Base Load Power Hub (BLPH)

OTP – HYDROGEN STORAGE & VENTING SYSTEMS

Document Number: 123A90-PML-COM-PRO-03041

Document Class: 2

01	27/02/2025	Accepted for Construction (AFC)	G.DEL MISSIER	A.IVESON	M.BRUNELLI
00	09/12/2024	Issue for Review (IFR)	G.DEL MISSIER	A.IVESON	M.BRUNELLI
Rev.	Date	Description	Prepared	Reviewed	Approved

This document undergoes an issuance cycle within EDMS "FusionLive". Its distribution is electronically controlled.
Once printed shall be considered as "NOT CONTROLLED" copy.

Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

Table of Contents

1. INTRODUCTION 7
1.1 Project Overview 7
1.2 Project Location 7
1.3 Project Concept 8
2. DOCUMENT SCOPE 10
3. OTP SUMMARY 11
3.1 Test Objective 11
3.2 System Boundary Limits 11
3.3 Test and System Description 17
3.4 Safety Devices 17
3.5 HSE Management 18
3.6 Acceptance Criteria 18
4. DOCUMENTS REFERENCES AND ABBREVIATIONS 19
4.1 Reference Document 19
4.1.1 Company Documents and Standards 19
4.1.2 Project Documents 19
4.1.3 Vendor Documents (Hydrogen KO Drum) 21
4.1.4 Vendor Documents (Hydrogen Vent) 21
4.1.5 Vendor Documents (Hydrogen Storage Vessel) 22
4.2 Acronyms and Abbreviations 23
5. OTP TEST REQUIREMENTS – ONSHORE WORKSITE 25
5.1 Planning and manpower 25
5.1.1 Planned Tasks with Estimated Manpower 25
5.1.2 Test Duration Estimate 25
5.1.3 Vendor assistance 25
5.1.4 Items Postponed C&E OTP 25
5.1.5 Summary of HARDWARE items to be Tested (list sequence by Vessel) 25
5.2 OTP TEST REQUIREMENT – ONSHORE WORKSITE 28
5.2.1 Pre-Commissioning Achievement 28
5.2.2 Commissioning Achievement 28
5.2.3 Status of associated Subsystems 28
5.2.4 Special Tools & Test Equipment 28
5.2.5 Consumable List 29

This document undergoes an issuance cycle within EDMS "FusionLive". Its distribution is electronically controlled.
Once printed shall be considered as "NOT CONTROLLED" copy.

5.2.6 Commissioning Spare Part 29
5.2.7 Temporary Facilities 29
5.3 OTP DESCRIPTION – ONSHORE WORKSITE 29
5.3.1 OTP Test Preparation 29
5.3.2 Electrical Preparation 30
5.3.3 Mechanical Preparation 30
5.3.4 Instrument Preparation 31
5.3.5 Piping Preparation 31
5.3.6 Additional Discipline Preparation 31
5.4 OTP TEST STEPS – ONSHORE WORKSITE 31
5.4.1 Test Preparation 32
5.4.2 Test Steps 32
5.4.3 OTP Worksite Test Notes and Remark 108
5.4.4 OTP Worksite Test Certifying Authority Table Attendances 109
5.4.5 OTP Worksite Test Final Signature and Company Acceptance 109
5.5 POST TEST CONDITION 109
5.6 REINSTATEMENT AND PRESERVATION TASKS 109
6. OTP AT OFFSHORE SITE 110
6.1 PLANNING AND MANPOWER 110
6.1.1 Offshore Site Test Overview 110
6.1.2 Planned Tasks with Estimated Manpower 110
6.1.3 Test Duration Estimate 110
6.2 OTP TEST REQUIREMENT – OFFSHORE SITE 110
6.2.1 Pre-Commissioning Achievement 110
6.2.2 Commissioning Achievement 110
6.2.3 Status of Required Associated Subsystems 110
6.2.4 Special Tools & Test Equipment 111
6.2.5 Consumable List 111
6.2.6 Commissioning Spare Parts 111
6.3 OTP DESCRIPTION – OFFSHORE WORKSITE 111
6.3.1 OTP Test Preparation 111
6.3.2 Electrical Preparation 112
6.3.3 Mechanical Preparation 112
6.3.4 Instrument Preparation 112
6.3.5 Piping Preparation 112
6.3.6 Additional Discipline Preparation 112

6.4 OTP TEST STEPS – OFFSHORE WORKSITE 113
6.4.1 Test Preparation 113
6.4.2 Test Steps 113
6.4.3 OTP Site Tests Notes and Remarks 114
6.4.4 OTP Site Tests Certifying Authority Table of Attendances 115
6.4.5 OTP Site Tests Final Signature and Company Acceptance 115
6.5 POST TEST CONDITIONS 115
6.6 REINSTATEMENT AND PRESERVATION TASKS 115
7. APPENDICES 116
7.1 Vendor SAT Procedure (where applicable) 117
7.2 Proverlis Summary System Reports 118
7.3 Equipment Relates Technical Queries (where applicable) 119
7.4 As Built Documentation (where applicable) 120
7.5 Management of Changes – Summary Table of tasks and Details of Affected related Documentation (where applicable) 121

This document undergoes an issuance cycle within EDMS "FusionLive". Its distribution is electronically controlled.
Once printed shall be considered as "NOT CONTROLLED" copy.

List of Figures

Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map 7
Figure 2 - Wind Park Details 8
Figure 3 – BLPH Concept 9
Figure 4 - System Boundary Limits [HYDROGEN STORAGE VESSELS HEADER (INLET)] 11
Figure 5 – System Boundary Limits [HYDROGEN STORAGE VESSEL (V-25001A/B/C/D/E/F)] 12
Figure 6 – System Boundary Limits [HYDROGEN STORAGE VESSELS HEADER (OUTLET)] 13
Figure 7 – *System Boundary Limits* [FROM HYDROGEN STORAGE VESSEL HEADER (OUTLET)] 14
Figure 8 – System Boundary Limits [HYDROGEN VENT HEADER] 15
Figure 9 – System Boundary Limits [HYDROGEN VENT DRUM] 16

List of Tables

Table 1: company Documentation and Standards 19
Table 2: Project Documents 20
Table 3: Vendor Documents (Hydrogen KO Drum) 21
Table 4: Vendor Documents (Hydrogen Vent) 22
Table 5: Vendor Documents (Hydrogen Storage Vessel) 23
Table 6: Acronyms and Abbreviations 23
Table 7: Summary of Items HARDWARE to be Tested 28

List of Attachments

- Not applicable

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.

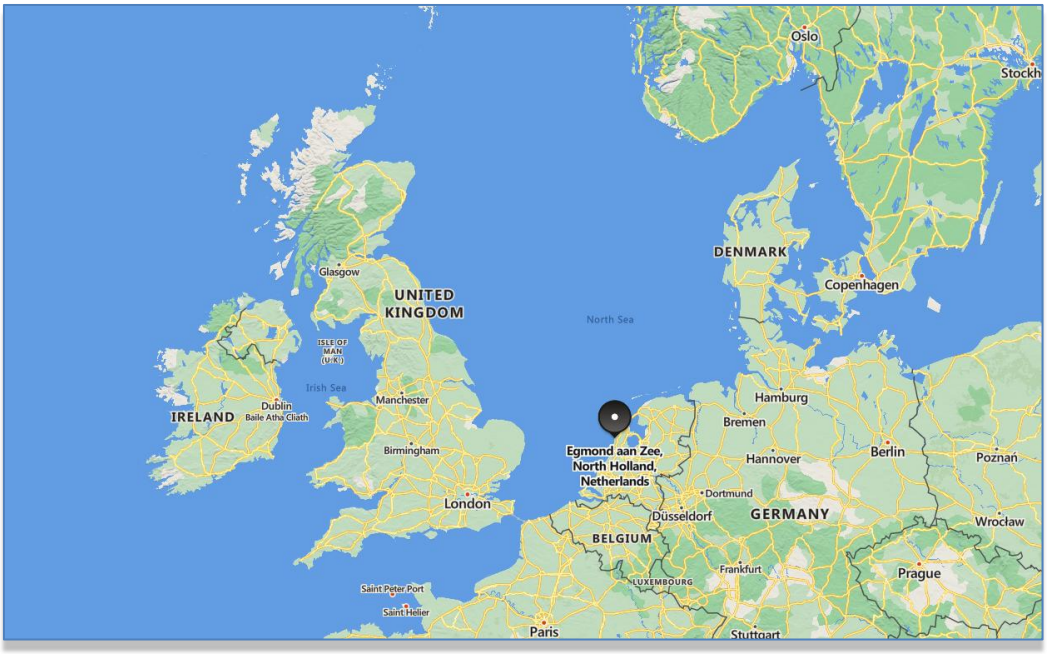


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

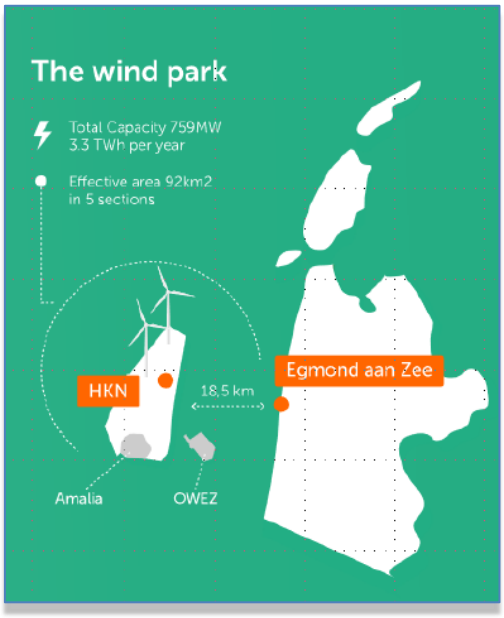


Figure 2 - Wind Park Details

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

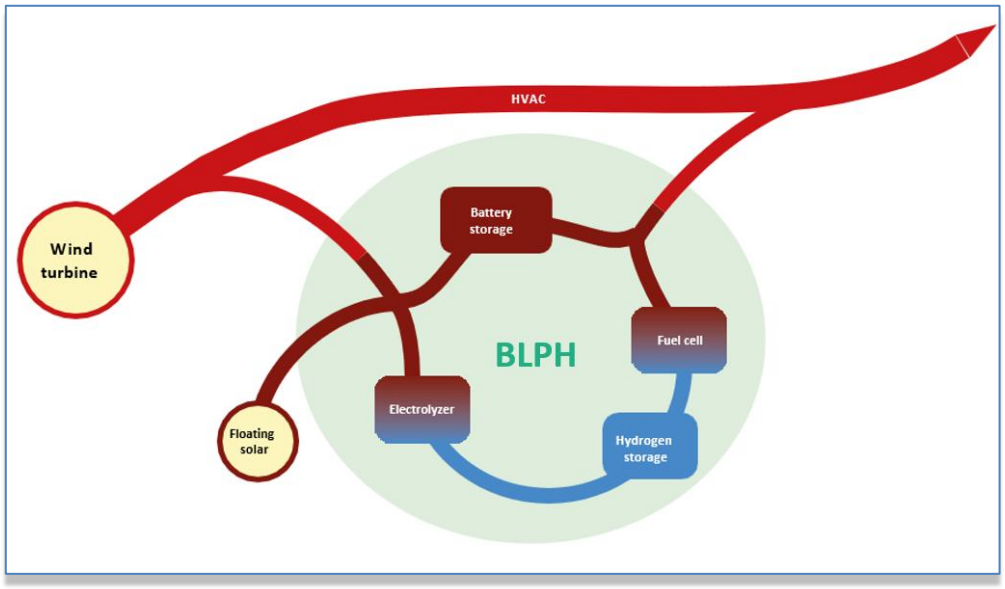


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops 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 minimize 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 Hydrogen Storage & Venting Systems 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.

The scope of this document is to explain the principal procedure for inspection and test the Hydrogen Storage & Venting Systems.

3.2 System Boundary Limits

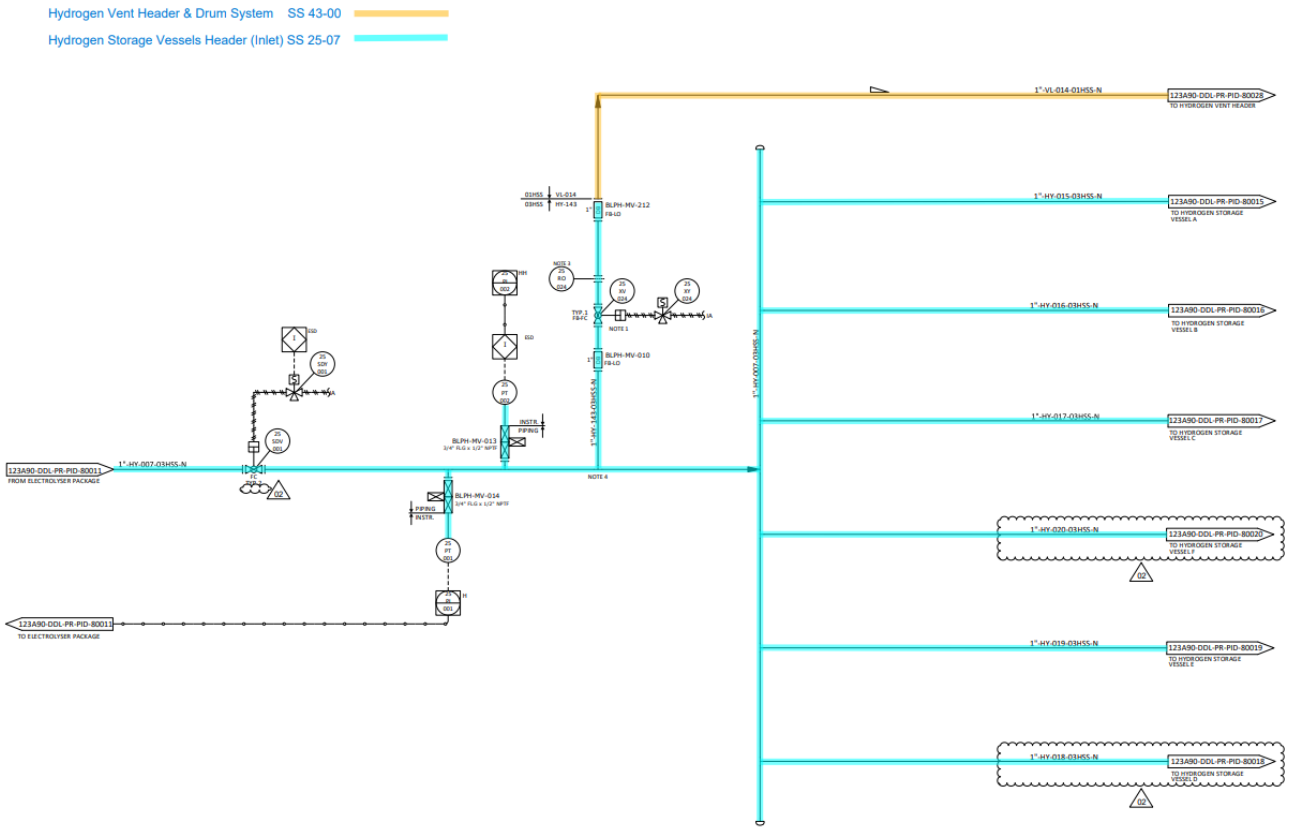


Figure 4 - System Boundary Limits [HYDROGEN STORAGE VESSELS HEADER (INLET)]

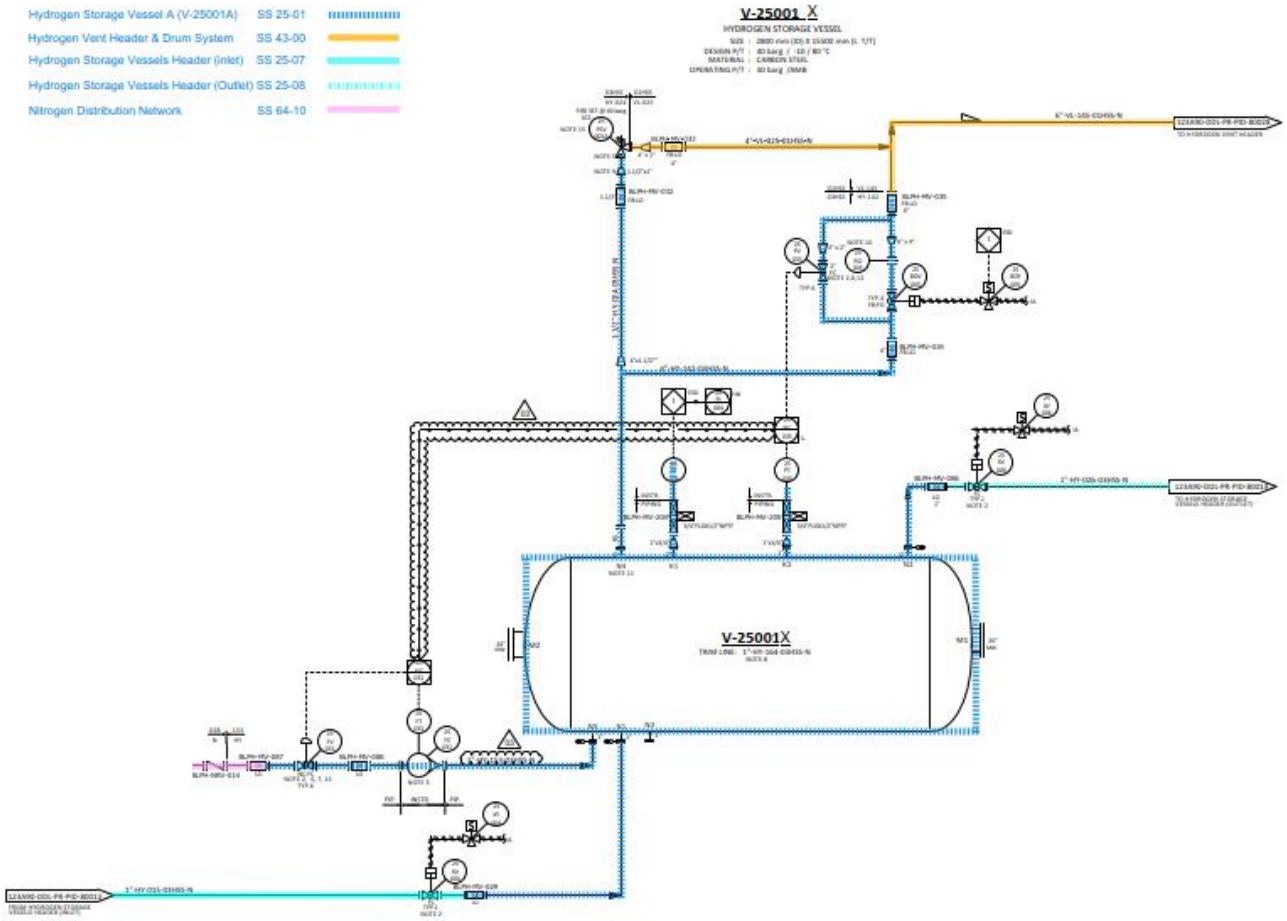


Figure 5 – System Boundary Limits [HYDROGEN STORAGE VESSEL (V-25001A/B/C/D/E/F)]

- N.B. Figure 5 is a typical representation for all six Vessels and consequently applies to Hydrogen Storage System Vessel V-25001A/B/C/D/E/F.

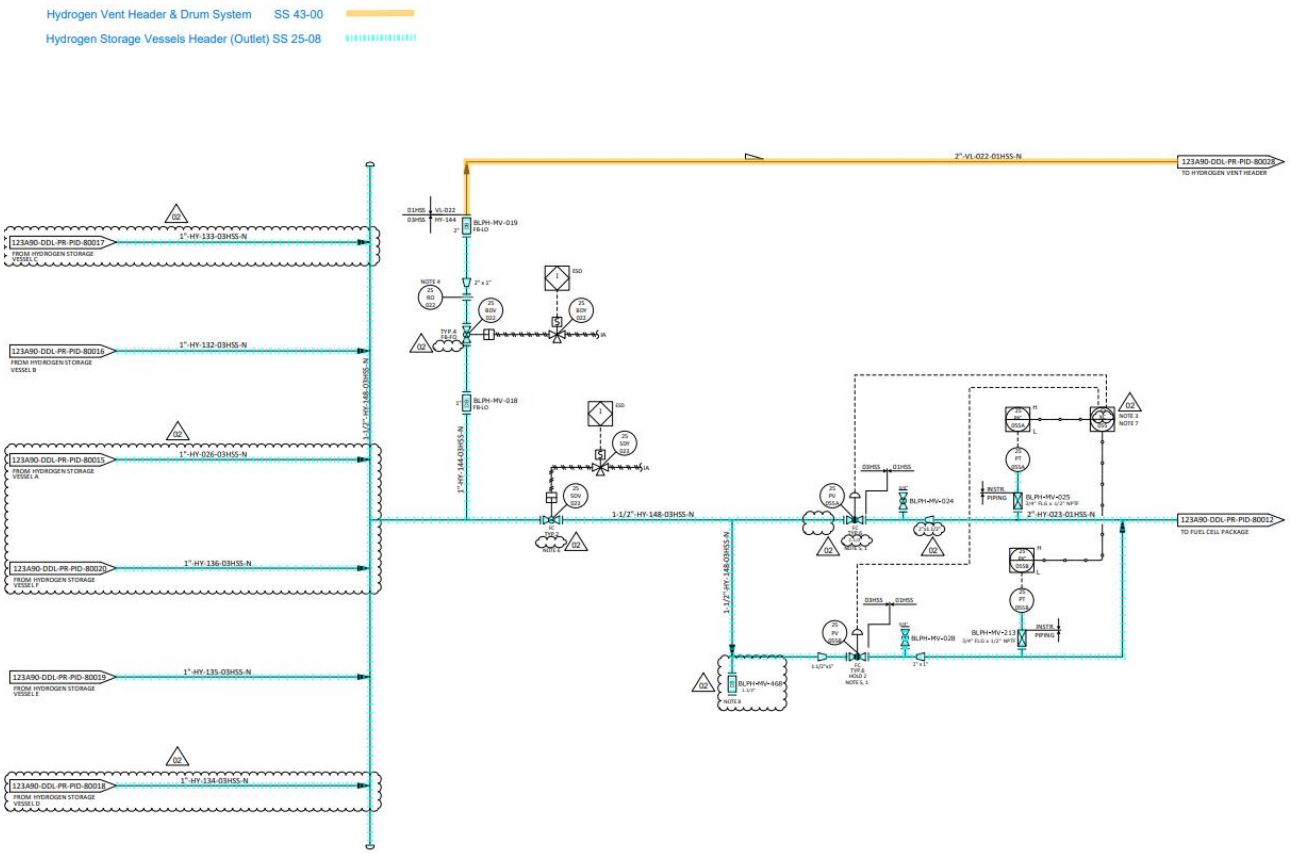


Figure 6 – System Boundary Limits [HYDROGEN STORAGE VESSELS HEADER (OUTLET)]

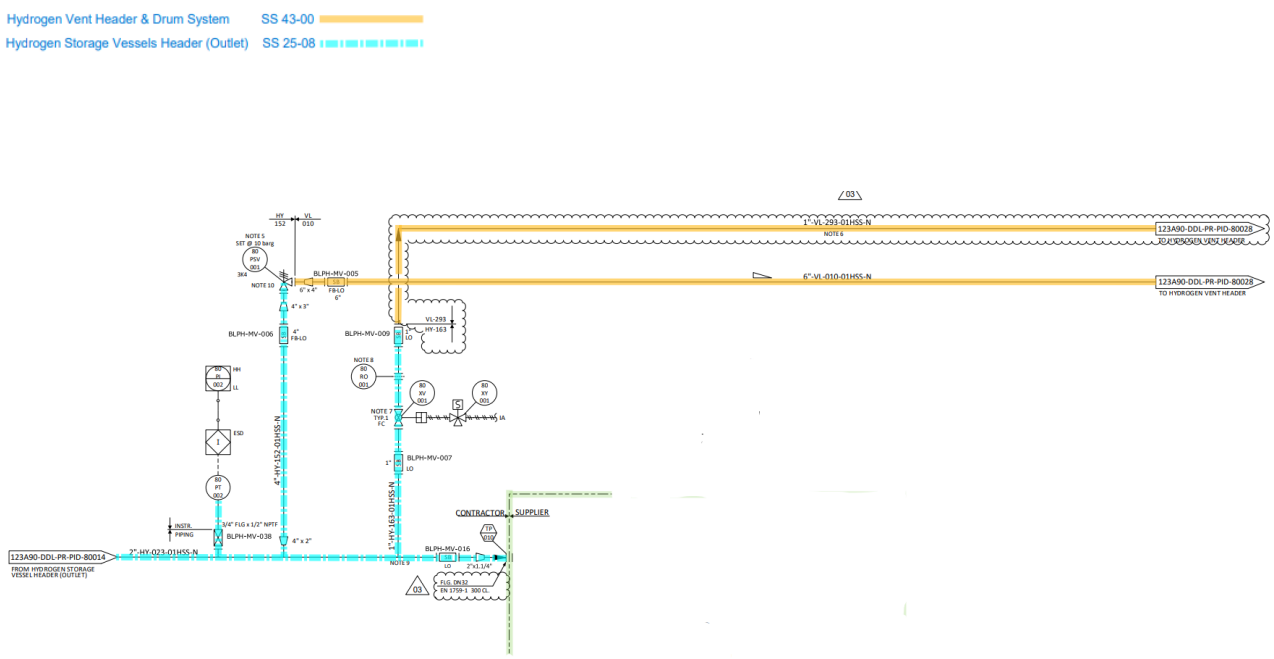


Figure 7 – *System Boundary Limits* [FROM HYDROGEN STORAGE VESSEL HEADER (OUTLET)]

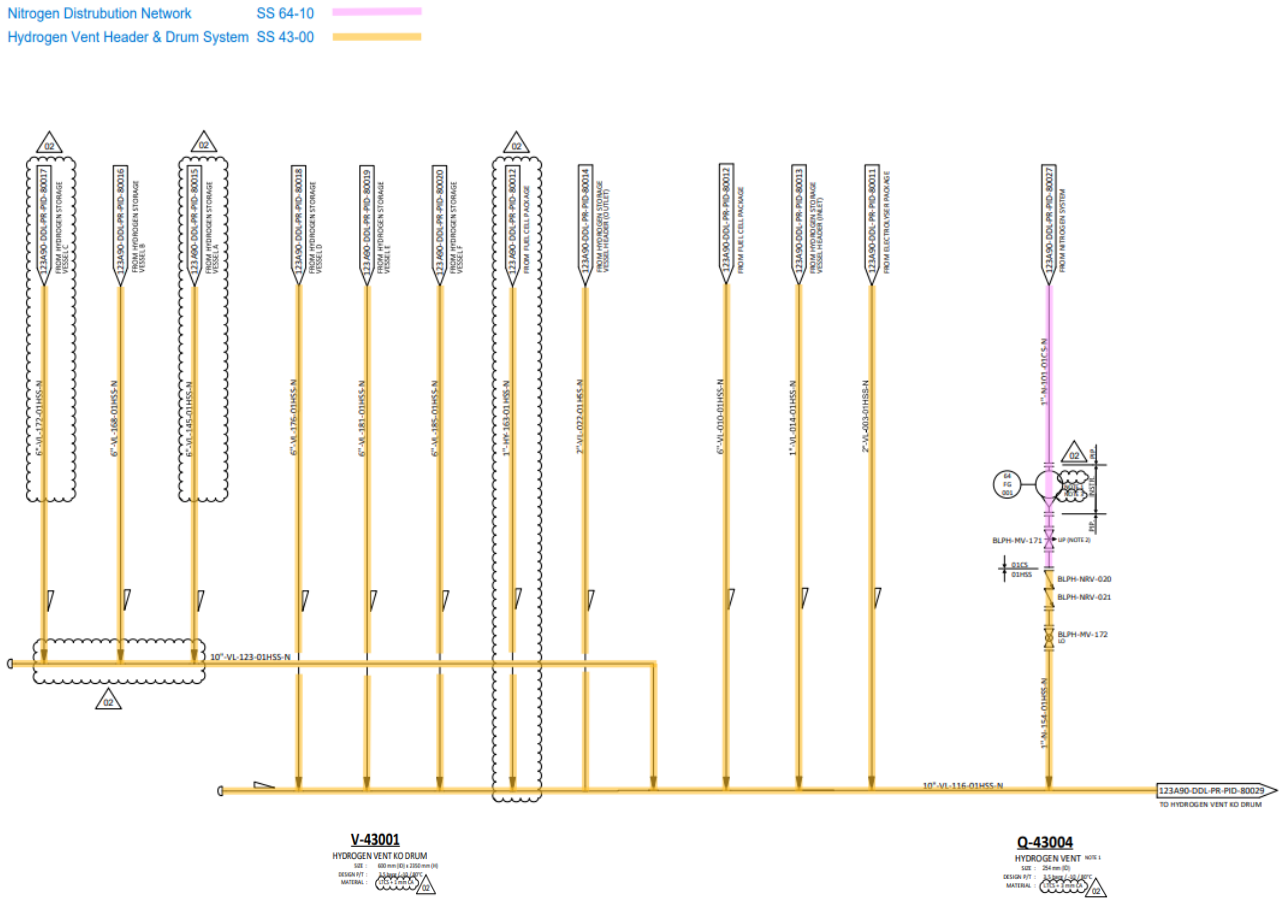


Figure 8 – System Boundary Limits [HYDROGEN VENT HEADER]

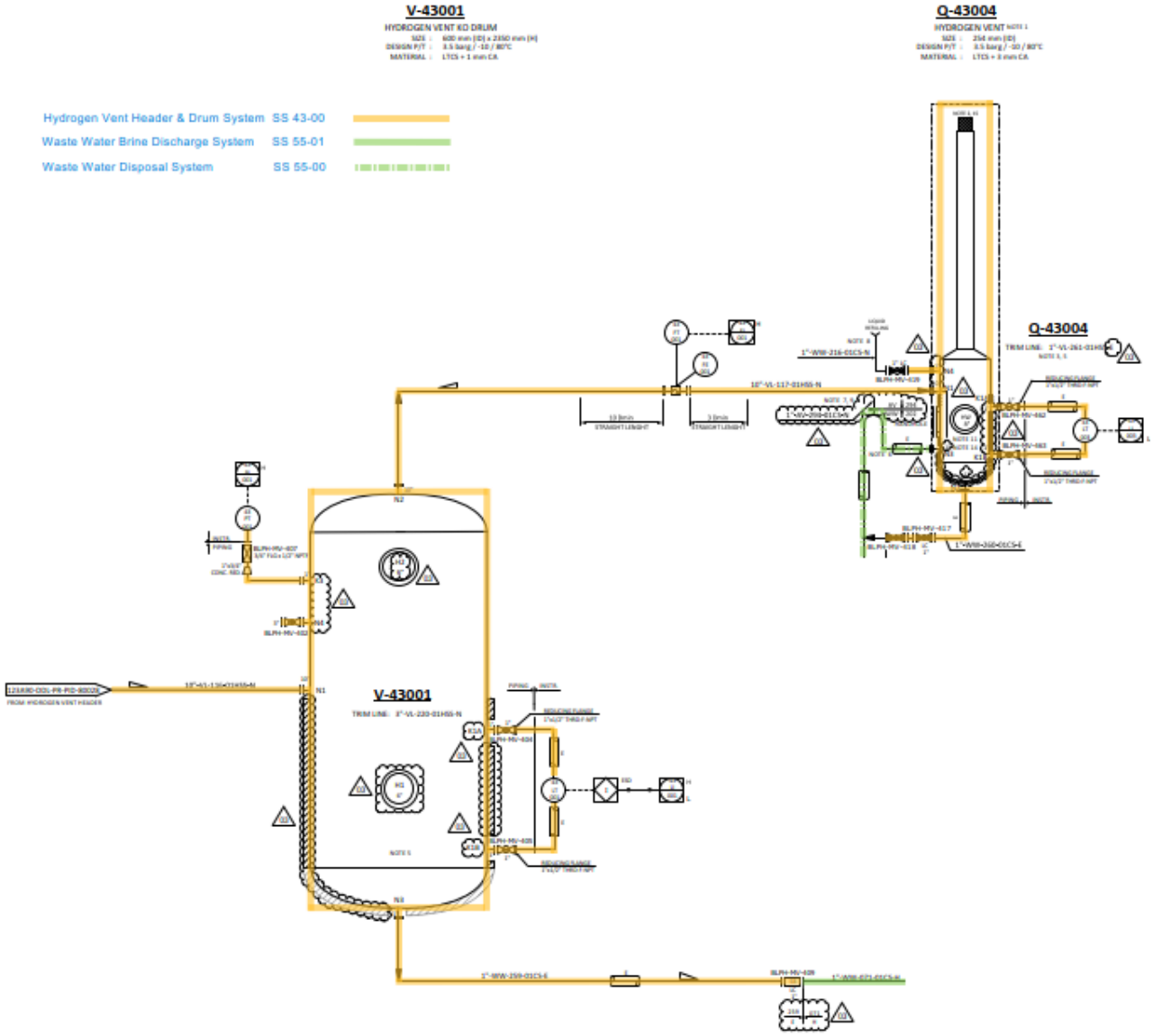


Figure 9 – System Boundary Limits [HYDROGEN VENT DRUM]

3.3 Test and System Description

This document is specifically related to the following system:

- SS 25-00 Hydrogen Storage
- SS 43-00 Hydrogen Vent Header & Drum System

All equipment must be properly installed according to vendor documents 123A90-DDL-PR-PID-80012 to 80020 and 123A90DDL-PR-PID-80029.
The limits of the system are defined in document 123A90-DDL-PR-PID-80012 to 80020 and 123A90DDL-PR-PID-80029.

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

The Instrument Hydrogen Storage & venting System data are the following
GENERAL CHARACTERISTICS CLIMATIC CONDITION:

Hydrogen Storage Vessel
- Design Pressure: 40 barg
- Design Temperature: -20°C / 80°C
- Operating Pressure: 30 barg
- Operating Temperature: 20°C

Hydrogen Vent KO Drum
- Design Pressure 3.5 barg
- Design Temperature: -29°C to 80°C

Piping material class 01HSS
- Design Pressure 10 barg
- Design Temperature 100°C

Piping material class 03HSS
- Design Pressure 40 barg
- Design Temperature 80°C

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.
- 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 color 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.
- 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 communication 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 commissioning the systems:
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.
Cross-checking the installation with engineering documentation ensures that the installation is done correctly. These steps can help identify any missing or incorrect components and connections.

- Verify the hardwired connection to SIS System
- Verify the hardwired connection to PCS System
- Verify the loop check from SIS
- Verify the loop check from PCS
- Validate control loops & logic

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 will provide a comprehensive and effective way to verify the equipment installation and functionality.

4. DOCUMENTS REFERENCES AND ABBREVIATIONS

4.1 Reference Document

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 Documentation and Standards

4.1.2 Project Documents

	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

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

Table 2: Project Documents

4.1.3 Vendor Documents (Hydrogen KO Drum)

Document ID	Document Title
[1] 1724000163-MD-LIS-00001	SUPPLIER MASTER INDEX REGISTER (SMIR)
[2] 1724000163-QC-ITP-00002	INSPECTION AND TEST PLAN
[3] 1724000163-MAC-CA-00003	MECHANICAL CALCULATION
[4] 1724000163-MAC-DA-00004	GENERAL ARRANGEMENT DRAWINGS AND FOUNDATION LOADING DIAGRAM AND SUPPORT DETAILS (INCL NOZZLE LOADS) and INCLUDING NAMEPLATE DRAWINGS
[5] 1724000163-MAC-DD-00005	DETAILED DRAWING INCLUDING CROSS SECTION/EXPLODED VIEW DRAWING WITH PART LIST
[6] 1724000163-MAC-DS-00006	EQUIPMENT DATA SHEETS INCLUDING WEIGHT DATA SHEETS
[7] 1724000163-MAT-PRO-00007	PAINTING PROCEDURE (including surface preparation)
[8] 1724000163-NDT-PRO-00008	NON-DESTRUCTIVE EXAMINATIONS PROCEDURES (NDE) INCLUDING PMI
[9] 1724000163-NDT-LIS-00009	NDE OPERATORS LIST AND QUALIFICATIONS
[10] 1724000163-QC-PRO-00010	HYDROSTATIC TEST PROCEDURES and PNEUMATIC TEST PROCEDURE (FAT PROCEDURE)
[11] 1724000163-WEL-LIS-00011	WELDING PROCEDURE SPECIFICATION (WPS) AND QUALIFICATIONS (PQR) RECORDS, WELDING OPERATORS LIST and WELDER QUALIFICATIONS RECORDS (WPQ) and WELDING MAP
[12] 1724000163-QC-LIS-00012	EQUIPMENT MANUFACTURERS RECORD BOOK (FINAL DOSSIER) - INDEX
[13] 1724000163-QC-DB-00013	EQUIPMENT MANUFACTURERS RECORD BOOK – COMPLETE
[14] 1724000163-COM-LIS-00014	SPARE PART INDEX REGISTER (COMMISSIONING, OPERATION)
[15] 1724000163-MAC-MAN-00015	INSTALLATION AND OPERATING MAINTENANCE MANUAL (IOM)
[16] 1724000163-QC-PRO-00016	SHIPPING, PACKING, HANDLING AND STORAGE and PRESERVATIONS, PROCEDURES

Table 3: Vendor Documents (Hydrogen KO Drum)

4.1.4 Vendor Documents (Hydrogen Vent)

Document ID	Document Title
[1] 1724000888-MD-LIS-00001	SUPPLIER MASTER INDEX REGISTER (SMIR) - HYDROGEN VENT
[2] 1724000887-QC-ITP-00002	INSPECTION AND TEST PLAN - HYDROGEN VENT
[3] 1724000887-MAC-CA-00003	GENERAL ARRANGEMENTS DRAWINGS, INCLUDING FOUNDATION LOADS-HYDROGEN VENT
[4] 1724000887-MAC-DA-00004	MECHANICAL CALCULATION - HYDROGEN VENT
[5] 1724000887-MAC-DD-00005	DETAILED DRAWING WITH PART LIST - HYDROGEN VENT

[6] 1724000887-MAC-DS-00006	EQUIPMENT DATA SHEETS - HYDROGEN VENT
[7] 1724000887-MAC-DG-00007	WIRING DIAGRAM (JB AND HT) - HYDROGEN VENT
[8] 1724000887-NDT-PRO-00008	NON-DESTRUCTIVE EXAMINATIONS PROCEDURES (NDE) AND OPERATORS LIST AND QUALIFICATIONS
[9] 1724000887-QC-PRO-00009	HYDROSTATIC TEST PROCEDURES -HYDROGEN VENT
[10] 1724000887-MAT-PRO-00010	PAINTING PROCEDURE- HYDROGEN VENT
[11] 1724000887-WEL-PRO-00011	WELD PROCEDURE SPECIFICATION (WPS) WLED LOCATION PLAN (WLP) AND QUALIFICATIONS RECORDS (PQR) WELD OPERATORS LIST and WELDER QUALIFICATIONS RECORDS (WPQ)
[12] 1724000887-QC-LIS-00012	ATEX REGISTER - HYDROGEN VENT
[13] 1724000887-MAC-LIS-00013	ATEX CERTIFICATION - HYDROGEN VENT
[14] 1724000887-QC-DB-00014	EQUIPMENT MANUFACTURERS RECORD BOOK – COMPLETE - HYDROGEN VENT
[15] 1724000887-QC-LIS-00015	EQUIPMENT MANUFACTURERS RECORD BOOK (FINAL DOSSIER) - INDEX - HYDROGEN VENT
[16] 1724000887-COM-LIS-00016	SPARE PART INDEX REGISTER (SPIR) - HYDROGEN VENT
[17] 1724000887-MAC-MAN-00017	INSTALLATION OPERATING AND MAINTENANCE MANUAL (IOM)
[18] 1724000887-QC-PRO-00018	PACKING, SHIPPING HANDLING AND STORAGE PROCEDURES
[19] 1724000887-MAC-DD-00019	LIFTING DRAWINGS - HYDROGEN VENT

Table 4: *Vendor Documents (Hydrogen Vent)*

4.1.5 Vendor Documents (Hydrogen Storage Vessel)

Document ID	Document Title
[1] 1723001756-MD-LIS00001	SUPPLIER MASTER INDEX REGISTER (SMIR)
[2] 1723001756-QC-ITP00002	INSPECTION AND TEST PLAN
[3] 1723001756-MACCAL-00003	PRESSURE VESSEL MECHANICAL CALCULATION
[4] 1723001756-MAC-DA00004	GENERAL ARRANGEMENTS DRAWINGS AND FOUNDATION LOADING DIAGRAM AND SUPPORT DETAILS (INCL NOZZLE LOADS)
[5] 1723001756-MAC-DD00005	DETAILED DRAWING INCLUDING CROSS SECTION/EXPLODED VIEW DRAWING WITH PART LIST
[6] 1723001756-MAC-DD00006	NAMEPLATE DRAWING
[7] 1723001756-MAC-DS00007	EQUIPMENT DATA SHEETS INCLUDING WEIGHT DATA SHEETS
[8] 1723001756-MATPRO-00008	PAINTING PROCEDURE (including surface preparation)
[9] 1723001756-NDTPRO-00009	NON-DESTRUCTIVE EXAMINATIONS PROCEDURES (NDE)
[10] 1723001756-NDT-LIS00010	NDE OPERATORS LIST AND QUALIFICATIONS

[11] 1723001756-QC-PRO00011	HEAT TREATMENT PROCEDURES (inc. PWHT)
[12] 1723001756-QC-PRO00012	HYDROSTATIC TEST PROCEDURES (FAT PROCEDURE)
[13] 1723001756-WELPRO-00013	WELDING PROCEDURE SPECIFICATION (WPS) AND QUALIFICATIONS (PQR) RECORDS
[14] 1723001756-WEL-DD00014	WELDING DETAIL DRAWINGS
[15] 1723001756-WEL-LIS00015	WELDING OPERATORS LIST and WELDER QUALIFICATIONS RECORDS (WPQ)
[16] 1723001756-QC-LIS00016	EQUIPMENT MANUFACTURERS RECORD BOOK (FINAL DOSSIER) - INDEX
[17] 1723001756-QC-DB00017	EQUIPMENT MANUFACTURERS RECORD BOOK – COMPLETE
[18] 1723001756-COM-LIS00018	SPARE PART INDEX REGISTER (COMMISSIONING, OPERATION)
[19] 1723001756-MACMAN-00019	INSTALLATION AND OPERATING MAINTENANCE MANUAL (PED)
[20] 1723001756-QC-PRO00020	SHIPPING, PACKING, HANDLING AND STORAGE and PRESERVATIONS, PROCEDURES
[21] 1723001756-TI-DD00021	TRANSPORTATION DRAWINGS
[22] 1723001756MAC-DD00022	LIFTING ARRANGEMENT DRAWINGS

Table 5: Vendor Documents (Hydrogen Storage Vessel)

4.2 Acronyms and Abbreviations

Acronyms and Abbreviations	Description
BDV	Blowdown Valve
BESS	Battery Energy Storage System
BLPH	Base Load Power HUB
CCR	Central Control Room
CCS	Central Control System
DP	Differential Pressure
E&I	Electrical & Instrumentation
EMCS	Electrical Monitoring & Control System
ESD	Emergency Shut Down
FIC	Flow Integration Controller
F&G	Fire & Gas
HKN	Hollandse Kust Noord
HMI	Human Machine Interface
HV	High Voltage
HSE	Health, Safety, & Environment
ITR	Inspection & Test Record

Acronyms and Abbreviations	Description
LC	Locked Closed
LOTO	Lock-Out / Tag-Out
LUN	Livening Up Notification
MC	Mechanical Completion
NDE	Non-Destructive Examination
OER	Onshore Equipment Room
OTP	Operational Test Procedure (Commissioning)
ORR	Operations Readiness Review
PCS	Process Control System
PIC	Pressure Integration Controller
PID (P&ID)	Piping and Instrumentation Diagram
PPE	Personnel Protective Equipment
PQR	Procedure Qualifications Records
PT	Pressure Transmitter
PV	Pressure Valve
PWHT	Post Weld Heat Treatment
RFC	Ready for Commissioning
RFO	Ready for Operation
SAT	Site Acceptance test
SDV	Shut Down Valve
SIS	Safety Instrumented System
SMIR	Supplier Master Information Register
SoF	Statement of Fitness
SPIR	Spare Part Index Register
UPS	Uninterruptible Power Supply
VooW	Van Oord Offshore Wind
WEF	Work Execution Flow Scheme
WLP	Weld Location Plan
WPQ	Weld Procedure Qualification
WPS	Weld Procedure Specification

Table 6: Acronyms and Abbreviations

5. OTP TEST REQUIREMENTS – ONSHORE WORKSITE

This chapter refers to the activities at 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 from Contractor.
- 1 E&I commissioning supervisor from Contractor.
- 1 E&I commissioning technicians from Contractor.
- 1 MECH commissioning superintendent from Contractor
- 1 MECH commissioning technicians from Contractor
- 1 Operator workstation field engineer.

5.1.2 Test Duration Estimate

The test duration is forecast as follows:

- 8 days Functional Test

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

5.1.3 Vendor assistance

- Not Applicable

5.1.4 Items Postponed C&E OTP

- Not Applicable

5.1.5 Summary of HARDWARE items to be Tested (list sequence by Vessel)

Signal tag:	Signal description:
25-FT-031	Flow Transmitter - Nitrogen to V-25001A Vessel
25-PT-004	Pressure Transmitter - Vessel V-25001A Hydrogen Vent System
25-PT-035	Pressure Transmitter - Vessel V-25001A Pressure Control
25-BDV-005	On/Off Valve - Vessel V-25001A Hydrogen Vent System
25-FIC-031	Nitrogen to V-25001A vessel
25-PIC-035	Vessel V-25001A pressure control
25-PV-035	Control Valve - Vessel V-25001A Pressure Control
25-FV-031	Control Valve - Nitrogen to V-25001A Vessel

25-FT-032	Flow Transmitter - Nitrogen to V-25001B Vessel
25-PT-006	Pressure Transmitter - Vessel V-25001B Hydrogen Vent System
25-PT-037	Pressure Transmitter - Vessel V-25001B Pressure Control
25-BDV-007	On/Off Valve - Vessel V-25001B Hydrogen Vent System
25-FIC-032	Nitrogen to V-25001B vessel
25-PIC-037	Vessel V-25001B pressure control
25-FV-032	Control Valve - Nitrogen to V-25001B Ves
25-PV-037	Control Valve - Vessel V-25001B Pressure Control
25-FT-033	Flow Transmitter - Nitrogen to V-25001C Vessel
25-PT-008	Pressure Transmitter - Vessel V-25001C Hydrogen Vent System
25-PT-040	Pressure Transmitter - Vessel V-25001C Pressure Control
25-BDV-010	On/Off Valve - Vessel V-25001C Hydrogen Vent System
25-FIC-033	Nitrogen to V-25001C vessel
25-PIC-040	Vessel V-25001C pressure control
25-FV-033	Control Valve - Vessel V-25001C Pressure Control
25-PV-040	Control Valve - Vessel V-25001C Pressure Control
25-FT-034	Flow Transmitter - Nitrogen to V-25001D Vessel
25-PT-009	Pressure Transmitter - Vessel V-25001D Hydrogen Vent System
25-PT-043	Pressure Transmitter - Vessel V-25001D Pressure Control
25-BDV-013	On/Off Valve - Vessel V-25001D Hydrogen Vent System
25-FIC-034	Nitrogen to V-25001D vessel
25-PIC-043	Vessel V-25001D pressure control
25-FV-034	Control Valve - Nitrogen to V-25001D Vessel
25-PV-043	Control Valve - Vessel V-25001D Pressure Control
25-FT-038	Flow Transmitter - Nitrogen to V-25001E Vessel
25-PT-011	Pressure Transmitter - Vessel V-25001E Hydrogen Vent System
25-PT-046	Pressure Transmitter - Vessel V-25001E Pressure Control
25-BDV-016	On/Off Valve - Vessel V-25001E Hydrogen Vent System
25-FIC-038	Nitrogen to V-25001E vessel
25-PIC-046	Vessel V-25001E pressure control
25-FV-036	Control Valve - Nitrogen to V-25001F Vessel
25-PV-046	Control Valve - Vessel V-25001E Pressure Control
25-FT-036	Flow Transmitter - Nitrogen to V-25001F Vessel
25-PT-012	Pressure Transmitter - Vessel V-25001F Hydrogen Vent System
25-PT-049	Pressure Transmitter - Vessel V-25001F Pressure Control

This document undergoes an issuance cycle within EDMS "FusionLive". Its distribution is electronically controlled.
Once printed shall be considered as "NOT CONTROLLED" copy.

25-BDV-019	On/Off Valve - Vessel V-25001F Hydrogen Vent System
25-FIC-036	Nitrogen to V-25001F vessel
25-PIC-049	Vessel V-25001F pressure control
25-FV-038	Control Valve - Nitrogen to V-25001E Vessel
25-PV-049	Control Valve - Vessel V-25001F Pressure Control
25-PT-001	Pressure Transmitter - Hydrogen to Vessels Inlet Header
25-PT-002	Pressure Transmitter - Hydrogen to Vessels Inlet Header Shut-Down
25-SDV-001	On/Off Valve - Hydrogen to Vessels Inlet Header Shut-Down
25-XV-004	On/Off Valve - Vessel V-25001A Hydrogen Inlet
25-XV-008	On/Off Valve - Vessel V-25001B Hydrogen Inlet
25-XV-011	On/Off Valve - Vessel V-25001C Hydrogen Inlet
25-XV-014	On/Off Valve - Vessel V-25001D Hydrogen Inlet
25-XV-017	On/Off Valve - Vessel V-25001E Hydrogen Inlet
25-XV-020	On/Off Valve - Vessel V-25001F Hydrogen Inlet
25-XV-024	On/Off Valve - Hydrogen to Vessels Inlet Header Vent System
25-PT-055A	Pressure Transmitter - hydrogen from Vessels Outlet Header Pressure Control
25-PT-055B	Pressure Transmitter - Hydrogen from Vessels Outlet Header Pressure Control
80-PT-002	Pressure Transmitter - Hydrogen Storage to A-80000 Package
25-BDV-022	On/Off Valve - Hydrogen from Vessels Outlet Header Vent System
25-SDV-023	On/Off Valve - Hydrogen from Vessels Outlet Header Shut-Down
25-XV-006	On/Off Valve - Vessel V-25001A Hydrogen Outlet
25-XV-009	On/Off Valve - Vessel V-25001B Hydrogen Outlet
25-XV-012	On/Off Valve - Vessel V-25001C Hydrogen Outlet
25-XV-015	On/Off Valve - Vessel V-25001D Hydrogen Outlet
25-XV-018	On/Off Valve - Vessel V-25001E Hydrogen Outlet
25-XV-021	On/Off Valve - Vessel V-25001F Hydrogen Outlet
80-XV-001	On/Off Valve - Hydrogen Storage to A-80000 Package Vent System
25-PIC-055A	Hydrogen from vessels outlet header pressure control
25-HS-055	Hydrogen Storage Vessel Header (OUTLET) Press Control Loop Selection
25-PIC-055B	Hydrogen from vessels outlet header pressure control
25-PV-055A	Control Valve - hydrogen from Vessels Outlet Header Pressure Control
25-PV-055B	Control Valve - hydrogen from Vessels Outlet Header Pressure Control
43-FT-001	Flow Transmitter - Hydrogen from KO DRUM V-43001 to vent stack Q-43004
43-PT-001	Pressure Transmitter - KO Drum V-43001 Pressure

43-LT-001	Level DP Transmitter - KO Drum V-43001 High/Low Level
43-LT-003	Level DP Transmitter - H2 Vent Q-43004 Low Level

Table 7: Summary of Items HARDWARE to be Tested

5.2 OTP TEST REQUIREMENT – ONSHORE WORKSITE

5.2.1 Pre-Commissioning Achievement

Prior to the commissioning operation starts, the relevant pre-commissioning ITR-B's should be fully signed.

5.2.2 Commissioning Achievement

The commissioning achievement will be the successful operation, functionality of Hydrogen Storage & Venting Systems, installed and put in operation during the WORKSITE phase:

- SS 25-00 Hydrogen Storage
- SS 43-00 Hydrogen Vent Header & Drum System

5.2.3 Status of associated Subsystems

Subsystems required RFC for Commissioning of Nitrogen Storage & Venting Systems:

- SS 87-10 PCS System
- SS 79-00 SIS (ESD)
- SS 87-00 EMCS
- SS 88-00 Earthing System
- SS 25-01: V-25001 A
- SS 25-02: V-25001 B
- SS 25-03: V-25001 C
- SS 25-04: V-25001 D
- SS 25-05: V-25001 E
- SS 25-06: V-25001 F
- SS-25-07: Hydrogen Storage Vessel Header (Inlet)
- SS-25-08: Hydrogen Storage Vessel Header (Outlet)
- SS 43-00: Hydrogen Vent Header & Drum System
- SS 63-00: Instrument Air Package
- SS 63-30: Instrumentation Air Distribution Network
- SS 64-00: Nitrogen Generation Package
- SS 64-10: Nitrogen Distribution Network

5.2.4 Special Tools & Test Equipment

The following special tools and Test Equipment are required:

- Continuity tester (Multimeter)
- Toolbox
- Hart Communicator
- Fluke 725

- Portable radios (2 pcs + 1 per Technical Room)

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

5.2.5 Consumable List

- Not applicable

5.2.6 Commissioning Spare Part

- See reference doc. N. 1724000887-COM-LIS-0016 Hydrogen Vent.
- See reference doc. N. 1724000163-COM-LIS-0014 Hydrogen KO Drum.
- See reference doc. N. 1723001756-COM-LIS-00018 H2 Storage Vessel.

5.2.7 Temporary Facilities

- Not applicable

5.3 OTP DESCRIPTION – ONSHORE WORKSITE

5.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1.	System Ready for Commissioning Certificate (RFC) is issued and approved.			
2.	No Mechanical Completion or Pre-commissioning punch list 'A' items are outstanding against the system to be commissioned.			
3.	Factory Acceptance Test Procedures have been carried out successfully (Hydrogen KO Drum refer to Doc. 1724000163-QC-PRO-PRO-00010 and Hydrogen Vent refer to Doc. 1724000887-QC-PRO-00010 and H2 Storage Vessel 1723001756-QCPRO-00012).			

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 as per section 5.2.4.			
10.	System(s) (de)isolations as per LOTO procedure defined within HSSE Permits to Work and Commissioning procedures duly prepared and approved			
11.	All yard personnel have been duly notified by dedicated LUN (Livening Up Notification) that the system(s) is ready for commissioning.			

5.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1.	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
2.	Verify that all relevant associated systems / subsystems are completed.			

5.3.3 Mechanical Preparation

Step	Description	Result	Verified by	Date
1.	Check the correct flow direction of the valves			
2.	Visual Check			
3.	Instrument Air Package A-63000 up and running			
4.	N2 generation package A-64000 up and running			
5.	Confirm leak testing is complete and documented			
6.	Confirm mechanical alignment of all package pumps & equipment			

7.	Ensure package PSV setpoints are correct for the designed operating pressure			
8.	Ensure all unnecessary isolation are removed and vent system is ready to receive hydrogen			

5.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
1.	Check related punch list 'B' items and confirm acceptability for start of commissioning activities.			
2.	Verify that all relevant associated systems / subsystems are ready.			
3.	Verify that relevant equipment/ components are available and in operation for start of commissioning activities.			
4.	Verify availability of test equipment as per section 5.2.4.			
5.	Check of overrides and interlocks			

5.3.5 Piping Preparation

Step	Description	Result	Verified by	Date
1.	Verify the completion of piping in conformity with system battery limit.			
2.	Gross air leak test successfully performed.			
3.	Review Rosetti flange management and confirm all interface connections have been torqued and leak tested with details recorded and signed for.			
4.	Ensure blind flange positive isolation is in place at test boundary.			

5.3.6 Additional Discipline Preparation

- Not applicable

5.4 OTP TEST STEPS – ONSHORE WORKSITE

In the following steps the functionality of the Hydrogen Storage & Venting Systems shall be tested:

- SS 25-00 Hydrogen Storage
- SS 43-00 Hydrogen Vent Header & Drum System

5.4.1 Test Preparation

Need to Verify:

- SS 87-10 PCS System
- SS 79-00 SIS (ESD)
- SS 87-00 EMCS
- SS 88-00 Earthing System
- SS 25-01: V-25001 A
- SS 25-02: V-25001 B
- SS 25-03: V-25001 C
- SS 25-04: V-25001 D
- SS 25-05: V-25001 E
- SS 25-06: V-25001 F
- SS-25-07: Hydrogen Storage Vessel Header (Inlet)
- SS-25-08: Hydrogen Storage Vessel Header (Outlet)
- SS 43-00: Hydrogen Vent Header & Drum System
- SS 63-00: Instrument Air Package
- SS 63-30: Instrumentation Air Distribution Network
- SS 64-00: Nitrogen Generation Package
- SS 64-10: Nitrogen Distribution Network

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

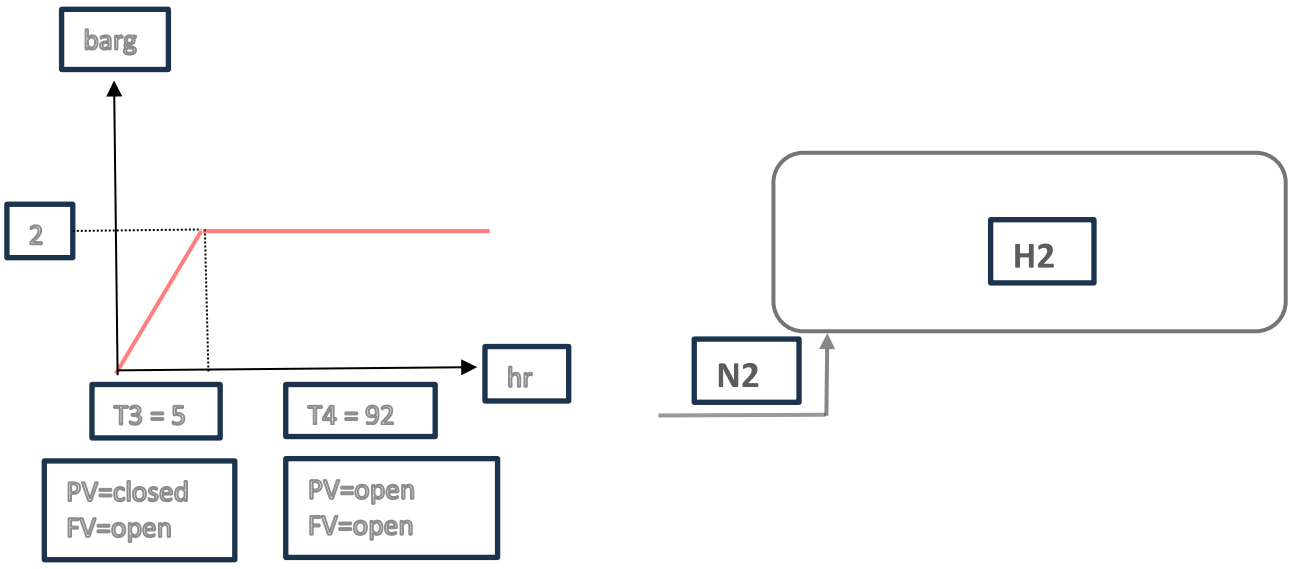
5.4.2 Test Steps

Step	Description	Result	Verified by	Date
SS 25-00 Hydrogen Storage. SS 43-00 Hydrogen Vent Header & Drum System.				
Verify related ITR-B for Systems SS 25-00 / SS 43-00 are completed.				
1	Verify loop check from workstation located in temporary yard CCR. with reference doc. 123A90-DDL-IN-DG-40014.			
2	Verify alarm setting from workstation located in temporary yard CCR. with reference doc. 123A90-DDL-IN-DG-40014.with reference doc. 123A90-DDL-IN–LIS-40089.			
3	Verify the Cause & Effect from workstation located in temporary yard CCR. with reference doc. 123A90-DDL-IN-DG-40014 and with reference doc. 123A90-DDL-IN-CE-40000 sheets 6-8.			
4	Confirming the steps from 1 to 3 let's proceed with the Control Logics.			
5	The Control Logic steps are listed below: • Purging mode after Shutdown (for H2 displacement).			

Step	Description	Result	Verified by	Date
	• Purging mode after maintenance (Air displacement). • Process Start-up Charging mode. • Fully Charged Status (indication on HMI). • Discharging. • Process Empty Status (indication on HMI). • Process Charging mode.			
6	Since this test is performed with nitrogen instead of H2, Vessels A/B/C/D/E/F will be pressurized up to 6 barg consequently related set-points will be temporarily modified. When the test has been successfully completed, all set-points and simulations will be restored and checked.			
7	PURGING MODE AFTER SHUTDOWN (H2 DISPLACEMENT) SYSTEM PREPARATION WITH VALVES ALIGNMENT READY FOR PURGING. During this procedure the nitrogen used for purging will be produced by the Nitrogen Generation System A-64000. On the outlet line of the Nitrogen system (A-64000) a pressure control is provided, in order to guarantee and maintain a pressure of 7 barg. The control loop is identified with: • 64-PIC-031A/B • 64-PT-031A/B • 64-PV-031A/B The operator, through a software push button on HMI will activate the purging after shutdown for H2 displacement. This push button will be active only in electrical "Research MODE 7". All the XV valves shall be managed with an automatic sequence. The sequence shall be the following: Close the valves on the inlet line 25-XV-004/008/011/014/017/020 **(time to close 3 seconds)** and verify the feedback 25-ZSL-004/008/011/014/017/020. When the feedback status is active, close the valve on the outlet line 25-XV-006/009/012/015/018/021 **(time to close 3 seconds)** and verify the feedback 25-ZSL-006/009/012/015/018/021. When the feedback status is active the controllers 25-FIC-031/032/033/034/038/036 will force the output signal to 0% automatically.			

Step	Description	Result	Verified by	Date
	Close the valve on the inlet line 25-FV-031 /032/033/034/038/036 **(time to close 20 seconds).** Verify the feedback 25-ZSL-031/032/033/034/ 038/036. When all feedback status is active the controllers 25-PIC-035/037/040/043/046/049 will force the output signal to 0% automatically. Close all valves on the outlet lines 25-PV-035/ 037/040/043/046/049 **(time to close 20 seconds).** Verify the feedback 25-ZSL-035/037/040/043/ 046/049. When all feedback status is active the valve 64-SDV-001 will open, installed on the nitrogen line. The 64-SDV-001 valve is normally closed and through a software push button is permitted to open/closed remotely on HMI. A software interlock controls the operation of the valve which is only permitted during purging modes **(time to open 8 seconds).** 64-SDV-001 t=…… Second Verify the feedback status 64-ZSH-001.			

PURGING MODE AFTER SHUTDOWN (H2 DISPLACEMENT)



Step	Description	Result	Verified by	Date

ITEM	TAG. SIGNAL	PERMANENT SET-POINT	TEMP. TEST SET-POINT	DATA	RESTORED SET-POINT	DATA
1.	T3A (Tag. T3A refers to H2 storage tank V-25001)	5 hr.	1 hr. …… hr.			
2.	T4A (below)	92 hr.	1 hr. …… hr.			

8 H2 Vessel V-25001 A

Before starting the Purging mode after shutdown (H2 displacement) cycle the logic sequence will verify:

- If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-035 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL B.

Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable ≤ 8 barg and confirm the above sequence.
Restore normal operating parameters and disconnect the HART COMMUNICATOR.

The logic sequence will proceed as per designed when:

- If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-035 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-031 and assign the set point to 42 Nm³/hr.

25-FIC-031 SP=……..…….... Nm³/hr.

Step	Description	Result	Verified by	Date
	Verify the timer required to pressurize V-25001A T3A = 1 hr. (TEMP.) and the flow totalizer 25-FQ-031 and pressure gradient calculation. T3A t=…… hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-035 < 2 barg when timer is expired an alarm T3AAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-031, stop and reset the flow totalizer 25-FQ-031and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-031, stop and reset the Flow Totalizer 25-FQ-031and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-035 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-035 and assign the set point to 2 barg. Consequently valve 25-PV-035 will operate and release the Nitrogen gas to the vent			

Step	Description	Result	Verified by	Date
	system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4A = 1 hr. (TEMP.) Vessel V-25001A. T4A t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-035 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-035 and 25-FIC-031, stop and reset the flow totalizer 25-FQ-031 and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-035 ≥ 1.5 barg (during all T4A). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-031 and 25-PIC 035. The valves 25-FV-031 and 25-PV-035 close. Time to close 20 seconds. 25-ZSL-031 t=…….. second. 25-ZSL-035 t=…….. second. With feedback status 25-ZSL-031 and 25-ZSL-035 valves closed, the logic sequence will automatically proceed with the purging of VESSEL B.			

Step	Description	Result	Verified by	Date
9	H2 Vessel V-25001 B Before starting the Purging MODE after shutdown (H2 displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-037 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-037 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-032 and assign the set point to 42 Nm³/hr. 25-FIC-032 SP=……...…….... Nm³/hr. Verify the timer required to pressurize V-25001B T3B = 1 hr. (TEMP.) and the flow totalizer 25-FQ-032 and pressure gradient calculation. T3B t=…….…… hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-037 < 2 barg when timer is expired an alarm T3BAH will alert the operator, the automatic sequence will override the force output 0% of the			

Step	Description	Result	Verified by	Date
	controller 25-FIC-032, stop and reset the flow totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-032, stop and reset the Flow Totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-037 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-037 and assign the set point to 2 barg. Consequently valve 25-PV-037 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4B = 1 hr. (TEMP.) Vessel V-25001B. T4B t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-037 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-037 and 25-FIC-			

Step	Description	Result	Verified by	Date
	032, stop and reset the flow totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-037 ≥ 1.5 barg (during all T4B). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-032 and 25-PIC 037. The valves 25-FV-032 and 25-PV-037 close. Time to close 20 seconds. 25-ZSL-032 t=……..……...……...…….. second. 25-ZSL-037 t=……...……...…….…..... second. With feedback status 25-ZSL-032 and 25-ZSL-037 valves closed, the logic sequence will automatically proceed with the purging of VESSEL C.			
10	H2 Vessel V-25001 C Before starting the Purging MODE after shutdown (H2 displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-040 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable ≤ 8 barg and confirm the above sequence.			

Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-040 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-033 and assign the set point to 42 Nm³/hr. 25-FIC-033 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001C T3C = 1 hr. (TEMP.) and the flow totalizer 25-FQ-033 and pressure gradient calculation. T3C t=…….. hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 2 barg when timer is expired an alarm T3CAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-033, stop and reset the flow totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic			

Step	Description	Result	Verified by	Date
	sequence will override the force output 0% of the controller 25-FIC-033, stop and reset the Flow Totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-040 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-040 and assign the set point to 2 barg. Consequently valve 25-PV-040 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4C = 1 hr. (TEMP.) Vessel V-25001C. T4C t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-040 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-040 and 25-FIC-033, stop and reset the flow totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when:			

Step	Description	Result	Verified by	Date
	• If 25-PT-040 ≥ 1.5 barg (during all T4C). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-033 and 25-PIC 040. The valves 25-FV-033 and 25-PV-040 close. Time to close 20 seconds. 25-ZSL-033 t=……..……..……..…….. second. 25-ZSL-040 t=……..……..……..…….. second. With feedback status 25-ZSL-033 and 25-ZSL-040 valves closed, the logic sequence will automatically proceed with the purging of VESSEL D.			
11	H2 Vessel V-25001 D . Before starting the Purging MODE after shutdown (H2 displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-043 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-043 internal Vessel, the automatic sequence will override the forced output			

Step	Description	Result	Verified by	Date
	0% of the controller 25-FIC-034 and assign the set point to 42 Nm³/hr. 25-FIC-034 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001D T3D= 1 hr. (TEMP.) and the flow totalizer 25-FQ-034 and pressure gradient calculation. T3D t=…….. hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-043 < 2 barg when timer is expired an alarm T3DAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-034, stop and reset the flow totalizer 25-FQ-034and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-04, stop and reset the Flow Totalizer 25-FQ-034 and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	Once the pressure 25-PT-043 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-043 and assign the set point to 2 barg. Consequently valve 25-PV-043 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4D = 1 hr. (TEMP.) Vessel V-25001D. T4D t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-043 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-043 and 25-FIC-034, stop and reset the flow totalizer 25-FQ-034 and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-043 ≥ 1.5 barg (during all T4D). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-034 and 25-PIC 043. The valves 25-FV-034 and 25-PV-043 close. Time to close 20 seconds. 25-ZSL-034 t=…….. second. 25-ZSL-043 t=…….. second.			

Step	Description	Result	Verified by	Date
	With feedback status 25-ZSL-034 and 25-ZSL-043 valves closed, the logic sequence will automatically proceed with the purging of VESSEL E.			
12	H2 Vessel V-25001 E Before starting the Purging MODE after shutdown (H2 displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-046 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-046 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-038 and assign the set point to 42 Nm³/hr. 25-FIC-038 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001E T3E = 1 hr. (TEMP.) and the flow totalizer 25-FQ-038 and pressure gradient calculation. T3E t=…….. hr. The logic sequence is not achieved as per designed when:			

Step	Description	Result	Verified by	Date
	• If the pressure 25-PT-046 < 2 barg when timer is expired an alarm T3EAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-038, stop and reset the flow totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-038, stop and reset the Flow Totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-046 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-046 and assign the set point to 2 barg. Consequently valve 25-PV-046 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4E = 1 hr. (TEMP.) Vessel V-25001E. T4E t=…….. hr. The logic sequence is not achieved as per designed when:			

Step	Description	Result	Verified by	Date
	• if the pressure 25-PT-046 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-046 and 25-FIC-038, stop and reset the flow totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-046 ≥ 1.5 barg (during all T4E). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-038 and 25-PIC 046. The valves 25-FV-038 and 25-PV-046 close. Time to close 20 seconds. 25-ZSL-038 t=……..……...……...…….. second. 25-ZSL-046 t=……...……...…….…..... second. With feedback status 25-ZSL-038 and 25-ZSL-046 valves closed, the logic sequence will automatically proceed with the purging of VESSEL F.			
13	H2 Vessel V-25001 F Before starting the Purging MODE after shutdown (H2 displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-049 internal Vessel, the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve			

Step	Description	Result	Verified by	Date
	process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-049 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-036 and assign the set point to 42 Nm³/hr. 25-FIC-036 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001F T3F = 1 hr. (TEMP.) and the flow totalizer 25-FQ-036 and pressure gradient calculation. T3F t=…….. hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-049 < 2 barg when timer is expired an alarm T3FAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-036, stop and reset the flow totalizer 25-FQ-036 and the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

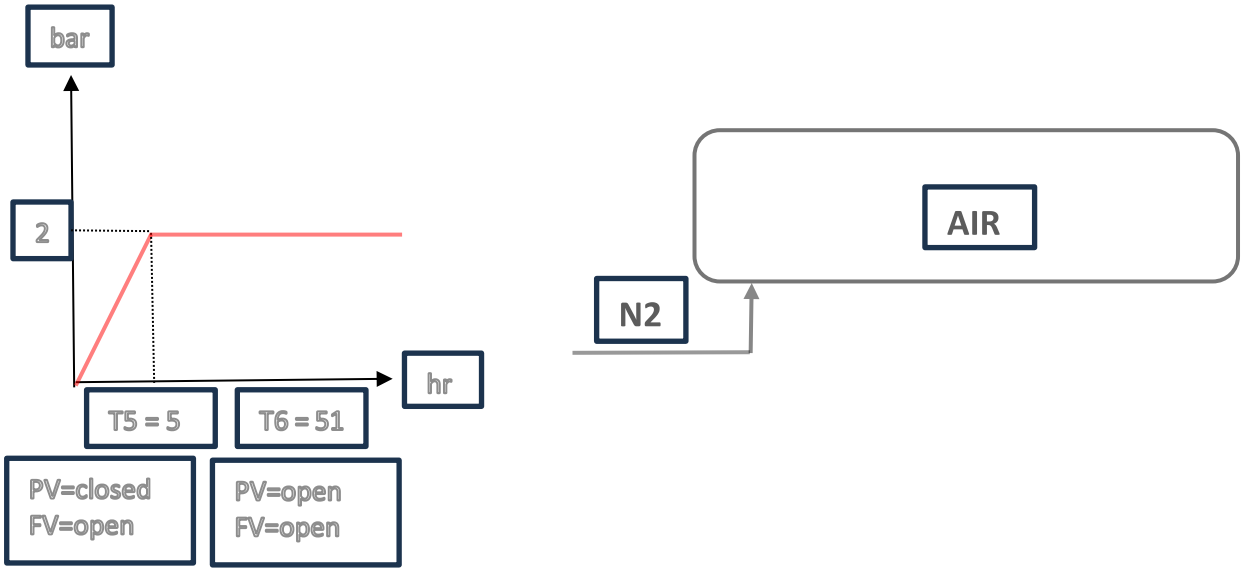
Step	Description	Result	Verified by	Date
	• If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-036, stop and reset the Flow Totalizer 25-FQ-036 and the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-049 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-049 and assign the set point to 2 barg. Consequently valve 25-PV-049 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T4F = 1 hr. (TEMP.) Vessel V-25001F. T4F t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-049 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-049 and 25-FIC-036, stop and reset the flow totalizer 25-FQ-036 and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	The logic sequence will proceed as per designed when: • If 25-PT-049 ≥ 1.5 barg (during all T4F). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-036 and 25-PIC 049. The valves 25-FV-036 and 25-PV-049 close. Time to close 20 seconds. 25-ZSL-036 t=……..……..……..…….. second. 25-ZSL-049 t=……..……..……..…….. second. With feedback status 25-ZSL-036 and 25-ZSL-049 valves closed, the logic sequence will automatically proceed with EXIT.			
14	As soon as the flow totalizers are stopped (25-FQ-031/032/033/034/038/036) the PCS will compare the value with the expected value FQH. Total flow expected for purging after shutdown (H2 displacement). FQH =……Nm³/hr.			
15	PURGING MODE AFTER MAINTENANCE (AIR DISPLACEMENT) SYSTEM PREPARATION WITH VALVES ALIGNMENT READY FOR PURGING. During this procedure the nitrogen used for purging will be produced by the Nitrogen Generation System A-64000. On the outlet line of the Nitrogen system (A-64000) a pressure control is provided, in order to guarantee and maintain a pressure of 7 barg. The control loop is identified with: • 64-PIC-031A/B • 64-PT-031A/B • 64-PV-031A/B The operator through a software push button on HMI will activate the "Purging mode". This push button will be active only in "Research MODE 7".			

Step	Description	Result	Verified by	Date
	All the XV valves shall be managed with an automatic sequence. The sequence shall be the following: Close the valves on the inlet line 25-XV-004/008/011/014/017/020 **(time to close 3 seconds)** and verify the feedback 25-ZSL-004/008/ 011/014/017/020. When the feedback status is active, close the valve on the outlet line 25-XV-006/009/012/015/018 /021 **(time to close 3 seconds)** and verify the feedback 25-ZSL-006/009/012/015/018/021. When the feedback status is active the controllers 25-FIC-031/032/033/034/038/036 will force the output signal to 0% automatically. Close the valve on the inlet line 25-FV-031 /032/033/034/038/036 **(time to close 20 seconds).** Verify the feedback 25-ZSL-031 /032/033/034/ 038/036. When all feedback status is active the controllers 25-PIC-035/037/040/043/046/049 will force the output signal to 0% automatically. Close all valves on the outlet lines 25-PV-035/ 037/040/043/046/049 **(time to close 20 seconds).** Verify the feedback 25-ZSL-035 /037/040/043/ 046/049. When all feedback status is active the valve 64-SDV-001 will open, installed on the nitrogen line. The 64-SDV-001 valve is normally closed and through a software push button is permitted to open/closed remotely on HMI. A software interlock controls the operation of the valve which is only permitted during purging modes **(time to open 8 seconds).** 64-SDV-001 t=…… Second Verify the feedback status 64-ZSH-001.			

Step	Description	Result	Verified by	Date

PURGING MODE AFTER MAINTENANCE (AIR DISPLACEMENT)



ITEM	TAG. SIGNAL	PERMANENT SET-POINT	TEMP. TEST SET-POINT	DATA	RESTORED SET-POINT	DATA
3.	T5A (Tag. T5A refers to H2 storage tank V-25001A)	5 hr.	1 hr. …… hr.			
4.	T6A (below)	51 hr.	1 hr. …… hr.			

16	H2 VESSEL V-25001A Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-035 internal Vessel, the logic sequence			

Step	Description	Result	Verified by	Date
	will automatically proceed with purging of VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-035 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-031 and assign the set point to 42 Nm³/hr. 25-FIC-031 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001A T5A = 1 hr. (TEMP.) and the flow totalizer 25-FQ-031 and pressure gradient calculation. T5A t=……. hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-035 < 2 barg when timer is expired an alarm T5AAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-031, stop and reset the flow totalizer 25-FQ-031and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 2 barg and confirm the above sequence.			

Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-031, stop and reset the Flow Totalizer 25-FQ-031and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-035 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-035 and assign the set point to 2 barg. Consequently valve 25-PV-035 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T6A = 1 hr. (TEMP.) Vessel V-25001A. T6A t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-035 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-035 and 25-FIC-031, stop and reset the flow totalizer 25-FQ-031 and the logic sequence will automatically proceed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	The logic sequence will proceed as per designed when: • If 25-PT-035 ≥ 1.5 barg (during all T6A). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-031 and 25-PIC 035. The valves 25-FV-031 and 25-PV-035 close. Time to close 20 seconds. 25-ZSL-031 t=……..……..……..…….. second. 25-ZSL-035 t=……..……..……..…….. second. With feedback status 25-ZSL-031 and 25-ZSL-035 valves closed, the logic sequence will automatically proceed with the purging of VESSEL B.			
17	H2 VESSEL V-25001B Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-037 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-			

Step	Description	Result	Verified by	Date
	PT-037 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-031 and assign the set point to 42 Nm³/hr. 25-FIC-032 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001B T5B = 1 hr. (TEMP.) and the flow totalizer 25-FQ-032 and pressure gradient calculation. T5B t=…….…… hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-037 < 2 barg when timer is expired an alarm T5BAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-032, stop and reset the flow totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-032, stop and reset the Flow Totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 1 barg and confirm the above sequence.			

Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-037 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-035 and assign the set point to 2 barg. Consequently valve 25-PV-037 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T6B = 1 hr. (TEMP.) Vessel V-25001B. T6B t=…….…….…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-037 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-037 and 25-FIC-032, stop and reset the flow totalizer 25-FQ-032 and the logic sequence will automatically proceed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-037 ≥ 1.5 barg (during all T6B). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-032 and 25-PIC 037. The valves 25-FV-032 and 25-PV-037 close. Time to close 20 seconds. 25-ZSL-032 t=……..……..……... second.			

Step	Description	Result	Verified by	Date
	25-ZSL-037 t=……..……..…….…..... second. With feedback status 25-ZSL-032 and 25-ZSL-037 valves closed, the logic sequence will automatically proceed with the purging of VESSEL C.			
18	H2 Vessel V-25001 C Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-040 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-040 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-033 and assign the set point to 42 Nm³/hr. 25-FIC-033 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001C T5C = 1 hr. (TEMP.) and the flow totalizer 25-FQ-033 and pressure gradient calculation. T5C t=…….. hr.	———		

Step	Description	Result	Verified by	Date
	The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 2 barg when timer is expired an alarm T5CAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-033, stop and reset the flow totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-033, stop and reset the Flow Totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-040 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-040 and assign the set point to 2 barg. Consequently valve 25-PV-040 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purge T6C = 1 hr. (TEMP.) Vessel V-25001C. T6C t=…….. hr.			

Step	Description	Result	Verified by	Date
	The logic sequence is not achieved as per designed when: • if the pressure 25-PT-040 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-040 and 25-FIC-033, stop and reset the flow totalizer 25-FQ-033 and the logic sequence will automatically proceed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-040 ≥ 1.5 barg (during all T6C). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-033 and 25-PIC 040. The valves 25-FV-033 and 25-PV-040 close. Time to close 20 seconds. 25-ZSL-033 t=……..……...……...…….. second. 25-ZSL-040 t=……...……...…….…..... second. With feedback status 25-ZSL-033 and 25-ZSL-040 valves closed, the logic sequence will automatically proceed with the purging of VESSEL D.			
19	H2 Vessel V-25001 D Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-043 internal Vessel, the logic sequence			

Step	Description	Result	Verified by	Date
	will automatically proceed with purging of VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-043 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-034 and assign the set point to 42 Nm³/hr. 25-FIC-034 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001D T5AD= 1 hr. (TEMP.) and the flow totalizer 25-FQ-034 and pressure gradient calculation. T5D t=…….…… hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-043 < 2 barg when timer is expired an alarm T5DAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-034, stop and reset the flow totalizer 25-FQ-034and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 2 barg and confirm the above sequence.			

Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-04, stop and reset the Flow Totalizer 25-FQ-034 and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-043 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-043 and assign the set point to 2 barg. Consequently valve 25-PV-043 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T6D = 1 hr. (TEMP.) Vessel V-25001D. T6D t=…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-043 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-043 and 25-FIC-034, stop and reset the flow totalizer 25-FQ-034 and the logic sequence will automatically proceed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	The logic sequence will proceed as per designed when: • If 25-PT-043 ≥ 1.5 barg (during all T6D). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-034 and 25-PIC 043. The valves 25-FV-034 and 25-PV-043 close. Time to close 20 seconds. 25-ZSL-034 t=……..……..……..…….. second. 25-ZSL-043 t=……..……..……..…….. second. With feedback status 25-ZSL-034 and 25-ZSL-043 valves closed, the logic sequence will automatically proceed with the purging of VESSEL E.			
20	H2 Vessel V-25001 E Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-046 internal Vessel, the logic sequence will automatically proceed with purging of VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-046 internal Vessel, the automatic			

Step	Description	Result	Verified by	Date
	sequence will override the forced output 0% of the controller 25-FIC-038 and assign the set point to 42 Nm³/hr. 25-FIC-038 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001E T5E = 1 hr. (TEMP.) and the flow totalizer 25-FQ-038 and pressure gradient calculation. T5E t=…….…….. hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-046 < 2 barg when timer is expired an alarm T5EAH will alert the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-038, stop and reset the flow totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-038, stop and reset the Flow Totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

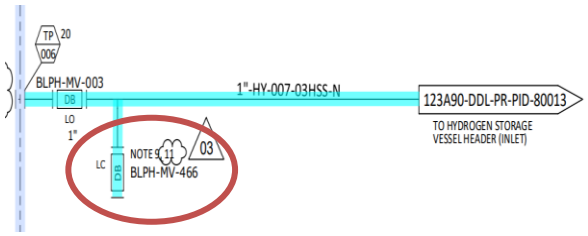
Step	Description	Result	Verified by	Date
	Once the pressure 25-PT-046 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-046 and assign the set point to 2 barg. Consequently valve 25-PV-046 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purge T6E = 1 hr. (TEMP.) Vessel V-25001E. T6E t=…….…….…….. hr. The logic sequence is not achieved as per designed when: • if the pressure 25-PT-046 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-046 and 25-FIC-038, stop and reset the flow totalizer 25-FQ-038 and the logic sequence will automatically proceed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-046 ≥ 1.5 barg (during all T6E). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-038 and 25-PIC 046. The valves 25-FV-038 and 25-PV-046 close. Time to close 20 seconds. 25-ZSL-038 t=…….……..……..…….. second. 25-ZSL-046 t=……..……..…….…..... second.			

Step	Description	Result	Verified by	Date
	With feedback status 25-ZSL-038 and 25-ZSL-046 valves closed, the logic sequence will automatically proceed with the purging of VESSEL F.			
21	H2 Vessel V-25001 F Before starting the Purging mode after maintenance (air displacement) cycle the logic sequence will verify: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is ≤ that of the 25-PT-049 internal Vessel, the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable ≤ 8 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure measured by 64-PT-031A/B (depends on the control valve 64-PV-031A/B that is working) is > that of the 25-PT-049 internal Vessel, the automatic sequence will override the forced output 0% of the controller 25-FIC-036 and assign the set point to 42 Nm³/hr. 25-FIC-036 SP=……..…….... Nm³/hr. Verify the timer required to pressurize V-25001F T5F = 1 hr. (TEMP.) and the flow totalizer 25-FQ-036 and pressure gradient calculation. T5F t=…….…… hr. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-049 < 2 barg when timer is expired an alarm T5FAH will alert			

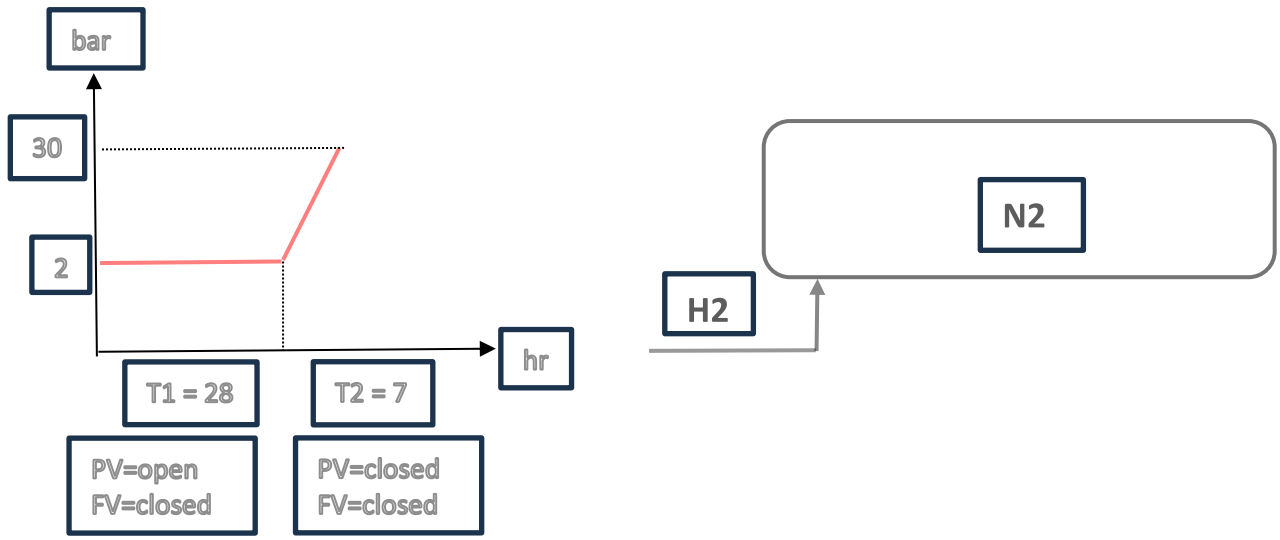
Step	Description	Result	Verified by	Date
	the operator, the automatic sequence will override the force output 0% of the controller 25-FIC-036, stop and reset the flow totalizer 25-FQ-036 and the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 2 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. (TEMP.), the automatic sequence will override the force output 0% of the controller 25-FIC-036, stop and reset the Flow Totalizer 25-FQ-036 and the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. Once the pressure 25-PT-049 ≥ 2 barg the automatic sequence will override the forced output 0% of the controller 25-PIC-049 and assign the set point to 2 barg. Consequently valve 25-PV-049 will operate and release the Nitrogen gas to the vent system while maintaining a constant pressure 2 barg. Verify the timer required to purging T6F = 1 hr. (TEMP.) Vessel V-25001F. T6F t=…….…….…….. hr. The logic sequence is not achieved as per designed when:			

Step	Description	Result	Verified by	Date
	• if the pressure 25-PT-049 < 1.5 barg a low-pressure alarm is activated. The automatic sequence will override the force output 0% of the controller 25-PIC-049 and 25-FIC-036, stop and reset the flow totalizer 25-FQ-036 and the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-049 ≥ 1.5 barg (during all T6F). When the timer is expired, the logic sequence will force output to 0% for both the controller 25-FIC-036 and 25-PIC 049. The valves 25-FV-036 and 25-PV-049 close. Time to close 20 seconds. 25-ZSL-036 t=……..……..……... second. 25-ZSL-049 t=……..……..……..... second. With feedback status 25-ZSL-036 and 25-ZSL-049 valves closed, the logic sequence will automatically proceed with EXIT.			
22	As soon as the flow totalizers are stopped (25-FQ-031/032/033/034/038/036) the PCS will compare the value with the expected value FQA. Total flow expected for purging after maintenance (Air displacement). FQA =……..…Nm³/hr.			

Step	Description	Result	Verified by	Date
23	PROCESS START-UP CHARGING MODE SYSTEM PREPARATION WITH VALVES ALIGNMENT READY FOR CHARGING All BDV valves 25-BDV-005/007/010/013/016/019 (installed between Hydrogen Vessels and vent system) and 25-BDV-022 (Hydrogen vessels outlet header system) are in closed position, the feedback statuses are 25-ZSL-005/007/010/013/016/019 /022. The inlet and outlet hydrogen header shutdown valves 25-SDV-001 and 25-SDV-023 are in open position, the feedback statuses are 25-ZSH-001 and 25-ZSH-023. On-Off valve 25-XV-024 (Hydrogen to vessels inlet header vent system) and 80-XV-001 (installed on outlet manifold) are in closed position, the feedback statuses are 25-ZSL-024 and 80-ZSL-001. Shutdown valve 64-SDV-001 (installed on the nitrogen line) is in closed position, the feedback status is 64-ZSL-001. The procedure can be activated only if pressure in the H2 Vessels ≥ 2 barg. All valves shall be managed with an automatic sequence. The sequence shall be the following: The controllers 25-FIC-031/032/033/034/038/036 will force the output signal to 0% automatically. Verify closure of the valves on the inlet line 25-FV-031/032/033/034/038/036 **(time to close 20 seconds).** When the valves closed feedback status is active 25-ZSL-031/032/033/034/038/036 the controllers 25-PIC-035/037/040/043/046/049 in auto mode will force the output to 0%. Verify closure of the valves on outlet lines 25-PV-035/037/040/043/046/049 **(time to close 20 seconds).** When the valves closed feedback status is active 25-ZSL-035/037/040/043/046/049 the sequence closes all valves installed on the inlet line of each H2 storage Vessel 25-XV-004/008/011/014/017/020 **(time to close 3 seconds).**			

Step	Description	Result	Verified by	Date
	When the valves closed feedback status is active 25-ZSL-004/008/011/014/017/020 the sequence close all valves installed on the outlet line of each H2 storage Vessel 25-XV-006/009/012/015/018/021 **(time to close 3 seconds).** Verify the feedback statuses 25-ZSL-006/009/012/ 015/018/021. Vessels V-25001A/B/C/D/E/F are now completely isolated.			
24	Since this test is performed with nitrogen instead of H2, the vessels will be pressurized up to 6 barg with the gas from the nitrogen generation package connected to the BLPH-MV-466 insertion point. 			

PROCESS START-UP CHARGING MODE



Step	Description	Result	Verified by	Date

ITEM	TAG. SIGNAL	PERMANENT SET-POINT	TEMP. TEST SET-POINT	DATA	RESTORED SET-POINT	DATA
1.	T1A (below)	28 hr.	1 hr. …… hr.			
2.	T2A (charging)	7 hr.	80 min. ……min.			
3.	25-PT-035	30 barg	5 barg			

25

H2 Vessel V-25001A

Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg.

.

- If 25-PT-035 < 2 barg the logic sequence will automatically proceed with Vessel B.

Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 2 barg and confirm the above sequence.
Restore normal operating parameters and disconnect the HART COMMUNICATOR.

The logic sequence will proceed as per designed when the internal Vessel A pressure is ≥ 2 barg.

- If 25-PT-035 ≥ 2 barg, the automatic sequence will open the valve 25-XV-004 (time to open 8 seconds).

25-ZSH-004 t=……..……..……..…….second.

When the feedback status 25-ZSH-004 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-035 and assigned the set point to 2 barg.
Verify the timer required to displacement V-25001A T1A= 1 hr. (TEMP.)

T1A t=…….. hr.

During the nitrogen displacement sequence the internal Vessel pressure must not fall below 1.5 barg.

Step	Description	Result	Verified by	Date
	The logic sequence is not achieved as per designed when: • If the pressure 25-PT-035 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-035 will be forced to 0%, the inlet valve 25-XV-004 will close, the logic sequence will automatically proceed with charging of Vessel B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If the pressure 25-PT-035 ≥ 1.5 barg, when the time is expired the automatic sequence will override the forced output 0% of the controller 25-PIC-035 and the valve 25-PV-035 will close **(time to close 20 seconds).** 25-ZSL-035 t=……..……..…….....second. When the feedback status 25-ZSL-037 is active start the timer T2B= 80 min. (TEMP.) T2A t=……. hr. During the time if the pressure 25-PT-035 ≥ 5 barg (TEMP.) the automatic sequence will finish, and the valve 25-XV-004 will close **(time to close 3 seconds).** 25-ZSL-004 t=……..……..…….....second. When the feedback status 25-SZL-004 is active proceed with VESSEL B. The logic sequence is not achieved as per designed when:			

Step	Description	Result	Verified by	Date
	• If the pressure 25-PT-035 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-004 will close **(time to close 3 seconds).** When the feedback status 25-ZSL-004 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel A not completed" and proceed with Vessel B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-004. When the feedback 25-ZSL-004 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel A not completed" and proceed with Vessel B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
26	H2 VESSEL V-25001 B Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg. • If 25-PT-037 < 2 barg the logic sequence will automatically proceed with Vessel C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 2barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 2 barg. • If 25-PT-037 ≥ 2 barg open the valve 25-XV-008 **(time to open 8 seconds).**			

Step	Description	Result	Verified by	Date
	25-ZSH-008 t=……..……..……..…….second. When the feedback status 25-ZSH-008 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-037 and assign the set point to 2 barg. Start the timer T1B= 1 hr. (TEMP.) T1B t=…….…….. hr. During the nitrogen displacement sequence the internal Vessel B pressure must not fall below 1.5 barg. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-037 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-037 will be forced to 0%, the inlet valve 25-XV-008 will close, the logic sequence will automatically proceed with charging of Vessel C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel B pressure is > 1.5 barg. • If the pressure 25-PT-037 ≥ 1.5 barg, when the time is expired the automatic sequence will override the forced output 0% of the controller 25-PIC-037 and the valve 25-PV-037 will close **(time to close 20 seconds).** 25-ZSL-037 t=……..……..……..…….second. When the feedback status 25-ZSL-037 is active start the timer T2B= 80 min. (TEMP.)			

Step	Description	Result	Verified by	Date
	T2B t=…….…….. hr. During the time if the pressure 25-PT-037 ≥ 5 barg (TEMP.) the automatic sequence will finish and the valve 25-XV-008 will close **(time to close 3 seconds).** 25-ZSL-008 t=……..……..…….....second. When the feedback status 25-SZL-008 is active proceed with VESSEL C. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-037 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-008 will close **(time to close 3 seconds).** When the feedback status 25-ZSL-008 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel B not completed" and proceed with Vessel C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-008. When the feedback 25-ZSL-008 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel B not completed" and proceed with Vessel C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
27	H2 VESSEL V-25001 C Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg.			

Step	Description	Result	Verified by	Date
	• If 25-PT-040 < 2 barg the logic sequence will automatically proceed with Vessel D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 2barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 2 barg. • If 25-PT-040 ≥ 2 barg open the valve 25-XV-011 **(time to open 8 seconds).** 25-ZSH-011 t=……..……..…….....second. When the feedback status 25-ZSH-011 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-040 and assign the set point to 2 barg. Start the timer T1C= 1 hr. (TEMP.) T1C t=…….. hr. During the nitrogen displacement sequence the internal Vessel pressure must not fall below 1.5 barg. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-040 will be forced to 0%, the inlet valve 25-XV-011 will close, the logic sequence will automatically proceed with charging of Vessel D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	The logic sequence will proceed as per designed when the internal Vessel pressure is > 1.5 barg. • If the pressure 25-PT-040 ≥ 1.5 barg, when the time is expired the automatic sequence will override the forced output 0% of the controller 25-PIC-040 and the valve 25-PV-040 will close **(time to close 20 seconds).** 25-ZSL-040 t=……..……..…….....second. When the feedback status 25-ZSL-040 is active start the timer T2C= 80 min. (TEMP.) T2C t=…….. hr. During the time if the pressure 25-PT-040 ≥ 5 barg (TEMP.) the automatic sequence will finish and the valve 25-XV-011 will close **(time to close 3 seconds).** 25-ZSL-008 t=……..……..…….....second. When the feedback status 25-SZL-011 is active proceed with VESSEL D. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-011 will close **(time to close 3 seconds).** When the feedback status 25-ZSL-011 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel C not completed" and proceed with Vessel D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-011. When the feedback 25-ZSL-011 is active, the			

Step	Description	Result	Verified by	Date
	operator is alerted with the alarm "Process Start-up Charging Sequence Vessel C not completed" and proceed with Vessel D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
28	H2 VESSEL V-25001 D Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg. • If 25-PT-043 < 2 barg the logic sequence will automatically proceed with Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 2barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 2 barg. • If 25-PT-043 ≥ 2 barg open the valve 25-XV-014 **(time to open 8 seconds).** 25-ZSH-014 t=……..……..……..…….second. When the feedback status 25-ZSH-014 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-043 and assign the set point to 2 barg. Start the timer T1D= 1 hr. (TEMP.) T1D t=…….. hr. During the nitrogen displacement sequence the internal Vessel pressure must not fall below 1.5 barg.			

Step	Description	Result	Verified by	Date
	The logic sequence is not achieved as per designed when: • If the pressure 25-PT-043 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-043 will be forced to 0%, the inlet valve 25-XV-014 will close, the logic sequence will automatically proceed with charging of Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is > 1.5 barg. • If the pressure 25-PT-043 ≥ 1.5 barg, when the time is expired the automatic sequence will override the forced output 0% of the controller 25-PIC-043 and the valve 25-PV-037 will close **(time to close 20 seconds).** 25-ZSL-043 t=……..……..…….....second. When the feedback status 25-ZSL-043 is active start the timer T2D= 80 min. (TEMP.) T2D t=…….. hr. During the time if the pressure 25-PT-043 ≥ 5 barg (TEMP.) the automatic sequence will finish and the valve 25-XV-014 will close **(time to close 3 seconds).** 25-ZSL-014 t=……..……..…….....second. When the feedback status 25-SZL-014 is active proceed with VESSEL E. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-043 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-014			

Step	Description	Result	Verified by	Date
	will close **(time to close 3 seconds).** When the feedback status 25-ZSL-014 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel D not completed" and proceed with Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-014. When the feedback 25-ZSL-014 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel D not completed" and proceed with Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
29	H2 VESSEL V-25001 E Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg. • If 25-PT-046 < 2 barg the logic sequence will automatically proceed with Vessel F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 2barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 2 barg. • If 25-PT-046 ≥ 2 barg open the valve 25-XV-017 **(time to open 8 seconds).** 25-ZSH-017 t=……..……..……..…….second.			

Step	Description	Result	Verified by	Date
	When the feedback status 25-ZSH-017 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-046 and assign the set point to 2 barg. Start the timer T1E= 1 hr. (TEMP.) T1E t=…….…… hr. During the nitrogen displacement sequence the internal Vessel pressure must not fall below 1.5 barg. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-046 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-046 will be forced to 0%, the inlet valve 25-XV-017 will close, the logic sequence will automatically proceed with charging of Vessel F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is > 1.5 barg. • If the pressure 25-PT-046 ≥ 1.5 barg, when the time is expired the automatic sequence will override the forced output 0% of the controller 25-PIC-046 and the valve 25-PV-046 will close **(time to close 20 seconds).** 25-ZSL-046 t=……..……..…….....second. When the feedback status 25-ZSL-046 is active start the timer T2E= 80 min. (TEMP.) T2E t=…….…… hr.			

Step	Description	Result	Verified by	Date
	During the time if the pressure 25-PT-046 ≥ 5 barg (TEMP.) the automatic sequence will finish and the valve 25-XV-017 will close **(time to close 3 seconds).** 25-ZSL-017 t=……..……..……..…….....second. When the feedback status 25-SZL-017 is active proceed with VESSEL F. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-046 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-017 will close **(time to close 3 seconds).** When the feedback status 25-ZSL-017 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel E not completed" and proceed with Vessel F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-017. When the feedback 25-ZSL-017 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel E not completed" and proceed with Vessel F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
30	H2 VESSEL V-25001 F Before starting the H2 charging cycle the logic sequence will verify that the internal vessel pressure is ≥ 2 barg. • If 25-PT-049 < 2 barg the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve			

Step	Description	Result	Verified by	Date
	process variable < 2barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 2 barg. • If 25-PT-049 ≥ 2 barg open the valve 25-XV-020 **(time to close 8 seconds).** 25-ZSH-020 t=……..……..…….....second. When the feedback status 25-ZSH-020 is active the automatic sequence will override the forced output 0% of the controller 25-PIC-049 and assign the set point to 2 barg. Start the timer T1F= 1 hr. (TEMP.) T1F t=…… hr. During the nitrogen displacement sequence the internal Vessel pressure must not fall below 1.5 barg. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-049 < 1.5 barg, low pressure alarm activates, the controller 25-PIC-049 will be forced to 0%, the inlet valve 25-XV-020 will close, the logic sequence will automatically proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 1.5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is > 1.5 barg. • If the pressure 25-PT-049 ≥ 1.5 barg, when the time is expired the automatic sequence			

Step	Description	Result	Verified by	Date
	will override the forced output 0% of the controller 25-PIC-049 and the valve 25-PV-049 will close **(time to close 20 seconds).** 25-ZSL-049 t=……..……..…….....second. When the feedback status 25-ZSL-040 is active start the timer T2F= 80 min. (TEMP.) T2F t=…….. hr. During the time if the pressure 25-PT-049 ≥ 5 barg (TEMP.) the automatic sequence will finish and the valve 25-XV-020 will close **(time to close 3 seconds).** 25-ZSL-020 t=……..……..…….....second. When the feedback status 25-SZL-020 is active proceed with EXIT. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-049 < 5 barg (TEMP.) and timer is expired, the valve 25-XV-020 will close **(time to close 3 seconds).** When the feedback status 25-ZSL-020 is active, the operator is alerted with alarm "Process Start-up Charging Sequence Vessel F not completed" and proceed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-020. When the feedback 25-ZSL-020 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel F not completed" and proceed with EXIT.			

Step	Description	Result	Verified by	Date
	Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			
31	FULLY CHARGED STATUS (Indication on HMI) When all the vessels have reached maximum operating pressure (PCS sends the "Process Fully charged Status" status to EMCS) the flag indication on HMI shall indicate that the "Process Fully charged Status" is active.			
32	DISCHARGING MODE SYSTEM PREPARATION WITH VALVES ALIGNMENT READY FOR DISCHARGING All BDV valves 25-BDV-005/007/010/013/016/019 (installed Vessels Hydrogen vent system) and 25-BDV-022 (Hydrogen from vessels outlet header vent systemin) are in closed position, the feedback statuses are 25-ZSL-005/007/010/013/016/019/022. The inlet and outlet hydrogen streams across the hydrogen storage vessels to do shutdown valves 25-SDV-001 and 25-SDV-023 in open position, the feedback statuses are 25-ZSH-001 and 25-ZSH-023. On-Off valves 25-XV-024 (Hydrogen to vessels inlet header vent system) and 80-XV-001 (installed on outlet manifold) are in closed position, the feedback statuses are 25-ZSL-024 and 80-ZSL-001. Shutdown valve 64-SDV-001 (installed on the nitrogen line) is in closed position, the feedback status is 64-ZSL-001. Control Loop 25-PV-055A/B inlet to Fuel Cell package. During Fuel Cell operation, only one valve (25-PV-055 A or B) will be used, while the other one will be fully closed. Pressure control valves 25-PV-055A/B working in split range. • pressure controllers: 25-PIC-055A/B. • pressure transmitters: 25-PT-055A/B. (Process Variable, PV).			

Step	Description	Result	Verified by	Date
	• final elements: 25-PV-055A/B. • SP value: normal 6 barg. Put the EMCS in "Research mode" and verify the enabling of the corresponding push button in HMI. Verify that the same push button is disabled in every other electrical mode. The vessel's discharging order is A to F. Verify that all valves on the inlet line 25-FV-031 /032 /033/034/038/036 are closed **(time to close 20 second)**. Put the controllers 25-FIC-031/032/033/034/ 038/ 036 in auto mode and force the output to 0%. When the feedback statuses 25-ZSL-031/032/ 033/034/038/036 are active, put the controllers 25-PIC-035/037/040/043/046/049 in auto mode and force the output to 0%. Close all valves on the outlet lines 25-PV-035/ 037/040/043/046/049 **(time to close 20 second).** When the feedback statuses 25-ZSL-035/037/040/ 043/046/049 are active close all valves installed on the inlet line of each H2 storage Vessel 25-XV-004/008/011/014/017/020 **(time to close 3 second).** When the feedback statuses 25-ZSL-004/008/ 011/014/017/020 are active close all valves installed on the outlet line of each H2 storage Vessel 25-XV-006/009/012/015/018/021 **(time to close 3 second).** When the feedback statuses 25-ZSL-006/009/012/ 015/018/021 are active check the pressure in V-25001A. Vessels V-25001A/B/C/D/E/F are now ready for discharging.			
33	H2 VESSEL V-25001A Before starting the H2 discharging cycle the logic sequence will verify that the internal Vessel A pressure is < 5 barg (TEMP.). • If 25-PT-035 < 5 barg (TEMP.) the logic sequence will automatically proceed with Vessel B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve			

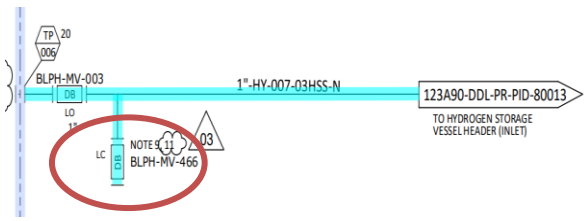
Step	Description	Result	Verified by	Date
	process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel A pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 6 barg (TEMP.) open the valve 25-XV-006 installed on the outlet of the Vessel A **(time to open 8 second).** **25-ZSH-006 t**=……..……..…….....second. Close the valves 25-XV-009/012/015/018/021. When the feedback status 25-ZSH-006 and 25-ZSL-009/012/015/018/021 are activated wait until the pressure inside the Vassel A is ≤ 4.5 barg (pressure indicator 25-PT-035, installed on the Vessel A). **When the pressure 25-P-035 is ≤ 4.5 barg the logic sequence will automatically proceed with Vessel B.**			
34	**H2 VESSEL V-25001B** Before starting the H2 discharging cycle the logic sequence will verify that the internal Vessel B pressure is < 5 barg (TEMP.). • If 25-PT-037 < 5 barg (TEMP.) the logic sequence will automatically proceed with Vessel C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel B pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 6 barg (TEMP.) open the valve 25-XV-009 installed on the outlet of the Vessel B **(time to open 8 seconds).**			

Step	Description	Result	Verified by	Date
	25-ZSH-009 t=……..……..……..…….second. Close the valve 25-XV-006/012/015/018/021 installed on the outlet of the Vessel V-25001A/C/D/E/F **(time to close 3 seconds).** When the feedback status 25-ZSH-009 and 25-ZSL-006/012/015/018/020 are activated wait until the pressure inside the Vessel B is ≤ 4.5 barg (pressure indicator 25-PT-037, installed on the Vessel B). When the pressure 25-PT-037 is ≤ 4.5 barg the logic sequence will automatically proceed with Vessel C.			
35	H2 VESSEL V-25001C Before starting the H2 discharging cycle the logic sequence will verify that the internal vessel pressure is < 5 barg (TEMP.). • If 25-PT-040 < 5 the logic sequence will automatically proceed with Vessel D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 6 barg open the valve 25-XV-012 installed on the outlet of the Vessel C **(time to open 8 seconds).** 25-ZSH-012 t=……..……..……..…….second. Close the valve 25-XV-006/009/015/018/021 installed on the outlet of the Vessel V-25001A/B/D/E/F **(time to close 3 seconds).** When the feedback status 25-ZSH-012 and 25-ZSL-006/009/015/018/021 are activated wait until the pressure inside the Vessel C is ≤ 4.5 barg (pressure indicator 25-PT-040, installed on the Vessel C). When the pressure 25-PT-040 is ≤ 4.5 barg the logic sequence will automatically proceed with Vessel D.			

Step	Description	Result	Verified by	Date
36	H2 VESSEL V-25001D Before starting the H2 discharging cycle the logic sequence will verify that the internal vessel pressure is < 5 barg (TEMP.). • If 25-PT-043 < 5 the logic sequence will automatically proceed with Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 6 barg open the valve 25-XV-015 installed on the outlet of the Vessel D **(time to open 8 seconds).** 25-ZSH-015 t=……..……..……..…….second. Close the valve 25-XV-006/009/012/018/021 installed on the outlet of the Vessel V-25001A/B/C/E/F **(time to close 3 seconds).** When the feedback status 25-ZSH-015 and 25-ZSL-006/009/012/018/021 are activated wait until the pressure inside the Vessel D is ≤ 4.5 barg (pressure indicator 25-PT-043, installed on the Vessel D). When the pressure 25-PT-043 is ≤ 4.5 barg the logic sequence will automatically proceed with Vessel E.			
37	H2 VESSEL V-25001E Before starting the H2 discharging cycle the logic sequence will verify that the internal vessel pressure is < 5 barg (TEMP.). • If 25-PT-046 < 5 the logic sequence will automatically proceed with Vessel E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 5 barg and confirm the above sequence.			

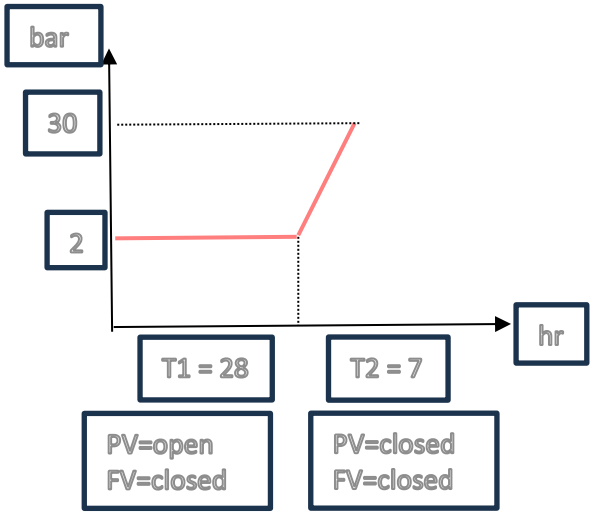
Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 6 barg open the valve 25-XV-018 installed on the outlet of the Vessel F **(time to open 8 seconds).** **25-ZSH-012 t**=……..……..…….....second. Close the valve 25-XV-006/009/012/015/021 installed on the outlet of the Vessel V-25001A/B/C /D/F **(time to close 3 seconds).** When the feedback status 25-ZSH-018 and 25-ZSL-006/009/012/015/021 are activated wait until the pressure inside the Vessel E is ≤ 4.5 barg (pressure indicator 25-PT-046, installed on the Vessel E). When the pressure 25-PT-046 is ≤ 4.5 barg the logic sequence will automatically proceed with Vessel F.			
38	**H2 VESSEL V-25001F** Before starting the H2 discharging cycle the logic sequence will verify that the internal vessel pressure is < 5 barg (TEMP.). • If 25-PT-049 < 5 the logic sequence goes in "Process Empty Status". Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable < 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when the internal Vessel pressure is ≥ 6 barg (TEMP.). • If the pressure ≥ 5 barg open the valve 25-XV-021 installed on the outlet of the Vessel E **(time to open 8 seconds).**			

Step	Description	Result	Verified by	Date
	25-ZSH-021 t=……..……..……..…….second. Close the valve 25-XV-006/009/012/015/018 installed on the outlet of the Vessel V-25001A/B/C/D/E (time to close 3 seconds). When the feedback status 25-ZSH-021 and 25-ZSL-006/009/012/015/018 are activated wait until the pressure inside the Vessel F is ≤ 4.5 barg (pressure indicator 25-PT-049, installed on the Vessel F). When the pressure 25-PT-039 is ≤ 4.5 barg the logic sequence goes in "Process Empty Status".			
39	PROCESS EMPTY STATUS (Indication on HMI) When all the vessels have reached minimum operating pressure (PCS sends the "Process Empty Status" status to EMCS) the flag indication on HMI shall indicate that the "Process Empty Status" is active.			
40	CHARGING MODE All BDV valves 25-BDV-005/007/010/013/016/019 (installed Vessels Hydrogen vent system) and 25-BDV-022 (Hydrogen from vessels outlet header vent system) are in closed position, the feedback statuses are 25-ZSL-005/007/010/013/016/019/022. The inlet and outlet hydrogen streams across the hydrogen storage vessels to do shutdown valves 25-SDV-001 and 25-SDV-023 in open position, the feedback statuses are 25-ZSH-001 and 25-ZSH-023. On-Off valves 25-XV-024 (Hydrogen to vessels inlet header vent system) and 80-XV-001 (installed on outlet manifold) are in closed position, the feedback statuses are 25-ZSL-024 and 80-ZSL-001. Shutdown valve 64-SDV-001 (installed on the nitrogen line) is in closed position, the feedback status is 64-ZSL-001. Put the EMCS in "Research mode" and verify the enabling of the corresponding push button in HMI. Verify that the same push button is disabled in every other electrical mode. The vessel's charging order is A to F.			

Step	Description	Result	Verified by	Date
	The "Process Charging mode" can be activated only if pressure in the H2 Storage Vessels 25-PT-035/037/ 040/043/046/049 ≥ 2 barg. The sequence shall be the following: Verify that all valves on the inlet line 25-FV-031 /032 /033/034/038/036 are closed **(time to close 20 second)**. Put the controllers 25-FIC-031/032/033/034/ 038/ 036 in auto mode and force the output to 0%. When the feedback statuses 25-ZSL-031/032/ 033/034/038/036 are active, put the controllers 25-PIC-035/037/040/043/046/049 in auto mode and force the output to 0%. Close all valves on the outlet lines 25-PV-035/ 037/040/043/046/049 **(time to close 20 second).** When the feedback statuses 25-ZSL-035/037/040/ 043/046/049 are active close all valves installed on the inlet line of each H2 storage Vessel 25-XV-004/008/011/014/017/020 **(time to close 3 second).** When the feedback statuses 25-ZSL-004/008/ 011/014/017/020 are active, close all valves installed on the outlet line of each H2 storage Vessel 25-XV-006/009/012/015/018/021 **(time to close 3 second).** When the feedback statuses 25-ZSL-006/009/012/ 015/018/021 are active, check the pressure in Vessel A.			
41	Since this test is performed with nitrogen instead of H2, the vessels will be pressurized up to 6 barg with the gas from the nitrogen generation package connected to the BLPH-MV-466 insertion point.  			

Step	Description	Result	Verified by	Date

CHARGING MODE





ITEM	TAG. SIGNAL	PERMANENT SET-POINT	TEMP. TEST SET-POINT	DATA	RESTORED SET-POINT	DATA
1.	T1A (below)	28 hr.	1 hr. …… hr.			
2.	T2A (charging)	7 hr.	80 min. ……min.			
3.	25-PT-035	30 barg	5 barg			

42	H2 VESSEL V-25001A Before starting the H2 charging cycle the logic sequence will verify the internal Vessel A pressure 25-PT-035. • If 25-PT-035 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable ≥ 5 barg and confirm the above sequence.			

Step	Description	Result	Verified by	Date
	Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-035 < 2 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL B. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-035 < 5 and ≥ 2 barg open the valve 25-XV-004 **(time to open 8 seconds).** 25-ZSH-004 t=……..……..…….....second. When feedback status 25-ZSH-004 is active start the timer T2A= 7 hr. T2A t=…… hr. During the time: • If the pressure 25-PT-035 ≥ 5 barg (TEMP.) close the valve 25-XV-004 **(time to close 3 seconds).** 25-ZSL-004 t=……..……..…….....second. When the feedback status 25-SZL-004 is active the logic sequence will proceed as per designed with VESSEL B. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-035 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-004 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve			

Step	Description	Result	Verified by	Date
	process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback status 25-ZSL-004 is active received the alert operator with (T7AAH) alarm "Process Start-up Charging Sequence Vessel A not completed" and proceed with Vessel B. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-004 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-035 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback 25-ZSL-004 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel A not completed" and proceed with Vessel B.			
43	H2 VESSEL V-25001B Before starting the H2 charging cycle the logic sequence will verify the internal Vessel B pressure 25-PT-037. • If 25-PT-037 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable ≥ 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-037 < 2 barg the logic sequence will proceed as per designed with VESSEL C. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve			

Step	Description	Result	Verified by	Date
	process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-037 < 5 and ≥ 2 barg. Open the valve 25-XV-008 **(time to open 8 seconds)** and close the valve 25-XV-004/011/014/ 017/020 installed on the Vessel A/C/D/E/F. **(time to close 3 seconds).** **25-ZSH-008 t**=……..……..…….....second. When feedback status 25-ZSH-008 is active start the timer T2B= 7 hr. **T2B t**=…… hr. During the time: • If the pressure 25-PT-037 ≥ 5 barg (TEMP.) close the valve 25-XV-008 **(time to close 3 seconds).** **25-ZSL-008 t**=……..……..…….....second. When the feedback status 25-SZL-008 is active the logic sequence will proceed as per designed with VESSEL C. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-037 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-008 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	When the feedback status 25-ZSL-008 is active received the alert operator with (T7BAH) alarm "Process Start-up Charging Sequence Vessel B not completed" and proceed with Vessel C. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-008 **(time to close 3 sec).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-037 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback 25-ZSL-008 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel B not completed" and proceed with Vessel C.			
44	H2 VESSEL V-25001C Before starting the H2 charging cycle the logic sequence will verify the internal Vessel C pressure 25-PT-040. • If 25-PT-040 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable ≥ 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-040 < 2 barg the logic sequence will proceed as per designed with VESSEL D. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when:			

Step	Description	Result	Verified by	Date
	• If 25-PT-040 < 5 and ≥ 2 barg. Open the valve 25-XV-011 **(time to open 8 seconds)** and close the valve 25-XV-004/008/014/ 017/020 installed on the Vessel A/B/D/E/F. **(time to close 3 seconds).** 25-ZSH-011 t=……..……..…….....second. When feedback status 25-ZSH-011 is active start the timer T2C= 7 hr. T2C t=…… hr. During the time: • If the pressure 25-PT-040 ≥ 5 barg (TEMP.) close the valve 25-XV-011 **(time to close 3 seconds).** 25-ZSL-011 t=……..……..…….....second. When the feedback status 25-SZL-011 is active the logic sequence will proceed as per designed with VESSEL D. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-011 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback status 25-ZSL-011 is active received the alert operator with (T7CAH) alarm "Process Start-up Charging Sequence Vessel C not completed" and proceed with Vessel D. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-011 **(time to close 3 sec).**			

Step	Description	Result	Verified by	Date
	Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback 25-ZSL-011 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel C not completed" and proceed with Vessel D.			
45	H2 VESSEL V-25001D Before starting the H2 charging cycle the logic sequence will verify the internal Vessel D pressure 25-PT-043. • If 25-PT-043 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable ≥ 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-043 < 2 barg the logic sequence will proceed as per designed with VESSEL E. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-040 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-040 < 5 and ≥ 2 barg. Open the valve 25-XV-014 **(time to open 8 seconds)** and close the valve 25-XV-004/008/011/017/020 installed on the Vessel A/B/C/E/F. **(time to close 3 seconds).** 25-ZSH-014 t=……..……..……..…….second.			

Step	Description	Result	Verified by	Date
	When feedback status 25-ZSH-014 is active start the timer T2D= 7 hr. T2D t=…… hr. During the time: • If the pressure 25-PT-043 ≥ 5 barg (TEMP.) close the valve 25-XV-014 **(time to close 3 seconds).** 25-ZSL-014 t=……..……..…….....second. When the feedback status 25-SZL-014 is active the logic sequence will proceed as per designed with VESSEL E. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-043 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-014 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback status 25-ZSL-014 is active received the alert operator with (T7DAH) alarm "Process Start-up Charging Sequence Vessel D not completed" and proceed with Vessel E. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-014 **(time to close 3 sec).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-043 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR.			

Step	Description	Result	Verified by	Date
	When the feedback 25-ZSL-014 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel D not completed" and proceed with Vessel E.			
46	H2 VESSEL V-25001E Before starting the H2 charging cycle the logic sequence will verify the internal Vessel E pressure 25-PT-046. • If 25-PT-046 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable ≥ 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-046 < 2 barg the logic sequence will proceed as per designed with VESSEL F. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-046 < 5 and ≥ 2 barg. Open the valve 25-XV-017 **(time to open 8 seconds)** and close the valve 25-XV-004/008/011/014/020 installed on the Vessel A/B/C/D/F. **(time to close 3 seconds).** 25-ZSH-017 t=……..……..…….....second. When feedback status 25-ZSH-017 is active start the timer T2E= 7 hr. T2E t=…… hr. During the time:			

Step	Description	Result	Verified by	Date
	• If the pressure 25-PT-046 ≥ 5 barg (TEMP.) close the valve 25-XV-017 **(time to close 3 seconds).** 25-ZSL-017 t=……..……..……..…….second. When the feedback status 25-SZL-017 is active the logic sequence will proceed as per designed with VESSEL F. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-046 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-017 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback status 25-ZSL-017 is active received the alert operator with (T7EAH) alarm "Process Start-up Charging Sequence Vessel E not completed" and proceed with Vessel F. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-017 **(time to close 3 sec).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-046 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback 25-ZSL-017 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel E not completed" and proceed with Vessel F.			
47	H2 VESSEL V-25001F Before starting the H2 charging cycle the logic sequence will verify the internal Vessel F pressure 25-PT-049.			

Step	Description	Result	Verified by	Date
	• If 25-PT-049 ≥ 5 barg (TEMP.) the logic sequence will proceed as per designed with Exit. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable ≥ 5 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. • If 25-PT-049 < 2 barg the logic sequence will proceed as per designed with EXIT. Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable 1 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. The logic sequence will proceed as per designed when: • If 25-PT-049 < 5 and ≥ 2 barg. Open the valve 25-XV-020 **(time to open 8 seconds)** and close the valve 25-XV-004/008/011/014/ 017 installed on the Vessel A/B/C/D/E. **(time to open 3 seconds).** **25-ZSH-020 t**=……..……..…….....second. When feedback status 25-ZSH-020 is active start the timer T2F= 7 hr. **T2F t**=…… hr. During the time: • If the pressure 25-PT-049 ≥ 5 barg (TEMP.) close the valve 25-XV-020 **(time to close 3 seconds).** **25-ZSL-020 t**=……..……..…….....second.			

Step	Description	Result	Verified by	Date
	When the feedback status 25-SZL-020 is active the logic sequence will proceed as per designed with EXIT. The logic sequence is not achieved as per designed when: • If the pressure 25-PT-040 < 5 barg (TEMP.) and timer is expired, close the valve 25-XV-020 **(time to close 3 seconds).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback status 25-ZSL-020 is active received the alert operator with (T7FAH) alarm "Process Start-up Charging Sequence Vessel F not completed" and proceed with EXIT. • If the pressure gradient becomes negative for a time 5 min. close the 25-XV-020 **(time to close 3 sec).** Proceed to connect a HART COMMUNICATOR to force the 4-20mA signal from 25-PT-049 to achieve process variable 4 barg and confirm the above sequence. Restore normal operating parameters and disconnect the HART COMMUNICATOR. When the feedback 25-ZSL-020 is active, the operator is alerted with the alarm "Process Start-up Charging Sequence Vessel F not completed" and proceed with EXIT.			
48	FULLY CHARGED STATUS (Indication on HMI) When all the vessels have reached maximum operating pressure (PCS sends the "Process Fully charged Status" status to EMCS) the flag indication on HMI shall indicate that the "Process Fully charged Status" is active.			
49	HYDROGEN VENT HEADER & DRUM SYSTEM the Vent network is continuously purged with nitrogen in order to keep it slightly pressurized and inert.			

Step	Description	Result	Verified by	Date
	The hydrogen KO drum V-43001 is equipped with the following transmitters: • 43-PT-001 as remote pressure indicator to PCS and High alarm threshold 43-PAH-001. • 43-LT-001 as remote level indicator, providing high- and low-level alarm to SIS (43-LAH-001 and 43-LAL-001). • 43-FT-001 ultrasonic flow transmitter with High alarm threshold (43-FAH-001) to monitor the flowrate towards the stack. The Hydrogen Vent Stack Q-43004 is simply equipped with a level transmitter. • 43-LT-003 as remote level indicator that allows to monitor the liquid level inside the bottom, providing a low level alarm to PCS (43-LAL-003). The gas line must be kept submerged in a hydraulic seal to prevent the ingress of air into the system.			
50	SHUTDOWN WITH DEPRESSURIZATION In order to test the depressurization of Hydrogen Storage, it is necessary to cause a ESD-1D. The more practical way to achieve that without having a full ASD is to configure a temporary push button in HMI to activate the ESD-1D without having all the effects that the ASD will initiate. The ESD-1D will have the following effects: • 25-BDY-005 – open 25-BDV-005 on V-25001A. • 25-BDY-007 – open 25-BDV-007 on V-25001B. • 25-BDY-010 – open 25-BDV-010 on V-25001C. • 25-BDY-013 – open 25-BDV-013 on V-25001D. • 25-BDY-016 – open 25-BDV-016 on V-25001E. • 25-BDY-019 – open 25-BDV-019 on V-25001F. • 25-BDY-022 – open 25-BDV-022 on outlet H2 header to Fuel Cell package. • 64-SDY-01 – close 64-SDV-001 nitrogen to H2 storage tanks.			

Step	Description	Result	Verified by	Date
	• 25-SDY-023 – close 25-SDV-023 on outlet H2 header to Fuel Cell package. • 25-SDY-001 – close 25-SDV-001 on H2 header to storage tanks. Other effects of ESD-1D which are not required for this test, and thus will be bypassed, are the following: • 79-XS-010 – elect. isolation soft. cables communication cat 6A. • 83-XS-001A – shutdown seawater lift pump P-50001A. • 83-XS-001B – shutdown seawater lift pump P-50001B. Once the ESD-1D is activated, the Hydrogen lines and vessels will be isolated and vented.			

5.4.3 OTP Worksite Test Notes and Remark

5.4.4 OTP Worksite Test Certifying Authority Table Attendances

Name and Surname	Certifying Authority	Position	Signature

5.4.5 OTP Worksite Test Final Signature and Company Acceptance

Name and Surname	Company Representative	Position	Signature

5.5 POST TEST CONDITION

The previous chapters are successfully performed.

- All necessary tests are performed and accepted for that system.
- All Communication Cables are tested and completed.
- All panels are in normal operation and no alarm pending.

5.6 REINSTATEMENT AND PRESERVATION TASKS

- All the electrical contacts which were disconnected for testing purposes must be reconnected.
- After functional tests have been completed, system / sub-systems are left in safe condition and they are operational.
- All preservation routines identified and required will be included in relevant Preservation ITR within the Proverlis Completions System.

6. OTP AT OFFSHORE SITE

6.1 PLANNING AND MANPOWER

6.1.1 Offshore Site Test Overview

The purpose of this test is to recheck the good condition of all equipment and the commissioning of:

- SS 25-00 Hydrogen Storage.
- SS 43-00 Hydrogen Vent Header & Drum System

6.1.2 Planned Tasks with Estimated Manpower

Estimated manpower for the entire duration of the Test:

- 1 E&I commissioning supervisor from Contractor.
- 1 E&I commissioning technician from Contractor.
- 1 Operator workstation field engineer.

6.1.3 Test Duration Estimate

The test duration should be as follows:

- 1 day

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

6.2 OTP TEST REQUIREMENT – OFFSHORE SITE

6.2.1 Pre-Commissioning Achievement

- Not applicable

6.2.2 Commissioning Achievement

- Not applicable

6.2.3 Status of Required Associated Subsystems

Subsystems required for Commissioning of Hydrogen Storage & Venting Systems:

- SS 87-10 PCS System
- SS 79-00 SIS (ESD)
- SS 87-00 EMCS
- SS 88-00 Earthing System
- SS 25-01: V-25001 A
- SS 25-02: V-25001 B
- SS 25-03: V-25001 C
- SS 25-04: V-25001 D
- SS 25-05: V-25001 E

- SS 25-06: V-25001 F
- SS-25-07: Hydrogen Storage Vessel Header (Inlet)
- SS-25-08: Hydrogen Storage Vessel Header (Outlet)
- SS 43-00: Hydrogen Vent Header & Drum System
- SS 20-00: Electrolyser Package
- SS 80-00: Fuel Cell Package
- SS 63-00: Instrumentation Air Package
- SS 63-30: Instrumentation Air Distribution Network
- SS 64-00: Nitrogen Generation Package
- SS 64-10: Nitrogen Distribution Network

6.2.4 Special Tools & Test Equipment

The following special tool and Test Equipment are required:

- Continuity tester (Multimeter)
- Hart communicator
- Toolbox
- Portable radios (2 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

- See reference doc. N. 1724000887-COM-LIS-0016 Hydrogen Vent
- See reference doc. N. 1724000163-COM-LIS-0014 Hydrogen KO Drum
- See reference doc. N. 1723001756-COM-LIS-00018 H2 Storage Vessel

6.3 OTP DESCRIPTION – OFFSHORE WORKSITE

6.3.1 OTP Test Preparation

Step	Description	Result	Verified by	Date
1.	System Ready for Commissioning Certificate (RFC) is issued and approved.			

2.	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).			
3.	A final walkdown of the system has been completed, to ensure that the system and the area are ready for start-up.			
4.	Check that areas are free for work and escape routes are clear of any obstructions.			
5.	All safety barriers and warning signs have been installed.			
6.	Verify availability of test equipment as per section 6.2.4.			

6.3.2 Electrical Preparation

Step	Description	Result	Verified by	Date
1.	Verify that all relevant associated systems / subsystems are ready.			

6.3.3 Mechanical Preparation

Step	Description	Result	Verified by	Date
1.	Visual Check			

6.3.4 Instrument Preparation

Step	Description	Result	Verified by	Date
1.	Verify that all relevant associated systems / subsystems are ready.			
2.	Verify that relevant equipment/ components are available and in operation for start of commissioning activities.			
3.	Verify availability of test equipment as per section 6.2.4.			

6.3.5 Piping Preparation

- Not applicable

6.3.6 Additional Discipline Preparation

- Not applicable

6.4 OTP TEST STEPS – OFFSHORE WORKSITE

6.4.1 Test Preparation

Need to Verify:

- SS 87-10 PCS System
- SS 79-00 SIS (ESD)
- SS 87-00 EMCS
- SS 25-01: V-25001 A
- SS 25-02: V-25001 B
- SS 25-03: V-25001 C
- SS 25-04: V-25001 D
- SS 25-05: V-25001 E
- SS 25-06: V-25001 F
- SS-25-07: Hydrogen Storage Vessel Header (Inlet)
- SS-25-08: Hydrogen Storage Vessel Header (Outlet)
- SS 43-00: Hydrogen Vent Header & Drum System
- SS 20-00: Electrolyser Package
- SS 80-00: Fuel Cell Package

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

6.4.2 Test Steps

Step	Description	Result	Verified by	Date
SS 25-00 Hydrogen Storage. SS 43-00 Hydrogen Vent Header & Drum System.				
Systems SS 25-00 / SS 43-00 are completed.				
1.	Check and verify that control systems (PCS, SIS, EMCS) are up and running			
2.	Check and confirm the systems Electrolyser Package and Fuel Cell Package are up and running			
3.	Check and verify that OER/CCR are operational, and communication is functioning.			
4.	Check and verify that all instrumentation is functioning. All valves are opened and closed from OER/CCR to verify proper operation. All transmitters are simulated with HART Communicator to verify proper operation.			
5.	Confirmed the steps from 1 to 3 the SS 25-00 / SS 43-00 are ready for start-up.			

6.4.3 OTP Site Tests Notes and Remarks

6.4.4 OTP Site Tests Certifying Authority Table of Attendances

Name and Surname	Certifying Authority	Position	Signature

6.4.5 OTP Site Tests Final Signature and Company Acceptance

Name and Surname	Company Representative	Position	Signature

6.5 POST TEST CONDITIONS

- The previous chapters are successfully performed.
- The systems are in normal operation and no alarm pending.

6.6 REINSTATEMENT AND PRESERVATION TASKS

- After the tests are completed, the systems are left in a safe condition and they are operational.

7. APPENDICES

7.1 Vendor SAT Procedure (where applicable)

7.2 Proverlis Summary System Reports

7.3 Equipment Relates Technical Queries (where applicable)

7.4 As Built Documentation (where applicable)

7.5 Management of Changes – Summary Table of tasks and Details of Affected related Documentation (where applicable)