Base Load Power Hub (BLPH)

PIPING FLUSHING, TESTING, DRYING AND REINSTATEMENT PROCEDURE

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

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

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

1.1.1 Project Location

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

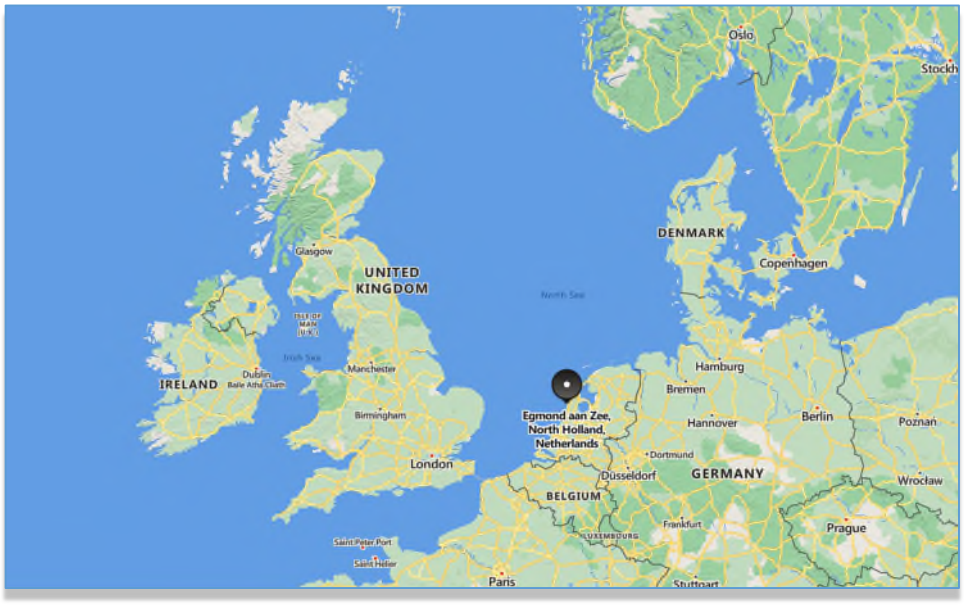


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

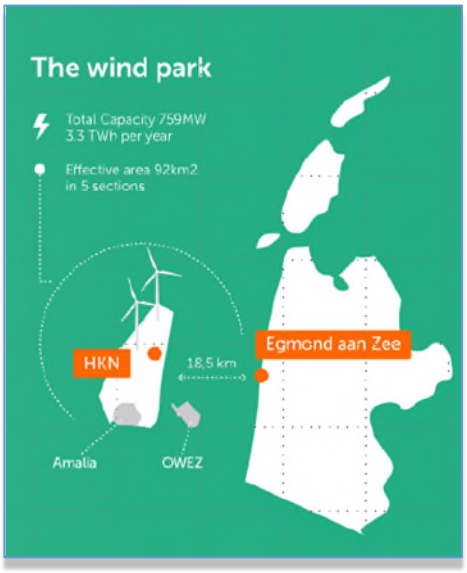


Figure 2 - Wind Park Details

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

1.1.2 Project Concept

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

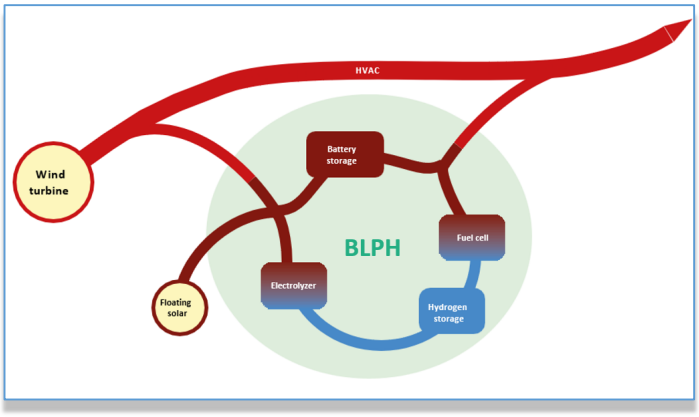


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting

wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

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

2 SCOPE

This procedure establishes the requirements for the execution of hydrostatic testing of the piping system in the BLPH CROSSWIND project. It defines responsibilities and methods for the proper implementation and certification of pressure tests on piping spools. It also outlines the technical requirements for flushing of piping systems to ensure cleanliness, mechanical strength, and leak tightness. The document ensures activities are conducted safely and in compliance with applicable specifications, codes, and rules.

Exclusions: This procedure excludes pressure testing of pressure vessels, exchangers, pumps, filters, and package units, which have been tested by the manufacturer in accordance with the relevant codes and standards.

3 REFERENCE DOCUMENTS

CW-I-WP4-2023-05	CONTRACT for the BASE LOAD POWER HUB
SECTION V	Scope Description
ASME B31.3-2022	Process Piping
123A90-DDL-MAT-RE-60011	Material Selection Report
123A90-DDL-PR-LIS-80035	Process Line List
123A90-PML-QHSE-ITP-00076	Inspection And Test Plan Piping
123A90-PML-QHSE-QP-002	Project Quality Plan
123A90-PML-PM-PL-001	Project Execution Plan
123A90-PML-CON-RE-04006	Flange Management Strategy

4 DEFINITIONS AND ABBREVIATIONS

COMPANY (CPY)	CrossWind, a Shell and Eneco joint venture. The Company is registered in The Netherlands.
CONTRACT	Contract Nr. CW-I-WP4-2023-05 for the BASE LOAD POWER HUB
CONTRACTOR	Rosetti Marino Spa

CA – Certification Agency
CM - Construction Manager
CPY - Company (CrossWind)
CRA - Corrosion-Resistant Alloy
CW - CrossWind
HTP - Hydrostatic Test Pack
IFR - Issue for Review
ISO - Isometric (Drawing)
ITP - Inspection and Test Plan

ITR - Inspection and Test Record
LTP – Leak Test Pack
NDE - Non-Destructive Examination
P&ID - Piping and Instrumentation Diagram
PEM - Project Engineering Manager
PQM - Project Quality Manager
PSV - Pressure Safety Valve
QCI - Quality Control Inspector
RM - Rosetti Marino Spa

5 RESPONSIBILITIES

Project Engineering Manager (PEM):

- Ensure the identification on the technical documents of the test type and pressure for each component and system.

Construction Manager (CM):

- Responsible for managing the pressure test according to this procedure and HTPs.

Project Quality Manager (PQM):

- Verify the application of this procedure.

Quality Control Inspector (QCI):

- Verify the calibration of pressure gauges as per this procedure.
- Notify CPY and CA of any ITP "Hold" and "Witness" points.
- Perform inspections together with CPY and CA representatives.
- Certify the pressure test.

Piping Lead :

- Responsible for supervising the preparation of the hydrostatic test packs, including all necessary documentation and drawings.

6 SAFETY PRECAUTIONS

6.1 SAFETY MEASURES FOR PRESSURE TEST

- Minimize personnel in the test area by restricting access and conducting tests during off-hours when possible.
- Implement a Permit to Work system and conduct a detailed risk assessment.
- Ensure all personnel involved are trained and aware of the risks and necessary controls.

- Establish a communication system for emergencies and ensure emergency response equipment is available.
- Conduct a Toolbox Talk before the commencement of the pressure test. During the Toolbox Talk, the roles and responsibilities of each individual involved in the test shall be clearly defined.

6.2 HYDROSTATIC TESTS OPERATIONAL DEVELOPMENT

- Open air bleeds along the line/circuit and slowly fill the system with the test fluid.
- Gradually pressurize the system, monitoring pressure gauges for any abnormal oscillations.
- Relief valves shall be positioned in areas where personnel cannot be exposed.
- Test equipment utilized (gauges and valves) properly connected and in calibration range

6.3 PRESSURE TEST EXCLUSION ZONE DISTANCE GUIDELINES

- Define exclusion zones based on the potential failure scenarios, considering internal energy, failure points, and temperature variations.
- Establish safety distances and barricades to protect personnel from potential hazards. The established safety distances based on the potential failure scenarios shall be included in the "Comments" section of the Permit to Work (PTW) to ensure clear communication and adherence to safety measures during the test.
- The test documentation shall include test setup details, including exclusion zones, blast walls, and barriers (if required). All zones will be marked and monitored throughout the test.

7 PRESSURE TEST DOCUMENTATION (HTP)

7.1 GENERAL REQUIREMENTS

Each Hydrostatic Test Pack (HTP) must be prepared under the responsibility of the Piping Lead, ensuring it includes all necessary documentation and drawings to execute the hydrostatic tests.

HTPs must be submitted to the Company for review.

The HTP shall be specific to each test circuit, clearly identifying boundaries and conditions for the test.

7.2 HTP CONTENTS

1. Cover Page
2. Coloured Marked P&IDs : Include Piping and Instrumentation Diagrams (P&IDs) with clearly marked boundaries of the test circuit. Highlight the locations of blind flanges, spool pieces, blanks, spades, caps, plugs, and any additional vents and drains required for the test.
3. Hydrostatic Test 3D Circuit: A 3D representation of the test circuit. It contains Detailed 3D models indicating the test boundaries, locations of pressure gauges, vents, drains, and filling points. Notes on excluding certain valves and ensuring all instruments are not installed during the test.

4. **Material List for Test:** A comprehensive list of materials required for the hydrostatic test. Itemized list including descriptions, quantities, specifications (e.g., valves, nipples, tees, caps, couplings), and any special notes about materials to be used during testing.
5. **Extract of Line List**: Include an extract of the line list, detailing each line within the test circuit. This list shall specify line numbers, sizes, materials, design pressures, and test pressures.
6. **Isometric Red-Marked Drawings & Extract of ISO List:** Provide isometric drawings of the piping system with marked test boundaries and pre-test requirements.
7. **Extract of Support List & Details:** Provide a list of all piping supports within the test circuit, including specifications and locations. Detail any temporary supports required to maintain the stability of the piping during testing.
8. **Welding Register & Material Traceability Record:** Provide a detailed welding register that includes information on each weld within the test circuit. This shall include weld numbers, welder identification, welding process, NDE results. Material Traceability Records: List tracing the materials used in the fabrication of the spools to be tested. Each material component in the test section shall be traceable to its original material certificate, confirming its compliance with the required standards.
9. **Inspection and Test Records:** Checklist and records for Mechanical Completion activities.

7.3 HTP REVIEW AND APPROVAL

The complete HTP must be reviewed and approved by PIPING LEAD before the test can proceed.

Any revisions or modifications to the HTP must be documented and re-approved before implementation.

8 HYDROTEST EQUIPMENT & MATERIAL

8.1 TEST EQUIPMENT

Ensure that the following equipment is available and in good working order for the pressure test:

- **Test Pumps:** Capable of pressurizing the piping systems to the required test pressure. The pumps shall be suitable for the fluid being used in the test.
- **Manifolds and Piping:** Required to connect the test pump to the system being tested. Ensure that the manifolds and piping are rated for the test pressure.
- **Hoses and Fittings:** Flexible hoses and fittings, including valves and pressure safety valves (PSVs), suitable for hydrostatic testing. Ensure that all connections are secure and rated for the test pressure.
- **Pressure/Temperature Gauges and Recorders:** Calibrated gauges and recorders to monitor the test pressure and temperature throughout the test. Gauges shall cover the full range of test pressures as indicated in the HTP.Where applicable, equipment calibration certs shall be checked.

8.2 MATERIAL

Temporary materials required for the pressure test include:

- Blind Flanges
- Stud Bolts and Nuts
- Gaskets
- Washers (optional)

8.3 WAREHOUSE MANAGEMENT:

The Warehouse Manager is responsible for handling, maintaining, and filing certificates and operation manuals related to the pressure testing equipment. Maintenance operations shall be carried out by qualified personnel from the Maintenance Department to ensure that all equipment is in good working condition.

9 PRESSURE TESTING GENERAL REQUIREMENTS

System Integrity: Wherever possible, the piping system shall be tested as a complete unit, including as many valves and piping components as feasible. All permanent flanged joints shall be tightened and certified before testing begins.

Pre-Erection Testing: If some spools can be tested before erection, a dedicated, suitably prepared, and safe area shall be identified for testing these spools.

Hook-Up Spools: All hook-up spools must be hydrostatically tested. Spools intended for field welding offshore shall be temporarily terminated with welded caps, screwed plugs, or standard blind flanges as appropriate. After the test, any welded caps shall be removed and replaced with temporary closures.

Interconnected Test Packs: Test packs that have similar flange ratings, materials, and use the same test pressure and medium may be interconnected for testing purposes.

Instrument Take-off Piping: Instrument take-off piping up to the first block valve shall be tested along with the piping or equipment to which it is connected.

Sensitive Equipment: Equipment that could be damaged by flushing or testing operations shall not be flushed or tested through. Such equipment shall be isolated or removed from the system.

Package Units: Package units shall be isolated and bypassed as necessary during testing.

Safety Valves: Remove safety valves before testing and install suitable spool pieces or blanks in their place.

Removable Components: Remove orifice plates, rupture discs, thermowells, pressure gauges, and other intrusive instruments before testing. Ensure these components are properly reinstalled after testing is complete.

Check Valves: For piping containing check valves, remove or jack open and lock the check valve discs during flushing and testing.

Valve Positions: Ball and control valves shall be fully open during flushing and three-quarters open during pressure testing. Drain the valves thoroughly afterward. All other valves shall remain fully open during both flushing and pressure testing.

Pressure Test Limits: Pressure test limits shall not be set against closed valves. Where a valve forms the boundary of a test pack, the valve shall be open, and a blind flange shall be installed on the valve.

Care shall be taken to ensure that pressure equipment is not subjected to any form of shock loading during testing. Gradual pressurization will be applied in stages to prevent any sudden impact or stress on the system. The pressurization process shall be carefully monitored to ensure stability and to avoid any sudden pressure spikes that could cause damage.

To prevent brittle fracture, the temperature of the medium used in the pressure test shall be monitored to ensure it is not lower than the minimum test temperature stated in the procedure.

Piping Support: Ensure all piping is adequately supported during testing, preferably with permanent supports. Temporary supports shall be used if additional stability is needed.

Inspection Presence: All pressure testing shall be conducted in the presence of the Quality Control Inspector (QCI), COMPANY (CPY) representatives, and Certification Agency (CA) representatives as specified in the ITP intervention points.

Coating and Painting: Piping may be fully painted to final coat before hydro-testing.

Joint Visibility: Leave all piping joints, including flanged, threaded, and welded joints, uninsulated and exposed to a minimum distance of 50 mm on either side of the joint until pressure testing is completed successfully.

Vent and Drain Positioning: Ensure that all hydro-test vents and drains are properly installed before flushing and testing. Verify that all ancillary fittings, including temporary piping, spades, blanks, and caps, are rated for the correct test pressure.

10 FLUSHING

10.1 GENERALS

Pre-Testing Flushing: Before pressure testing, flush the piping system with the pressure-testing medium until the interior of the piping is thoroughly cleaned.

Debris Control: Take necessary precautions to prevent debris from entering associated equipment or settling in "dead ends" of the piping system.

Water Quality: Use clean, clear water for flushing during onshore work. For corrosion-resistant alloy (CRA) piping systems, ensure that the chlorine content of the flushing water does not exceed 30 ppm. Provide a report confirming water quality.

Valve Positioning: Ensure that all inline gate valves and ball valves that remain in place during flushing and testing are fully open. After testing, drain these valves using the connection on the valve body to prevent debris or water from becoming trapped inside.

Flushing Duration: For open-ended systems, continue flushing until clear water, free of debris and foreign materials, is discharged from the system.

Documentation: Record all flushing activities, including flow rates, pressure, duration, and inspection results, to provide evidence of cleanliness.

Hydrogen Systems: due to the crucial importance of cleanliness on hydrogen lines, a dedicated method of statement will be submitted specifically targeting cleaning protocols to be followed.

10.2 FLUSHING METHODS CHOICE

The choice of a flushing method depends on several factors related to the specific conditions of the piping system, project requirements, and operational constraints.

Ensure that all parts of the system are accessible for flushing, and that vent and drain points are positioned effectively.

Choose flushing methods that minimize water usage and waste, particularly in areas with environmental regulations.

The following two flushing methods could be used in BLPH project

10.3 WATER FLUSHING (HYDRO-FLUSHING)

Description: Water flushing involves the circulation of clean water through the piping at sufficient velocity to remove debris, scale, and other contaminants.

Procedure:

System Setup: Ensure that all valves are fully open, and all necessary vents and drains are in place.

a) **Connection:** Connect a water source (high-capacity hose or pump) to the lowest point of the piping system.

b) **Flow Rate:** Maintain a high flow rate to create turbulence within the piping, helping to dislodge and carry away debris.

c) **Continuous Flow:** Continue flushing until the water exiting the system is clear and free of visible contaminants.

d) **Final Check:** Inspect the drained water for clarity and particulate content to confirm that the system is clean.

10.4 AIR-PRESSURE FLUSHING (BLOWDOWN METHOD)

Description: Air-pressure flushing involves using compressed air to blow out debris and contaminants from the piping system.

Procedure:

a) **System Setup:** Ensure all vents and drains are open. Install a compressed air line at the highest point of the system.

b) **Pressure Application:** Gradually apply compressed air, starting at a low pressure and increasing as needed to create sufficient force to dislodge debris.

c) **Cycle Repeats:** Perform multiple cycles of pressurizing and venting to ensure that all contaminants are expelled.

d) **Final Check:** Inspect exit points for expelled debris.

11 PRESSURE TESTING

Competency of Test Team: Ensure that pressure testing is executed by a competent test team familiar with the procedures and safety requirements. To ensure this, a training session must be conducted with

the involved team before the start of the testing campaign. This session shall cover a comprehensive understanding of the pressure testing procedures, the operation of testing equipment, the ability to read and interpret technical documents, and a thorough knowledge of safety protocols.

Toolbox Talks: Conduct toolbox talks before testing begins to discuss the specific tasks, risks, and controls for the test.

System Filling: Fill the system to be tested from the lowest point, with all vent valves open to eliminate air entrapment. Ensure that all valves are open before filling begins.

Test Pressure Application: Apply the test pressure using a suitable test pump or other pressure source. The pump or pressure source shall have an independent pressure gauge fitted and must be constantly attended by an authorized person during the test.

Pressure Monitoring: Check test pressures using calibrated gauges and recorders located at both the lowest and highest points of the piping system.

Repair of Defects: If any joints or connections fail during the test, depressurize the system, repair the defects using new gaskets, and retest the system to ensure integrity. Welded seams can also fail under certain circumstances. In the event of a welded seam failure, the system shall be depressurized, and the defect shall be repaired and tested according to the applicable welding and quality control standards. After the repair, the system will be retested to ensure full integrity and compliance with project specifications.

Temperature Monitoring: Continuously monitor and record the temperature of the pipework during the test. Be aware of any pressure increases due to the heating of the test medium.

Pressure Application: Gradually apply hydraulic pressure in steps of approximately 25% of the test pressure, but not exceeding 50 bar per step, until the full test pressure is achieved. Hold the pressure for at least 30 minutes.

Test Acceptance Criteria

All pressure-containing components must maintain their integrity throughout the stabilization and test hold periods. The acceptance criteria for the test are as follows:

- No evident leaks or pressure loss should occur during the test.
- In cases where a pressure drop is detected and no leaks are identified, it can be performed a pressure-temperature calculation, using the coefficient of thermal expansion of water, to assess whether external temperature fluctuations could be the cause of the pressure change.
- Any sign of leakage, deformation, or failure will result in the test being considered failed.

Pressure Release: After the test, release the pressure in a controlled manner to prevent injury or equipment damage. Open all vents before draining the system to prevent creating a vacuum.

12 DRYING AND PRESERVATION

12.1 DRYING REQUIREMENT

When required, dry the piping system following drainage to remove any remaining test medium, particularly in low points, pockets, or other areas prone to fluid accumulation. The drying process is critical to prevent corrosion and ensure the system remains in optimal condition until it is put into service.

Select inlet and outlet points for drying to avoid dead ends, low points, and pockets. Install protection screens on vents above lines to prevent rainwater ingress, which could compromise the drying process.

12.2 DRYING METHOD

Dry the system using a flow of dry air, ensuring all drains are open to facilitate the removal of moisture. Continue drying until no moisture remains in the system, particularly in areas that are difficult to reach. The drying process shall be monitored closely to ensure complete moisture removal.

After drying, isolate and close the inlet and outlet points to prevent moisture re-entry. This step is crucial to maintaining the integrity of the dry system.

12.3 PRESERVATION WITH INERT GAS

Sealing with Inert Gas: When specified, seal the piping system with an inert gas, such as nitrogen, after drying. This process is essential for systems that are prone to corrosion or where a long preservation period is anticipated before the system is commissioned.

Procedure: After ensuring that the system is fully dried, introduce the inert gas through the inlet point until the system is completely filled and pressurized to a slightly positive pressure. This pressure shall be maintained to prevent the ingress of moisture or contaminants.

Monitoring: Regularly monitor the pressure of the inert gas within the system to ensure the integrity of the preservation. Any drop in pressure shall be investigated immediately to identify and address potential leaks.

Sealing: Once the inert gas has been introduced, seal all entry points securely. This includes closing and securing valves, installing caps or plugs on all openings, and verifying that all seals are intact to prevent any gas from escaping or air/moisture from entering.

Documentation:
Record all drying and preservation activities, including the type of inert gas used, pressure levels, and the date of sealing.

13 SYSTEM REINSTATEMENT

13.1 REMOVAL OF TEMPORARY COMPONENTS

Temporary Spools and Blanks: Carefully remove all temporary connection spools, blind flanges, blanks, spades, caps, and other items that were installed specifically for the purpose of flushing, pressure testing, or isolation during the testing process.

Drainage and Venting Points: Ensure that all temporary drainage and venting points that were installed for the test are also removed, unless specified to remain in place as part of the final system configuration. Any remaining vents or drains shall be properly sealed to prevent future leaks.

Temporary Supports: If any temporary supports were used to stabilize the piping system during testing, remove these supports and ensure that the system is correctly positioned and secured with permanent supports as per the design specifications.

13.2 REINSTALLATION OF REMOVED COMPONENTS

Critical Components Reinstallation: Reinstall all components that were removed prior to testing to protect them from potential damage, including but not limited to orifice plates, thermowells, pressure gauges, safety valves, and any instrumentation that was temporarily taken out.

Gasket Replacement: Use new gaskets during reinstallation to ensure a reliable seal.

Tightening and Torquing: All connections must be properly tightened according to the specified torque values. For details regarding this activity, refer to Flange Management Strategy, doc.nr 123A90-PML-CON-RE-04006.

Valve and Instrumentation Settings: Ensure that all reinstalled valves are set to the correct open or closed position as required by the system's operational design. Verify that all instrumentation is calibrated and functioning correctly after reinstallation.

13.3 REPLACEMENT OF TEMPORARY MATERIALS

Permanent Bolting Materials: Replace any temporary bolts, nuts, or other fastening materials used during testing with the specified permanent materials. These shall be of the correct grade and size as indicated in the project specifications.

Reuse of Permanent Bolts: If permanent bolts were used during testing, they may be reused provided they are still in good condition and have not been damaged or overstressed during the initial installation or testing process. Inspect all reused bolts carefully for signs of wear, corrosion, or elongation.

Final Tightening: After replacing temporary materials, ensure that all permanent connections are tightened to the appropriate specifications. This final tightening shall be documented, especially for critical joints, to maintain traceability and quality control.

13.4 FINAL INSPECTION

Comprehensive Inspection: Conduct a thorough final inspection of the entire piping system. This inspection shall verify that all components are correctly installed, all temporary items have been removed, and the system is in full compliance with the project's design and specification documents.

Cleanliness Verification: Ensure that the piping system is clean and free from debris, foreign materials, and any remnants of the testing process.

Compliance Check: Verify that all aspects of the system's reinstatement comply with the relevant codes, standards, and project-specific documentation. Any deviations shall be documented, reviewed, and rectified as necessary before final approval.

13.5 ITR COMPLETION

Documentation of Activities: Complete the Inspection and Test Record documenting all activities related to the system reinstatement, including the removal of temporary components, reinstallation of permanent components, and final inspections.

Signatures and Approvals: Ensure that the ITR is signed off by the CONTRACTOR (RM), the COMPANY (CPY), and the Certification Agency (CA) representatives. This provides formal approval that the system reinstatement has been completed according to the required standards and that the system is ready for further commissioning or operation.

Record Keeping: Maintain all completed ITRs, along with any associated documentation, as part of the project's quality records. These documents shall be accessible for future reference, audits, or reviews as needed.

14 GROSS AIR LEAK TEST

14.1 PURPOSE OF THE GROSS AIR LEAK TEST

The gross air leak test is conducted after the reinstatement of the piping system and during the pre-commissioning phase. The primary purpose of this test is to identify any significant leaks or defects in the piping system that could compromise its integrity or performance before the system is put into service. By using air or nitrogen at a **pressure of 7 bar,** this test helps to ensure that the piping is free from major leaks that could lead to safety hazards, operational inefficiencies, or costly repairs later on.

Verification of Reinstatement: After the removal of temporary components and the reinstallation of critical parts, the gross air leak test acts as a final check to verify that all connections, joints, and fittings have been correctly installed and sealed. This test provides an added layer of assurance that the system has been properly reassembled and is ready for further commissioning activities.

Pre-Commissioning Safety Check: Conducting this test as part of the pre-commissioning process helps to ensure that the system is safe and reliable before introducing process fluids or gases. Identifying and addressing any leaks at this stage can prevent potential hazards during the commissioning and operational phases.

14.2 TEST PROCEDURE

Preparation:

Ensure that the piping system is fully reinstated and all components, such as valves, instruments, and fittings, are properly installed and secured.

All vent and drain points shall be closed, and the system shall be isolated from any connected equipment that could be damaged by the test pressure.

Pressurization:

Connect the air or nitrogen supply to the system. The gas used for the test shall dry and free of contaminants.

Gradually increase the pressure in the system to 7 bar. Monitor the pressure gauges to ensure a controlled and uniform pressurization of the system.

Once the pressure reaches 7 bar, maintain this pressure for a sufficient period to allow for the detection of any leaks. The exact duration can vary depending on the size and complexity of the system, but it typically ranges from 15 minutes to an hour.

Leak Detection:

Inspect all joints, flanges, and connections for signs of leaks. This can be done using Soap Solution. Apply a soap solution to potential leak points and watch for bubbles, which indicate escaping air or nitrogen.

Document the location and severity of any detected leaks for further action.

Depressurization:

After the test, carefully depressurize the system in a controlled manner to avoid any sudden pressure drops that could cause damage.

Open all vents and drains to release the remaining air or nitrogen safely.

Post-Test Actions:

Leak Repair: If leaks are detected during the test, depressurize the system, and make the necessary repairs. This may involve tightening flanges, replacing gaskets, or rechecking welds. After repairs, the test shall be repeated to confirm that all leaks have been resolved.

Final Verification: Once the system passes the gross air leak test with no detectable leaks, it can be considered ready for the final commissioning stages. This test serves as a critical checkpoint before moving on to more sensitive or hazardous operations involving the actual process fluids.

Documentation:

Test Records: Document the results of the gross air leak test, including pressure readings, duration of the test, locations of any leaks, and actions taken to repair them. This documentation shall included in the pre-commissioning records and be available for review by the project's quality assurance team.

Approval: Obtain sign-off from the CONTRACTOR (RM), COMPANY (CPY), and Certification Agency (CA) representatives to confirm that the gross air leak test has been successfully completed and that the system is leak-free at 7 bar.

Note: a dedicated procedure will be issued to cover the leak test activities.

15 RECORDS

ITR Registration: Register all activities described in this procedure on the appropriate ITRs from the 123A90-PML-QHSE-SP-00118 - Mechanical Completion ITR Template Collection:

Form code	Form description	Discipline code
CLX02A	Pipework Before Test	P
CLX02B	Pipework After Test	P
CXX01	Thermal Insulation	P
CXX02	Painting Line	P
TMX03	Cleaning	P
TMX05	Pressure Test	P
TMX25	Gross Air Leak Test	P
TMX27	Bolt tensioning / torquing	P
TPLX05	Drying	P

Post-Test Documentation: Upon completion of the test, include the following in the final Test Pack:

- **Pipe Flushing/Testing Certificates:** Duly signed by all parties involved.
- **Punch List:** A list of any items requiring further attention before system handover.
- **Pressure/Temperature Graphs:** Signed and dated by RM, CPY, and CA representatives.
- **Flange Management Records:** Detailed records of flange management activities, including installation and torque data.

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