Base Load Power Hub (BLPH)

Coating and Painting Specification

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4	Resolved - FRP grating for the H2 pressure vessels' service platforms
5	Resolved - External and internal coating systems for the caissons
6	Resolved - Cathodic Protection to be considered in the splash zone topside

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Table of contents

1 INTRODUCTION 6
1.1 PROJECT OVERVIEW 6
1.1.1 Project Location 6
1.1.2 Project Concept 7
2 DOCUMENT SCOPE 9
2.1 REFERENCES 9
2.2 DEFINITIONS AND ABBREVIATIONS 10
3 STANDARDS, CODES AND GUIDELINEs 11
3.1 DEVIATIONS 11
4 DESIGN DATA 12
4.1 DESIGN LIFE 12
4.2 INTERFACE ISSUES BETWEEN PILE AND TOPSIDE 12
4.3 CORROSION CATEGORIES 12
4.4 APPROVED PAINT MANUFACTURERS 12
5 GENERAL REQUIREMENTS 13
5.1 GENERAL 13
5.2 PLANNING 14
5.3 EQUIPMENT PROTECTION AND CLEANUP 14
5.4 COATING MATERIALS 14
5.5 UNPAINTED SURFACES 14
5.6 ADDITIONAL REQUIREMENTS TO EQUIPMENT 15
5.7 SCAFFOLDING AND ACCESSIBILITY 15
5.8 COATING CONTRACTOR'S RESPONSIBILITIES 15
6 SURFACE PREPARATION 18
6.1 STEEL PREPARATION BEFORE BLASTING 18
6.2 BLAST CLEANING 18
6.3 WORKING RESTRICTIONS 19

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6.4 FINAL SURFACE CONDITION 19
7 PAINT APPLICATION 20
7.1 GENERAL 20
7.2 APPLICATION EQUIPMENT 20
7.3 APPLICATION 20
8 QUALITY CONTROL, INSPECTION AND TESTING 21
8.1 GENERAL 21
8.2 PRE-PRODUCTION MEETING 21
8.3 MANUFACTURER'S SUPPORT AND SUPERVISION 21
8.4 COMPANY SPECIALIST 21
9 INSPECTION AND TESTING 22
10 APPENDIX A EXTERNAL COATING SYSTEMS FOR TOPSIDE 24
11 APPENDIX B EXTERNAL COATING SYSTEMS FOR THE SPLASH ZONE TOPSIDE 26
12 APPENDIX C TOPCOAT COLOURS 27
13 APPENDIX D AREAS INSIDE MECHANICALLY VENTILATED MODULES AND HVAC CONTROLLED 29
14 APPENDIX E COLOUR CODING OF PIPES 30
15 APPENDIX F ESCAPE ROUTES AND SAFETY ROUTES 31

List of Figures

Figure 1 – HOLLANDSE KUST NOORD WIND PARK Location Map 6
Figure 2 – Wind Park Details 7
Figure 3 – BLPH Concept 7

List of Tables

Table 2-1 – Reference Documents 10
Table 2-2 – Definitions and Abbreviations 10
Table 3-1 – List of codes and standards 11
Table 9-1 - Inspection and testing 22
Table 10-1 - Coating Systems 24
Table 11-1- Top coat colours 28
Table 12-1 - Internal coating systems within Instrument Control Rooms 29

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.

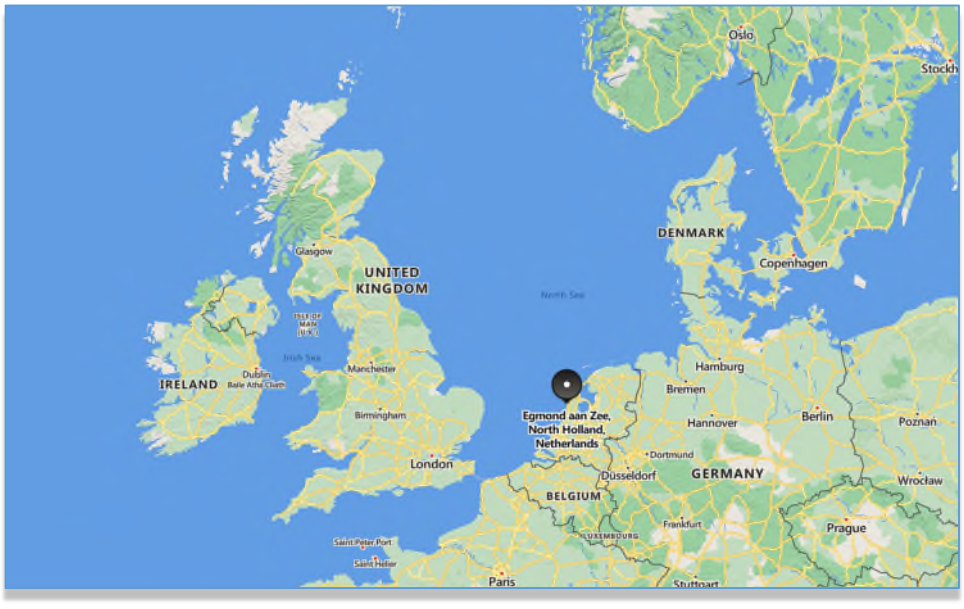


Figure 1 – HOLLANDSE KUST NOORD WIND PARK Location Map

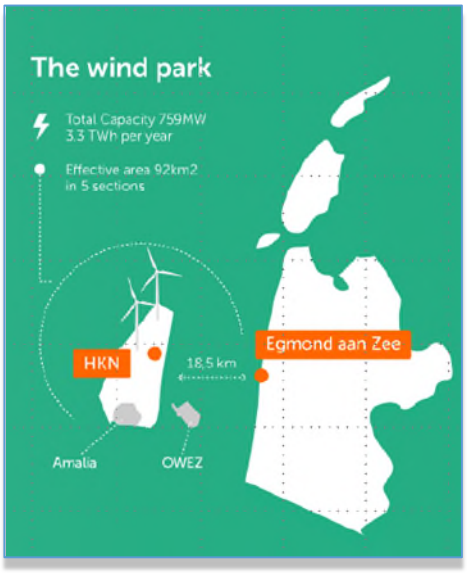


Figure 2 – Wind Park Details

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.

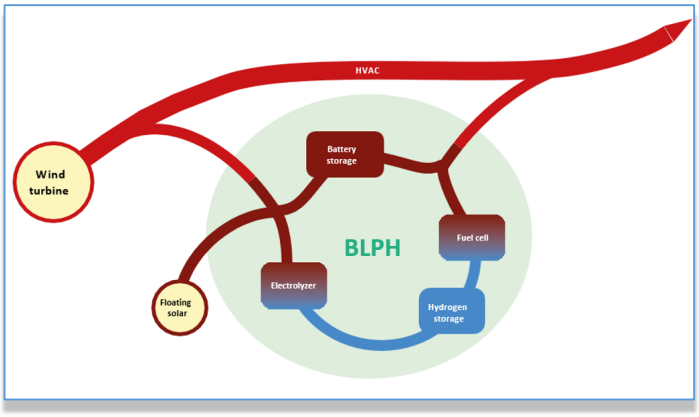


Figure 3 – BLPH Concept

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 DOCUMENT SCOPE

The purpose of this specification is to define the minimum technical requirements of the Hollandse Kust Noord Wind Park Project for the selection and the execution of the following-

- Both external and internal painting and coating systems for a topside facility including Structures, Piping, Equipment, Instrument Control Rooms and Transition Piece between topside and single pile. The single pile jacket will be supplied by others,
- Vessels and Piping identification.

This document shall be read in conjunction with Ref. (4) NORSOK M-501 and Ref. (5) NORSOK Z-DP-002 which should be followed unless otherwise indicated herein including any specific qualifications, surface preparation, paint application and checks, inspection and acceptance.

2.1 REFERENCES

Doc. No.	Description
[1] K559-2254-PM-PLN-003	Basic Design Engineering Package
[2] K559-2254-MT-REP-0001	Material Selection Report
[3] 123A90-DDL-MAT-RE-60011	Material Selection Report
[4] NORSOK M-501 Ed 6	Surface Preparation and protective coating
[5] NORSOK Z-DP-002	Coding System
[6] ISO 9223	Corrosion of metals and allows – corrosivity of atmospheres – Classification, Determination and Estimation
[7] ISO 1461	Metallic coatings – Hot Dip Galvanising coating on fabricated ferrous products – Requirements
[8] NS 476	Paints and coatings – Approval and certification of surface treatment inspectors
[9] ISO 8501-1	Preparation of Steel Substrates before Application of Coatings and Related Products – Visual Assessment of Surface Cleanliness – Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Removal of Previous Coatings.
[10] ISO 8501-3	Preparation of Steel Substrates before Application of Coatings and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation Grades of Welds, Cut Edges and Other Areas with Surface Imperfections

[11] ISO 11124-1-4	Preparation of Steel Substrates before Application of Paints and Related Products – Parts 1-4, Specifications for Metallic Blast-Cleaning Abrasives
[12] ISO 11126-1-10	Preparation of Steel Substrates before Application of Paints and Related Products – Parts 1-10, Specifications for Non-Metallic Cleaning Abrasives
[13] ISO 12944-4	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation
[14] ASTM D4285	Standard Test Method for Indicating Oil or Water in Compressed Air

Table 2-1 – Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY): Crosswind
CONTRACTOR (CTR): ROSETTI MARINO S.p.A.
PROJECT: HOLLANDSE KUST NOORD WIND PARK Project

CX	Offshore Environment
C3	Medium Corrosion
CRA	Corrosion Resistant Alloy
ITP	Inspection Test Plan
PQT	Procedure Qualification Test
NORSOK	Norsk Sokkels Konkurranseposisjon
FLG	Flange
CRA	Corrosion Resistant Alloys
CSDS	Coating System Data Sheet
HSE	Health Safety Environment
FRP	Fibre Reinforced Polymers

Table 2-2 – Definitions and Abbreviations

3 STANDARDS, CODES AND GUIDELINES

The codes, standards and specifications referenced in this specification shall be taken to mean the latest edition and addenda. It is not a definitive list and does not preclude the use of other Codes if approved in writing by CONTRACTOR.

In case of conflict between this specification, other referenced specifications and the codes and standards, this shall be brought to the COMPANY's attention for resolution in writing. In all cases the most stringent requirements shall apply.

Document Number	Document Title
SFS 8145	Anticorrosive painting, surface preparation methods of blast cleaned and shop primer coated steel substrates and preparation grades for respective treatments
EN 10204	Metallic products – Types of inspection documents
ISO 8501-2	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Preparation grades of previously coated steel substrates after localized removal of previous coatings
ISO 8501-6	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting.
ISO 8502-9	Preparation of Steel Substrates Before Application of Paints and Related Products – Tests for the Assessment of Surface Cleanliness – Part 9: Field Method for the Conductometric Determination of Water-Soluble Salts
ISO 4624	Paints and varnishes – pull-off test for adhesion

Table 3-1 – List of codes and standards

3.1 DEVIATIONS

Any deviations from the requirements stated within the Requisition, and the documents and specifications referenced within the Requisition (including this specification and all attachments), shall be submitted in writing to the CONTRACTOR's for approval, with the SUPPLIER's bid. It shall be assumed that if deviations are not listed, then the SUPPLIER's bid shall be fully compliant.

4 DESIGN DATA

4.1 DESIGN LIFE

The topside facility shall be designed for a minimum operating life of two years. Individual coating systems shall surpass the minimum operating life of two years.

4.2 INTERFACE ISSUES BETWEEN PILE AND TOPSIDE

An elevation of El 17.050m for the interface level between the single pile (by others) and topside has been determined. The external and internal splash zone LAT values are as follows-

External splash zone	
Upper limit external splash zone	+ 7.0m LAT
Lower limit external splash zone	- 2.8m LAT

Internal splash zone	
Upper limit internal splash zone	+ 3.6m LAT
Lower limit internal splash zone	- 0.6m LAT

4.3 CORROSION CATEGORIES

In accordance with Ref. (6) ISO 9223, corrosion categories are as follows for topside external coatings.

- CX for the main structure,
- CX shall be used for all pressure containing materials in 316SS/316L SS regardless of temperature,
- C3 minimum for Carbon Steel and equipment with a two year design life.

4.4 APPROVED PAINT MANUFACTURERS

The following paint suppliers are acceptable.

- Jotun,
- Hempel,
- PPG,
- Carboline.

Other paint manufacturers can be considered on a case by case basis if dedicated NORSOK M-501 approvals are provided together with an offshore North Sea reference list.

5 GENERAL REQUIREMENTS

5.1 GENERAL

This specification describes the requirements for the selection of appropriate coating materials, surface preparation, application procedures and inspection for protective coatings to be applied on the following entities.

New equipment consisting of the following-

- Electrolyser Package, Fuel Cell Package, Hydrogen Storage Vessels, Seawater Lift Pumps and Caissons, Seawater Coarse Filter Package, Electro-Chlorination Package, Ultra Filtration Unit, Filtered Seawater Tank, Desalination Unit, Fresh Water Tank/Pumps, UV Water Filter, Waster Water Tank, Instrument Air Package, Nitrogen System, Hydrogen Vent KO Drum, KO Vent.
- Piping including their supports and both manual and actuated valves,
- Life Raft and their structures QTY 2
- Structures for topside and transition piece,
- Instrument Control Rooms QTY 4
- Davit electrical crane 3T
- Caissons consisting of QTY 2 seawater and QTY 1 Brine
- Utilities.

Items which do not require to be coated are stated in Sect. 5.5.

This specification is applicable to equipment and materials suppliers, main fabricators and their respective sub-suppliers.

This specification only covers new construction and does not address coating inspection and maintenance activities over the design life of the asset.

This specification incorporates the FEED specification Ref. (2) K559-2254-MT-REP-0001 and detailed engineering specification Ref. (3) 123A90-DDL-MAT-RE-60011. The defining document is Ref. (4) NORSOK M-501, which shall be read in conjunction with this specification and any discrepancies between this specification and NORSOK M-501 shall be highlighted to CONTRACTOR.

NOTE

It shall be noted that, as per Basic Design Engineering Package (Ref. [2]), the operational design life of the topsides piping and equipment is only 2 years, however the topside structure is designed for 25.5 years. The long structural design life requires offshore coating systems while the equipment could follow Vendor

standard coatings. If vendors use their own standards, they can bypass NORSOK requirements. However, they must still meet the minimum corrosion category C3.

5.2 PLANNING

Before commencement of coating activities, the following shall be finalised and documented.

- Coating Procedures Specification
- Coating Procedure Test
- Coating inspector's qualifications
- Operator's qualifications
- Approved ITP
- PQTs as and when relevant and agreed.

5.3 EQUIPMENT PROTECTION AND CLEANUP

All temporary equipment provided to complete the work shall fully comply with all appropriate legislative and COMPANY requirements.

Site craneage shall be certified to nationally accepted standards. Certification documentation shall be available on site. Non-certified or damaged equipment shall not be used. Wire rope slings, chains or other lifting equipment likely to damage pipe coatings or weld bevels shall not be used for pipe handling. Care shall be taken during all handling operations to prevent damage to coatings, flange faces etc.

5.4 COATING MATERIALS

Pertinent coating systems shall comply with Ref. (4) NORSOK M-510 Annex A and relevant coating detailed in Sect. 10 Appendix A of this specification.

Coating system no. 1, system no. 3B, system no. 4, system no. 5 and system no. 7 shall be pre-qualified.

Any alternatives to the systems state can be proposed as an option only provided full details of the alternative paint is provided include similar applications.

Topcoat colours should be in accordance with Appendix B.

5.5 UNPAINTED SURFACES

The following items shall not be blasted or painted unless specifically required. However, these items shall be protected during blasting and coating application of surrounding equipment.

- All instrument CRA tubing consisting of SS316 and 25% Cr super duplex. Junction Boxes in SS316 and cable trays 316SS and their supports.
- Insulated or un-insulated stainless steel heating/ventilation/air-conditioning ducts,
- All galvanized structural bolting,

- Aluminium, Titanium, Copper, Nickel, Brass, 25% Cr super duplex and non-metallic materials such as CPVC, GRP Brine Caisson, FRP grating,
- Flange sealing surfaces,
- Movable parts such as valve spindles, stems, pump shafts or similar,
- All CRA surfaces to be installed both external and internal environments such as cabinets, panels, all types of CRA enclosures and any external and internal cabinet piping in CRA 25% Cr super duplex and 316SS material.

If stainless steel is connected to carbon steel i.e. piping FLG x FLG connection, insulation kits shall be used to prevent any galvanic corrosion.

5.6 ADDITIONAL REQUIREMENTS TO EQUIPMENT

The following general requirements are applicable to surface protection of valves, actuators, gearboxes, pumps and motors.

- Handwheels and levers shall be in stainless steel or hot dip galvanised carbon steel according to Ref. (7) ISO 1461. The valves' gearboxes, handwheels and levers top coat colour shall be as follows:
    - Handwheels, levers and gearboxes shall be with system 6A complete with RAL 9005 black
- Unused threaded bolt holes, etc. shall be plugged or sealed.

Valves' actuators shall be carbon steel system 1 or stainless steel system 6A. Topcoat RAL colour shall be identical to the valve body to which it is assembled. Aluminium material is not acceptable.

5.7 SCAFFOLDING AND ACCESSIBILITY

Fixed scaffolding, staging etc, where applicable, shall be used in accordance with relevant local regulations and requirements and shall comply with (Ref.14). Scaffolding boards shall be firmly fixed at all times. Clear access shall be provided to perform work such as surface preparation, painting application and inspection.

5.8 COATING CONTRACTOR'S RESPONSIBILITIES

The coating Contractor shall demonstrate their experience in the execution of similar coating work in terms of surface preparation as well as coating application for the coating systems described in Ref. (4) NORSOK M-501 Annex A.

Personnel carrying out inspection or verification shall be qualified in accordance with NS 476, Inspector level II, Certified NACE Coating Inspector Level II or equivalent.

Supervisors and foremen should be qualified to tradesman level.

The coating Contractor shall be responsible for the supply of the following:

- An evaluation of hazards and provision of proposal to meet HSE requirements,
- Skilled and competent personnel/supervisors as described above,
- Product data and material safety datasheets for relevant paint systems,
- Paint work procedure(s) and Inspection/Test plan(s),
- Provision and maintenance of plant, equipment and tools as listed below:
    - Air compressors and generators,
    - Scaffolding, staging etc., if required,
    - The required lighting,
    - Ventilation, spray booths, weather protection, heating,
    - Abrasives,
    - Surface preparation equipment i.e., grinders, blasting equipment, vacuum cleaners,
    - Paint stores,
    - Paint material and thinners (from COMPANY approved vendors),
    - Paint mixing equipment, spraying equipment, brushes, solvents, cleaning rags,
    - Inspection and testing equipment as required, such as air/surface thermometers, hygrometers, surface profile gauges, wet and dry film thickness gauges, holiday detectors and copies of Ref. (9) ISO 8501-1 for visual testing.

Special precaution shall be taken to ensure protection of surrounding equipment and for this reason the coating CONTRACTOR shall not perform sand blasting during and after installation of equipment, unless agreed with COMPANY. In all cases, blasting dust and grit contaminants shall not be allowed to cross contaminate coated surfaces which are not fully cured. Surrounding equipment shall be sufficiently masked/protected during blasting.

Finished paintwork shall not be damaged due to other coating activities and the coating CONTRACTOR is responsible to repair any such damages.

In case of painting offsite, protection and packing shall be carefully assessed to minimise damages. The coating Contractor is responsible to repair any damages caused by improper transport or handling.

If the coating Contractor demonstrates signs of poor performance during the execution of work, the work shall be repeated at no extra cost to the Company till the quality requirements of this technical specification are met.

The following results are considered a result of poor performance by the coating Contractor:

- Inadequate coating coverage,
- Inadequate or excessive film thickness,
- Poor adhesion properties,
- Evidence of dirt, grease or other contamination or inclusions, voids,
- Coating sags/runs/blisters, etc.

The selected coating systems shall be compliant with this technical specification and with Manufacturer's recommendations.

After coating work completion, surplus materials, scaffolding and other equipment shall be removed at coating Contractor's responsibility.

6 SURFACE PREPARATION

6.1 STEEL PREPARATION BEFORE BLASTING

In general, all surfaces shall be finished in accordance with Ref. (10) ISO 8501-3 and preparation grade P3, which implies that all edges, including cut-outs, rat holes and welds shall be generally rounded to a radius of at least 2 mm.

Untreated surfaces such as flange faces, shall not be blasted, and require suitable protection prior to blasting to avoid damage.

6.2 BLAST CLEANING

Abrasives used for blasting shall be grit. The size of the abrasive particles shall be such that the surface preparation profile height (anchor patter profile) is in compliance with the requirements for the selected coating system. Abrasives shall not contain carcinogenic substances, lead or lead compounds, biological available nickel or more than 1 weight % quartz or crystalline silica.

On carbon steel surfaces, metallic abrasives comply with Ref. (11) ISO 11124-1-4.

On stainless steels and duplex substrates, only non-metallic abrasives in compliance with Ref. (12) ISO 11126-1-10 shall be used.

All steel shall be cleaned for the removal of weld flux, oils, grease and salt prior to blasting in accordance with Ref. (13) ISO 12944-4. This shall be performed using pressurised, Manufacturer approved, emulsion cleaning (100 to 200 bar), followed by fresh water washing and drying.

The surfaces shall be allowed to dry before proceeding with further preparation work or painting.

All steel surfaces shall be dry blast cleaned in accordance with individual relevant coating systems in Appendix B as per Ref. (9) ISO 8501-1.

Spent abrasives used on open sites or in facilities that are not specifically designed and constructed to preserve the cleanliness of spent abrasive shall not be re-cycled. CONTRACTOR shall ensure recycled abrasives are of adequate size to achieve blast profile by regular sieve checks. Blasting equipment that includes devices to recycle abrasives shall have equipment that ensures removal of dust, fines, corrosion products, and other contaminants.

Handling of degreased and blast cleaned surfaces shall be done with clean gloves and with lifting equipment that does not contaminate the surfaces.

The surface roughness shall be to grade medium G according to Ref. (10) ISO 8501-3.

For items to be welded after coating, there shall be no blasting of the bevelled edge +100mm.

The compressed air supply for abrasive blasting shall comply with Ref. (14) ASTM D4285. It shall be clean and dry, free from water and oil. Adequate separators and trays shall be provided and these shall be emptied regularly. Traps, in addition to oil and water extractors mounted on the compression, shall be used in compressed air lines to remove oil and moisture from air close to the point of use. Prior to using compressed

air, the quality of the air downstream of the separator shall be tested in accordance with Ref. (14) ASTM D4285.

Resuming after a work break, a blast of air alone shall be directed against a clean white sheet of absorbing paper for at least 15 seconds. If any droplets or contamination is shown the source of contamination shall be found and eliminated. This test shall be repeated till proven successful, prior to any blasting activity.

6.3 WORKING RESTRICTIONS

Unless special approval has been given by COMPANY, surface preparation shall not be carried out:

- If relative humidity is greater than 85% or surface temperature is less than 3°C above the ambient dew point,
- Coating shall only be applied or cured at ambient and steel temperatures above 5°C, if not otherwise specified in the material technical data sheet,
- If the air or the surface temperature are outside the Manufacturer recommendations,
- Outside daylight hours on exterior locations, unless special lighting arrangements have been provided,
- In case of impending adverse weather conditions (fog, mist, rain), surface preparation either shop-applied or on the platform/jacket during site construction activities shall be suspended if there is unlikely to be sufficient time for painting to be completed and/or the paint to have dried sufficiently to withstand weather damage, unless the coating Contractor can guarantee the required environmental conditions are constantly met during surface preparation, coating application and curing via means of heaters, de-humidifiers and other similar equipment.

6.4 FINAL SURFACE CONDITION

The steel or prepared surfaces and preceding coating surfaces shall be free from dust and clean from impurities such as grease, oil, dirt, moisture, weld spatter, salts etc.

Surface defects such as slivers or laminations, scabs that may be detrimental to the protective coating system shall be removed suitably by dressing. These areas shall be re-blasted to the specified standard. Dressing shall be carried out to a COMPANY approved procedure supplied by the coating Contractor and shall not compromise the material tolerances as specified by COMPANY.

7 PAINT APPLICATION

7.1 GENERAL

Contrasting colours shall be used for each coat of paint.

The coating manufacturer shall provide a CSDS for each coating system to be used, containing at least the following information for each product.

- Surface pre-treatment requirements,
- Film thickness (maximum, minimum and specified),
- Maximum and minimum re-coating intervals at relevant temperatures,
- Final curing time at relevant temperatures,
- Information on thinners to be used (quantities and type),
- Coating repair system.

7.2 APPLICATION EQUIPMENT

The method of application shall be governed by the coating manufacturer's recommendation for the particular coating being applied.

Roller application of the first primer coat is not acceptable. When paints are applied by brush, the brush shall be of a style and quality acceptable to the coating manufacturer. Brush application shall be done so that a smooth coat, as uniform in thickness as possible, is obtained.

7.3 APPLICATION

For each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, edges of beams etc. and areas not fully reachable by spray in order to obtain the specified coverage and thickness.

Edges of existing coating shall be feathered towards the substrate prior to overcoating.

Each coat shall be applied uniformly over the entire surface. Skips, runs, sags and drips shall be avoided.

Each coat shall be free from pinholes, blisters and holidays.

Contamination of painted surfaces between coats shall be avoided. Any contamination shall be removed.

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8 QUALITY CONTROL, INSPECTION AND TESTING

8.1 GENERAL

The coating Contractor shall be responsible for all the inspection and quality control functions necessary to achieve coating standards in accordance with this technical specification and Manufacturer recommendations. All relevant inspection points shall be included in CONTRACTOR's approved ITP.

The person responsible for inspection and quality control shall be nominated. Their qualifications shall be in line with requirements defined within this technical specification and shall be submitted to COMPANY for final approval.

8.2 PRE-PRODUCTION MEETING

A pre-production meeting shall take place at least one week prior to commencement of any coating work. All work plans, quality and HSE considerations shall be discussed. This shall include the presence of coating Contractor and Manufacturer representatives.

8.3 MANUFACTURER'S SUPPORT AND SUPERVISION

The coating Contractor shall arrange for a technical representative from the Manufacturer side to be in attendance at site in case of Company request, or as defined in the approved Inspection and Test plan. This is to ensure that surface preparation, coating application and subsequent inspection and possible repairs are in line with this technical specification and with Manufacturer recommendations and best industry practises. Manufacturer shall be available to provide support to the coating Contractor throughout the work execution.

Company shall be given access at all times during work execution, and shall be also given permission to review coating log books/records as produced by the coating Contractor.

8.4 COMPANY SPECIALIST

Company may or may not, appoint a specialist coating inspector to monitor the work. This by no means removes the responsibility from the coating Contractor to carry out the work to the highest possible quality standard.

The work undertaken by the coating Contractor may be subject to quality inspection by Project at any time, to ensure the highest workmanship standards are maintained.

Access to all facilities shall be given to Company specialist to enable him/her to carry out relevant duties. Reasonable notice of activity commencement shall be given to the Company specialist, as necessary.

9 INSPECTION AND TESTING

Testing and inspection shall be carried out in accordance with Ref. (4) NORSOK M-501 Table 3 and modified as stated below in Table 9-1. Surfaces shall be accessible until final inspection is carried out.

Test Type	Method	Frequency	Acceptance criteria	Consequence
Environmental conditions	Ambient and steel temperature. Relative humidity. Dew point.	Before start of each shift + minimum twice per shift.	In accordance with specified requirements	No blasting or coating
Visual examination	Visual for sharp edges weld spatter slivers, rust grade, etc. ISO 8501-3	100 % of all surfaces	P3 Extensive Preparation: the surface is free from significant visible imperfections. Where defects are noted on pressure retaining equipment such as pipework, these items shall be quarantined and the CONTRACTOR advised prior to repair.	Defects to be repaired
Cleanliness	a) ISO 8501-1 b) ISO 8502-3	a) 100 % visual of all surfaces b) Spot checks	a) The required blast standard shall be minimum SA 2.5 for all coating systems. b) Maximum quantity and size rating 2	a) Reblasting b) Recleaning and retesting until acceptable
Salt test	The ISO 8502-9 method shall be used.	Tests shall be carried out on each fabricated item.	Maximum conductivity corresponding to 20 mg/m2 NaCl	Repeated washing with potable water and retesting until acceptable
Roughness	Comparator, stylus instrument (preferred) or testex tape (see ISO 8503). Surface profile comparators in accordance with ISO 8501-2 may be used but only as an inspection tool to supplement DFT measurements.	Each component or once per 10 m2	As specified	Reblasting
Curing test (for Zn silicate).	ASTM D4752. This test is not required for system 7 coatings.	Each component or once per 100 m2	Rating 4 to 5	Allow to cure
Visual examination of coating	Visual to determine curing, contamination, solvent retention, pinholes/popping, sagging and surface defects	100% of all coating shall be holiday tested and pinholes repaired.	According to specified requirements	Repair of defects
Holiday detection	ISO 29601. Voltage, see table 1	As per coating system specification	No holidays	Repair and retesting.
Film thickness	ISO 19840. Calibration on a smooth surface. Measurement of DFT readings on non magnetic (e.g. DSS) surfaces shall be subject to agreement with COMPANY. Supplier shall select suitable instrument and demonstrate accuracy of readings (against precision foils and against test plate and micrometer).	ISO 19840	ISO 19840, and coating system data sheet	Repair, additional coats or recoating as appropriate
Adhesion	ISO 4624. For adhesion testing, only hydraulic type 'pull-off' testing devices shall be used.	An adhesion test shall be performed as part of qualification and on each item during production with separate tests panels sprayed at the same time as the primary item.	See notes below	Coating to be rejected

NOTE 1 For coating system no. 2 A, adhesion during CPT shall be minimum 9,0 MPa. Adhesion measured during production shall be minimum 7,0 MPa for any single measureme
NOTE 2 For coating system no. 3A, system no. 3C, system no. 3D, system no. 3E, system no. 3F and system no. 3G, maximum 30 % reduction from the CPT is acceptable. Absolute minimum value is 5 MPa.
NOTE 3 For sprayed on passive fire protection, maximum 50 % reduction from CPT value read as cohesion is acceptable. Absolute minimum values are 2.0 MPa for cement based products and 5.0 MPa for epoxy based products. Epoxy based passive fire protection may be used to glue the test dollies to the primer in order to measure the
NOTE 4 For the remaining coating systems, 50 % reduction of average adhesion value from the CPT is acceptable as minimum adhesion during production coating. Absolute minimum value is 5 MPa.
NOTE 5 For adhesion test during CPT, glue failure with values below 15 MPa is not accepted. X-cut test can be used as a supplementary test for adhesion, when relevant.
NOTE 6 Spot checks shall be defined and agreed on before start of each project and included in the inspection and test plan (ITP).
NOTE 7 Holiday detection shall only apply for the splash zone, subsea and internally lined vessels.

Table 9-1 - Inspection and testing

All tests shall be carried out in accordance with international standards at the defined frequency. All results shall meet the specified acceptance criteria and shall be included as part of the coating CONTRACTOR's test reports.

10 APPENDIX A EXTERNAL COATING SYSTEMS FOR TOPSIDE

All areas exposed to weather conditions.

The coating manufacturer, in conjunction with the applicator shall adhere to the tabulated coating systems in Table10-1.

Area Description	Coating System NORSOK M-501
All structural topside steel and transition piece	1
Underside of lower deck at El. 17.050m, CS structural for skid bases and framework for equipment	1
Solid plate decks for walkways, escape routes and lay down areas (1)	4
Service platform for hydrogen vessels FRP grating	N/A
All non-accessible and non-reachable solid plated decks	1
Carbon steel galvanised handrails and stairs	6B
LTCS pipework(4), valves, vessels, tanks, machinery, pumps, equipment and all types of enclosures, panels, etc up to operating temperature 120°C non-insulated	1
LTCS all insulated surfaces of tanks vessels and pipework(4), valves, > 120°C insulated	2A or 2B
316SS/316L SS pipework(4), valves, vessels, tanks, machinery, pumps, equipment less than 150°C insulated	6C
316SS/316L SS pipework(4), valves, vessels, tanks, machinery, pumps, equipment and all types of enclosures, panels, etc non-insulated	6A
25% Cr sdplx pipework(4), valves, machinery, equipment not painted for both insulated and non-insulated	N/A
Atmospheric Vent (within a package CS + 3mm)	1
All enclosures (external) carbon steel panels and cabinets	1(2)
HVAC ducting 316SS(3)	N/A

Table 10-1 - Coating Systems

Notes

1. Carbon Steel galvanised grating without coating to be used for walkways.

2. Manufacturers' standard qualified in accordance with Ref. (4) NORSOK M-501
3. All HVAC internal and externally 316SS ducting with or without insulation to be bare.
4. Piping including circumferential welds shall be coated after leak testing.

11 APPENDIX B EXTERNAL COATING SYSTEMS FOR THE SPLASH ZONE TOPSIDE

This appendix defines the external and internal coating systems to be applied on QTY 2 seawater caissons carbon steel and QTY 1 Brine Caisson carbon steel based on the definition of the splash zone elevations in sect. 4.2.

System 7A shall be applied externally throughout each caisson length. Internal coating of each caisson can be either 7A, 7B or 3B throughout.

Area Description	Coating System NORSOK M-501
Carbon and stainless steel in the splash zone	7A (externally)
Submerged carbon steel and stainless steel <= 50°C	7A (externally)

Note 1 Stainless steel shall be blasted with non-metallic and chloride free abrasive

Note 2 The coating system shall always be used in combination with cathodic protection

Note 6 For system 7A the coating system shall also fulfil the pre-qualification requirements for coating system no.1.

12 APPENDIX C TOPCOAT COLOURS

The topcoat colour for structural steel, piping and equipment shall be as stated in Table 11-1.

Applicable to	Colour	RAL Number
Davit electrical crane, hoists, lifting lugs and runway beams	Grey	RAL 7038
All structural steel.	Grey	RAL 7035
Tanks, vessels, piping, valves, machinery, equipment, skids/plinths.	White	RAL 9002
All external and internal and galvanised handrails and stairs	Yellow	RAL 1016
Solid deck (floor) surfaces (except escape routes), electric motors, pumps, generators, and drives.	Grey	RAL 7035
Escape routes (where marked with paint or clips)	Green Yellow	RAL 6002 RAL 1023(4)
Temporary structural steel Removal by hook-up CONTRACTOR Removal by installation CONTRACTOR	 Blue Green	 RAL 5015 RAL 6002
Overhead obstructions	Yellow with Black stripes	RAL 1016 and RAL 9017
Internal: Instrument Control Room AC-UPS, Equipment Room, LV Switchroom, HV-MV Switchroom	White	RAL 9002
External: Instrument Control Room, AC-UPS Equipment Room, LV Switchroom, HV-MV Switchroom	Grey	RAL 7035
Transition Piece	Yellow	RAL 1023
Internal floor finish rubber	Suppliers Standard	

External and Internal Doors	Grey	RAL 7035
All enclosures external and internal (if painted for CS) panels and cabinets	Grey	RAL 7035

Table 12-1- Top coat colours

Notes

1. Lifting equipment shall be painted yellow and marked with black writing,
2. All cable trays and their supports, etc in 316SS will not painted and coated,
3. All Instrument Control Rooms shall be with anti-skid screed.

13 APPENDIX D AREAS INSIDE MECHANICALLY VENTILATED MODULES AND HVAC CONTROLLED

Area Description	Coating System NORSOKM-501
CS surfaces in dry and ventilated areas including emergency accommodation	8
Internal walls and ceilings lined with panels, insulation or protective sheeting	8

Table 13-1 - Internal coating systems within Instrument Control Rooms

14 APPENDIX E COLOUR CODING OF PIPES

The procedure for colour coding of pipes per service type shall be in accordance with Ref. (5) NORSOK Z-DP-002.

Pipe markers shall be applied and the letter sizes per pipe DN are as follows -

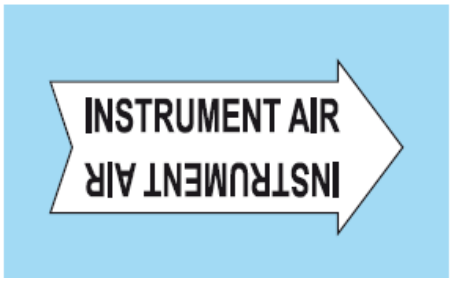
i. Size of letters for 3 inch (7.5cm) and smaller piping shall be ¾ in. (2cm) high.

ii. For piping 4" and larger the letters shall be 1½ in. (4cm) high.

The pipes shall be dry and free from dust, dirt oil and grease and ideally wiped with Isopropyl alcohol or equivalent.

Due to DN size both pipe labels and pipe markers will be used and are as follows –

A) Pipe Labels DN 1" to DN 4" self-adhesive UV laminated suitable for exterior and interior use

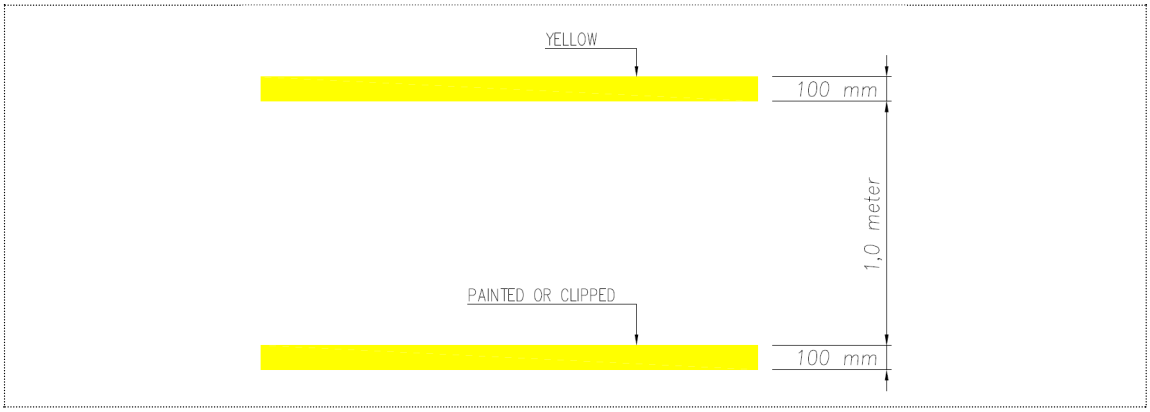


B) Pipe Markers DN 6" and above semi-rigid UPVC marker secured to the pipe with cable ties UV laminated for exterior and interior use. Pipe labels self-adhesive type can be used as an alternative.



15 APPENDIX F ESCAPE ROUTES AND SAFETY ROUTES

Escape route dimensions on grating.



Yellow marking can either be directly painted on to the grating or laid by clips.

Escape route dimensions on solid plate decks (A) main and (B) secondary escape route complete with painted yellow markings.

