



THIRD PARTY INSPECTION REPORT ON CPC SINGLE POINT BOUY MOORING SYSYTEM OVERHAUL- 2023



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CEYLON PETROLEUM CORPORATION

12.05.2023

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 BUREAU VERITAS	INSPECTION REPORT ON SPBM 01, PERIODIC OVERHAUL –2023	Job No:
	Report No: CPC/COL/22182/IR/SPBM1	SRL.C.8.22.182

PROJECT: Third Party Inspection for Dry Docking of Crude Oil SPBM 01	CPC Agreement No: CPC/SUP/SER/04/2023
BV Client: Ceylon Petroleum Corporation, No.609, Dr. Danister De Silva Mawatha, Colombo 09, Sri Lanka.	P/O Nb. (client to BV) 4600034957 dated 22.02.2023
BV Proposal No: SRL.C.8.22.182	Service/Repair Provider: Colombo Dockyard PLC, P.O.Box 906, Colombo, Sri Lanka.

This is to certify, being a member of IACS (International Association of Classification Society) , Surveyors of Bureau Veritas Lanka (Pvt)Ltd attended Inspection of SPBM 01 Refurbishment work carried out at the Dry dock of Colombo Dockyard PLC between 27th January 2023 to 09th March 2023, in line with the scope of work as detailed in the attached annex A.

Field Inspection Report for each Inspection visit covering the scope of work detailed from DIR 001 to DIR 038 has been submitted timely to all concerned in Ceylon Petroleum Corporation and this final report is delivered without prejudice, for the ends and purposes for which it was designed.

Issued in Colombo , Sri Lanka on 08th June 2023.

For & on behalf of Bureau Veritas





Shan NANAYAKKARA

General Manager / Authorized Signatory

Encl. annex A

GCH

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1.0 INTRODUCTION

Ceylon Petroleum Corporation (CPC) purchased a Catenary Anchor Leg Mooring (CALM) design Single Point Buoy Mooring (SPBM) system in the year 1987. This buoy performs the function of keeping a tanker moored and transferring fluids, from tanker to shore-and vice-versa- via a subsea pipeline, while allowing the ship to weathervane. The SPBM is used on location N-6°58'40", E-79°46'30" with a maximum depth of 30 meter.



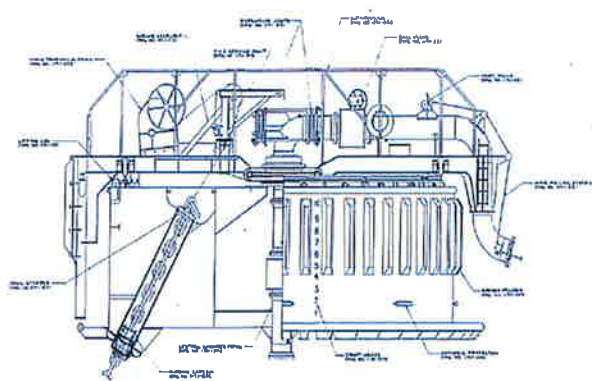
Over All Length	Loa =	14.45	m
Length	L =	11	m
Breadth	B =	11	m
Depth	D =	3.66	m

The unit is operated by CPC (Ceylon Petroleum Corporation) and it was last overhauled, inspected and repaired during March to May 2015 (45-day Overhaul). Repairs were performed by Colombo Dockyards PLC (CDL) under the Third-Party Inspection of Bureau Veritas Lanka (PVT) Limited. The 2023 Overhaul was planned for 38 days from 27/01/2023 to 09/3/2023.

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The CPC-SPBM's Planned Overhaul 2023 was completed on schedule under on-site supervision of OEM (IMEDCO) and Third-Party Inspection Coverage from Bureau Veritas Lanka (PVT) Limited. A Chartered Mechanical Engineer with a long Marine Engineering exposure was mobilized as a residential TPI from BVL. The TPI Surveyor issued 38 Daily Reports summing up the Inspection Observations, Maintenance Highlights, Lessons Learned, and Repair Activities. These daily reports were effectively instrumental in timely transmission of BVL recommendations and potential improvements to CPC, aimed at enhanced integrity and optimized maintenance care in synchrony with the progressive repair works.

This Final Inspection Report was compiled following the chronological order based on the Inspector's Daily Visit Reports. The report format is a blend of pictorial evidence and written observations together to allow the reader to visualize the reported event most accurately and realistically.




General Arrangement



SPBM Elevation Cross Section showing 6-Anchor Hawse Pipes, Centre Tank Suction Pipe, 30-nos Rubber Fenders, SPBM Hull Depth, SPBM Discharge Fittings & Piping & Miscellaneous Appurtenances.


SPBM Deck Plan Showing 6-Tanks, 6-Manhole (Legs), 6-Anchor Hawse Pockets, & Centre Tank.

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2.0 INSPECTION OBSERVATIONS – HIGHLIGHTS

BV captured several Inspection Observations for documentation and sharing aimed at either improvements or continued followed-ups:

- 2.1 **Lubrication PM** - Pay attention to the SPBM Preventive Maintenance Program with emphasis to lubrication of SPBM parts such as PDU, Mooring Arms & Mounting Pins, Winch Arm Pins, Rotating Parts, Boggy Wheels Lubrication System and Bearings etc. Removal of Pipe Arm Pins was difficult due to interface galling caused by insufficient Lubrication. These parts were found inadequately or less effectively lubricated, eventually causing more damages and schedule delays. Many blocked, dried, or restricted lubrication paths, Use of sub-standard lubricants and inadequate frequency of refreshing the lubricants were captured as PM Gaps. An effective PM Program can minimize contingency replacement costs.
- 2.2 **Sacrificial Anodes** - Periodic program for assessing the anticipated Anode Activity will be crucial to save the SPBM Hull. Unconsumed Anodes should be investigated for the potential reasons. During the 2023 Overhaul 29/30 Zinc Anodes (20kg each) have been found 100% decayed as intended. One anode showed no activity. This means that unconsumed anodes are very likely failures (*it has happened in the site*) and CPC should establish a PM practice to avoid inactive anodes.
- 2.3 **Floation Foam in the SPBM Compartments (6 Nos)** - The SPBM has six (6) Buoyancy Compartments and 1 Central Tank. The design requires 3/7 alternative compartments to be filled with a Floation Foam. During the overhaul, these Foam Substances were removed as a fire safety precaution for planned hot work (welding) in the proximity of the foam filled compartments. At the end of the repairs, the removed foam was not replaced, with the consent of the on-site OEM representative as well as OEM's technical advice since foam is no longer use in their design..
- 2.4 **Continued Overcoating and Maintenance Care** of the SPBM (by Operations & Maintenance Teams) is recognized. The Buoy Bottom and Hull substrates were found with no signs of rusting, pitting or metal loss corrosion.
- 2.5 **CPC modified the Antifouling Structure** by providing a Center Pipe which will extend the integrity life span than previous design.
- 2.6 **CPC continue replacing the Rubber Bellows and Rubber Fenders** every other overhaul as a minimum. CPC keeps spare sets of bellows and fenders in hand before an Overhaul. The removed bellows & fenders showed less flexible (become hard and brittle) due weathering effects in sunny marine environment. Typical lifetime of these elastomers ranges from 7 to 10 years.

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2.7 In-situ Machining Facility for Damaged Gasket Faces was a proven advantage during this SPBM Overhaul too. Leaks from the flanged gasket joints may cause Oil Spills and related environmental pollution. The flange under the Buoy was successfully machined (in-situ) and rectified for radial damages more than 1/3rd Serration width. This is highlighted as a strength from the CPC maintenance capabilities.

2.8 Rotary Laser Level Technique (By SkyTech Laser Technologies) was utilized for checking the Rail Mounting Bed flatness. The subject Rail and the Rail Bed were found with heavy and Irregular corrosion damage. CPC approach to use the Laser Leveling technique to rectify the situation is recognized as a good practice. BV Recommends Verifying the Final Placement also with a repeated Laser Scan. It was not verified in 2023 Overhaul.


2.9 Sounding Pipes- There were three (3) Sounding Pipes (@ 2" Dia x Sch 40) inserted into the empty 3/6 SPBM compartments. The pipe enters the tank in the middle and stay open ended above the tank bottom (with V-cut to avoid blockages and deposits). The intent is to early detection of any leaking tanks that will be unveiled during periodic level checks (Sounding Tapes).

CPC replaced existing 3 nos Sounding Pipes due to top end meal loss corrosion. Further, CPC installed another 3nos new Sounding Pipes into the previously Foam Filled Tanks. This will mitigate the Risk Level of the removal of Floatation Foam, if the tank leaks are through localized corrosion with a mode of Corrosion Hole max. A proper Rain Cover is very essential for each Sounding Pipe.

3.0 DISCUSSION AND CONCLUSIONS

The CPC Single Point Buoy Mooring (SPBM) Facility used for Crude Oil transfers is in good integrity to operate Safely, Reliably and Environmentally Friendly for another five (5) Years provided that an effective Preventive Maintenance (PM) Program is in place and the SPBM is Operated within the Operating Integrity Envelope.

The CPC-SPBM's Planned Overhaul 2023 was completed on schedule under on-site supervision of OEM (IMEDCO) and Third-Party Inspection coverage from Bureau Veritas Lanka (PVT) Limited. This TPI Report recommends potential improvements aimed at enhanced integrity and optimized maintenance care. Some of the generic and critical integrity concerns are discussed in detail under this paragraph:


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- 3.1 Periodic Audits & OMC Checklists** – These internal Integrity Assurance Action Items keeps the Equipment Owners, Operators, Safety Personnel as well as decision making personnel (Leadership, Accountants & Planning Heads) aware of the action implementation timelines and their cost impacts, material procurement challenges, and business commitments to customers.

In the Equipment or Plant Integrity Maintenance Worklists, certain requirements appearing as trivial actions, may save the plant from major disasters, expensive repairs, or huge business losses. In this regard, keeping the decision makers on the same page with awareness on potential hazards, it will be easy to protect such “trivia-looking” action items from famous “Cost-cutting” drives. Performance of Structured & Periodic Audits based on OMC Checklist Reviews with a Team from Operations, Maintenance and Safety Representatives would be of a vital importance and success. All reports and results shall be shared with Top Management at least every 6-Month intervals.

- 3.2 Management of Change (MOC)**- BV noted a critical change executed by the Client with a proper internal approval following a routine like ISO 9001 Management of Change Procedure.

Client removed Flotation Foam filled inside the SPBM Buoyancy Compartments. This is to allow hot work (welding) in the proximity due to fire-risk. At the end of the repairs, the Client did not replace the removed foam, with the consent of the on-site OEM representative as well as OEM’s technical advice since foam is no longer use in their design.

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3.3 Degradation of Rubber Products due to Sun & Marine Exposures


Fender Material- Rubber types such as Polymer Polybutadiene and its Copolymer derivatives (SBS or NBR-Nitrile Rubber) are developed using a process called cross-linking, which involves joining polymer chains together to form one single molecule. Free radicals produced by heat, oxygen, and light (over time) combine to form new crosslinks, which reduces flexibility and leads to hardening. ***This is called “Chain Hardening”.***

Bellows Material- Neoprene (or Chloroprene) has good resistance to petroleum-based connections (Crude Oil) for submerged marine applications. Neoprene's waterproof and corrosion resistant properties make it resilient to a range of environmental factors, including UV, ozone, oxidation, and good thermal stability (-40 °C to +120 °C).

4.0 RECOMMENDATIONS - IN-SERVICE PREVENTIVE MAINTENANCE (PM) PROGRAMS

This Inspection Reports recommends CPC to continue maintaining the SPBM Preventive Maintenance Program improved with below guidelines as applicable and plausible:

- 4.1 Maintain a documented and updated Preventive Maintenance Program and an Operating Maintenance Checklist (OMC) approved by the Top Management. There should be a defined and documented mechanism for a PM Elements Implementation and other periodic inspection timelines. The documented progress and results shall be shared with top management for review and directions. Lubrication Program, Regulatory Inspections on Lifting Accessories, Visual Inspections on accessible areas susceptible for Coating Damages and Rusting, Diver Inspections on Sacrificial Anode Activity and potential anomalies pertaining to PDU are key-focus areas for the subject PM and OMC Scope:

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4.1.1 Authorized Engineers to develop an Operating Maintenance Checklist (**OMC**) and obtain approval from the Top Management. OMC to include:

- a. Remove the manholes and inspect inside compartments, periodically.
- b. Recommend immediate action to rectify any corrosion, deformation, and coating failures.
- c. Periodical UT Thickness Monitoring of Pipe Bend and other Accessible Supply Pipes every 12 months for wall thickness and external corrosion trends.
- d. Recommend Over Coating of Buoy Internal Surfaces if Corrosion Blisters are observed.
- e. Include the periodic re-examination of the Hull Dent Areas using MT within every 12 months and share MT Photographs with the Checklist Report Circulated.


4.1.2 Mandate Interim Diver-inspections on status of Potential Decay of Zinc Anodes, every 2 Years as a minimum. Ensure active anodes showing signs of sacrificial decay. If any Anode is found inactive, explore the means of rectifying the situation as permitted by the site conditions.

Unconsumed Zinc Anodes should be investigated for the potential reasons (inadequate Electrical Connectivity or Anode Surface fully isolated from Algae or Seaweeds thus isolating it from Seawater Electrolyte).

4.1.3 **Checklist Item** - Monitor the Seal Tightness of Battery Box and the Door-lock Handle during Operations. It may need replacement. This is a very trivial action which can result in reasonable consequence (Moderate Risk Level).

4.1.4 **OMC Frequency**- Perform the Check-list Actions with a Team from Operations, Maintenance and Safety Representatives as a minimum. Report and share the results with Top Management at least every 6-Month intervals.

4.1.5 **Lubrication** – This is a Key PM Element and there were ample lessons learned during the 2023-SPBM Overhaul due to inadequate or ineffective in-service lubrication procedures and supervision. The Winch Arm Pins were found galling due to poor in-service lubrication. Almost Seizures were observed with the Pipe Arm Pins. Besides, many blocked or restricted lubricant paths were noted while the used lubricants were rated sub-standard, and frequency of refreshing the lubricants seemed inadequate.

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- a. **Periodic Deblocking of Lubrication Paths-** Ensure all Lubricating paths, particularly Mooring Arm Pins, new Winding Cable to the Winch are cleared before periodical injection of lubricants.
- b. **General Lube Oil Grade-** Avoid using sub-standard lubricants. BV recommends using **CALTEX lubricants**, which comply with required properties.
- c. **PDU Lubricant Grade** - Recommended to use marine grade gear oil and grease for all lubrication work in PDU unit 2. Recommend checking and confirm grease path before fixing the center pin to confirm sound operations while at sea.
- d. **Anti-seize Copper Grade Compound-** Ensure the threaded bolts are tightened with Anti-seize Copper Grade Compound.
- e. **Silicone Grease** – Specify using Silicone Grease for “O” Ring fixing. Ensure periodic renewal of gasket seal and grease cup as part of the PM program.
- f. **Ensure Periodic PM Activity for Boggy Wheels** Lubrication System aimed at regular de-blocking of the Lubrication Paths.
- g. **Battery Box** - Proposed to use anti-seizure compound (Copper slip) while tightening bolts to provide joint protection from heat and corrosion. Recommend keeping Battery box lid in closed position every time to avoid seawater ingress.

4.2 **RISK MITIGATION ACTIONS DURING NEXT OVERHAUL -2028 OR AN OPPORTUNITY**


This Third-Party Inspection Report emphasizes the CPC attention during the planning stage of next SPBM Overhaul in 2028 to face contingency repairs:

4.2.1 Risk Mitigation Actions for CPC SPBM during the Overhaul-2028 or an Opportunity:

- a. **Worn-out Teflon pads** – Plan to replace the worn-out PTFE Pads.
- b. **Rail Mounting Bed** – Plan replacing the Rail Mounting Bed which is heavily and irregularly Corroded.
- c. **SPBM Deck** – Plant mechanical insert-plate type repairs and re-coating of the Buoy Deck Topside. Strongly recommended high thick, abrasion resistant marine grade coating system to re-coat the entire deck after blast-cleaning.
- d. **Tugger Winch Pulley-** This was touching a Pipeline and it was corrected by re-aligning the Pipe Layout. This was a temporary repair with CDL adjustment related to this potential Abrasion Damage. Plan to rectify this situation as per 2028 observations.
- e. Plan to replace the **Toolbox on Pipe Arm**. Clean and offer for re-inspection of all Grease Paths for Arm Lubricating System.
- f. Plan to replace all **PDU Seals (O’ Rings)** to be replaced.


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- g. Replace the corroded (marked) **Bolts of Tension Winch** in-kind. Recommend replacing all Bolting Materials (Studs and Nuts in-kind). Worn out surface to be weld build up using suitable filling materials.
- h. Check **Zinc Anodes** for purpose, or plan to replace otherwise, Check anode decay level, electrical continuity, and noble material surface exposure for sacrificial corrosion.
- i. Replace the Corroded **Rail, Rail-bed, Nuts, and Bolts**. Plan to mobilize Rotary Laser Level Technique for both pre and post repair flatness verifications.
- j. Plan to **replace the defective cable of Chain Tension Winch** with the Thimble End.
- k. Plan to replace damaged **Balance Arm Fender Brackets**.





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4.3 MATERIAL AVAILABILITY FOR OVERHAUL-2028 OR THE NEXT OPPORTUNITY


- 4.3.1 **Rubber Fenders & Rubber Bellows**– Have in hand 15 nos Neoprene or NBR Rubber Fenders and set of Rubber Bellows.
- 4.3.2 All OEM Spares for **PDU Seals**.
- 4.3.3 **Worn-out Teflon pads** – Have in hand, replacement Teflon (PTFE) pads.
- 4.3.4 **Cable of Chain Tension Winch** with the Thimble End.
- 4.3.5 Replacement **Toolbox on Pipe Arm**.
- 4.3.6 All **PDU (O' Rings) -OEM** Spares.
- 4.3.7 Replace the corroded (marked) **Bolts of Tension Winch Bolts**, other Bolting Materials (Studs and Nuts in-kind).
- 4.3.8 Have a set of **20kg Zinc Anode Blocks** in hand (30 nos).
- 4.3.9 **Fender brackets for Balance Arm**.


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5.0 PICTORIAL EVIDENCE & DAILY REPORT SUMMARY


Inspection Date & Report Ref.	Inspection Observations, Recommendations & Repairs Performed and Pictorial Evidences.		
28/01/2023	Mobilization and initial Overhaul Plan was reviewed by Eng.Sisira Kumara, BV Surveyor and concurred.		
29/01/2023 DIR -001			<p>P-001: Single Path - Single Point Buoy Mooring (SPBM) was brought to the Colombo Dockyard (CDL) and berthed to Dock No 3 for Overhaul.</p> <p>P-002: The Rubber Fenders were noted damaged. CPC had a plan to replace the Fenders. Accordingly they were replaced during the overhaul.</p>
30/01/2023 DIR-002			<p>P-003: The SPBM Winch Arm Pins were very tight due to insufficient lubrication (PM Program to be secured).</p> <p>P-004: Rubber Bellow and Flanges found weathered & decayed badly. Heavily corroded bolts on the 24" NPS Inlet Pipeline were flame cut for flange opening.</p>

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31/01/2023 DIR – 003		
	<p>P-005: <i>Galling in the Winch Arm Pins due to Inadequate PM Program (Lubrication). CPC to improve the PM Program and Lubricant Type.</i></p>	<p>P-006: <i>UV degraded Rubber Bellows. CPC to Use Neoprene (or Chloroprene) Elastomers to improve the Bellows Lifetime.</i></p>
		
	<p>P-007: <i>24" NPS Pipe-bend in See P-036 & P-037. Showed thickness loss at outer radius.</i></p>	<p>P-008: <i>24" NPS Ball Valve was Serviced & Tested per API 598 Guidelines. Accepted.</i></p>
		<p>P-009: <i>The SPBM Winch was removed to the Workshop, Serviced, Tested and Painted externally. Satisfactory.</i></p>

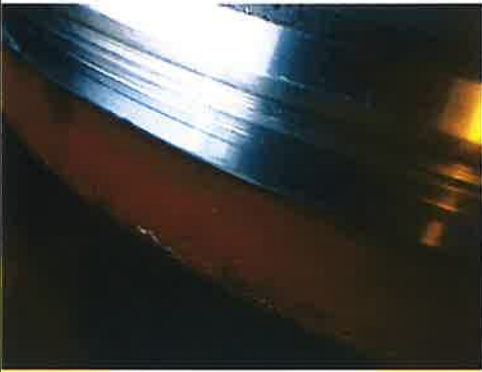



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01/02/2023 DIR-004 (P-010 - P-013)		
	P-010: Main Watertight Door at the Buoy Entrance to PDU compartment. Deteriorated Beading was replaced. -Satisfactory.	P-011: Rotating trolley roller required Heavy Repairs. The Mounting Brackets re-bolted & painted. Rail was re-installed later.
		
	P-012: Rotating Trolley Rail Wheel Mounting bolting heavily corroded & replaced with Spring Washers. Satisfactory. Also the corroded Tugger Winch Pulley, Mounting Pin, Bracket & Bolting replaced.	P-013: The Tank Ladders revealed that heavily corroded mounting bolts. All ladders re-painted & re-bolted. Satisfactory.
02/02/2023 DIR-005 (P-014 - P-019)		
	P-014: PDU dismantling and repairs were performed under OEM presence at the site.	P-015: PDU Main Bearing was dismantled after 7 Years in Operations. The decayed O' rings were replaced







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03/02/2023 DIR-006 (P-020 - P-021)		
	<p>P-016: Cleaning of inner part of the PDU revealed no issues. Satisfactory, except the discoloured lubricant. See P-017.</p>	<p>P-017: Existing lubricant discoloured in inner parts of assembly. As per OEM recommendation, new lubricant was (Grease) used satisfactorily.</p>
		
	<p>P-018: The Arm Mounting Pin's Lubricating paths were found blocked. In an overview, the PM Lubrication program noted effective.</p>	<p>P-019: The Chain Tension Winch Cable was defective including the Thimble end it was replaced.</p>
		
	<p>P-020: PDU Disassembly in Progress.</p>	<p>P-021: PDU Disassembly Completed. Arm Connecting Table without PDU in place.</p>





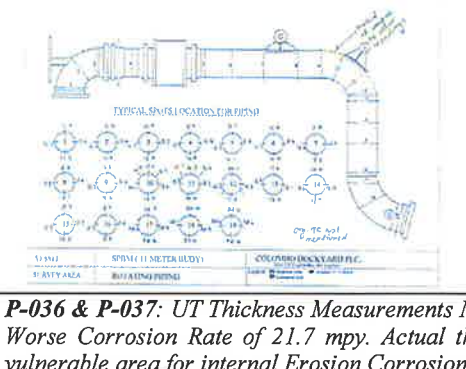
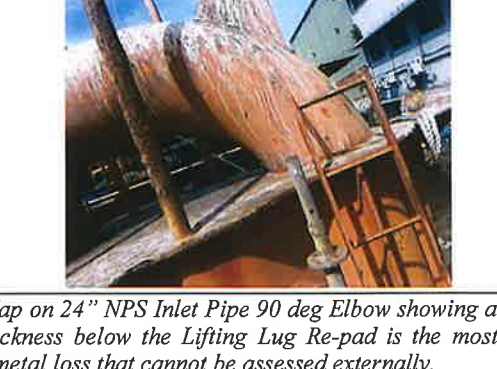
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04/02/2023	Holiday in CDL due to independent day (04.02.2023)	
05/02/2023 DIR-007 (P-022 - P-025)		
	<p>P-022: PDU-Weather Seal-rubbing Surface was seriously damaged due to re-installation upset during the previous overhaul. Affected area was weld build up using a suitable compatible electrode. PT carried out & successful.</p>	<p>P-023: Bearing lubricating paths of Mooring Arm Eye was heavily blocked. Cleared and Re-inspected before Unit Assembly.</p>
		
	<p>P-024: Design intent for Foam Filled Tanks is to keep the SPBM Floating even during a Tank Perforation (for Safe Self Buoyancy). This Foam was removed to allow Welding Repairs (Potential Fire). The removed Foam was not replaced before recommissioning. Need change documentation with an approved Management of Change (MOC).</p>	<p>P-025: Winch cable running pulley pin observed with galling due to insufficient lubricant.</p>





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06/02/2023 DIR-008 (P-026 - P-031)		
	<i>P-026: Mooring Arm Bush almost galling due to insufficient lubrication.</i>	<i>P-027: Mooring Beam Pin was difficult to remove due to lack of lubrication.</i>
		
	<i>P-028: Mooring Arm Deck Timber Sheathing Floor with corroded angle irons.</i>	<i>P-029: Corroded Mooring Arm Fire Leak Bracket was found heavily thinned & replaced.</i>
		
	<i>P-030: Rotating arms Teflon Pads</i>	<i>P-031: SPBM shifted to Dock No 4.</i>

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07/02/2023 DIR -009 (P-032 - P-037)		
	<p>P-032: Main Ball Valve Actuator being Dismantled.</p>	<p>P-033: Main Valve Actuator Internal Deposits due to potential Sea-water Ingress. Actuator cup thinned down due to Under-deposits-Corrosion.</p>
		
	<p>P-034: Mooring Arm Deck Timber Floor showed Deterioration.</p>	<p>P-035: Rotating Arm Antifouling Structure – Corroded Bolts replaced in-kind.</p>
		
<p>P-036 & P-037: UT Thickness Measurements Map on 24" NPS Inlet Pipe 90 deg Elbow showing a Worse Corrosion Rate of 21.7 mpy. Actual thickness below the Lifting Lug Re-pad is the most vulnerable area for internal Erosion Corrosion metal loss that cannot be assessed externally.</p>		

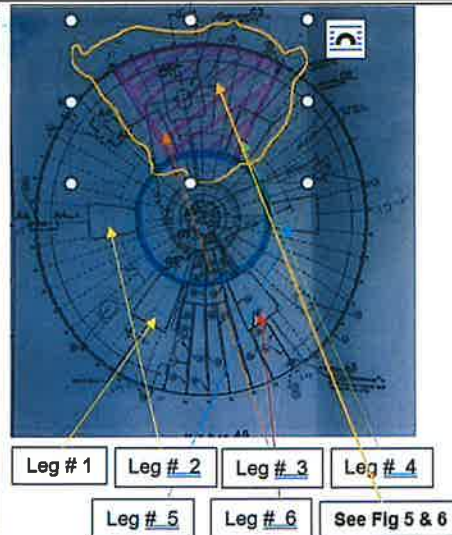
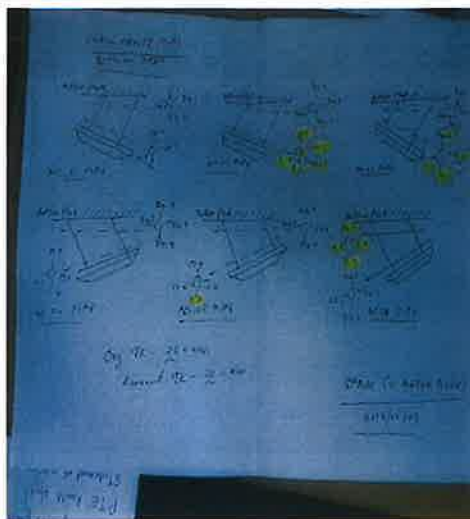
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08/2/2023 DIR -010 (P-038 - P-041)		
	<p>P-038: SPBM at Doc # 4. The Hull and Bottom showed usual Marine Growth as expected. Algae, Aquatic Weeds, or Marine Invertebrates such as Asian Clams, Zebra Mussels, and other small organisms. Marine growth was removed by mechanical scraping. Usual Anti-fouling Technique is applying an effective marine grade coating System.</p>	<p>P-039: Anchor Hawse Pipe after Cleaning of Marine Growth. Reasonably in good Integrity. There are Six (6) Anchor Hawse Pipes for handling the SPBM Anchors. They are open to Sea Water. BV noted deep isolated corrosion pits on the Anchor Hawse Pipe ID.</p>
		
	<p>P-040: Rail and rail bed on the SPBM Deck were heavily corroded. Total Station Survey showed unacceptable Rail Bed Levels. Corroded and deformed rail and rail-bed were satisfactorily refurbished.</p>	<p>P-041: Extremely good CP installation; 29 Nos Zinc Sacrificial Anodes (20 kg Each) almost Consumed (> 95%) except for one Zinc Anode. It may be inactive possibly due to improper installation thus allowing Marine Growth to isolate the Anode and Hull. Anodes were mounted on board with M-16 SS 316 Bolt with Nut and lock Washer.</p>

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9/2/2023
DIR – 011

(P-042 - P-047)










P-042 & P-043: Anchor Hawse Pipes UT Thickness Measurements showed relatively heavy general metal loss (From 25 mm original thickness to 11-12 mm metal loss where minimum required thickness specified is 20mm) due to Anchor Chain **Abrasion** Assisted Corrosion Metal Loss. The Leg # 2 Anchor Hawse pipe has **perforated** near the outlet mouth while the remaining wall measured even 3.2 mm around the corrosion-hole. Noticeably, the Leg # 6 Hawse Pipe thinning was confined to the area near the Buoy Exit, unlike the rest shown as at Pipe Exit. In summary, the minimum-measured thickness of other Anchor Hawse Pipes are: Leg # 1 (16.1 mm), Leg # 3 (13.4mm), Leg # 4 (16.9 mm), Leg # 5 (11.3mm) and Leg # 6 (11.2mm) out of original thickness of 25 mm.











P-044: Internal Corrosion Hole was noted on Leg # 2 Anchor Hawse Pipe Outlet Mouth. The 25 mm original thickness showed readings around 3.2 mm. Only Leg # 6 Anchor Hawse ID showed relative thinning by Buoy Exit. There are 6 Anchor Hawse Pipes.


P-045: Tank Internal Zinc Anodes decayed > 95% proving high rated functionality. However, fair degree of rusting was noted on structures potentially due to Under-deposit-Corrosion.







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10/2/2023 DIR-012 (P-048 - P-051)			<p>P-046: Tank Interior between Leg # 3 & Leg # 4 showed localized initial rusting & required Spot Priming and Overcoating.</p>	<p>P-047: Protective Coating in the Centre Tank Internal Surface showed no signs of significant damages.</p>
			<p>P-048: SPBM Deck Lifting Davit was found externally corroded, but the davit is in good integrity. Repainted successfully.</p>	<p>P-049: The Teflon pads placed in Mooring/ Balancing/Piping Arm, revealed significant wear. Worn pads were replaced in-kind.</p>
			<p>P-050: Total 15 nos Rubber Fenders were found Chain Hardened and Brittle. Free radicals produced by heat, oxygen and light combine to form new crosslinks, which reduces flexibility and leads to hardening</p>	<p>P-051: Flexible Joint in the PDU Unit (Suspected SS 316) noted for > 1mm deep wear-out against rubbing of Weather-shield. CDL attempted applying Devcon which failed during machining. Finally weld-overlaid with compatible electrodes & machined successfully.</p>

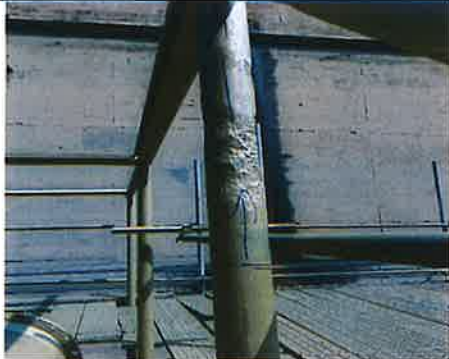




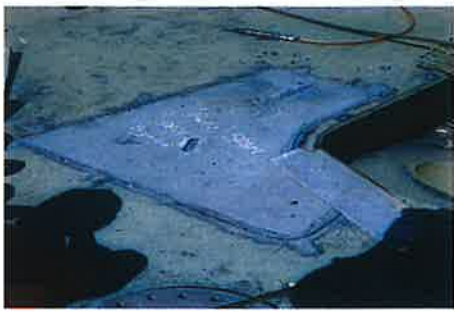
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11/2/2023 DIR-013 (P-052 - P-056)			
P-052, P-053, & P-054: Cavitation Damages at ID of Anchor Hawse Pipes @ Legs Nos. 2, 4 & 5, respectively. Deep cavities were weld build-up internally as accessible.			
			
	P-055: No Grease Hole for New Arm Bushes. Drilled new holes and rectified. Satisfactory.	P-056: No Grease Hole for New Arm Bushes. Drilled new holes and rectified. Satisfactory	
12/02/2023 DIR-014 (P-057 - P-060)			
P-057 & P-058: Corrosion Holes near Leg #2 & Leg #4 Anchor Pockets. Topside Corrosion. Areas were replaced with insert plates.			

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			<p>P-059: The SPBM Deck Rail Mounting Bed was thinned down and patch repaired with SS 316 Strips. Visual inspection revealed no considerable deck deformation.</p>	<p>P-060: Rubber Fender Mounting Strips (SS 316) in satisfactory condition. The chain hardened Neoprene Fenders were replaced.</p>
13/02/2023 DIR -015 (P-061 - P-066)			<p>P-061: Buoy Bottom & Hull OD showed successful CP Activity. Only 1/30 Zinc Anodes (20kg each) showed Zero Activity. Rest showed more than 95% Decay.</p>	<p>P-062: The Area Around Small Boat Mooring Cleat was found Heavily Pitted. Some of them were found distorted noticeably.</p>
			<p>P-063 & P-064: Both front side and backside of Chain Stoppers were found intact.</p>	









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	<p>P-065 & P-066: - Deep Localized External Corrosion on the piping associated with Antifouling Structure of Arms. Root-cause is unknown. Operators to stay vigilant. Weld repaired and OK.</p>
14/02/2024 DIR-16 (P-067- P-068)	 
	<p>P-067: BV Witnessed the Centre Chamber Valve Pressure-test @ 15 barg and found satisfactory.</p> <p>P-068: Perforations in the SPBM main deck due to topside under-deposit-corrosion.</p>
15/2/2023 DIR -017 (P-069- P-074)	 
	<p>P-069: BV reviewed UT Thickness Report on SPBM Deck and marked replacement location as, Blue for Insert Plates & Red for Reinforcing.</p> <p>P-070: CDL utilized plate material equivalent to ABS Grade A for Insert Plates. Used Doubler plates for Reinforcing requirements.</p>









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<p>P-071 & P-072: Most of All Sounding Pipes were found heavily corroded at top and bottom. CPC replaced all corroded sounding pipes. The Sounding pipes are corroded from Sea Water Side and anticipated alge growth and Seawater Corrosion.</p>		
		
<p>P-073 & P-074: The SPBM Design had 3/6 Alternative Tanks filled with Floatation Foam (Closed Cell System) keeping the SPBM floating even with water leaks to all 6 tanks. Foam was removed to mitigate potential fire-risk during welding. These 3/6 tanks were not re-filled with a compatible Closed Cell Buoyancy Flotation Foam. BV highlighted the very high-risk level of SPBM Sinking (Major Business & Environmental Risk).</p>		

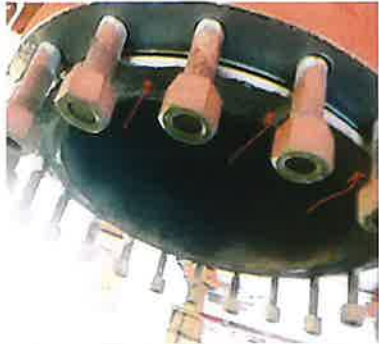

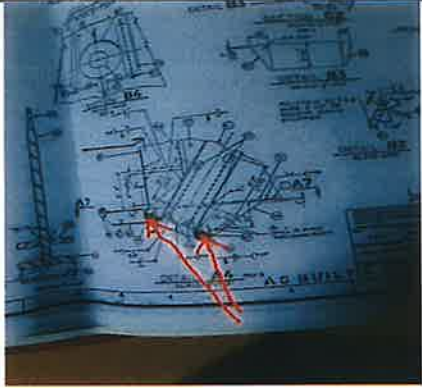

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16/2/2023 DIR -018 (P-075- P-078)				
	P-075: Corroded Antifouling structure mechanical repair. To be painted later.		P-076: SPBM tanks (3/6) after removal of foam revealed mechanical scratch marks. Coating damages were patch repaired.	
				
	P-077 & P-078: BV observed two (2) Hull Dents between Leg 2 / Leg 3 and Leg 4/ Leg 5. The areas were examined for surface cracks utilizing Magnetic Particle Testing. MT reported no relevant indications. Shown above is the locations concerned between Leg# 2/Leg #3.			
17/02/2023 DIR -019 (P-079- P-082)				
	P-079: Solar PV Panel Maint. Service -OK	P-080: Light System Maint. Service - OK	P-081: New Hatch Manhole Covers.	P-082: Anchor Chain Hawse Access Door-ok







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18/2/2023 DIR -020 (P-083- P-085)			
	<p>P-083: Coating thickness measured on the Hull underwater area. DFT was above OEM recommendations.</p>	<p>P-084: Anchor Hawse Pipe was weld built up. Corrosion pits could not be repaired due to limited access were filled with a marine filler.</p>	<p>P-085: Visual inspection was done to weld built up area of PDU item No 2 and BV observed that repaired area was in satisfactory condition.</p>
19/2/2023 DIR -021 (P-086- P-089)			
	<p>P-086: Machining of weld built up area of PDU item no 2. VT & PT showed no anomalies.</p>	<p>P-087: Dismantling of Tension winch Gear Box.</p>	<p>P-089: Fixing new bushes (12 Nos). Satisfactory.</p>
20/02/2023 DIR -022 (P-090- P-093)			
	<p>P-090: PT performed on PDU Item no 2, weld built up area showed 2 Porosities. Rectified same time.</p>	<p>P-091: Leg # 3 Anchor Hawse Pipe Flanged End - Doubler Plate installed. near the flange.</p>	



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	<p>P-092: The pipe flange under the Buoy revealed several gasket-face damages some > 1/3rd of the face-width. In situ machining was performed and rectified the situation.</p>	<p>P-093: DFT was verified for OEM compliance on the Antifouling Coating Sigma-cover 555 at bottom of SPBM. Satisfactory.</p>
21/02/2023 DIR -023 (P-094- P-099)	 <p>P-094: Shown with RED Arrows above is the Half Tubular Circular Section welded to the Anchor-Hawse Outlet Periphery as a Belmouth Opening aimed at minimizing potential rubbing and subsequent abrasion damage to the Anchor Hawse Nozzle Opening by the Anchoring Chains due to continued Sea Wave Surges as well as Tidal (High and Low) Transitions. One of the Belmouth Half Tubular Section showed signs of Water Ingress and corroding the Tube Wall internally (Crevice Corrosion). Water was dripping from a hole.</p>	 <p>P-095: PDU Turning Bed Bottom Face showing dry adherent Paint Scales and Rust Deposits. Cleaned with Mechanical and Emery Paper Cleaning and ensured a smooth flat Profile.</p>

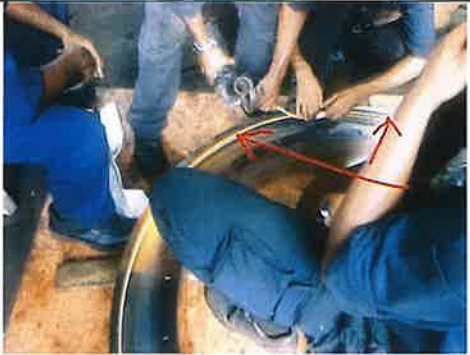

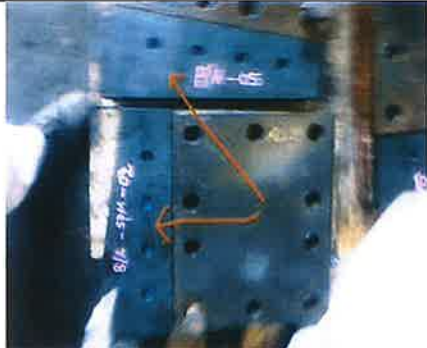

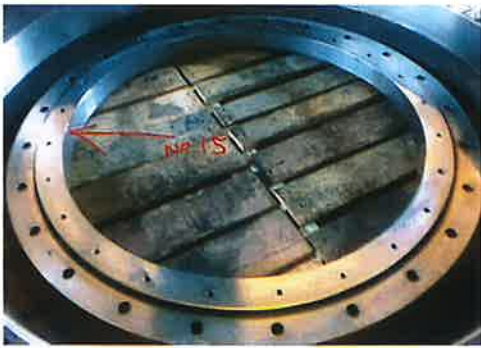

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	<p>P-096 & P-097: Both flanged Inlet & outlet (24") pipe spools required gasket face dressing (In-situ Machining) due to both mechanical scratches and shallow corrosion pitting.</p>	
		
	<p>P-098: PDU Item # 2 Re-assembly required a new O'-Ring (OEM Supplied) beneath the Fixing Ring. The O' Ring occupies the Space outside the Fixing Ring Bolt Circle Outer Circumference.</p>	<p>P-099: PDU re-assembly was witnessed by BV with OEM and ensured compliance to the assembly drawing and OEM instructions.</p>
22/02/2023 DIR -024 (P-100- P-101)		
	<p>P-100: PDU Main Bearing (New) Installation was in progress.</p>	<p>P-101: New PDU Main Bearing was installed satisfactorily.</p>


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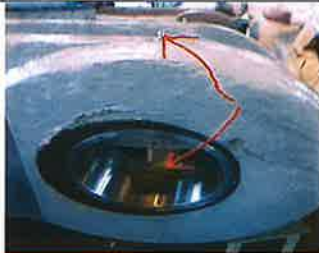

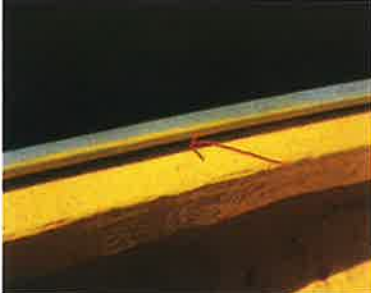

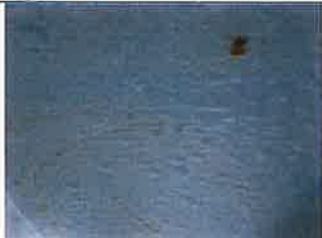

23/2/2023 DIR -025 (P-102- P-107)		
	<i>P-102: Wheel Buggy Set – An Overview</i>	<i>P-103: Lubrication Path was blocked and required clearing.</i>
		
	<i>P-104: Weather Shield being re-installed. This is the item that was not installed properly in 2015 and eventually abraded the PDU Item # 2 which had to be weld-overlaid and machined during 2023 overhaul.</i>	<i>P-105: PDU after Weather Shield was re-installed properly. OEM and BV both on-site with the Client, CPC.</i>
	<i>P-106 & P-107: Mooring Arm Painting. Some Coating Holidays marked and rectified. DFT Measurements reviewed and in compliance.</i>	


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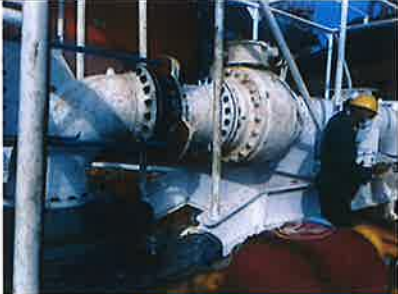
24/2/2023 DIR -026 (P-108- P-111)		
	P-108: Weather-seal installation on Item # 17. Installation of Item No 3, Item No 4, Item No 13, Item no14 ("O" Ring), Item No 17(Weather-seal)- All satisfactory	P-109: PDU item no 4-installation completed.
		
	P-110: – New Teflon Pads Installed at Balancing Arm, Mooring Arm and Pipe Arm.	P-111: All 3 Arms Re-assembled using New Pins.
25/02/2025 DIR -027 (P-112- P-115)		
	P-112: Item No 15 – Bearing	P-113: Lubrication After Bearing No 15 is fixed


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26/2/2023 DIR-028 (P-116- P-122)		
		
	P-116: Lubrication of Pipe Arm Mounting Bush	P-117: Lubrication of Mooring Arm Mounting Bush
		
	P-119: Gaps between Rail and Rail Resting Beam, between leg 5 & Leg 6. Noted is that recommended confirmation Laser Survey was not performed after repairs.	P-120: PDU is placing at the centre of SPBM.
		
	P-121 & P-122: BV reported many locations with blistered or burnt protective coating. All locations were patched up and accepted.	







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27/2/2023 DIR-029 (P-123- P-124)			
	<p><i>P-123: Re inspection revealed deep lake type irregular corrosion pits in the Leg # 2 Anchor Hawse Pipe internal surface. Weld repaired satisfactorily, as per BV recommendations.</i></p>	<p><i>P-124: New Neoprene Rubber Bellows with new bolting materials. Replaced in-kind.</i></p>	
28/2/2023 DIR-030 (P-125- P-130)			
	<p><i>P-125: Tugger Winch Motor was Re-assembled. No integrity issues. Satisfactory.</i></p>	<p><i>P-126: Air Motor was fixed to Tugger Winch. On-board. BV witnessed and accepted.</i></p>	
			
	<p><i>P-127: Mooring Arm Wooden Plank –Satisfactory Finish and Integrity.</i></p>	<p><i>P-128: Pipe Arm Valve Assembly Pressure Tested (15 barg) with a Blind in place (Yellow Arrow). BV witnessed and accepted the test. Note Rods (White Arrow) for Protection of Expansion Bellows during Maintenance & Testing</i></p>	




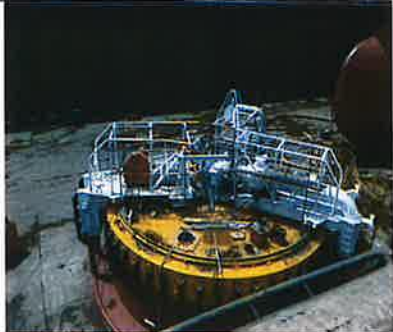


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	P-129: Teflon Pad Assembly Fixed on Arms Showed a 15mm Gap between the Pad & Deck.	P-130: New Rubber Fenders. No MTC available, no stamp, no evidence for Neoprene Rubber. Replaced as old Fenders are Chain Hardened.
01/03/2023 DIR - 031 (P-131- P-132)		
	P-131: The Tugger Winch Ready to return to Buoy after Servicing & Oiling & Lubrication).	P-132: Three (3) Arms, Pipe Arm, Mooring Arm and Balancing Arm, were Tested for Rotationality. BV Witnessed & accepted the tests.
02/03/2023 DIR – 032 (P-133- P-138)		
	P-133: SIGMASHIELD™ PRIME -Gray with 65% Volume Solids x 250 microns for Cargo External Exposure. Note the Fender Mounting Clips with required integrity.	P-134: The Tugger Winch Gear Oil Reservoir showed a Leaking Pin-hole due to External Under Deposit Corrosion.






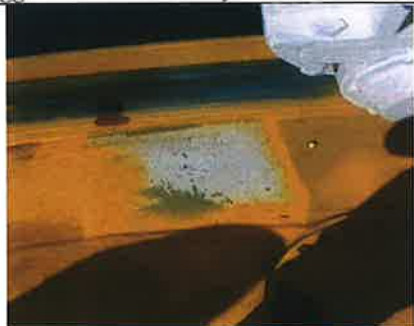
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	P-135: BV recommended a lap welded 10mm thick doubler pad.	P-136: Further replaced the knife-edged Radial Reinforcing Flat Bar as well. Flat Iron using 8.0 mm Plate Section was used. PT Results satisfactory.
		
DIR – 033 03/03/2023 (P-139- P-138)	P-137: Blistered & detached Coating Damages due to poor application techniques or environmental conditions.	P-138: Power Tooled Substrate was Satisfactory (St-2- Finish).
		
	P-139: Some area of Mooring Arm underside was not painted. Revealed during final Punch listing.	P-140: Side wall below load water line DFT was found more than 830 microns


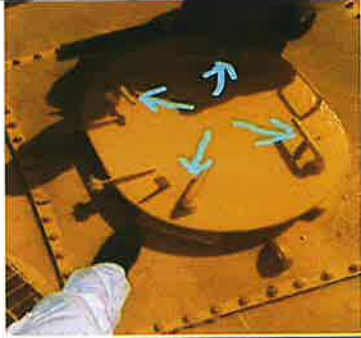

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04/03/2023 DIR – 034 (P-141- P-144)		
	P-141: Hull Bottom Anode Continuity Testing (Anode = Zinc w/20kg Weight (24"x4"x4" Volume). Satisfactorily conductive.	P-142: Rubber Fender Installation.
05/03/2023 DIR – 035 (P-145- P-146)		
	P-143: Mooring Arm Deck-timber Sheathing	P-144: Top View of Assembled Arms (Pipe, Balancing & Mooring Arms).
		
	P-145: Canvas Roof Installed- Satisfactory.	P-146: Manhole Covers Seating Confirmed Satisfactory with Chalk Test.

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07/03/2023 DIR – 036 (P-147- P-148)		
	P-147: Sigma Putty Application on Deck Thinned Down Area near Deck Rail	P-148: Before Non-Skid Coat Application on the Deck Topside (Note Sigma Putty applied area).
08/03/2023 DIR -037 (P-149- P-154)		
	P-149: Solar charging Battery Box.	P-150: Weather-tight Covers used for both Tugger Winch and Battery Box. Good Practice.
		
	P-151: Some areas under the Balancing arm found without painting. Final Punch listing. Area was painted.	P-152: Some areas on the Deck were found without painting. Final Punch listing. Area was painted.

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09/03/2023 DIR -038 (P-155)		
	<p>P-153: Inside access cover was not painted. Final Punch listing. Area was painted.</p>	<p>P-154: No Open-Close marking on the Access Door Handles. Final Punch listing. Marked.</p>
		<p>P-155: The SPBM Integrity is assured for Safe, Reliable and Uninterrupted Operation for another five (5) Years provided that an Effective Preventive Maintenance (PM) Program is in place and monitored closely. PM Program shall include:</p> <ul style="list-style-type: none"> a. Operating Maintenance Checks at least every 6-Month intervals. b. Maintain the Lubrication Process for PDU, Arms Mounting Pins, Mooring beams c. Perform periodic Diver Inspections to confirm Active Decay of Zinc Anodes. Rectify any inactive Anodes. f. Include inspections on Anchor Hawse Pipes for bad corrosion damages.

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Inspected by:

Eng. Y. S. Sisira Kumara – B.Sc (Eng), C.Eng, MIESL



Signatures:

Reviewed & Approved By:

Eng. Thushara Jayasinghe

B.Sc (Eng.), AMIESL, API Certified,



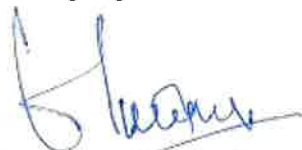
Signature:

Reviewed and concurred by:

Eng. G. C. Hapuarachchi– B.Sc Eng (Hons), C.Eng,

HLMIESL, MInstNDT, ASNT Level III

Senior Consulting Engineer



Signatures:

Date of issue: 08.06.2023

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Annex A – Scope of Work

01. Inspection of Docking & Undocking of the Buoy
02. Inspection of Clearing of Buoy including the removing of all marine growth
03. Inspection of Grit blasting up to the parent metal (LEVEL Sa 2.5)
04. Inspection of Painting of the Buoy (including power tooling if needed). Original Paint Scheme will be provided by CPC.
05. Inspection of repairing and replacement of rails and rail bed and conforming the welding procedures.
06. Inspection of replacement of all bushes and pins in 03 arms of the buoy
07. Inspection of Servicing of chain tensioning winch
08. Inspection of Refurbishment of the entire product distribution unit of SPM (PDU) (spares will be provided by the CPC) & witness the conducting of pressure test of PDU and rotation test of the buoy.
09. Inspection of Removing and re-fixing of fenders of Mooring Arm and repairing/replacing of fender brackets and repairing boat landing Ladder.
10. Inspection of Repairing of 06 Nos. water tight hatch doors and covers on the deck & leak test (04Nos hatch covers and 02 access hatch doors)
11. Inspection of Replacing of battery box and providing padlock-locking arrangement for battery box.
12. Inspection of Service/repair of toolbox and providing padlock-locking arrangement for toolbox.
13. Inspection of servicing of lifting davit
14. Inspection of Service/repair or replace trolley hoist Rail beam
15. Inspection of Service/repair of anchor chain hawse access including replacement /repair of access covers.
16. Inspection of servicing/replacement of anchor chain holders/stoppers
17. Inspection of expansion joint assembly following jobs to be carried out
 - Replacing 02nos expansion joints (Spares will be provided by CPC)
 - Replacing of rods (Spares will be provided by CPC)
 - Repair & replacement work on the other parts of assembly.
18. Inspection of Replacement of anodes and repairing of bracket (New anodes will be supplied by the CPC).
19. Inspection of replacement of wooden fenders on mooring arm and wooden plank to the mooring arm deck.
20. Inspection of Replacement/service of 02 Nos. of ball valves in central chamber/pipe arm.
21. Inspection of servicing the gear box of pipe arm ball valve & testing

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22. Inspection of Replacing the mooring beam anchor connecting pin & bush(spares will be supplied by the CPC)
23. Inspection of Replacement of Teflon Pads on all 03 arms.
24. Inspection of repair/replacement of under buoy pipe flange
25. Inspection of Repairing of 06 Nos. of Anchor hawser pipes
26. Inspection of Repair of Sounding pipes
27. Inspection of removing and refilling existing foam.
28. Inspection of Repair of the anti-fouling structure and providing of suitable canvas roof on anti-fouling structure.
29. Inspection of Replacing Navigation aids and solar array and service of Electrical wiring and fog horn.
30. Inspection of Thickness gauging of the plates of hull and deck structure where necessary.
31. Inspection and recommending of Replacement of plates where thickness are low
32. Inspection of Repairing of mooring fairlead and small boat mooring cleat.
33. Recommendation of Inspection on Weld build-ups as necessary.
34. Recommending carrying out any other work which affect to the integrity of the buoy.
35. Witness and certifying of all testing work related to the buoy repair work.
36. Inspection of mooring and confirming all chain angles after fixing the buoy to its original location.