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SPM Operation & Maintenance at BPCL, Kochi, India and KRML Experiences Since 2007

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Abstract:

KEI-RSOS Maritime Limited (KRML) is specialised in Operation & Maintenance of Single Point Mooring (SPM) Facilities in and around Indian Coast. O & M of SPM Facility at BPCL, Kochi is being done by KRML since 2007. Till now 676 crude oil tankers has been berthed successfully. The SPM facility is of CALM type with around 20 KM of Subsea pipelines. This Paper is presented to share the experience of major O & M activities handled by KRML. The technical, operational, safety related problems encountered and its solutions. It also incorporates a brief description on the activities such as hose & hawser maintenance and replacement activities, subsea pipeline pigging, diving and associated activities. Risk assessment, safety checks, logistics & marine spread management issues. The paper will help the offshore industry in understanding the status of present know-how and the future improvements needed.

1. Introduction

KEI-RSOS Maritime Limited (KRML) is an ISO 9001-2008, 14001-2004, 18001-2007 & ISM certified professional Company, comprising of young and result oriented marine professionals who have come together to ensure single point accountability of offshore oil field, port, construction and infrastructural related services for the marine and infrastructure industry on the east and west coasts of India.

The Company was established in 1999. Currently our team consist of most seasoned marine professional with rich experience and the company is handling various contracts related to Port Management, SPM Operations & Maintenance and Offshore Logistics.

Bharat Petroleum Corporation Limited (Kochi Refinery)'s (BPCL) SPM terminal is located in the Arabian Sea off Puthu Vypeen, which is about 12 km N.W of Ernakulum town. Puthu Vypeen area is under administrative control of Cochin Port Trust (CPT).

Bharat Petroleum Corporation Limited has started operation of its SPM facility at Kochi in 2007 and KRML was the first to take up the challenge of Operation & Maintenance of SPM and has continued till date by getting the contracts through competitive bidding.

2. Definitions

- SPM – Single Point Mooring STF – Shore Tank farm
- PLEM – Pipe Line End Manifold

Pigging - in the context of pipelines refers to the practice of using devices known as "pigs" to perform various maintenance operations on a pipeline include but are not limited to cleaning and inspecting the pipeline.

MBC: Marine Breakaway Coupling

3. Project Description

BPCL has given the contract to KRML for the provision of Operation & Maintenance of Single Point Mooring Facilities including but not limited to following

- Provision and operation of the Maintenance vessel and support vessel with tools, tackles, equipments, and manpower required for operation and maintenance of Kochi SPM
- Provide assistance to Pilot during tanker berthing/ castoff at SPM with suitable support crafts and carrying out hose connection/ disconnection/ tanker discharge monitoring/ continuous bow watch/ continuous manifold watch etc.,
- Carrying out scheduled and need based inspection activities of SPM system with supply and operation of underwater

videography for recording underwater inspection/ repair works and carrying out pressure testing/ leak testing of buoy with piping and hoses as part of planned/ unplanned/ maintenance works,

- Carrying out preventive maintenance, planned maintenance and unplanned need based repair activities buoy, floating hoses assembly, sub-sea hoses assembly, mooring hawser assembly and PLEM,
- Deployment of oil spill containment boom,
- Operation of Oil Spill combat equipments/ accessories like oil spill dispersants/skimbers/adsorbent pads,
- Maintenance of Owner supplied Oil Spill combat equipment,
- Provision and operation of twin screw engine boat,
- Conduct Pressure , vacuum test and electrical continuity test of individual hoses,
- Conduct leak/ integrity test of hose strings,
- Conduct burst test of hoses retrieved from service,
- Intelligent pigging of offshore crude pipe line.

3.1. General Climate

The climate of Kochi region according to Koppen's classification is tropical monsoon climate with seasonally excessive rainfall and hot summer. The region is characterised by annually recurring seasons or periods, which divide the year into three parts. The period from March to the end of May is the hot season. This is followed by the southwest monsoon season, which continues till the middle of October. From the middle of October begins the northeast monsoon season, which lasts till the end of February, although the rains associated with the North-East monsoon ceases by December and the rest of the season is generally dry. The climate is pleasant from September to February. Summer months from March to May are uncomfortable due to high temperatures and humidity.

3.2. SPM Location

SPM locations as established are as under:

- EASTING 614191.00 m
- NORTHING 1105284.90 m
- WATER DEPTH 30.0 m
- Seabed Features: SPM site seabed surface sediment is sandy clay. The seabed slope at VLCC location is about 1:500.

4. Project Execution

We have been rendering the services to BPCL for Operation & Maintenance of Single Point Mooring (SPM) facilities at Kochi since its inception i.e. 2007 to till date.

We have deputed a dedicated officer-in-charge in the rank of AGM (operations) for this project along with associated staff and office set up at Kochi to co-ordinate and liaise with all stakeholders for smooth execution of project. We have been handling approx 10 crude tanker per month at the SPM and till date we have maintained the SPM remarkably to facilitate the tanker berthings / un-berthings as per schedule without any delays.

Following men & material deployed at site for executing the project:

- Marine Spread:
 - Maintenance Vessel– M.V. Sea Diamond –II
 - Support Vessel - M.T. Bhuvan
 - Mooring Boat - Srinivasa
 - Twin Screw Boat - Amazon
- Operation & Maintenance Team:

• Contract Supervisor	-	1 No
• Diving Team Supervisor	-	1 No.
• Head Diver	-	2 Nos.
• Divers with mechanical skills	-	5 Nos.
• Qualified Riggers	-	4 Nos.
• Technician – Mechanical	-	2 Nos.
• Technician – Instrumentation	-	1 No.
• Licensed Electrician	-	1 No.

➤ Air Diving Spread:

Full set as required for SPM Operation & Maintenance

➤ Check Lists for SPM Operations & Maintenance:

- Daily Check list
- Weekly Check list
- Monthly Check list
- Pre-berthing Check list
- Post-berthing Check list
- Quarterly Check list
- Half-yearly Check list
- Annual check list
- Immediate after Cyclone

➤ SPM Operations:



Figure 1: Tanker Mooring at SPM Tanker



Figure 2: Pullback Operation by CPT Tug



Figure 3: Hose Connection onboard tanker



Figure 4: Deployment Oil Spill Containment Boom

➤ Major Maintenance Activities:

Following are the major activities we had done in respect of Maintenance of SPM facilities at Kochi till date:

- Intelligent Pigging of 48" Subsea Crude Pipeline from STF to SPM – one time during 2014
- Annual Inspection of SPM - Every year during 01st week of April
- Sub Sea Hose Without Umbilical Change out Operations - 4 times
- Sub Sea Hose with Umbilical change out operation – 01 time
- Inner string Floating hose change out Operations - 01 time.
- Outer String Floating Hose change out Operations – one time
- Mooring Hawser change out Operations - 3 times
- Intermediate hoses(08 nos) change out Operations – 01 time
- Uni-joint of Load Cell Pin - 01 time
- Lateral & Free Span survey of 48" Pipelines - Yearly

- Outer load cell pin change out - 01 time
- MBC change out Operations – 01 time
- Umbilical removal / servicing / installation – 1

With our dedicated operation & maintenance team, we have completed all the above maintenance activities successfully as per the scheduled time frame up to the satisfaction of BPCL with appreciation expressed from time to time.



Figure 5: Intelligent Pigging of 48 “ Offshore Crude Pipeline

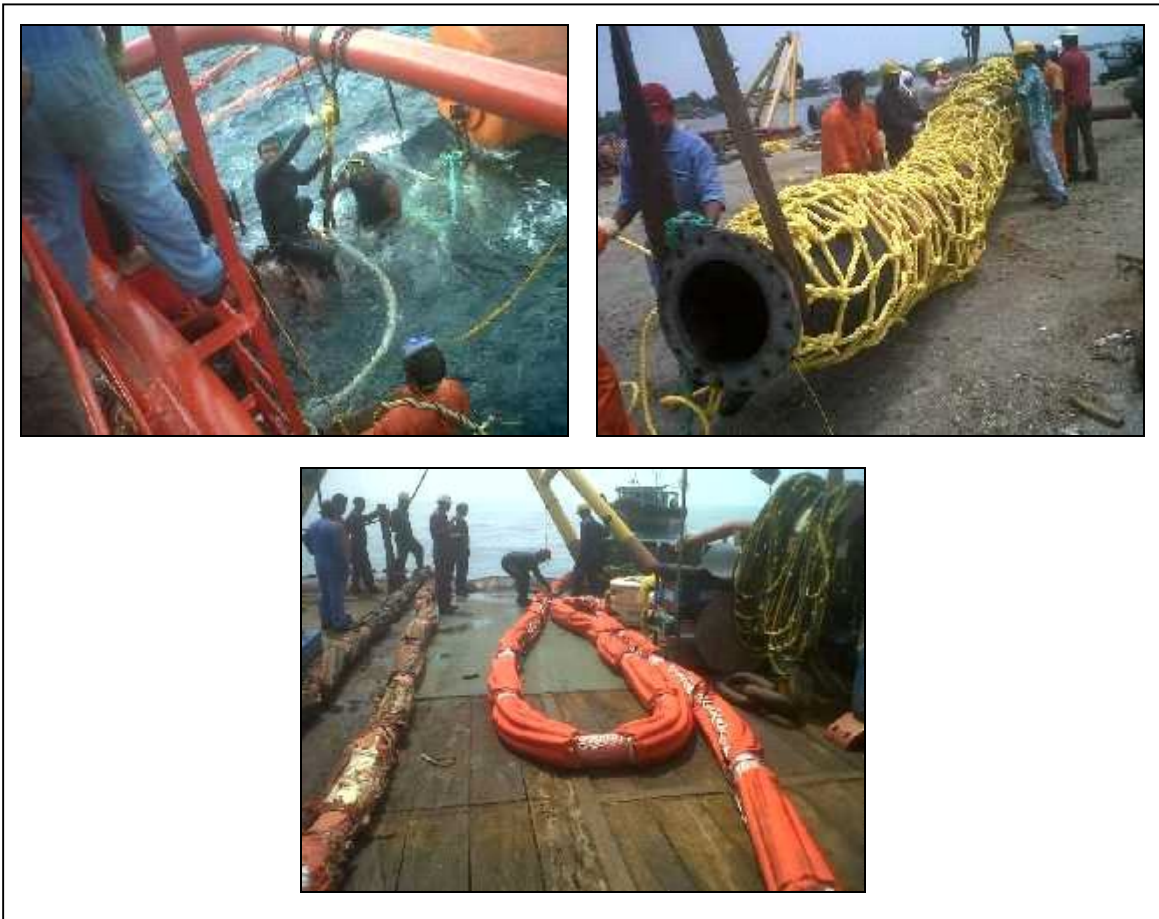


Figure 6: Maintenance Activities

➤ No. of tankers handled:

We have successfully handled 676 crude oil tankers of various types like Long Range 1 (LR1), Afra Max (AM), Suez Max (SM), Very Large Crude Carrier (VLCC) etc. at Kochi SPM since 2007 to till date.

➤ A typical Annual Inspection of SPM:

Surface Inspection :-

- a) General inspection of SPM:- All lightings, communication, navigational equipments, fog horn, Solar Panel, piping's, HPU system, Load cell system (measuring the bear & tear of shackles and end links at SPM). Painting work, Door's handles rubber biddings, Buoyancy compartments (measuring thickness of bottom & side plates), Ballast plates painting work, checking the movements of all the sheaves fitted on SPM. Checking the operational status of all valves (1001, 1002, 1003, 1004, 1005 & 1006) on SPM. Flow meters and All gauges. RTU compartment.
- b) Inspection of mooring assembly:- Both chafe chains bear & tear measurements, All shackles pins etc.
- c) Inspection of mooring hawser, "D" buoy assembly.
- d) Grease sampling, Inspection of main & swivel bearings by Rotation test.
- e) Tool tensioning test to check main bearing nuts and bolts efficiency.
- f) Cam lock assembly checking for operational status.
- g) Floating hose string inspection
- h) SPM winch inspection for operational status.
- i) Inspection of automatic flash light of life buoys
- j) Inspection of fire extinguishers.
- k) Boat landing's gratings inspection
- l) Inspection of wooden planks underneath the Uni joint.
 - Underwater Inspection :-
 - a) Videography inspection of both the Sub Sea hoses.
 - b) Videography inspection of hydraulic umbilical
 - c) Videography inspection of SUTU, All PLEM valves (5000.5001, 5002, 5003 & 5004) operational status by operating the valves.
 - d) Whole PLEM Videography inspection all cables etc.
 - e) Ultra Sonic measurements of 48" & 24" pipe line at various points by UT meter.
 - f) Sub Sea Hose configuration.
 - g) Videography inspection under buoy :- PDU Seal, Anchor chain passing through piping, locking plates, Whole spider, Angle measurement of all anchor chains, Thickness measurements of anchor chain of various links. Anode measurement and Readings by CP meter. Spool Piece, All nuts bolts of flanges. Inspection of FOB hoses.

5. Challenges Encountered

Since we are in this project continuously since 2007, we have faced challenges during the marine spread statutory dry-docks as we have to place a suitable vessel in place of the vessel going for dry-dock. With our well planned dry-dock schedule and being owned a fleet of 21 vessels (including OSV, AHTS, Tugs, etc.), we were coping up the situations and able to mobilize a suitable replacement vessel all the times during statutory dry-docks of existing marine spread.

In the west coast, during foul weather seasons we have to take special precautions for all the activities in offshore (ship board & diving) to avoid accidents & incidents.

Since the SPM is in harbor limits, the problems associated with fishing nets & fishing boats to be taken care.

6. Codes and Standards

All services for the project are being done as per all applicable standards of API/ DNV/ OISD/ ASME. Details of some of the standards are given below:-

REFERENCE CODES, STANDARDS AND SPECIFICATIONS

- DNV Rules for Submarine Pipeline Systems-1996
- ANSI B31.4 Liquid Petroleum Transportation Piping System
- API 1104 Standard for Welding Pipelines and Related Facilities
- API RP 1111 Recommended Practice for Design, Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines.
- AWS 5 11 E American Welding Society Standard
- ASME Boiler And Pressure Vessel Section IX Code
- SIS-055 900 Swedish Standard Pictorial Surface Preparation Standards For Painting Steel Surfaces
- OCIMF Guide to Purchasing, Manufacturing and Testing Of Loading And Discharge Hoses For Offshore Moorings Fourth Edition 1991
- OCIMF Recommendations for Equipment deployed In the Mooring of Ships at Single Point Mooring Third Edition 1993
- OCIMF Guide on Marine Terminal Fire Protection and Emergency Evacuation First Edition-1987

- OCIMF Recommendations for Oil Tankers Manifolds & Associated Equipment Forth Edition-1991
- OCIMF Guide to Purchasing Hawsers First Edition-1987
- OCIMF Single Point Mooring Maintenance and Operation Guide. January- 1985
- OCIMF/ICS/ International Safety Guide for Oil Tankers & Terminals Edition- 1991
- INTERNATIONAL ASSOCIATION OF PORTS & HARBOURS
- OCIMF SPM Hose Ancillary Equipment Guide Third Edition-1987
- OCIMF Anchoring Systems and Procedure for Large Tankers First Edition- 1982
- OCIMF Prevention of Oil Spillages through Cargo Pump room & Sea Valves second Edition-1991
- OISD-STD-113 Classification of Area for Electrical Installation At Hydrocarbon and Handling Facilities-1996
- OISD-STD-116 Fire Protection Facilities for Petroleum Refineries And Oil/Gas Processing Plants-1991
- OISD-STD-135 Inspection of Loading & Unloading Hoses for Petroleum Products-1996
- OISD-STD-139 Inspection of Pipelines- Offshore-1990
- OISD-STD-140 Inspection of Jetty Pipelines
- OISD-STD-141 Design and Construction Requirements For Cross Country Hydrocarbon Pipelines-1990
- OISD-STD-142 Inspection of Fire Fighting Equipments and Systems-1996
- OISD-STD-153 Maintenance & Inspection of Safety Instrument In Hydrocarbon Industry-1993
- OISD-STD-155 Personnel Protective Equipment-1995
- Part-I Non-Respiratory Equipment
- Part-II Respiratory Equipment
- OISD-GDN-156 Fire Protection Facilities for Port Oil Terminals-1992
- OISD-STD-176 Safety Training for Offshore Personnel-1996

7. Conclusion

This paper will be useful for the offshore industry as a source of knowledge & experience related to O & M of SPM facilities.

8. Future works

The oil transfer using SPM will become more & more popular in future as the tanker do not have to come to the jetty and hence all the safety & environmental related risks are avoided. As the draft at SPM is more, the tanker of VLCC size can be easily berthed.

9. Acknowledgments

We, KEI-RSOS Maritime Limited hereby thankful to Bharat Petroleum Corporation Limited for the confidence reposed on us for the long association from 2007 to till date for carrying out O & M of SPM facilities.

We also thankful & feel proud of our dedicated operation & technical team who are the part of successful journey of this project.