Base Load Power Hub (BLPH)

FLANGE MANAGEMENT STRATEGY

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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.

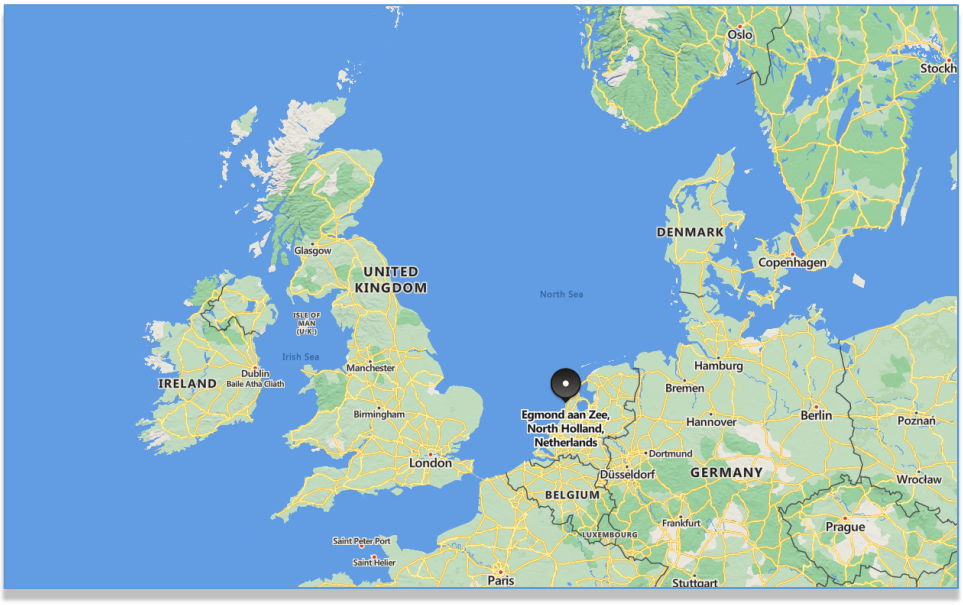


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

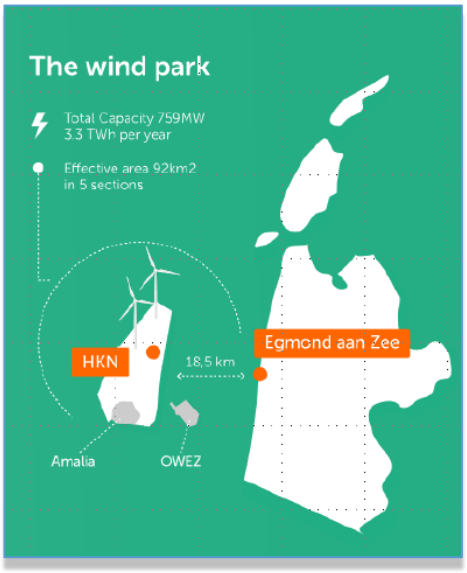


Figure 2 - Wind Park Details

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.

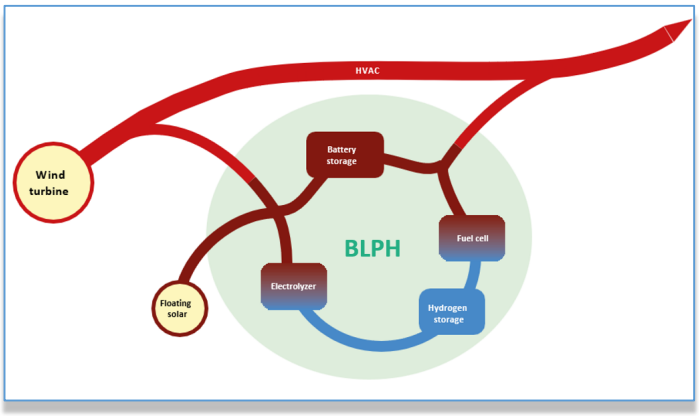


Figure 3 – BLPH Concept

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.

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2 PURPOSE

This procedure applies to the activities carried out in Rosetti Marino yard for CROSSWIND BLPH project. Its aim is to ensure piping flange joint management is carried out in accordance with Drawings, Specifications and Schedules, and that all flanged joints are assembled correctly to the required technical standard, with suitable records kept and maintained.

Flange Management is the process of ensuring designed mechanical integrity is achieved by managing materials, alignment, cleanliness, assembly & correct application of torque values to achieve the material and pressure class rating within final installed design requirements.

This document is applied also to the management of the joints that are broken during commissioning where another tag will be required.

Exclusions

This procedure excludes flange management within the packages, that will be covered by Suppliers procedures and separate joint registers.

3 SCOPE

This procedure is specifically issued and implemented for the Base Load Power Hub (BLPH) project, undertaken for Crosswind.

4 REFERENCES

Doc. No.	Description
CW-I-WP4-2023-05	CONTRACT
CONTRACT SECTION V	SCOPE DESCRIPTION
CONTRACT SECTION IX	QUALITY_MANAGEMENT
123A90-PML-QHSE-QP-00002	PROJECT QUALITY PLAN

Table 1 - Reference Documents

4.1. DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
PLANT:	Base Load Power Hub (BLPH)

VENDOR OR SUPPLIER	Any organization employed by Rosetti Marino to supply either products or services.
Inspection and Test Plan (ITP)	Document, which identifies the activities to be inspected as well as specifications, methods and acceptance criteria for monitoring and/or testing. It is a synonymous of "Quality Control Plan" (QCP)
Detail Design	Structural design by TECON (TE); Civil, Structural and Architectural; Instrumentation, Automation and Electrical, Piping and Layout; Technical Safety and Environmental Studies; Mechanical, Process, 3D modelling by Rosetti Marino S.P.A in Milan (RM).
FUSIONLIVE	Contractor Electronic Document Management System.
MDR	Master Document Register
DDL	Design Document List
SDL	Supplier Document List
FDL	Fabrication Document List
CPI	Company provided Items

Table 2 - Definitions and Abbreviations

5 RESPONSIBILITIES

- CONSTRUCTION MANAGER (CM)
  - Ensure that personnel involved in flange management have full understanding and competency in the integrity of bolted joints, and that personnel have sufficient knowledge in the principle and management of the preparation and assembly of flanged connections.
  - Ensure that the register of approved personnel and register of all bolt tightening equipment with relevant certification are maintained.
- PIPING ERECTION SUPERVISOR:
  - Direct and supervise all personnel involved in joint management.
  - Ensure the correct bolting equipment for each individual joint is used.
  - Carry out toolbox talks on a regular basis on Flange Management.
  - Daily coordination to allow witnessing by inspectors of joints during assembly and tightening activities.

- Demonstrate safe working practices, including handling and working of bolting equipment.
- Ensure the preparation and maintenance of bolt tightening equipment is carried out where required.
- Ensure that all joint tags are in place.

- PIPING OPERATORS:
  - Prepare for assembly all bolted flange connections for all the piping lines.
  - Inspect joint to ensure cleanliness and free from defects and damage for all the piping lines
  - Assemble all bolted flange connections using correct bolts, gaskets, for all the piping lines
  - Tighten the bolts using calibrated torque wrench.

- QC INSPECTOR:
  - Witness 100% of joint make up
  - Inspect all bolted connections for all the piping lines to ensure cleanliness and free from defects and damage, bolts & gaskets material
  - Assist all bolted connections assembling and tightening verifying correct alignment, tightening sequence & values and calibration of torque wrench.
  - Complete the Flange Management and prepare the dedicated Check Sheet for every Joint
  - Record and sign the torque values, etc. on the correct documentation (Attachment 1)
  - Ensure the ongoing completion of records and accurate reflection of these details on the flange tags within the field

6 PRE-ENGINEERING

6.1. THE MANAGEMENT & COMPLETION OF THIS PROCEDURE SCOPE OF WORK INVOLVES:

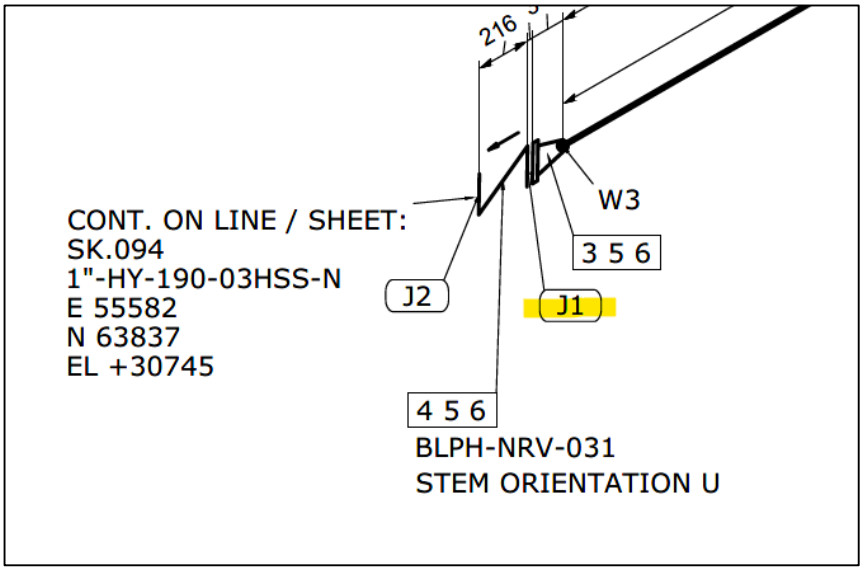
- Flange joints on Piping Systems, including equipment and valves.
- Flange joints on Piping Systems require reinstatements following hydrotest, flushing and pickling activities.

6.2. JOINT TRACEABILITY / IDENTIFICATION

Joint identification is composed of Isometric Number + Sheet Number + Joint Number, as per following example:

"128-1-J1"

Joint 128-1-J1 detail on isometric drawing 123A90-FDL-PP-DI-00049



Each flange joint will be given a multiple section tag.

The Mechanical Completion certificate is an Individual flange certification record and will contain the following data, for the fully complete joint (Attachment #1):

- System / Sub-System. Line Number
- Test Pack No.
- Isometric shop drawing No.
- Individual Bolted Joint No.
- Class rating.
- Actual Torque value.
- Gasket type / material.
- Bolt material / sizing.
- Lubricant type coefficient.
- Operator responsible for making the joint and for tightening.
- Date the joint was made and tightened.
- Serial number of the tool used to tighten the joint.

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7 BOLT TORQUE VALUES

The applicable bolt torque values are listed in Attachment #3. The values are defined based on the type of flange, diameter, rating and materials involved.

8 PERFORMANCE OF OPERATIONS

The Systems / Sub-System Joints will be tightened and released prior to hydro-testing.

If a break into the schedule is required to complete a hydro-test then the Contractor shall track any changes and advise the Flange management team of the location of any flange breaks / flanges to be classed as temporary and this shall be added to a separate register to manage.

- Tightened / broken flange connections require a new tag as per the following procedure.
- Temporary flanges for Hydro-Test shall be identified with a new temporary tag applied.

9 FLANGE JOINT ASSEMBLING AND BOLT TIGHTENING

9.1. FLANGE JOINT ASSEMBLING

Prior to executing any joint assembling, Contractor personnel shall undergo a basic assessment or surveillance of competency in joint make-up and bolt tightening. The assessment or surveillance shall be carried out in accordance with requirements of this procedure.

All involved personnel shall be entered into a Register of Approved Personnel, and each approved person will be issued with a unique number identifier. The register shall be made always available at request and will be incorporated into the project Final documentation

All gaskets shall be brought up flush and square so that the entire mating surfaces bear uniformly on the gasket.

9.2. BOLT-UP CONNECTION PREPARATION

Prior to bolting the following preparation activities are required. These basic steps will be reinforced in the tool box talks to be performed by Contractor and be used in review of operator competency

- Mating faces shall be cleaned of all dirt, grease, rust, paint and protective coatings and shall be inspected and confirmed free of defects such as scratches, dents, burrs, pits, scale and weld splatter prior to joint assembly.

- Visually inspect all bolts and nuts for damaged or corroded threads. Replace bolts or nuts if necessary.
- Remove burrs from all threads; on super duplex bolts do not use brushes used for CS bolts.
- Lubricate with MOLYKOTE 1000 PASTE, the threads of the bolt or stud, and the surface of the nut face adjacent to the flange.
- Install the new gasket and be sure the gasket is properly centered. DO NOT REUSE old gaskets or use MULTIPLE gaskets in a standard flange connection.
- Check alignment according to ASME B31.3 Process Piping:
  - flange faces must be parallel within 1/16" per foot of diameter, and flange bolt holes must be aligned to within 1/8" maximum offset.
- Adjust the position of the nuts to insure that there is complete thread engagement for the full depth of the nut.

9.3. GASKET

Gaskets shall be treated in accordance with the manufacturer's recommendations.
Ensure the correct & safe storage of gaskets is maintained up to fitting within the flange connection.

Ensure the correct gasket has been issued to the work scope by review of the flange check sheet, and Isometric drawing.
Care shall be taken to ensure that the gasket and mating flanges are clean, true and free from defects.

Joint rings shall not, under any circumstance protrude into the bore of the pipe.

Fit Ring type Joint gaskets using best practice techniques so that finger's do not become trapped / crushed.
Use of gaskets is not permissible after the gasket has been crushed or damaged.

9.4. BOLTING

All flanges and bolting shall be checked for correct grade and damage prior to fitting.

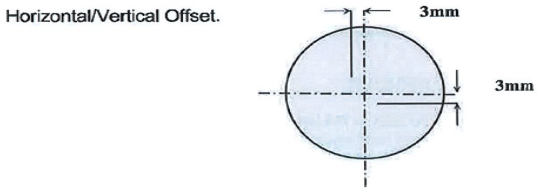
All flange bolting shall be free to move through mating flange holes in a plane at right angles to the flange face and parallel to the pipe run (misalignment of flange space holes resulting in knurling of the nut on the flanges will be rejected).

Bolts shall extend through their nuts such that there is complete thread engagement for the full depth of the nut. Stud bolts should protrude equally on both sides of the flange joint, with a maximum of five threads protruding in the final assembled condition through the nut.

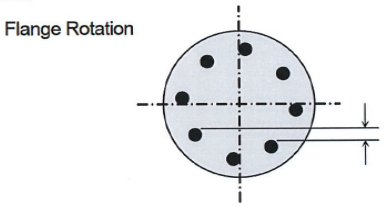
Nuts and bolts must have their grade markings visible after installation.

All Flange connections with RTJ gaskets should be revisited after 5 – 15 mins to ensure no relaxation has taken place.

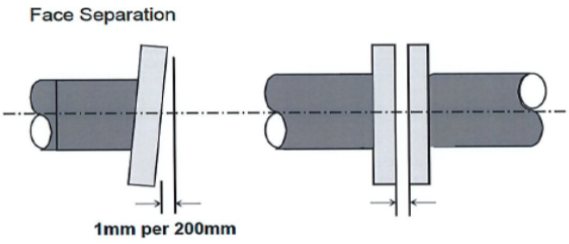
The following guidelines are recommended as acceptable for flange misalignment.



If the bolts can be passed through the boltholes of both flanges without force, then this mis-alignment is acceptable.



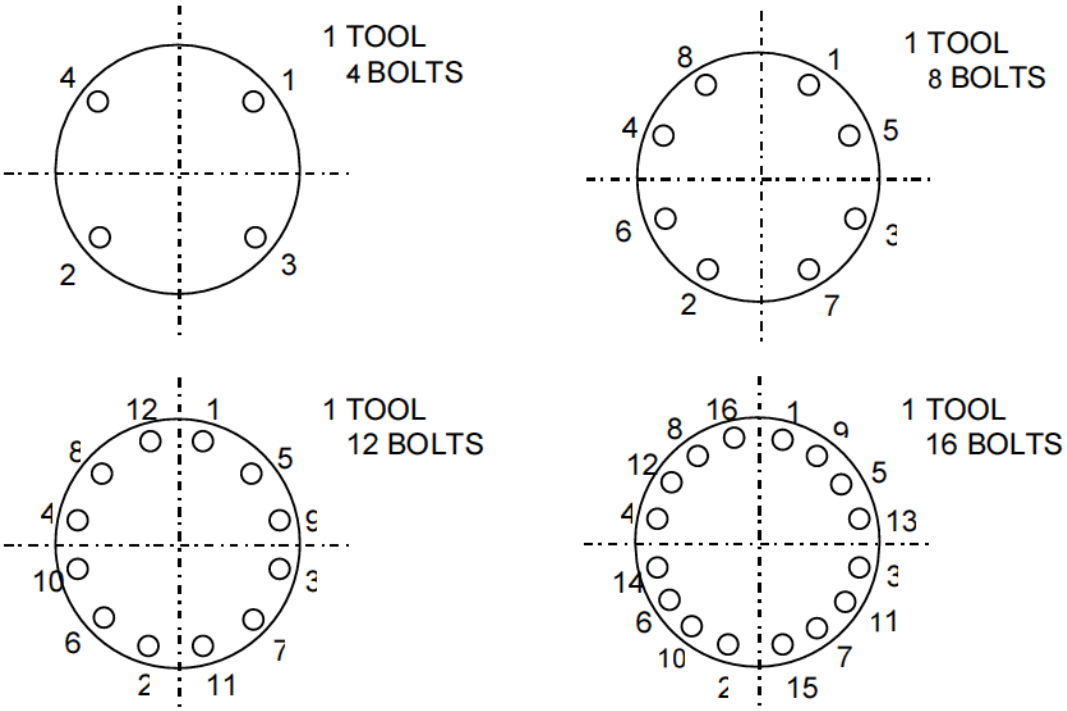
Again, if the bolts can be passed through the boltholes of both flanges without force, then this mis-alignment is acceptable.



Tightening of bolts shall be carried out in accordance with this procedure and good industry practice.

Torque tightening equipment will be used in strict accordance with instructions supplied in this procedure, which relate to the training completed by each individual.

Nut(s)/Bolt(s) shall be tightened to desired load in increments 30%, 60% and 100% of the bolt torque values, in the pre-planned sequence of uniform and diametrically opposite distribution of tightening as follows:



Number up the flange connection in a clockwise rotation:

4 Bolt Flanges – 1, 3, 2, 4

8 Bolt Flanges – 1, 5, 3, 7, 2, 6, 4, 8,

12 Bolt Flanges – 1, 5, 9, 3, 7, 11, 2, 6, 10, 4, 8, 12.

16 Bolt Flanges – 1, 9, 5, 13, 3, 11, 7, 15, 2, 10, 6, 14, 4, 12, 8, 16

9.5. MANUAL TIGHTENING

Only manual tightening is foreseen.

- Review work pack and assess requirements and safety precautions.
- Check all equipment is appropriately certified, in good condition and suitable for the intended job
- Check proper bolt lengths
- Set the torque wrench to achieve 30% torque.
- Employ manual handling techniques when using hand torque wrenches.

- Apply tool in sequence shown in diagrams above.
- Take up free movement and tighten nuts to bolts to the previous torque setting.
- For through bolts, ensure the back nut does not turn. If back nut does turn, use the correct size backing spanner to lock nut to prevent it turning.
- Check flange alignment when all bolts are tightened to 30%.
- If satisfactory, repeat the procedure at 60% torque setting.
- Check flange alignment when all bolts are tightened to 60% torque.
- If the alignment is satisfactory apply the calculated 100% torque figure following the same numbering sequence.
- We can now proceed to a rotational pass around the flange connection using the calculated 100% torque figure, this should continue until no nut movement is apparent even passing the original start position. This final pass should be completed by using one wrench only.
- Record the serial number of the torque wrench, and complete the Flange check sheet / Mechanical completion form.

Note: Flange connections with RTJ gaskets should be revisited after 5 – 15 mins to ensure no relaxation has taken place. Repeat the rotational pass if any relaxation has taken place.

10 FLANGE JOINT ASSEMBLING AND BOLT TIGHTENING

On final tightening of joints, complete the Five Part Flange Tag (Attachment #2).

Issue the 5 part flange management tag if access allows prior to flange assembly along with a marked up ISO documenting the flange positions, and Flange check sheets.

- The Flange Management Inspector / QC / Representative will verify the flange connections / materials to be used etc. and review the condition of the flange faces.
- Piping operators will assemble the flange connection and complete the detail required on the Red section of the flange tag and flange check sheet.
- The Red portion of the tag (Assembled) section will be removed along with the Blue portion which is used if opening a flange connection, and details should be recorded on the tag and flange check sheet.
- On completion of tightening activities the remaining parts of the Yellow (Flange Tag), Green (flange tested) and Orange (Tightened) sections will remain. As the Orange (Tightened) section will be completed, it will be handed to the Flange Management Inspector / QC / Representative.

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- The green portion of the tag (flange tested) will be completed and afterwards removed by the pre-comm – commissioning team whom will complete the activities along with the flange Management Inspector / QC / Representative.

At the completion of the connection, it is NOT allowed to move or stress the line.

When the Flange Management of a single joint is completed, the relevant Check Sheets will be closed issued to the flange Management Inspector or QC representative to allow progress reporting. (Flange Management check sheet – Mechanical Completion – Attachment #1).

Completions Management System is used as Project database for the Mechanical completion, Pre-commissioning, Commissioning and Handover of the Systems / Subsystems.

In particular, for the Flange Joint Management activities, this Data Base through the Proverlis operator, manage the engineering data populated with the flange register, the relative check sheets assigned and filled by inspectors, update the status of the flange joints completed and print out a progress status of the flange joints per Line / Iso / Test Pack.

The operator makes assembling of the joint (make-up first step) and the tightening activities (second step). The flange management QC inspector inspects and reviews these activities on relative check sheet, according this procedure. Only the people in the list of operators and inspectors are authorized to perform the Flange Joint Management activities, assigned by RM piping erection supervisor.

The inspectors / QC representative witness all joints and with the client approve by signature into the check sheet.

The Flange Joint Management activities steps will be recorded into the check sheet and sign by operator (first box), by inspector (second box), by client (third box) and by TP (fourth box), if applicable.

As expected, the check sheets compiled and signed will be put into the data base by the Proverlis operator.

11 EQUIPMENT

All equipment used shall be calibrated, suitable for the scope of work and inspected prior to use.

A register shall be created and maintained giving a description, quantity and serial number of all equipment to be used on the bolt tightening activities.

All equipment must be within the calibration period and it is certificate should be made available for reference.

12 JOINT INTEGRITY RECORDS

The Joint Integrity Records will be retained in the relevant Test Packs.

Test Pack / Work Pack & Sub-Systems Piping Dossiers will be compiled, and all completed dossiers will include for each system:

- Flanged joint register
- Break out register
- Completed joint integrity records and certificates.
- Isometric shop drawings indicating Unique Bolted Joint N°.
- Lubricant data sheet.
- Torque wrench calibration records
- Personnel qualification including proof of training

Breaking out joints already tightened and tagged should be minimized and controlled by using the breakout register

All Flange breaks that are made following application of the coloured tags as referred to in Section 10.0 shall be reported to Company.

On breaking, Contractor will then go through the same joint make-up process and flange management activities, as if it were new. Contractor will control the superseding activities and superseding information within their records in the flange break register, while Company will do likewise and will be issued a new five-part Tag when appropriate to do so.

The joints damage either can happen during make up or after, but in any case, the process is to remove the joint and substitute the bolts if damages are found. If the bolts are in good condition, it will be acceptable to re-use if the joint has been tightened previously in a controlled manner. Failure of sufficient documentation (including witness signatures) will require new bolting for the joint. The gaskets always require to be changed.

If broken joint is already closed and certified, with the flange management activities completed, remove the flange tag and send to the Flange management inspector or representative to add to the flange break register and all details issued to the Proverlis operator and will delete the assigned Check Sheet and re-open the joint into the Data Base. The Flange management team will issue a new Check Sheet with a new flange tag (the joint number will remain the same, as per applicable isometric) and the flange management activities will be repeated in full.

13 SAFETY – PPE/WORK AREA

Relevant recommendation stated in the Project HSE plant and Company safety standard shall be complied with. Hereafter are listed precaution concerning specific aspects.

Correct PPE will be worn at all times. Eye protection must be worn whilst on the worksite & must be worn during all torque tightening operations.

When working at heights or where danger exists from falling objects, equipment should always be secured wherever reasonably practicable.

When working at height, areas below must be cordoned off where risk of falling objects is present.

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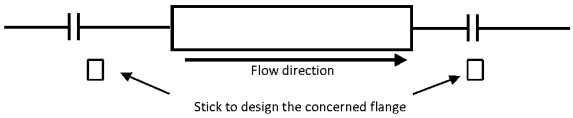
Attachment #1: FLANGE MANAGEMENT CHECK SHEET

ROSETTI MARINO — CROSSWIND

ITEM	Tag	:			Dwg		
	S/Sys	:			Module		
TASK	code			Location		User	
FORM	Process	MC	Activity PIP	Discipline Piping	Form TMX27		Bolt tensioning / torquing

Test Pack N.:

EQUIPMENT TAG



Flange Type		**Lubricant**	
Flange Size		**Lubricant Type**	
Gasket Type		**Used tools**	

Bolt tensioning/Torquing value

			Torque (Design Value)		
Sequence	Pre tension/torque	Final tension/torque	30%	60%	100%
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

1 **Clear Bore Inspection:** Pipe and Valve clear of debris/contamination.

2 **Flange Face Check:** Both flanges clean and free from damage.

3 **Gaskets and Bolts:** Gaskets and Bolts checked for correctness to specification, any damage and for correct length technique.

4 **Alignment:** Check alignment according to code.

Comments:

Page 1/1	Performed by	☐ WITNESS ☐ REVIEW	☐ WITNESS ☐ REVIEW
Company			
Name			
Date			
Signature			

Attachment #2: FIVE PART TAG SYSTEM



Attachment #3: JOINT & TORQUE TABLE (still in progress, not fully defined)

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