

TECHNICAL REQUIREMENT FOR SERVICE PROVISION

Provision of service for anti-corrosion wrapping application for protection of Jetty Piles located in the Splash Zone and Atmospheric Zone service

☒ Create

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1. General information/ Description:
Jetty Piles – Including total Approximately 860 piles in seawater, the piles are attached with anodes. .
As per Inspection in 2023, the following are findings as resulted from inspection activities: Many piles have a lot of rust, especially in the berth area 1A, 1B. the pile below the Bread Dolphin, below the Quick Release hook and the Fender is heavily rusted.
Current Status:
- Atmospheric Zone: lots of corrosion around the piles. Refer to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% area.
- Splash Zone: lots of corrosion on the piles. Refer to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% Marine growth – barnacle to hold on around the piles, a little paint damage under Marine growth.
- Submerged Zone: Not found abnormal, Cathodic Protection system is normal working

Code	Short Description	Vendor	UOM	Quantity	Related equipment
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1- The Jetty Piles general information:								
Item	Q'ty of piles	Dia. (mm)	Nominal Thickness (mm)	Length (mm)/ 1 pile		Area (m2)/ 1 pile		Corrosion Assessment (ISO 4628-3)
				Atmosphere zone	Splash zone	Atmosphere zone	Splash zone	
Piling Plan Berth 1A	122	1500	19	3100	2500	14.61	11.78	Ri5 (50% rust)
Piling Plan Berth 1B	136	1500	19	3100	2500	14.61	11.78	Ri5 (50% rust)
Trestle Piling	277	914.4	18	6900	2500	19.82	7.18	>Ri4 (30% rust)
Berth 2A/2B/3 Loading Platform	59	914.4	18	8600	2500	24.70	7.18	Ri5 (40% rust)
Berth 2A/2B/3 Breasting Dolphin Piling	72	812.8	18	2700	2500	6.89	6.38	Ri5 (40% rust)
Berth 2A/2B/3 Mooring Dolphin Piling	32	812.8	18	3700	2500	9.45	6.38	Ri5 (45% rust)
Berth 4A/4B Loading Platform Piling	30	914.4	18	8600	2500	24.70	7.18	Ri5 (45% rust)
Berth 4A/4B Breasting Dolphin Piling	56	914.4	18	3300	2500	9.48	7.18	Ri5 (45% rust)
Berth 4A/4B Mooring Dolphin Piling	66	914.4	18	4700	2500	13.50	7.18	Ri5 (45% rust)
Breakwater Dolphin Piling Plan and Elevation and Piling	6	812.8	18	5200	2500	13.28	6.38	Ri5 (45% rust)
Front Leading Light	4	914.4	18	2500	2500	7.18	7.18	Ri5 (45% rust)
Total	860							

2- Tentative execution plan:											
2025 (Pile)		2026 (Pile)							2027 (Pile)		
100	100	58	59	72	30	56	66	6	4	277	32
Piling Plan Berth 1A	Piling Plan Berth 1B	Piling Plan Berth 1B	Berth 2A/2B/3 Loading Platform	Berth 2A/2B/3 Breasting Dolphin Piling	Berth 4A/4B Loading Platform Piling	Berth 4A/4B Breasting Dolphin Piling	Berth 4A/4B Mooring Dolphin Piling	Breakwater Dolphin Piling Plan and Elevation and Piling	Front Leading Light	Trestle Piling	Berth 2A/2B/3 Mooring Dolphin Piling

2. Scope of work:
2.1 Provide completion service:
Contractor shall carry out anti-corrosion wrapping application for protection of piles located in the Splash Zone and Atmospheric Zone:
a, In accordance with the following technical documents:
•MOC-200-2025-1246 – Anti-Corrosion Protection Wrapping System for Jetty Piles
•NSRP-AI-TN-2024-006 Rev.01 – Protection Pile Design Requirement
Note:
+ The purpose of the Technical Note - Jetty Pile Protection is to provide a general design basis requirement in compliance with above code, standards for execution phase.
+ In execution phase, the detailed design shall be developed based on Manufacturer Specification and in compliance with technical note provided.
b, With basic scope as below:
+ Step 1: Remove all existing marine growth on the surface of the piles.
+ Step 2: Surface cleaning: follow ISO 8501-1 (Sa 2.5), SSPC-SP11 or recommendation of Product Manufacturer
+ Step 3: Primer layer: Protection and adhesion layer. Primer may consist of a soft petrolatum or alternative material as recommended by the manufacturer.
+ Step 4: Second layer: Wrapping tape layer, shall consist of a synthetic fiber fabric saturated with a soft petrolatum compound.
+ Step 5: Top layer: Installation Jacket outer cover. Outer mechanical protection shall be abrasion-resistant, UV-resistant and suitable for immersion in sea water.
Noted:
*All methods of Wrap Corrosion Protection Systems shall follow instruction and data sheet of Manufacturer and standard that Manufacturer follow.
*Thickness of each layer follow data sheet of Manufacturer to ensure lifetime above 20 years and request warranty above 10 years.
c, Contractor’s responsibilities.
+ The Contractor shall provide all required expertise, manpower, equipment, materials, consumables, and associated services to successfully perform and complete the Work Order, ensuring full compliance with NSRP’s technical specifications, quality requirements, safety regulations, and execution timeline.
+ Provide manpower, tools and equipment including special tools/equipment/services and materials/consumables to perform the service as per the Work Order issued by NSRP.
+ Provide materials including specification with detailed material properties, product datasheets, MSDS, and warranty documents for NSRP’s review and approval.

- + Conduct site-survey to collect input data for engineering analysis/ calculation/ develop working procedure and materials take-off as per requirements of Work Order from NSRP.
- + Develop a Work-pack including Job Execution Plan, Detailed Schedule, Risk Assessment (RA), Work method statement (SWMS), Job Safety Analysis (JSA), Quality control plan & ITP, list of Manpower, list of Tools/ Equipment, list of Materials/ Consumables, ...etc. for NSRP review & approval prior execution.
- + The Contractor shall ensure the availability of a Quality Control and Assurance system, including:
 - * QA/QC procedures aligned with NSRP requirements and relevant international standards,
 - * Inspection checklists and documentation for each step of surface preparation, primer, wrapping, jacket installation,
 - * Material traceability and proper record keeping.
- + The Contractor shall ensure all works are performed by trained and certified personnel, and shall:
 - * Provide adequate PPE and marine safety equipment (life jackets, lifelines, fall protection),
 - * Ensure marine access platforms or scaffolding are properly engineered and safely erected,
 - * Coordinate with NSRP for daily permit issuance and safety inspection.
- + The Contractor shall submit a Completion Dossier including:
 - * Inspection and test records,
 - * Material certificates (CO, CQ),
 - * Progress reports and photos,
 - * Warranty documentation,
 - * Final acceptance form for NSRP's approval.

2.2 Contractor experience requirements.

- + Contractor must have minimum of five (05) similar service contracts in the Chemical, Oil & Gas industry, power plants, or seaports and jetty in recent ten (10) years.

Detailed Scope of Work (SOW) of similar service contracts involving anti-corrosion wrapping application for jetty piles must be provided as evidence.

- + Contractor must have validated Quality Management Certification Iso 9001 and Environmental management systems ISO 14001

2.3 Organization chart and The Manpower required with certificated:

a, Organization chart.

- + Contractor has to propose Organization chart to execute the NSRP project. Contractor shall not replace the personnel proposed in organization chart without company's written letter to NSRP. In that case, the contractor is required to submit CVs of equivalent competent personnel for NSRP evaluation and approval.

b, Minimum Manpower required.

- + **Site manager:** Must have at least 20 years of experience in the industry, with a minimum of 07 years of specific experience in similar services at same position and must have successfully completed at least three (03) projects in similar service. Must have a university degree in a chemical engineering or related field and be training certification of wrapping material manufacturer.

- + **QA/QC engineer:** Must have at least 15 years of experience in the industry, with a minimum of 05 years of specific experience in similar services at same position and must have successfully completed at least two (02) projects in similar service. Must have a university degree in chemical engineering or related field and be certified by the material manufacturer.

Must have NACE CIP 3 or Corrosion Specialist Certification

- + **Planner:** Must have at least 5 years of experiences with 2 equivalent projects and Qualified based on University Degree for related field.

- + **Inspector:** Must have at least 15 years of experience in the industry, with a minimum of 07 years of specific experience in similar services at same position and must have successfully completed at least two (02) projects in a similar service. Must have a university degree in a chemical engineering or related field and be certified by the material manufacturer.

Must have NACE CIP 2.

- + **Supervisor:** Must have at least 15 years of experience in the industry, with a minimum of 05 years of specific experience in similar services at same position and must have successfully completed at least two (02) projects in a similar service. Must have a university degree in a chemical engineering or related field and be certified by the material manufacturer.

- + **Applicator/ Diver:** Must have at least 05 years of experiences and completed at least 01 project in similar service and qualified by material manufacturer. The Diver shall hold the following certificates: Diving certificate issued by government

- + **Safety supervisor:** Must have at least 10 years of experiences with a minimum of 5 years of specific experience in similar services at same position and must have successfully completed at least one (01) project in a similar service

Note: All manpower directly involved in the execution of the following activities such as marine growth removal (barnacle cleaning), rust removal, surface preparation, wrapping for jetty piles, must have prior experience working in overwater and underwater environments

3. Requirement of technical standard and procedure:

High performace for anti-corrosion wrapping application for protection of Jetty Piles located in the Splash Zone and Atmospheric Zone service in accordance with :

- MOC-200-2025-1246 – Anti-Corrosion Protection Wrapping System for Jetty Piles
- NSRP-AI-TN-2024-006 Rev.01 – Protection Pile Design Requirement

4. Safety requirement:

- Complying with occupational safety and health in accordance with current legal regulations
- Contractor has responsible to prepare and provide full PPEs/ SPPE but not limited to complete the service as required.
- Complying the safety requirements and regulations when perform tasks at NSRP according to Contractor safety management document.
- Comply with all internal NSRP safety procedure such as MD-04-HSE-HS-PD-003 (Permit to Work Procedure), MD-04-HSE-HS-PD-004 (JSA and Safe Work Method Statement procedure), MD-04-HSE-HS-PD-059 (Working at height procedure), MD-04-HSE-HS-PD-043 (Electrical safety procedure), MD-04-HSE-HS-PD-012 (Safe isolation and Lock out Tag out procedure), MD-04-HSE-HS-PD-027 (Safety golden rule), MD-04-HSE-HS-PL-008 (Onshore traffic safety management plan), MD-04-HSE-HS-PD-002 (Hand tool and portable Equipment safety procedure), MD-04-HSE-HS-PD-009 (Procedure for Routine Waste collection and Transpotion inside NSRP refinery), MD-04-HSE-ES-PL-007 (Waste Management plan), MD-04-HSE-HS-PD-059 (Manual handling Procedure).

5. Responsibility of NSRP and Contractor

Item	Item Description	Responsibilities by		Remarks and Clarification of Description
		Company	Contractor	
A	Temporary Buildings, Offices and Other Facilities			
1	Provision of the area for Contractor's Site Offices/ shelter		x	Contractor office to be located in E100 Area.

2	Supply and installation of the Contractor's Site Main Office, including telephone/LAN system, ACMV system, lighting system, furniture, communication facilities, etc.		x	All to be provided by Contractor, including waste collection, waste disposal, security and fencing.
B	Contractor's Equipment and Material			
1	Provision to supply all equipment and consumables to complete the Works.		x	All by Contractor.
C	Health, Safety, Security and Environment (HSSE) and Medical Facilities			
1	Provision of all safety signs, typically confined space restrictions, falling object, keep clear, PPE notification, barrier tapes etc.		x	
2	Contractor Health Checking, Communication device, Gas Detector, Safety Equipment		x	
3	Lightning / Typhoon Alerts, Electronic ID card, LOTO Device	x		
4	First aid within the Refinery and Ambulance / transportation to hospital	x		
D	Materials Handling and Transportation			
1	Transportation of the materials from NSRP Warehouse to the Work Site.		x	
2	Disposal of all waste – Industrial / Office / Domestic / Hazardous waste:		x	
3	Provision of contractor personnel transportation within Refinery		x	

6. Working time at refinery:

- Working time according to the term of contract.

7. Training for NSRP manpower:

NA

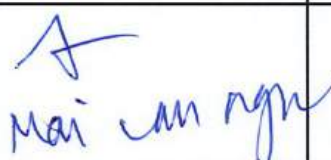
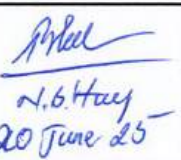
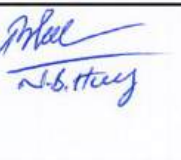
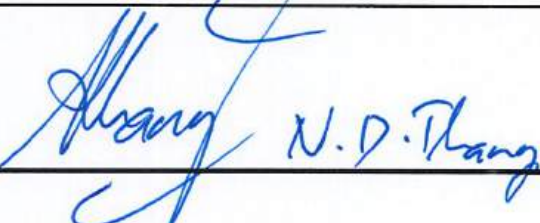
8. Handover requirement:

WO execution and WO close will carried out with:

- QC records with NSRP relevant party signature and warranty certificate of the service.
- Timesheet records with NSRP supervisor signature (if WO timesheet issued).
- WO close with NSRP PIC signature.
- Warranty confirmation letter.

9. Warranty:

- Minimum 10 Years from the handover or work order closing date.

Propose by (Engineer)	Review by Reliability Engineer	Review by Discipline Leader	Review by Section Manager	Approve by Division Manager
		 N.B. Huy 20 June 25	 N.B. Huy	 N.D. Thang
Receiver: - To upload PR in CMMS - Filling: Department/Division (DC team)				



SUMMARY PAGE

MOC TITLE: Provide Anti-Corrosion Protection Wrapping System for Jetty Piles		MOC NUMBER: MOC-200-2025-1246	
☐ SECTION 1: MOC INITIATION			
Approval:			
☒ Line Section Manager		☒ Facility Owner SM	
☒ Division Manger			
☐ SECTION 2: CHANGE REVIEW & SCREENING			
Risk assessment:		HAZID Conduct: ☒	
Base risk (before change): 4B			
Risk after change: 4A			
Justification: ☒ Health/ Safety/ Environment		☐ Legal/Compliance	
☐ Margin Improvement		☒ Asset & Reliability	
Cost estimation:		Benefit/Payback: Long-term integrity protection and save cost maintenance interval: 20 years	
Approval:			
☐ Technical Authority		☒ MOC Committee	
☐ SECTION 3: DESIGN REVIEW			
PHA Requirement:		☐ HAZOP	
		☐ SIL	
		☐ QRA	
		☐ HAZID	
☐ Review Completed		Procedure Updated ☐ Y ☐ N ☐ N/A	
N/A		☐ Training Conducted: ☐ Y ☐ N ☐ N/A	
Approval:			
☐ Technical Authority		☐ MOC Committee	
☐ SECTION 4: WORK AUTHORIZATION			
☐ Action Close-out		Approval: ☐ Approving Authority	
☐ SECTION 5: CONSTRUCTION & VERIFICATION			
☐ All change work has been completed as original approved design			
☐ Deviation (attached with Variation Form)			
☐ PSSR Completed		☐ Waiver of PSSR	
PSSR		☐ Not required	
☐ SECTION 6: SYSTEM HAND-OVER			
System Hanover Date:/...../.....		Approved by: ☐ Execution Party	
		☐ Facility Owner	
☐ System ready for start-up		Approval for Start-up: ☐ Facility Owner	
☐ SECTION 7: POST-CHANGE REVIEW- DOCUMENT UPDATE-CLOSE OUT			
☐ Post-Change Review		☐ Action Close-out	
		☐ Document Update	
Approval:			
☐ Approving Authority		☐ Facility Owner	

MOC Number

Title: Provide Anti-Corrosion Protection Wrapping System for Jetty Piles

Division: AI	Unit: Common	Initiator: Le Ngan	Date initiated: 14-May-25
Justification	☒ Safety ☐ Legal Compliance ☐ Margin Improvement ☒ Asset & Reliability		
Type of change	☒ Permanent ☐ Process Technology ☐ Process Equipment ☐ Temporary: ☐ Process Control ☐ Non-plant From: To: ☐ Urgent: ☒ Other		

NSRP has 860 Jetty piles with carbon steel material as the fig. below.

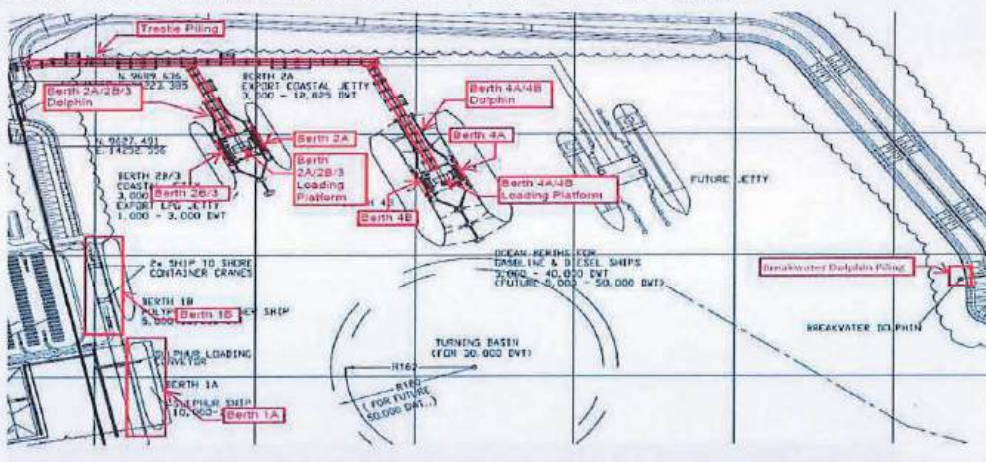


Fig. 1: Jetty Pile Plot Plan

Item	Q'ty of piles	Dia. (mm)	Nominal Thickness (mm)	Length (mm)/ 1 pile	
				Atmosphere zone	Splash zone
Piling Plan Berth 1A	122	1500	19	3100	2500
Piling Plan Berth 1B	136	1500	19	3100	2500
Trestle Piling	277	914.4	18	6900	2500
Berth 2A/2B/3 Loading Platform	59	914.4	18	8600	2500
Berth 2A/2B/3 Breasting Dolphin Piling	72	812.8	18	2700	2500
Berth 2A/2B/3 Mooring Dolphin Piling	32	812.8	18	3700	2500
Berth 4A/4B Loading Platform Piling	30	914.4	18	8600	2500
Berth 4A/4B Breasting Dolphin Piling	56	914.4	18	3300	2500
Berth 4A/4B Mooring Dolphin Piling	66	914.4	18	4700	2500
Breakwater Dolphin Piling Plan and Elevation and Piling	6	812.8	18	5200	2500
Front Leading Light	4	914.4	18	2500	2500
Total	860				

Table 1: Jetty Piles

The existing corrosion system includes

- Coating system B: 2 layers modified epoxy coal tar, DFT required thickness 450 μm
- Cathodic protection: Sacrificial Anode (Aluminum Alloy), lifetime 10 years.

Problem Statement:

The Jetty piles area was installed 09 years (2015-2024) occurring heavy external corrosion and pitting corrosion, existing coating damaged.

- Atmospheric Zone: lots of corrosion around the piles. Referring to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% area.

Splash Zone: lots of corrosion on the piles. Refer to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% Marine growth – barnacle to hold on around the piles, a little paint damage under Marine growth.

- Submerged Zone: Not found abnormal, Cathodic Protection system is normal working.

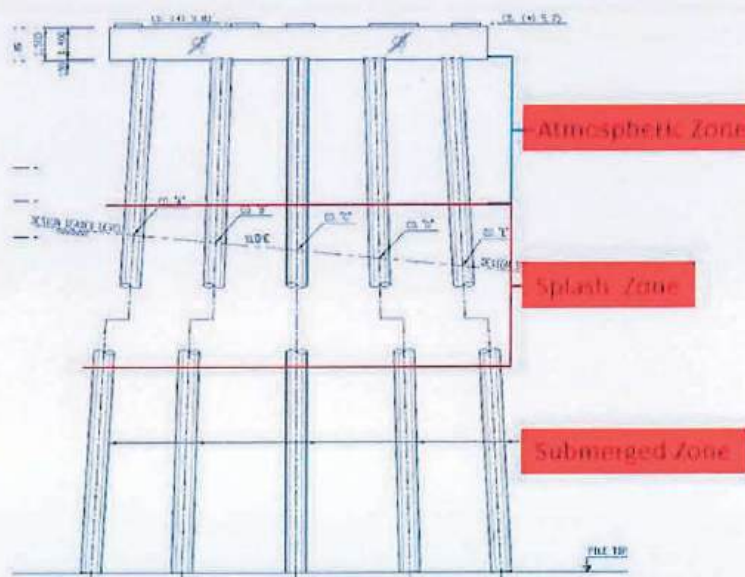


Fig. 2: Jetty Piles Zone Arrangement



Fig. 3: : Jetty Piles Current Situation



Root Cause Analysis / Proposed Solution:

Root Cause Analysis:

Root Cause Analysis:							
No	Root Cause	Possibility	Assessment				
1	Construction Phase and design assessment	High	- As design information (Refer Doc No. 9T7151/R054) the paint system shall have an initial life of 10 years. Design maintenance of coating system after an initial 10 years. After 4 years of the Construction Phase 2015, coating damage and corrosion occurred. <table><tr><th>Structural Element</th><th>Assumed Corrosion Philosophy</th></tr><tr><td>Piles</td><td>Painted from the head of the pile to 2m below future sea level. Paint system shall have an initial life of 10 years. For purposes of design it has been assumed only limited maintenance of paint system after initial 10 years. Cathodic protection system installed. Sacrificial steel allowance taken into account in design (see below).</td></tr></table>	Structural Element	Assumed Corrosion Philosophy	Piles	Painted from the head of the pile to 2m below future sea level. Paint system shall have an initial life of 10 years. For purposes of design it has been assumed only limited maintenance of paint system after initial 10 years. Cathodic protection system installed. Sacrificial steel allowance taken into account in design (see below).
Structural Element	Assumed Corrosion Philosophy						
Piles	Painted from the head of the pile to 2m below future sea level. Paint system shall have an initial life of 10 years. For purposes of design it has been assumed only limited maintenance of paint system after initial 10 years. Cathodic protection system installed. Sacrificial steel allowance taken into account in design (see below).						
2	Nature Marine corrosion, Environment impact	High	- The jetty is exposed to a marine environment, with a salinity and moisturizing atmosphere, the main degradation mechanism is atmospheric corrosion, Jetty piles corrosion in the splash zone, aside from seawater that causes normal marine corrosion such as water temperature variations, tidal action, wave impacts, man-made pollutants, sufficient oxygen (O₂), ultraviolet rays, Chemical composition of the stratum into which the steel is embedded and salt spray that continually washes upon objects, will cause severe corrosion damage. - The electrochemical reactions between the metal surface and the surrounding water. Saltwater acts as an electrolyte, enabling the flow of electrons and ions that leads to the corrosion process. The presence of dissolved oxygen in seawater further accelerates this process. Reference document: ISO 4628, Port Designer's Handbook ISBN 978-0-7277-6004-3, chapter 16- 3rd edition. Figure 16.1 Corrosion of a steel sheet pile				
4	Marine growth – barnacle to hold on around the piles	Low	Barnacles destroy the pipeline's protective paint layer, causing the pipe's metal surface material to come into direct contact with seawater and corrosion occurs.				

Proposed Solution:

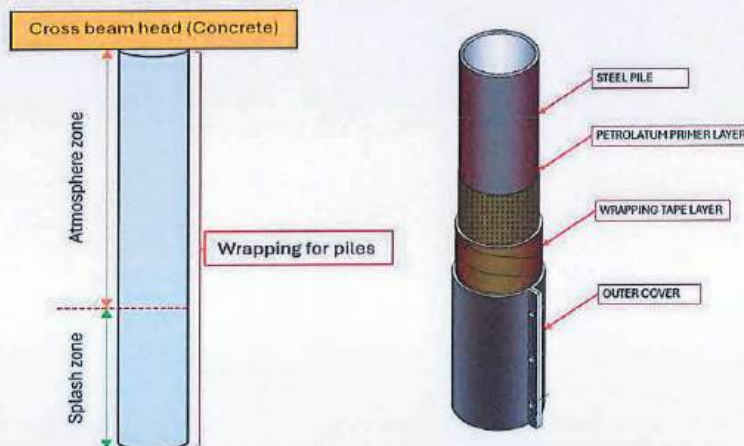
Apply the Wrap Corrosion Protection Systems for Atmospheric zone and Splash zone of piles to increase anti-corrosion function and increase lifetime for pile (lifetime above 20 years).

Technical basis:

Based on the Code, standard and NSRP requirement include TCVN 11197:2015: Steel Piles- Corrosion Protection Method- Requirement and Selection Principle, AMPP SP21484-2023: Splash Zone Site-Applied Wrap Corrosion Protection Systems, AWWA Standard C 217-04: Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipeline, the following solution is proposed:

- Application Wrap Corrosion Protection Systems by anti-corrosion product and installing jacket outer cover wrap for atmospheric and splash zone.

- Surface cleaning: follow ISO 8501-1 (Sa 2.5), SSPC-SP11 or recommendation of Product Manufacturer
- Primer coat: Protection and adhesion layer. Primer may consist of a soft petrolatum or alternative material as recommended by the manufacturer.
- Second layer: Wrapping tape layer, shall consist of a synthetic fiber fabric saturated with a soft petrolatum compound.
- Top layer: Installation Jacket outer cover. Outer mechanical protection shall be abrasion-resistant, UV-resistant and suitable for immersion in sea water.



All methods of Wrap Corrosion Protection Systems shall follow instruction and data sheet of Manufacturer and standard that Manufacturer follow.

Thickness of each layer follow data sheet of Manufacturer to ensure lifetime above 20 years and request warranty above 10 years.

Cost & Benefit

- Benefit

Pile protection	Wrapping method
Effective Corrosion Protection	- Provide effective corrosion
Mechanical Protection	- Wrapping materials offer mechanical protection, shielding the pile surface from physical damage caused by impacts, abrasion or marine growth.
Durability	- Long-term protection: more than 20 years
Marine growth prevention	- Effective prevention.
Maintenance interval	- More than 20 years

**Others (if any):**

[Describe the risk assessment (before and after the change) if it could be conducted at this step other content/notice if necessary]

List of attachments.

- Compare Coating & Wrapping Solution for Jetty Piles study/report
- Technical Note: AI-TN-2024-006 Rev.01

	Prepared by MOC Initiator	Reviewed by		Approved by Division Manager
		Section Manager	Facility Owner (Section Manager)	
INITIAL CHANGE APPROVAL	 Le Ngan Name & Signature & Date	 Name & Signature & Date	 16 May 25 Name & Signature & Date	 19/5/25. Name & Signature & Date



Technical Note No.	NSRP-AI-TN-2024-006	Issued date: 13-May-25	Rev.No: 01
Analysis Type	Repair ☒ FFS ☐ Procedure ☐ Investigation ☐ Design ☐ Report ☐ Method Statement ☐ Material Selection ☐	Structural Analysis ☐ Inspection Guideline ☐ Other: Technical ☒ Requirement	Unit: 200
Subject	Protection Pile Design Requirement		
Reference Documents	FEED: 9T7151/SP057 MD-04-AI-CE-PD-009 D-000-1225-1003V: Marine Facility Plot Plan 2023 jetty inspection report AWWA Standard C217-04: Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipeline AMPP SP21484-2023: Splash Zone Site-Applied Wrap Corrosion Protection Systems. TVCN 11197:2015: Steel Piles – Corrosion Protection Method – Requirement and Selection Principle.		
Reference Document Title	Reports and drawings		
Destination Div./Sec. PIC	Operations Div & Maintenance Div.		

TECHNICAL NOTE

1. BACKGROUND

- Jetty Piles – Including total 860 piles in seawater, the piles are attached with anodes.
- Figure 1 shows locations of Jetty Pile.

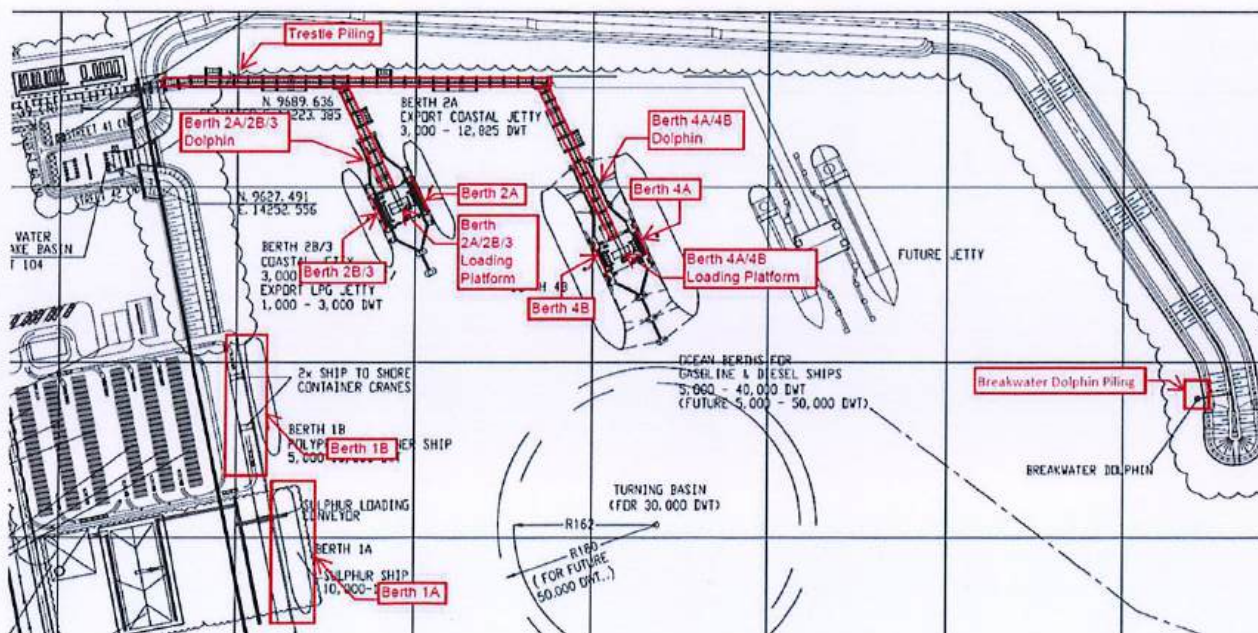


Figure 1. NSRP Jetty Plot Plan

2. PROBLEM STATEMENT

As per Inspection in 2023, the following are findings as resulted from inspection activities:

- Many piles have a lot of rust, especially in the berth area 1A, 1B. the pile below the Bread Dolphin, below the Quick Release hook and the Fender is heavily rusted.

Coating Thickness

- Coating thickness is measured for 50 piles, the average coating thickness is about 550 μm , all within accepted zone.

Wall Thickness (design Thk. 18 mm)

- Wall thickness at berth area 1A,1B ranges from 17.6 to 18.1
- Wall thickness at berth 2 and berth 4 ranges from 17.5 to 18.0

Protection Potential

- The protection potential is measured at 9 points. ranges from 1000 to 1070mV. All are within the
- Acceptable range.

Current Status:

- Atmospheric Zone: lots of corrosion around the piles. Refer to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% area.
- Splash Zone: lots of corrosion on the piles. Refer to ISO 4628-3, Degree of corrosion are Ri4, Ri5 with damage from 30-50% Marine growth – barnacle to hold on around the piles, a little paint damage under Marine growth.
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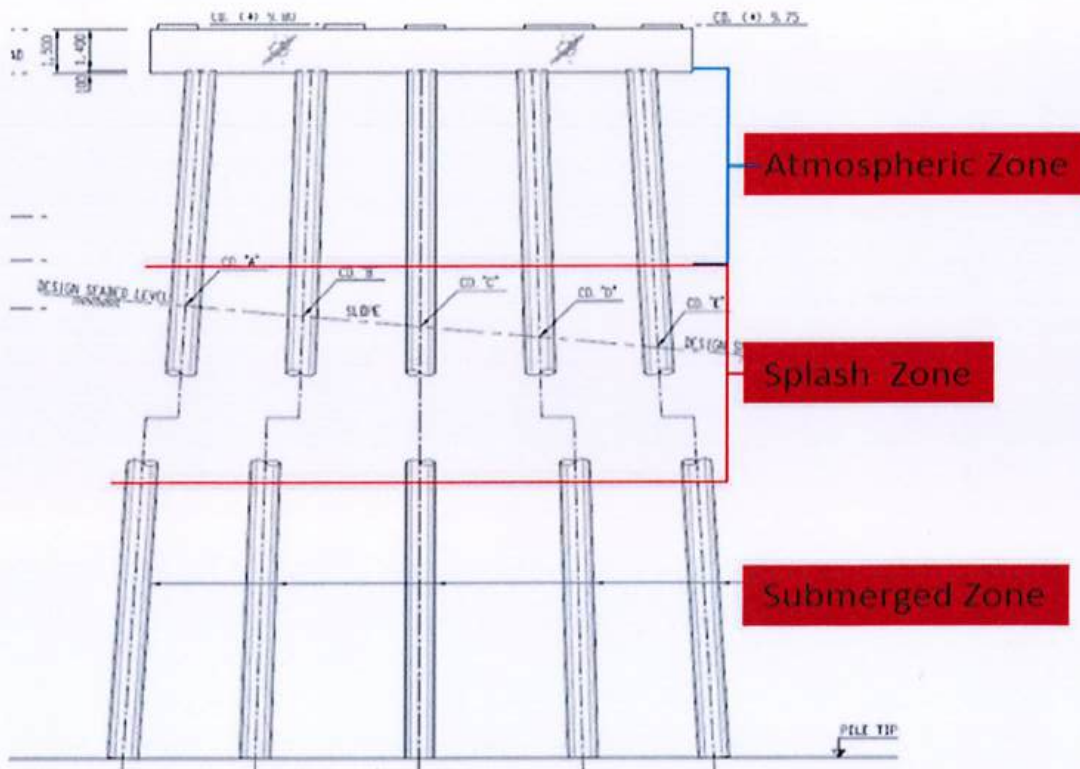


Figure 2. Atmospheric Zone, Splash Zone and Submerged Zone



Figure 3. Atmospheric Zone, Splash Zone Pile Corrosion and Marine Growth.

3. ANTI CORROSION AND PROTECTION PILE DESIGN REQUIREMENT

3.1 DESIGN REQUIREMENT

3.1.1 CODE AND STANDARD

- ISO 8501-1: Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
- NACE Recommend Practices.
- AWWA Standard C217-04: Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipeline.
- AMPP SP21484-2023: Splash Zone Site-Applied Wrap Corrosion Protection Systems.
- AMPP SP21484-2023: Splash Zone Site-Applied Wrap Corrosion Protection Systems.
- ASTM D70: Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method).
- ASTM D92: Standard Test Method for Flash and Fire Points.
- ASTM D127: Standard Test Method for Asphalt Viscosity by Torsion Viscometer.
- ASTM D1424: Standard Test Method for Strength Properties of Paper and Paperboard by the Tearing Method.
- ASTM D149: Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Insulating Materials at Commercial Power Frequencies.
- ASTM D937: Standard Test Methods for Cone Penetration of Petrolatum.
- ASTM D1000: Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
- ASTM D1603: Standard Test Method for Carbon Black in Olefin Plastics.
- ASTM D5199: Standard Test Method for Measuring the Nominal Thickness of Plastic Film and Sheeting.
- ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials.

- ASTM D4833: Standard Test Method for Puncture Resistance of Geomembranes and Related Products.

3.1.2 TECHNICAL REQUIREMENT

Apply wrapping and coating system for long-term to protection and anti corrosion piles at Splash Zone, Asmospheric Zone.

The wrapping system must provide effective corrosion resistance by acting as a barrier between the jetty steel pile and the aggressive marine environment (i.e., saltwater, humidity, oxygen, and other corrosive agents).

The wrapping system must adhere tightly to the steel pipe surface to ensure there are no gaps where water or moisture can seep through. The adhesion should remain strong even under environmental conditions like high humidity, temperature fluctuations, and wave action.

The wrapping system should be resistant to UV radiation to prevent degradation over time. UV exposure can cause the material to brittle, crack, or lose its protective properties.

The wrapping system must offer abrasion and impact resistance to protect the pipe from physical damage.

The integrity of the wrapping material should remain intact for this long duration, without significant degradation due to environmental factors.

- Warranty requirement: ≥ 10 years.
- Lifetime requirement: ≥ 20 years.

3.1.3 PILE PROTECTION SYSTEM

The Wrapping system requirements follows Figure 2:

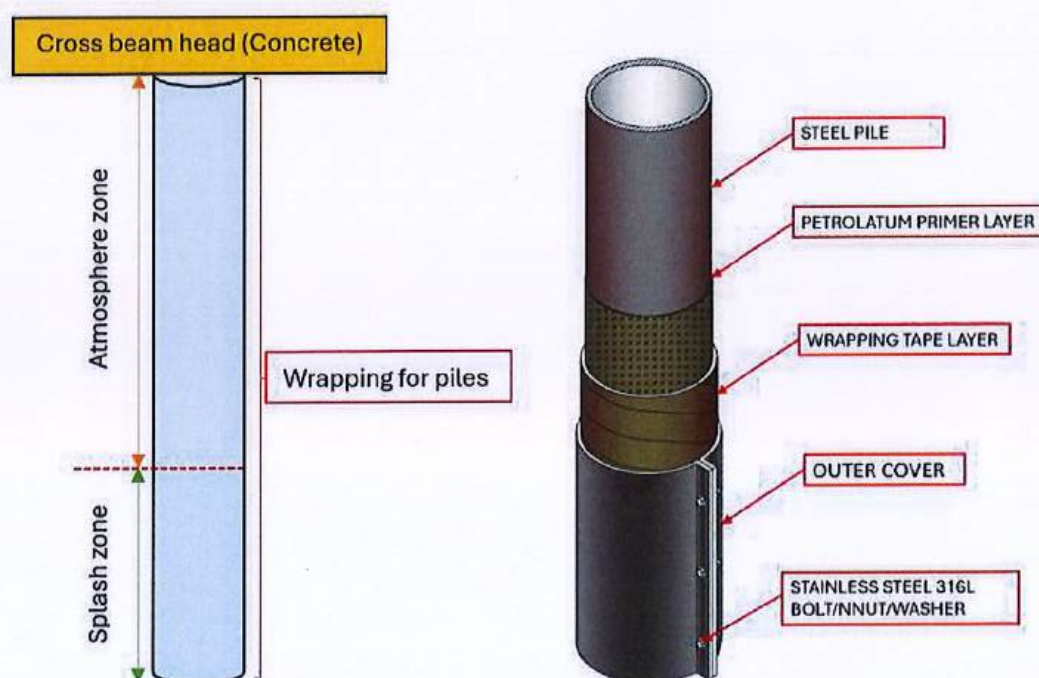


Figure 2. Wrapping Zone and Wrapping layers method.

- Surface Preparation

Surface preparation in accordance with ISO 8501-1, minimum archive cleanliness St 2. This can be achieved by mechanical wire brush, HP water (~ 15000 psi) ensuring all loose corrosion scale, loose coating systems and other deleterious materials are removed. Surface preparation shall follow instruction and data sheet of Manufacturer and standard that Manufacturer following:

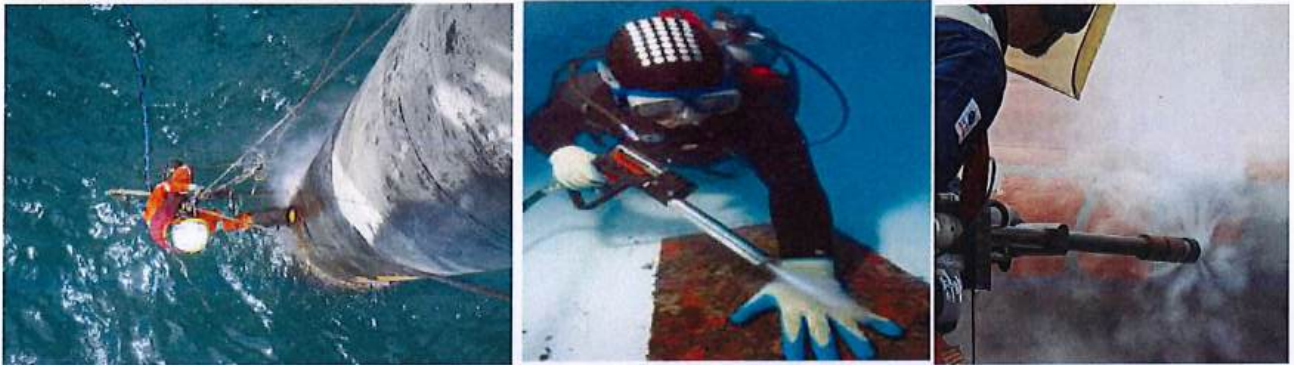


Figure 3. Surface Preparation method.

- Petrolatum Primer Layer

Petrolatum Primer to entire surface in a circular motion ensuring all pitting on substrate is filled with primer. Primer should be applied to the complete splash zone and atmospheric zone area and below water. (Figure 4). Petrolatum Primer Layer shall meet the requirements given Table 1.



Figure 4. Layers apply for protection Pile

- Wrapping Tape Layer

Apply Petrolatum wrapping tape maintaining overlap as per manufacture recommend. Apply Petrolatum wrapping tape commencing from top of pile with sufficient tension to ensure intimate contact with substrate. Blend all overlap seam by applying thumb pressure to create a homogenous coating (Figure 5). Petrolatum Tape Layer shall meet the requirements given Table 2.



Figure 5. Apply Petrolatum Wrapping Tape

- Jacket Outer Cover

For provides substantial physical resistance, Abrasion resistance, UV resistance and durability. Petrolatum Jacket Outer Cover shall meet the requirements given Table 3.



Figure 6. Jacket Outer Cover

The proposed wrapping system shall have circumferential inspection features. It shall be openable, reusable, and reinstalled instantly at the same location after inspection is completed without damaging the existing wrapping.

3.1.4 MATERIAL REQUIREMENT

• **Petrolatum Primer Layer**

Petrolatum Primer will follow the requirements below:

- Petrolatum Primer is a Petrolatum Compound incorporating inert fillers, water repellent agents, water displacement agent, wide spectrum biocides and corrosion inhibitors.
- Petrolatum Primer is inert, stable in nature, Petrolatum Primer maintains its plasticity over a wide temperature range.

Table 1: Petrolatum Primer technical Requirement

Item	Standard	Value
Flash Point	ASTM D92 or equal	65°C
Specific Gravity@25°C	ASTM D70 or equal	0.90-1.25
Drop Melting Point minimum	ASTM D127 or equal	56°C
Petrolatum wax Content minimum	AWWA-C217-09 or equal	70% by Weight
Coverage		1 to 2m ² /Kg or as per recommend from manufacture
Cone Penetration of Petrolatum@25°C 100g wt., 5sec.	ASTM D937 or equal	(7.4-22.4) mm
Application Temperature		0 to +50°C
Service Temperature		0 to +75°C
Service Life		More than 20 years
Shelf Life		More than 20 years

• **Petrolatum Wrapping Tape Layer**

Petrolatum wrapping tape will follow the requirements below:

- Petrolatum wrapping tape is non-woven polyester fabric fully impregnated and saturated with Petrolatum Compound consisting of blended inert fillers, corrosion inhibitors, wide spectrum biocide and thermal extenders.
- Petrolatum wrapping tape is inert and will not polymerize or oxidize. Its non-hardening properties allow the product to accommodate both substrate vibration and movement.

Table 2: Petrolatum Primer technical Requirement

Item	Standard	Value
Dielectric strength, minimum	ASTM D149 or equal	170 volts/mil
Thickness minimum	AWWA-C217-09 Sec.5.2.2.2 or equal	1,016 µm
Elongation at break, minimum	ASTM D1000 or equal	6%
Breaking Strength Width minimum	ASTM D1000 or equal	3,940 N/m
Water Vapor Transmission rate, maximum	ASTM E96 or equal	14.4/ng/Pa s m ²
Flash point minimum	ASTM D92 or equal	150°C
Petrolatum or petroleum wax components applied to fabric carriers, minimum	AWWA-C217-09 Sec.5.2.2.4 or equal	50%

Drop melting point of saturant, minimum	ASTM D127 or equal	60°C
Cone Penetration of saturant@25°C 100g wt., 5sec.	ASTM D937 or equal	(6.1 - 12.7) mm
Width deviation, maximum	AWWA-C217-09 Sec.5.2.2.1 or equal	±5% of width or 6.4mm, whichever is smaller
Application Temperatures		0 to +55°C
Service Temperature		0 to +75°C
Service Life		More than 20 years
Shelf Life		More than 20 years

• **Jacket Outer Cover.**

Jacket Outer Cover will follow the requirements below:

- Jacket Outer Cover is formulated from non-recycled UV Stable HDPE resin (or equal), providing mechanical protection to the Petrolatum coating materials applied to the substrate for corrosion protection.
- Jacket Outer Cover inherently possesses substantial mechanical properties, chemical and environmental stress crack resistance, thermal stability and long-life UV resistant characteristics.
- The 316 Stainless Steel Thermoplastic bolt-on fastening system enables its use in severe, open water environments (If applied).

Table 3: Jacket Cover technical Requirement

Item	Standard	Value
Thickness	ASTM D5199 or equal	2 mm or recommend from manufacture
Resistance to aging and weathering	ISO 4892-2-Method A	$1.25 \geq Ex / E0 \geq 0.75$
Ratio of tensile strength	ISO 527-2	$1.25 \geq Sx / S0 \geq 0.75$
Ratio of bursting strength	ISO 527-3	$1.25 \geq Bx / B0 \geq 0.75$
Resistance to aging and weathering Ratio of Shore hardness	ISO 16474-3/ISO 868 Or equal	$1.25 \geq Hy / H0 \geq 0.75$
Carbon Black Content	ASTM D1603 or equal	≥2%
Application Temperatures		0 to +55°C
Service Temperature		0 to +75°C
Service Life		More than 20 years
Shelf Life		More than 20 years

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