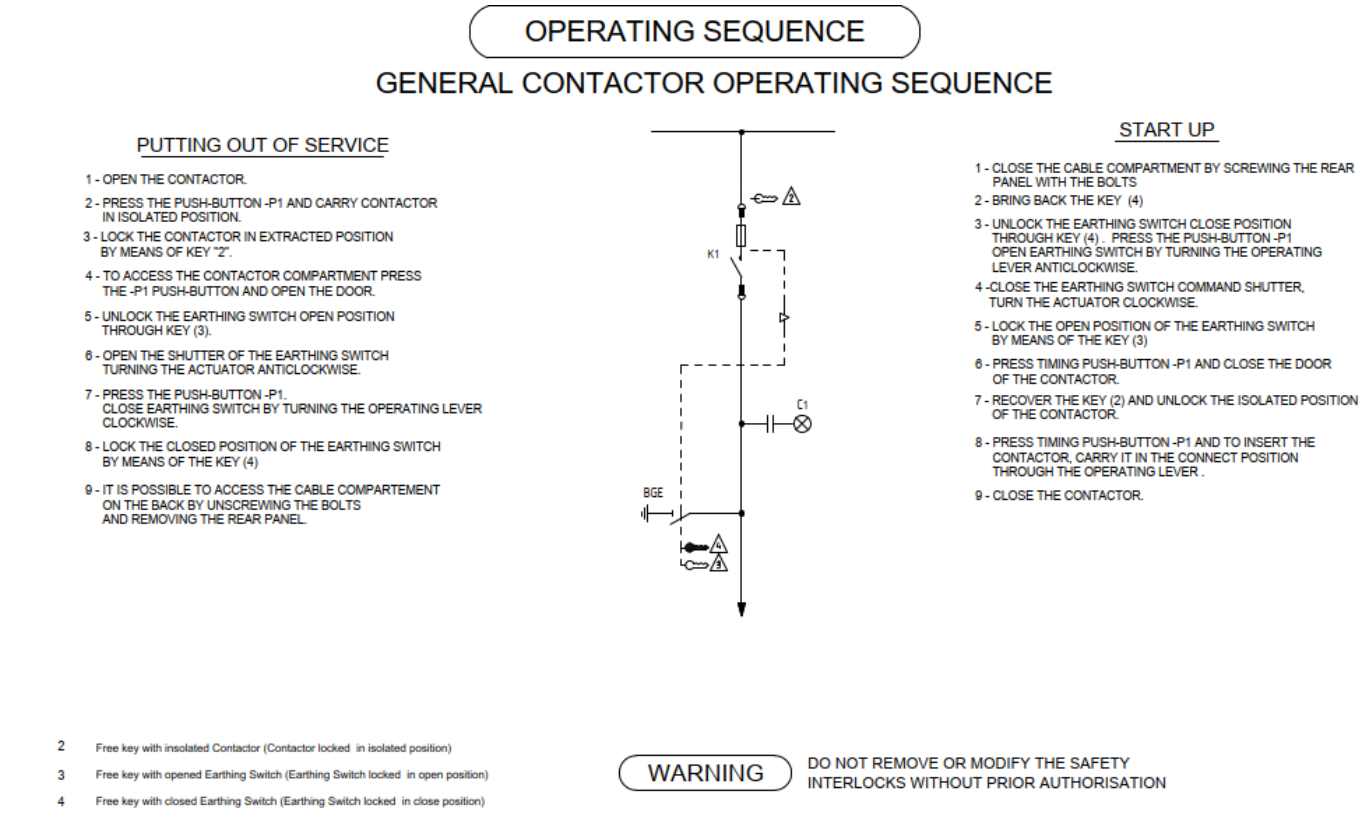
Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015)



The test starts with SWBD in safety status, the main busbars are powered on, Unit A2 has its Earthing Switch (BGE) Closed and Its Contactor K1 is in extract position and opened, it is in isolated status.

The 6,6kV supply is provided from main busbar will be possible to change isolated status, only after the following safety checks.

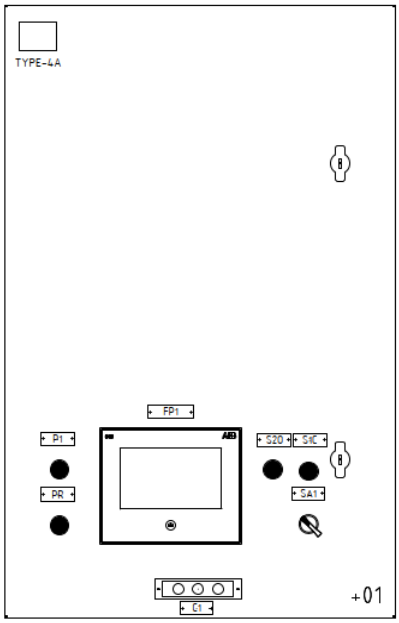
Step	Description	Result	Verified by	Date
	See the Feeder Unit A2 operating sequences to put the unit *out of service* or *in service*			
163	Verify and confirm that Unit A2 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-4 G3141/282 is on KD1 device. KEY-3 G3476, that is mechanically coupled (ringed) with safety device of Solar PV Package Power Transformer TR-200ED1, it is locked on BGE Earthing Switch closed ..... ☐ - K1 Contactor is locked in extract position and opened. KEY-2 14157 is locked on the LoTo Procedure ..... ☐			



Step	Description	Result	Verified by	Date
	N.B.: See the Key interlocks details on section 5.4.1.4 SG-100D1 Interlocks & Key Interlocks			
Unit preparation to receive 6,6kV from main busbar on Feeder Unit A2				
164	Ensure voltage reference on REX640 Protection relay: - Close MCB QV4 .....☐ - Close MCB QV5 .....☐ The protection relay is now available and ready to operate			
165	ESD Signal Healthy from SIS Ensure that the ESD signal from SIS is healthy (24Vdc), the KSIL (safety SIL relay) is ON. Measure between terminals: - XM 51-52 (24Vdc) .....☐ *N.B. If SIS system doesn't send the Healthy ESD signal, it needs to wait the availability of SIS system/Cabinet because the override is NOT present* *N.B.:* XM 51-52=24Vdc ESD is Healthy and KSIL is ON XM 51-52=0Vdc ESD is Tripped and KSIL is OFF			
166	The KEY-4 3114/282 is in KD1 device and it is withdrawable On Unit A2 - Take KEY-4 3114/282 insert it on BGE and open Earthing Switch.....☐ - KEY-3 G3476 is now unlocked and withdrawable to use it on Solar PV Package Power Transformer 0.5 MVA (TR-200ED1) .....☐			
167	To unlock Contactor Feeder of Unit A2			

Step	Description	Result	Verified by	Date
	- K1 main Contactor is locked in extract position .....☐ - KEY-2 14157 is locked on LoTo procedure to keep Contactor isolated in compliance with project PTW Procedure.....☐ - KEY-4 G3114 is locked on BGE Earthing Switch .....☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 HMI will turn to green .....☐ - The internal Interlock is unlocking Rack in/out Contactor system. The KEY-2 14157 has been freed from PTW procedure, insert it on Rack in/out system and bring contactor in test position.....☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green.....☐			

Step	Description	Result	Verified by	Date
	Test the Unit A2 Feeder for Solar PV Package Power Transformer TR-200ED1 contactor Functionality with "commissioning bypass" activated simulating the K1 contactor in "service position" (N.B.: *contactor kept in test position but with full functionality of service position).* With reference Vendor doc. N° 1723002197-EL-DG-00020) Note: *See next section 5.4.4.5/6/7 EMCS IEC61850 – A2 Unit I/O list*			
168	Hardwired I/O signals between Unit A2 and Solar PV Package Power Transformer TR-200ED1 There are not hardwired connections between Unit A2 and Solar PV Package Power Transformer TR-200ED1. There are the predispositions for some future signals. See following Available Opening Command Verify and confirm open contact between terminals - XM 9-10 .....☐ - XM 11-12 .....☐ - XM 13-14 .....☐			



DOOR LAY-OUT

DEVICES name plate

ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2O	PUSHBUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1C	PUSHBUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUSHBUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

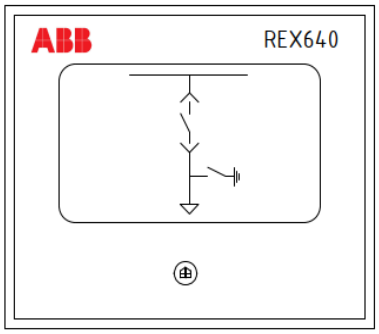
Step	Description	Result	Verified by	Date
	Available trip contact on lockout relay (K86) circuits Verify and confirm open contact between terminals - XM 15-16 .....☐ - XM 17-18 .....☐ "Transformer winding temperature" Verify and confirm open contact between terminals - XM 27-28 (trip).....☐ - XM 41-42 (alarm)..... ☐ Transformer Relay Buchholz Verify and confirm open contact between terminals - XM 21-22 trip .....☐ - XM 33-34 alarm ..... ☐ Transformer Oil Temperature Verify and confirm open contact between terminals - XM 23-24 trip .....☐ - XM 35-36 alarm ..... ☐ Transformer Pressure Relay Verify and confirm open contact between terminals - XM 25-26 trip .....☐ - XM 39-40 alarm ..... ☐ Transformer Oil Level Verify and confirm open contact between terminals - XM 37-38 Level.....☐			

Step	Description	Result	Verified by	Date
	Available external closing interlock Verify and confirm close contact between terminals - XM 29-30 (disconnect jumper) .....☐ External closing interlock from L.V. SWBD CB OPENED Verify and confirm close contact between terminals - XM 31-32 .....☐ From LV SWBD – C.B. TEST POSITION Verify and confirm open contact between terminals - XM 43-44 .....☐ From LV SWBD – TRIPPED Verify and confirm open contact between terminals - XM 45-46 .....☐ Available Remote Opening Command Verify and confirm open contact between terminals - XM 47-48 .....☐ - XM 49-50 .....☐ Available signal for Contactor opened and in test position to LV SWBD Confirm close contact with K1 contactor status opened or in test position: - XM 53-54 .....☐ Available lock out relay K86 healthy (on Unit A2) to LV SWBD.			

Step	Description	Result	Verified by	Date
	Confirm open contact between terminals: - XM 55-56 .....☐ Available Closing LV SWBD command permissive signal – Contactor status closed + contactor in service position + Earthing switch opened to LV SWBD Confirm close contact with K1 contactor in service position (with "commissioning bypass") and Closed and BGE Earthing Switch opened - XM 57-58 .....☐			

Step	Description	Result	Verified by	Date
	HMI of FP1 Protection Relay and its LEDs signalling			
169	The K1 Contactor is in test position. Closing and opening K1 Contactor command, simulating (K1 in) service position with "commissioning bypass" Close K1 Contactor feeder - Place the selector SA1 in Local Position ..... ☐ - All permissive interlock signals are authorizing the contactor closing. ..... ☐ - Close K1 Contactor by pressing push button S1C..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ☐			

PROTECTION DISPLAY



LHMI – TOUCH DISPLAY

- COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED
- PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 – VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 – TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 – TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIG (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	- See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ... ☐ Open K1 Contactor feeder - Open K1 Contactor by pressing push button S2O .... ☐ - Verify and confirm the Contactor status open via on board mechanical green signal ..... ☐ - See on FP1 Protection Relay Display if Contactor Opened is confirmed on REX640 HMI ... ☐			
170	ESD Test Signal from SIS Functioning test of the ESD signal (82xS003) that comes from SIS Contactor must be in test position and Closed (with commissioning Bypass), SIS sends to KSIL Relay an healthy signal and KSIL Relay is ON Send a trip signal from SIS: - K1 Contactor goes OFF ..... ☐ - KSIL Relay is off ..... ☐ Reinstate the healthy condition of K1 and KSIL relay			
171	Before to close the K1 Contactor ensure and confirm that the Solar PV Package Power Transformer TR-200ED1 has Ready for Commissioning Certificate and it is available to receive the 6,6kV Power Supply			
172	Rack in K1 Contactor in SERVICE position and confirm that it is available. N.B.: ensure that the "commissioning bypass" has been disabled to allow the following tests to be performed in the final operational configuration.			

Step	Description	Result	Verified by	Date
173	A2 Unit – Feeder for Solar PV Package Power Transformer TR-200ED1 Confirm the conditions to close the K1 Contactor following: - On Unit A5 the voltage presence lamps C1 are ON .. ☐ - Led-2 "CONTACTOR READY (TCS)" on Unit A2 protection relay REX640 is green ..... ☐ Close K1 Contactor, feeding downstream Solar PV Package Power Transformer TR-200ED1 - Place the selector SA1 in Local position ..... ☐ - All permissive interlock signals are authorizing the Contactor closing command. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00019 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN ..... ☐ o LED-3 must be GREEN ..... ☐ o LED-4 must be GREEN ..... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN .... ☐ o LED-8 must be GREEN ..... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF ..... ☐ o LED-11 must be OFF ..... ☐ - Close K1 Contactor by pressing push button S1C..... ☐			

Step	Description	Result	Verified by	Date
	- Verify and confirm the Contactor status closed via on board mechanical red signal ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON . ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI ... ☐			
174	A2 Unit – Feeder for Solar PV Package Power Transformer TR-200ED1 - Remote command Close K1 Contactor, feeding Solar PV Package Power Transformer TR-200ED1 - Place the selector SA1 in Remote position ..... ☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF ..... ☐ o LED-2 must be GREEN.... ☐ o LED-3 must be GREEN.... ☐ o LED-4 must be GREEN.... ☐ o LED-5 must be OFF ..... ☐ o LED-6 must be OFF ..... ☐ o LED-7 must be GREEN ... ☐ o LED-8 must be GREEN.... ☐ o LED-9 must be OFF ..... ☐ o LED-10 must be OFF..... ☐ o LED-11 must be OFF..... ☐			

Step	Description	Result	Verified by	Date
	- Close K1 Contactor from EMCS System ..... ☐ - Verify and confirm the Contactor status closed via on board mechanical red signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are ON ☐ - See on FP1 Protection Relay Display if Contactor Closed is confirmed on REX640 HMI . ☐ - Open K1 Contactor from EMCS System ..... ☐ - Verify and confirm the Contactor status opened via on board mechanical green signal ..... ☐ - Verify that the voltage presence lamps C1 on downstream busbar are OFF ..... ☐			

5.4.7.3 230Vac Auxiliary devices tests

The 230Vac auxiliary devices tests consist in the verification of internal lighting, internal space heater and internal socket.

Step	Description	Result	Verified by	Date
UNIT A4 - TRANSFORMER TR-200DE1 FEEDER				
175	Verify and confirm 230Vac auxiliary power is present between following terminals, take the value: - XC 9-11 (230V) V			
176	Power up 230Vac auxiliary circuits. - Close MCB QA2 .....☐			

Step	Description	Result	Verified by	Date
177	Internal Lighting test. The internal lighting is installed only inside the auxiliary compartment. There is a limit switch LS that switch on light with opened door and switch off it with door closed. - Verify and confirm.....☐			
178	Internal space heater test The internal space heater is installed only inside the auxiliary compartment. The thermostat HGR is installed inside the same compartment, its range is -10 ÷ +80°C. Decrease the set point till switch on the space heater and KGR relay will be ON. - Verify and confirm.....☐ - Led-12 "SPACE HEATER ON" on protection relay REX640 HMI will turn to red .....☐			
179	Internal 230Vac Socket test The internal 230Vac Socket XS1 is installed only inside the auxiliary compartment. Take a Multimeter and measure the voltage between socket poles. - Verify and confirm (230Vac).....☐			

5.4.7.4 SIS Safety Instrumented System - I/O signal from SIS to SG-100D1 UNIT A2

The following I/O list represent the hardwired signals that are connected on Unit A2 and they come from the SIS (Emergency Shut Down).

SIGNAL_DESCRIPTION	TYPE ANALOG/DIGITAL	ITEM TAG
TRANSFORMER FEEDER TR-200ED1 "A2"		
EMERGENCY OPEN BY SIS TRANSFORMER FEEDER TR-200ED1	DIGITAL	82XS001

Step	Description	Result	Verified by	Date
180	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results.....☐		

5.4.7.5 EMCS IEC61850 - Electrical Monitoring & Control System

The EMCS will be tested with the 6.6kV SWBD: In detail it will be tested the functionalities provided on I/O lists vendor document 1723002197-EL-LIS-00041 with the A2 Solar PV Package Power Transformer TR-200ED1.

5.4.7.6 EMCS IEC61850 – A2 Unit I/O List

The following data list is a part of redundant networking in ethernet technology from the electrical PROTECTIONS Relay REX640

DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
TRANSFORMER FEEDER TR-200ED1 "A2"		
PROTECTION TRIPPED "50-1"	DIGITAL	LD0.PHIPTOC1.ST.Op.general
PROTECTION TRIPPED "51-1"	DIGITAL	LD0.PHLPTOC1.ST.Op.general
PROTECTION TRIPPED "51N"	DIGITAL	LD0.EFLPTOC1.ST.Op.general
SYNCHRO "OK"	DIGITAL	LD0.LEDGGIO1.ST.Ind3.stVal
PROTECTION TRIPPED "59N-1"	DIGITAL	LD0.ROVPTOV1.ST.Op.general
PROTECTION TRIPPED "59N-2"	DIGITAL	LD0.ROVPTOV2.ST.Op.general
PROTECTION TRIPPED "27-1"	DIGITAL	LD0.PHPTUV1.ST.Op.general
PROTECTION TRIPPED "27-2"	DIGITAL	LD0.PHPTUV2.ST.Op.general
PROTECTION TRIPPED "59-1"	DIGITAL	LD0.PHPTOV1.ST.Op.general
PROTECTION TRIPPED "59-2"	DIGITAL	LD0.PHPTOV2.ST.Op.general
PROTECTION TRIPPED "67-1"	DIGITAL	LD0.DPHLPDOC1.ST.Op.general
PROTECTION TRIPPED "67-2"	DIGITAL	LD0.DPHLPDOC2.ST.Op.general
SELECTOR SWITCH IN LOCAL POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO6.stVal

DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
SELECTOR SWITCH IN REMOTE POSITION	DIGITAL	LD0.MVGAPC1.ST.SPCSO7.stVal
Line Current (L1)	ANALOG	LD0.CMMXU1.A.phsA.cVal.mag.f
Line Current (L2)	ANALOG	LD0.CMMXU1.A.phsB.cVal.mag.f
Line Current (L3)	ANALOG	LD0.CMMXU1.A.phsC.cVal.mag.f
Line Volts MAIN BUS BAR (L1-l2)	ANALOG	LD0.VMMXU1.PPV.phsAB.cVal.mag.f
Line Volts MAIN BUS BAR (L2-L3)	ANALOG	LD0.VMMXU1.PPV.phsBC.cVal.mag.f
Line Volts MAIN BUS BAR (L3-L1)	ANALOG	LD0.VMMXU1.PPV.phsCA.cVal.mag.f
Frequency	ANALOG	LD0.FMMXU1.Hz.mag.f
APPARENT POWER (kVA)	ANALOG	LD0.PEMMXU1.TotVA.mag.f
REAL POWER (kW)	ANALOG	LD0.PEMMXU1.TotW.mag.f
REACTIVE POWER (kVAR)	ANALOG	LD0.PEMMXU1.TotVAr.mag.f
POWER FACTOR	ANALOG	LD0.PEMMXU1.TotPF.mag.f
TRANSFORMER PROTECTION TRIPPED "BUCHHOLZ"	DIGITAL	LD0.SCBIGGIO1.ST.Ind7.stVal
TRANSFORMER PROTECTION ALARM "BUCHHOLZ"	DIGITAL	LD0.SCBIGGIO1.ST.Ind6.stVal
TRANSFORMER PROTECTION TRIPPED "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind9.stVal
TRANSFORMER PROTECTION ALARM "OIL TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind8.stVal
TRANSFORMER PROTECTION TRIP "OIL PRESSURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind12.stVal
TRANSF. OIL LEVEL VERY LOW ALARM	DIGITAL	LD0.SCBIGGIO1.ST.Ind11.stVal
TRANSFORMER PROTECTION ALARM "OIL PRESSURE"	DIGITAL	N.A.
TRANSF. PROTECTION TRIPPED "WINDING TEMPERATURE"	DIGITAL	LD0.SCBIGGIO1.ST.Ind14.stVal

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DESCRIPTION	SIGNAL TYPE	SIGNAL TAG
TRANSF. PROTECTION ALARM "WINDING TEMPERATURE	DIGITAL	LD0.SCBIGGIO1.ST.Ind13.stVal
TRANSF. GENERAL ALARM	DIGITAL	LD0.SDBIGGIO1.ST.Ind7.stVal
WATCHDOG PROTECTION RELAY	DIGITAL	LD0.LPHD1.PhyHealth.stVal
V.T. HEALTLY CIRCUIT	DIGITAL	LD0.SCBIGGIO1.ST.Ind2.stVal
INTERTRIP SEND TO L.V. SWITCHBOARD	DIGITAL	LD0.MVGAPC1.ST.SPCSO4.stVal
K86 TRIPPED	DIGITAL	LD0.SBBIGGIO1.ST.Ind7.stVal
Contactor CLOSED AND INSERTED	DIGITAL	LD0.MVGAPC1.ST.SPCSO8.stVal
Contactor OPENED OR ISOLATED	DIGITAL	LD0.MVGAPC2.ST.SPCSO2.stVal
MCB'S CLOSED	DIGITAL	LD0.MVGAPC2.ST.SPCSO3.stVal
Contactor READY (TCS)	DIGITAL	LD0.TCSSCBR1.ST.CircAlm.stVal
Contactor READY TO CLOSE	DIGITAL	LD0.MVGAPC2.ST.SPCSO1.stVal
OPENING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO2.stVal
CLOSING COMMAND	DIGITAL	LD0.SPCGAPC1.SPCSO1.stVal
PROTECTION RELAY UNIT 1 HEALTHY	DIGITAL	LD0.SDBIGGIO1.ST.Ind8.stVal
SELECTOR SWITCH OF OVERRIDE IN OFF (SIL ENABLED)	DIGITAL	LD0.SDBIGGIO1.ST.Ind9.stVal

Step	Description	Result	Verified by	Date
181	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.7.7 EMCS MODBUS TCP-IP

The following signals data type represent the thermal temperature of copper BUS BAR and CABLE Unit of the 6.6kV SWBD.

DESCRIPTION	SLAVE ADDRESS	MODBUS REGISTER	UNIT
TRANSFORMER FEEDER TR-200ED1 "A2"			
Phase L1 - Temperature Detection - cable Compart.	11	40117	ΔT
Phase L2 - Temperature Detection - cable Compart.	11	40118	ΔT
Phase L3 - Temperature Detection - cable Compart.	11	40119	ΔT
Phase L1 - Temperature Detection - Contactor Compart.	11	40120	ΔT
Phase L2 - Temperature Detection - Contactor Compart.	11	40121	ΔT
Phase L3 - Temperature Detection - Contactor Compart.	11	40122	ΔT
Phase L1 - Temperature Detection - Main Bus Bar	11	40123	ΔT
Phase L3 - Temperature Detection - Main Bus Bar	11	40124	ΔT

Step	Description	Result	Verified by	Date
182	Confirm correct and positive result of precommissioning Check Sheet for above signals I/O list	Correct and positive results ..... ☐		

5.4.7.8 OTP Worksite PHASE 7 Test Notes and Remarks

5.4.7.9 OTP Worksite PHASE 7 Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.7.10 OTP Worksite PHASE 7 Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

5.5 POST TEST CONDITIONS

All the electrical contacts which were disconnected for the testing purposes must be reconnected.

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

5.6 REINSTATEMENT AND PRESERVATION TASKS

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

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

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

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6 OTP AT SITE OFFSHORE

6.1 PLANNING AND MANPOWER

6.1.1 Offshore site test overview

It is expected that all precommissioning tests, systems energization and commissioning steps will have been successfully performed during the Onshore Phases.

Consequently, during the offshore SITE phase, the respective systems will be inspected prior to re-energization.

No additional test steps will be required on these items of equipment, correct operation and functioning will be verified.

6.1.2 Planned tasks with estimated manpower

Estimated manpower for the entire duration of the Test:

- 1 E&I commissioning superintendent
- 1 E&I commissioning supervisor from Contractor
- 2 E&I commissioning technicians from Contractor

6.1.3 Test duration estimate

The test duration should be as follows:

- 1 day

6.1.4 Vendor Assistance

Not applicable

6.1.5 Items Postponed to C&E OTP

Not applicable

6.1.6 HOLDS

Not applicable

6.2 OTP TEST REQUIREMENTS-OFFSHORE SITE

6.2.1 Pre-Commissioning Achievement

Not applicable

6.2.2 Commissioning Achievement

The commissioning achievement will be the successful operation, functionality and safeguarding test of Power distribution System 6.6KV, installed and put in operation during the WORKSITE IN ONSHORE phase.

In OFFSHORE Phase the 6,6kV Switchboard will be powered ON to be ready to operate with incomer/feeder connected on it.

Once powered on the 6.6KV Switchboard will be ready to operate with:

- Main power from HV grid connection
- BESS PACKAGE (source)
- FUEL CELL PACKAGE (source)
- SOLAR Package (Source)
- ELECTROLYSER PACKAGE (load)
- 6,6/0,4kV Transformer TR-200DE1 (load)

6.2.3 Status of Required Associated Subsystems

Subsystems required for Commissioning of 6.6KV Power Distribution:

- SS 83-00: 6,6 kV Switchboard
- SS 87-00: Electrical Monitoring & Control System (EMCS)
- SS 87-10: Process Control System (PCS)
- SS 79-00: SIS Safety Instrumented System
- SS 84-00: UPS System UP-200F1

6.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required:

- Voltage, frequency, continuity tester (Multimeter)
- Phases sequence tester
- extracting tool & transportation trolley
- Portable radios (3 pcs + 1 per Technical Room)

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

6.2.5 Consumable List

Not applicable

6.2.6 Commissioning Spare Parts

The commissioning spare parts are indicated in the document 1723002197-COM-LIS-00052 "Commissioning Spare Parts".

6.2.7 Temporary Facilities

Not applicable

6.3 OTP DESCRIPTION – OFFSHORE SITE

6.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1	System Ready for Operation (RFO) from worksite phase Certificate is issued and approved.			
2	No blocking punch list items are outstanding against the system to be commissioned.			
3	System(s), (de)isolations as per LOTO procedure enclosed within commissioning Work Permits procedures prepared and approved			
4	Verify and confirm that all steps performed at WORKSITE of this procedure are completed without any pending issues that would prevent from proceeding with the offshore SITE PROCEDURE			
5	All personnel involved in the implementation of this procedure are familiar with this procedure as well as with associated safety requirements (Toolbox Talk to be conducted before initiation of activities).			
6	A final walkdown after hook-up of the system has been completed, any preservation items have been removed and to ensure that the system and the area are ready for energization for following items:			

Step	Description	Result	Verified by	Date
	UP-200F1 110V AC UPS SG-100D1 6,6kV Main Switchboard			
7	Check that areas are free for work and escape routes are clear of any obstructions.			
8	Ensure that proper communications have been established between parties involved in the implementation of the procedure.			
9	Verify availability of test equipment and consumables as per chapters 6.2.4.			
10	Verify and confirm that the HV systems are ready to power on the 6.6KV Switchboard and the HV is present.			
11	All personnel have been duly notified during dedicated daily SIMOPS meetings that the system(s) is ready for commissioning.			

6.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
12	No blocking punch list items are outstanding against the system to be commissioned.			
13	Review and confirm no changes are required to be performed on existing protection settings.			

6.3.3 Mechanical Preparation

Not applicable.

6.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
14	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
15	Verify that all relevant associated systems / subsystems are ready.			
16	Verify as relevant Inhibit and Override list has been prepared and validated.			
17	Verify that relevant equipment/ components are available and in operation for start of commissioning activities.			

6.3.5 Piping Preparation

Not applicable

6.3.6 Additional Discipline Preparation

Not applicable.

6.4 OTP Steps OFFSHORE SITE

The previous chapters must be successfully performed prior to commissioning of the 6.6KV SWBD.

UPS-200F1 is energized at this point.

In the following steps the functionality of the 6.6KV Power Distribution Switchboards shall be tested for:

- SS 84-00: UPS-200F1 110 VDC
- SS 82-00: SWBD SG-100D1 6,6k V

6.4.1 Test preparation

Step	Description	Result	Verified by	Date
Auxiliaries Energization of 6,6kV SWBD SG-100D1				
18	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
19	Verify that all relevant associated systems / subsystems are completed.			
20	Verify and confirm the power by UPS supply A&B 110V on Column A5 With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 11 - Close MCB QD01 - Close MCB QD02			
21	Verify and confirm the power supply 110V on Column A1 With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 11 - Close MCB QD01 - Close MCB QD02.			
22	Verify and confirm the power supply 110V on Column A2			

Step	Description	Result	Verified by	Date
	With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 11 - Close MCB QD01 - Close MCB QD02			
23	Verify and confirm the power supply 110V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 11 - Close MCB QD01 - Close MCB QD02.			
24	Verify and confirm the power supply 110V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 10 - Close MCB QD01 - Close MCB QD02			
25	Verify and confirm the power supply 110V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 11 - Close MCB QD01 - Close MCB QD02			
26	Verify and confirm the power supply 110V on Column A7 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 11 - Close MCB QD01 - Close MCB QD02			
27	Verify and confirm the power supply 24V on Column A5			

Step	Description	Result	Verified by	Date
	With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 13 - Switch on MCB QD5 - Switch on MCB QD6 - Verify the led on ethernet switch A - Verify the led on ethernet switch B - Verify the led on ethernet switch C			
28	Verify and confirm the power supply 24V on Column A1 With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 11 - Close MCB QD4			
29	Verify and confirm the power supply 24V on Column A2 With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 11 - Close MCB QD4			
30	Verify and confirm the power supply 24V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 11 - Close MCB QD4			
31	Verify and confirm the power supply 24V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 11 - Close MCB QD4			
32	Verify and confirm the power supply 24V on Column A6			

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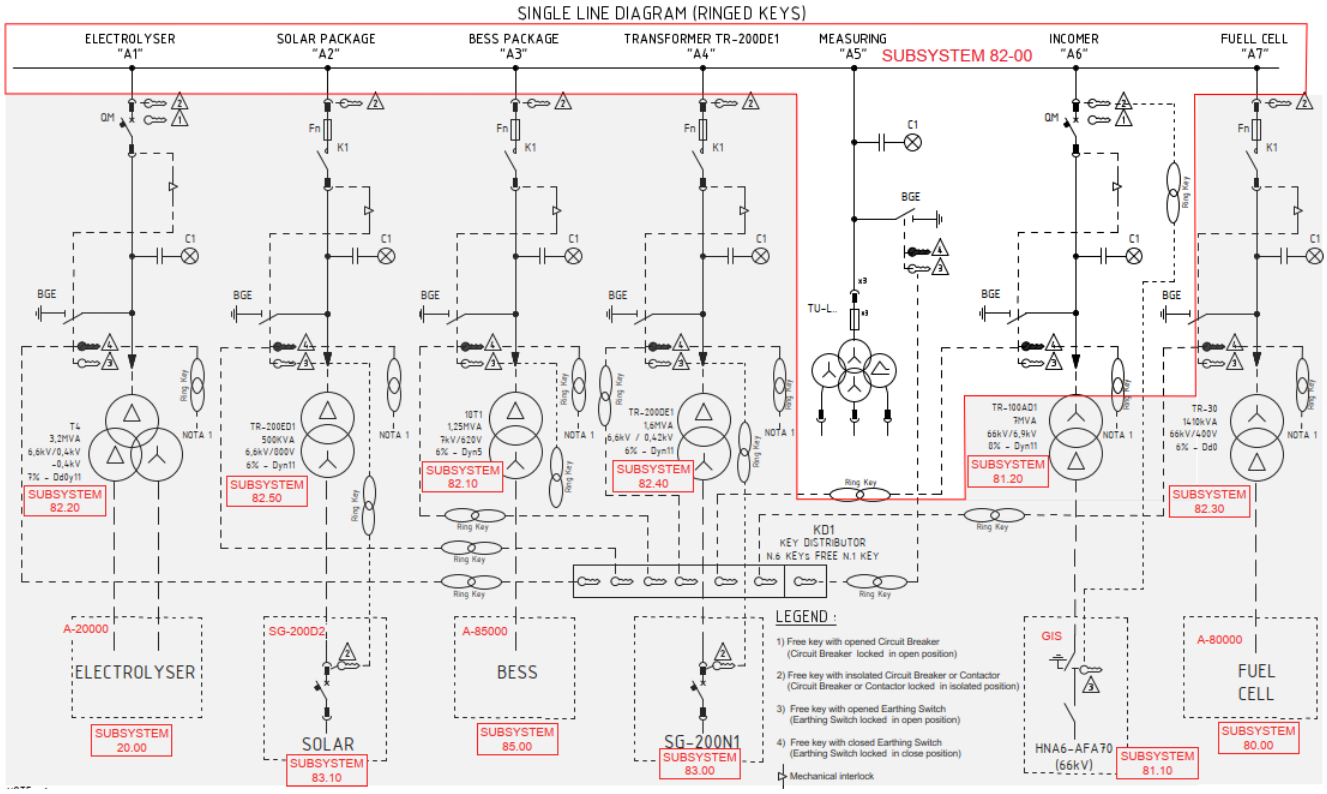
Step	Description	Result	Verified by	Date
	With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 11 - Close MCB QD4			
33	Verify and confirm the power supply 24V on Column A7 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 11 - Close MCB QD4			
34	Verify and confirm the power supply 230V on Column A5 With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 10 - Close MCB QA1 - Close MCB QA2			
35	Verify and confirm the power supply 230V on Column A1 With reference Vendor doc. N° 1723002197-EL-DG-00018 (Column A1) sheet 13 - Close MCB QA2			
36	Verify and confirm the power supply 230V on Column A2 With reference Vendor doc. N° 1723002197-EL-DG-00020 (Column A2) sheet 13 - Close MCB QA2			
37	Verify and confirm the power supply 230V on Column A3 With reference Vendor doc. N° 1723002197-EL-DG-00017 (Column A3) sheet 13 - Close MCB QA2			

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Step	Description	Result	Verified by	Date
38	Verify and confirm the power supply 230V on Column A4 With reference Vendor doc. N° 1723002197-EL-DG-00021 (Column A4) sheet 13 - Close MCB QA2			
39	Verify and confirm the power supply 230V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00015 (Column A6) sheet 13 - Close MCB QA2			
40	Verify and confirm the power supply 230V on Column A6 With reference Vendor doc. N° 1723002197-EL-DG-00019 (Column A7) sheet 13 - Close MCB QA2			
41	With reference Vendor doc. N° 1723002197-EL-DG-00016 (Column A5) sheet 8,9 Close the following MCBs - QV1 ..... ☐ - QV2 ..... ☐ - QV3 ..... ☐ - QV4 ..... ☐			
42	With reference Vendor doc. N° 1723002197-EL-DG-00015/17/18/19/20/21 (Column A6/A3/A1/A7/A2/A4) Close following MCBs for voltage references to protection relais: - Close MCB QV4 - Close MCB QV5			

6.4.2 Test Steps

The 6.6KV Switchboard SG-100D1 has all auxiliary circuits powered on, and it is ready to operate. After this steps the SWBD will remain powered ON to permit the package start up.

Step	Description	Result	Verified by	Date
SG-100D1 6.6KV Switchboard - Energization A5, A6 UNIT and main busbar				
Switchboard Single Line Diagram – Key & Mechanical Interlock (ref. to vendor doc. 1723002197-EL-DG-00056 sheet 015) 				
The test starts with SWBD in safety status, the upstream is not powered, Measuring Unit A5 has its Earthing Switch (BGE) Closed and Incomer Unit A6 has its Earthing Switch (BGE) Closed and Its Main Breaker QM in extract position and opened. The main 6,6kV supply will be provided from 6,6kV Temporary Yard Power Supply system and will be provided only after the following safety checks. See the Measuring Unit A5 operating sequences to put the unit ***out of service*** or ***in service***				

Step	Description	Result	Verified by	Date

OPERATING SEQUENCE

MEASURING AND BUS BAR OPERATING SEQUENCE

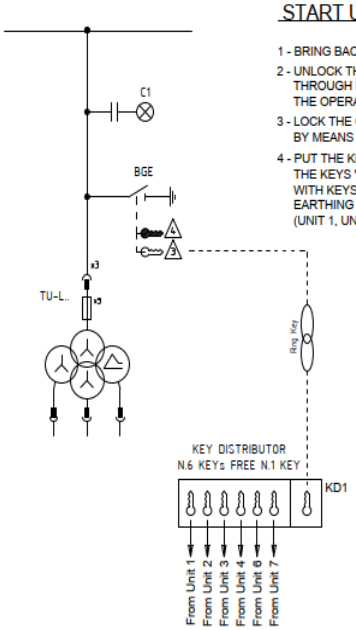
PUTTING OUT OF SERVICE

1 - OPEN AND CARRY IN ISOLATED POSITION ALL CIRCUIT BREAKERS AND CONTACTORS AND THEN CLOSE THE EARTHING SWITCH FOR THE FOLLOWING UNITS: (UNIT 1, UNIT 2, UNIT 3, UNIT 4, UNIT 6, UNIT 7). LOCK THE EARTHING SWITCH IN CLOSE POSITION BY MEANS OF THE RESPECTIVE KEYS (4).

2 - PUT THE KEYS "4" OF THE EARTHING SWITCHES IN THE KEYS-DISTRIBUTOR 'KD1'. WITH THE KEY THAT IS RELEASED FROM THE "KD1" KEY DISTRIBUTOR, UNLOCK THE OPENING POSITION OF THE EARTHING SWITCH

3 - OPEN THE COVER OF THE EARTHING SWITCH OPERATING SEAT BY TURNING THE ACTUATOR ANTICLOCKWISE, CLOSE EARTHING SWITCH BY TURNING THE OPERATING LEVER CLOCKWISE

5 - LOCK THE CLOSED POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY "4".



START UP

1 - BRING BACK THE KEY "4".

2 - UNLOCK THE EARTHING SWITCH CLOSE POSITION THROUGH KEY "4". OPEN EARTHING SWITCH BY TURNING THE OPERATING LEVER ANTICLOCKWISE

3 - LOCK THE OPEN POSITION OF THE EARTHING SWITCH BY MEANS OF THE KEY "3".

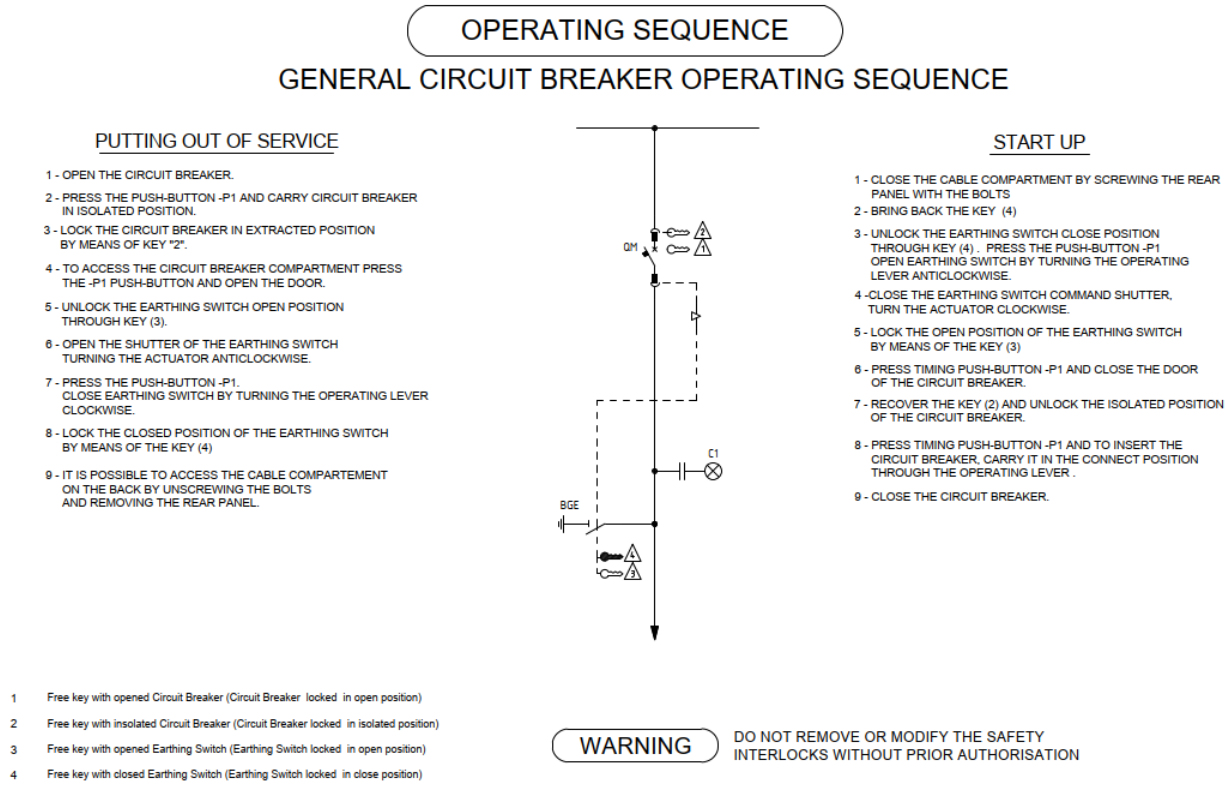
4 - PUT THE KEY "3" IN THE KEYS-DISTRIBUTOR "KD1", WILL BE RELEASE THE KEYS "4" OF ALL EARTHING SWITCHES . WITH KEYS "4" WILL BE POSSIBLE UNLOCKING THE CLOSE POSITION OF THE EARTHING SWITCHES OF THE FOLLOWING UNITS: (UNIT 1, UNIT 2, UNIT 3, UNIT 4, UNIT 6, UNIT 7) .

3 Free key with opened Earthing Switch (Earthing Switch locked in open position)

4 Free key with closed Earthing Switch (Earthing Switch locked in close position)

WARNING DO NOT REMOVE OR MODIFY THE SAFETY INTERLOCKS WITHOUT PRIOR AUTHORISATION

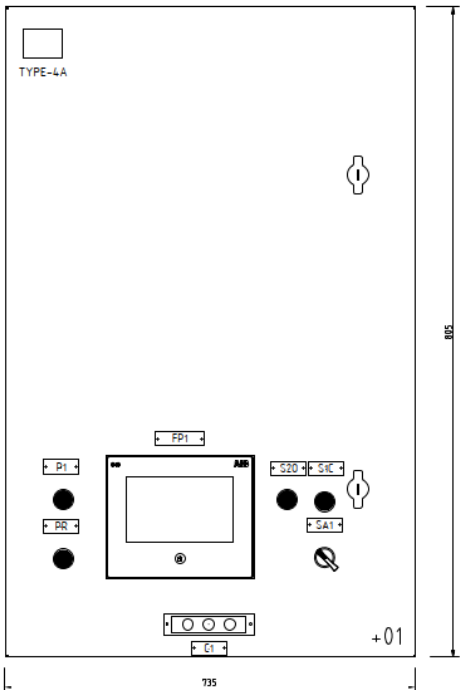
Step	Description	Result	Verified by	Date
	See the Incomer Unit A6 operating sequences to put the unit *out of service* or *in service*			
43	Verify and confirm that Unit A6 is in safety status with following checks: - BGE Earthing Switch is locked in closed position. KEY-4 G3228/279 is locked on KD1 device. KEY-3 G3355 is locked on BGE Earthing Switch closed ..... ☐ - QM Main Breaker is locked in extract position and opened. KEY-2 14466 is locked on 66kV upstream safety isolation device. ..... ☐ Note: see the detail of upstream safety isolation device (e.g. HV Earthing Switch) on HV OTP procedure			



Step	Description	Result	Verified by	Date
44	Verify and confirm that **Unit A5** is in safety status with following checks: - BGE Earthing Switch is locked in closed position. **KEY-3 G3098/277** is locked on KD1 device. ..... ☐ - **KEY-4 G3150** is unlocked and available to use in the LoTo Procedure..... ☐			
Switchboard preparation to receive 6,6kV Temporary Yard Power Supply on Incomer Unit A6				
45	The keys 278, 279, 280, 281, 282, 283 are interlocked on KD1. On Unit A5 - Take **KEY-4 G3150** insert it on BGE and open Earthing Switch .....☐ - **KEY-3 G3098/277** is now available, withdraw it and insert in keys Interlock device KD1 ..... ☐			
46	To unlock Incomer Unit A6 BGE Earthing Switch - QM main Breaker is locked in extract position ..... ☐ - **KEY-1 G3260** is locked on LoTo procedure to keep breaker isolated in compliance with project PTW Procedure.....☐ - **KEY-2 14466** is locked on 66kV **upstream** safety isolation device ...☐ - **KEY-3 G3355** is used and locked on PTW procedure. Once it is available insert it on BGE Earthing Switch to allow opening switch procedure.. ☐ - **KEY-4 G3228** has been released from KD1. Insert KEY-**4 G3228** on BGE and open it.....☐ - Led-7 "EARTHING SWITCH ENABLE" on protection relay REX640 will turn to green .....☐			

Step	Description	Result	Verified by	Date
	- Remove the safety isolation device, extract KEY-2 14466 and place it on rack in/out system to unlock the QM main breaker.....☐ - Led-8 "RACK IN/OUT ENABLE" on protection relay REX640 will turn to green.....☐			

Close the Unit A6 Incomer Breaker

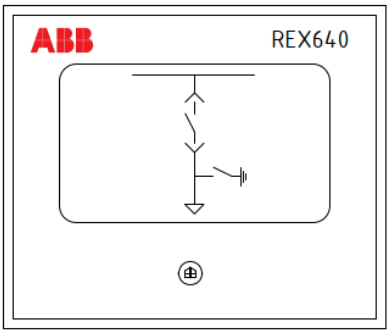


DOOR LAY-OUT

DEVICES name plate				
ITEM	COMPONENT	DESCRIPTION 1	DESCRIPTION 2	NOTE
FP1	PROTECTION RELAY	PROTECTION RELAY		TYPE-1A
S2O	PUSH BUTTON	OPEN COMMAND	CONTACTOR	TYPE-2A
S1C	PUSH BUTTON	CLOSE COMMAND	CONTACTOR	TYPE-2A
SA1	SELECTOR SWITCH	LOCAL / REMOTE		TYPE-2A
PR	LIGHT PUSH BUTTON	RESET LOCK-OUT	TRIP LOCK-OUT	TYPE-2A
C1	PILOT LIGHT	VOLTAGE	PRESENCE	
P1	PUSH BUTTON	TRUCK-DOOR-E.SWITCH	ENABLING	TYPE-2A

Step	Description	Result	Verified by	Date
	HMI of FP1 Protection Relay and its LEDs signalling			
47	Rack in QM Main Breaker in SERVICE position and confirm that it is available.			
48	Confirm availability of the 6,6kV Main Power Supply and prepare to energize. When the power supply is available confirm the following: - On Unit A6 the voltage presence lamps C1 are ON .....☐ - Led-2 "BREAKER READY (TCS)" on protection relay REX640 will turn to green.....☐			
49	A6 Unit – Incoming Breaker – **Local** command			

PROTECTION DISPLAY



LHMI – TOUCH DISPLAY

- COMMANDS "CLOSE C.B." AND "OPEN C.B." NOT ENABLED
- PUSH BUTTON "REMOTE / LOCAL" NOT ENABLED

LEDs PAGE 1

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-1	27-1/27-2/59-1/59-2 – VOLTAGE PROTECTION	RED	-	ALARM = OVER/UNDER VOLTAGE PROTECTION
LED-2	CONTACTOR READY (TCS)	-	GREEN	OK = TCS OK (CONTACTOR READY)
LED-3	SYNCHRO CHECK		GREEN	OK = SYNCHRONISM
LED-4	CONTACTOR READY TO CLOSE	-	GREEN	OK = CONTACTOR READY TO CLOSE
LED-5	50-1/51-1/67-1/67-2 – TRIPPED	RED	-	ALARM = OVERCURRENT PROTECTION TRIPPED
LED-6	51N/59N-1/59N-2 – TRIPPED	RED	-	ALARM = EARTH PROTECTION TRIPPED
LED-7	EARTHING SWITCH UNLOCKED	-	GREEN	OK = EARTHING SWITCH UNLOCKED
LED-8	RACK-IN/OUT ENABLED	-	GREEN	OK = CONTACTOR TRUCK UNLOCKED
LED-9	ARC PROTECTION TRIPPED	RED	-	ALARM = TRIP ARC PROTECTION
LED-10	GOOSE ALARM	RED	-	ALARM = GOOSE FAULT
LED-11	EMERGENCY OPENING BY SIS (ESD)	RED	-	ALARM = ESD TRIPPED

LEDs PAGE 2

Item	NAME PLATE	COLOUR		Note
		ALARM	OK	
LED-12	SPACE HEATER "ON"	RED	-	ALARM = SPACE HEATER "ON"
LED-13				
LED-14				
LED-15				
LED-16				
LED-17				
LED-18				
LED-19				
LED-20				
LED-21				
LED-22				

Step	Description	Result	Verified by	Date
	Close QM Incoming Breaker, feeding 6,6kV SWBD SG-100D1 main busbar - Place the selector SA1 in Local position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF.....☐ o LED-2 must be GREEN .....☐ o LED-3 must be GREEN .....☐ o LED-4 must be GREEN .....☐ o LED-5 must be OFF.....☐ o LED-6 must be OFF.....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN .....☐ o LED-9 must be OFF.....☐ o LED-10 must be OFF .....☐ o LED-11 must be OFF .....☐ - Close QM Breaker by pressing push button S1C.....☐ - Verify and confirm the breaker status closed via on board mechanical red signal .....☐ - On Unit A5 the busbar voltage presence lamps C1 are ON.....☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐			
50	A6 Unit – Incoming Breaker – **Remote** command from EMCS Close QM Incoming Breaker, feeding 6,6kV SWBD SG-100D1 main busbar			

Step	Description	Result	Verified by	Date
	- Place the selector SA1 in Remote position .....☐ - All permissive interlock signals are authorizing the Circuit Breaker closing. See LEDs status On REX640 protection relay (refer to Vendor doc. N° 1723002197-EL-DG-00015 sheets 4 and 5: o LED-1 must be OFF.....☐ o LED-2 must be GREEN .....☐ o LED-3 must be GREEN .....☐ o LED-4 must be GREEN .....☐ o LED-5 must be OFF.....☐ o LED-6 must be OFF.....☐ o LED-7 must be GREEN .....☐ o LED-8 must be GREEN .....☐ o LED-9 must be OFF.....☐ o LED-10 must be OFF .....☐ o LED-11 must be OFF .....☐ - Close QM Breaker from EMCS System .....☐ - Verify and confirm the breaker status closed via on board mechanical red signal .....☐ - On Unit A5 the busbar voltage presence lamps C1 are ON.....☐ - See on FP1 Protection Relay Display if Breaker Closed is confirmed on REX640 HMI .....☐ - Open QM Breaker from EMCS System .....☐ - Verify and confirm the breaker status opened via on board mechanical green signal.....☐ - On Unit A5 the busbar voltage presence lamps C1 are OFF .....☐			

6.4.3 OTP OFFSHORE SITE - Tests Notes and Remarks

6.4.4 OTP OFFSHORE SITE Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

6.4.5 OTP OFFSHORE SITE Tests Final Signatures and Company Acceptance

Name and Surname	Certifying Authority	Position	Signature

6.5 POST TEST CONDITIONS

All the electrical contacts which were disconnected for the testing purposes must be reconnected.

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

6.6 REINSTATEMENT AND PRESERVATION TASKS

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

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

7 APPENDICES

7.1 Vendor SAT Procedure

7.1.1 The Vendor SAT procedure is a document number 1723002197-QC-PRO-00046

7.2 Proverlis Summary Reports

7.3 Equipment Related Technical Queries

7.4 As built Documentation

After the commissioning phases, when the tests are terminated, it will be issued as built documentation of the 6.6KV SWBD as:

- General arrangement 1723002197-EL-DA-00006
- Wiring diagram A6 1723002197-EL-DG-00015
- Wiring diagram A5 1723002197-EL-DG-00016
- Wiring diagram A3 1723002197-EL-DG-00017
- Wiring diagram A1 1723002197-EL-DG-00018
- Wiring diagram A7 1723002197-EL-DG-00019
- Wiring diagram A2 1723002197-EL-DG-00020
- Wiring diagram A4 1723002197-EL-DG-00021

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