Pipe Marine Terminals – Its Multi-task Vessels SPM’s & Enhanced Safety Using Dynamic Positioning

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THE PAPER BRINGS OUT COST EFFECTIVE SOLUTIONS IN IMPROVING PERFORMANCE OF THE OFFSHORE SEGMENT OF A PIPELINE MARINE OIL TERMINAL ON THE BASIS OF CASE STUDIES IN AREAS RELATED TO:

- TERMINAL MULTI-TASK SUPPORT VESSEL
- TERMINAL MOORING BOUYY REPLACEMENT BY NEWER MAINTENANCE FREE TURRET TYPE BUOY’S
- OPERATIONAL SAFETY USING DYNAMIC POSITIONING
PIPELINE MARINE TERMINAL OVERVIEW

The Marine terminal is a key point for custody transfer and a point of sale/purchase between the buyer and seller of hydrocarbons.

A typical pipeline Export Marine terminal consists of the following main working sections:

- Tank Farm
- Pumping and Metering station
- Metering station to beach valve pipeline section
- Subsea Pipe Line – Beach Valve to (PLEM).
- Subsea flexible hoses from the PLEM to the Single Point Mooring (SPM)
- Floating Hoses from the SPM to the export oil Tanker cargo
- Manifold
GNPOC Marine Terminal is a SPM facility located 13 NM south of Port Sudan harbor in the Red sea

Tank farm capacity 10 X 400,000 Barrels

The crude oil comes to the Terminal via a 1500 Km on land Pipeline from Higleig CPF
Duties during berthing operations & surface IMR

- Mooring assistance to tanker & stern tow
- Haul floating hose string on deck & Flush string
- Test, replace hoses & collect oil waste in slop tank
Duties during Fire fighting & Pollution control Task

- Operate fire pump & monitor with an effective water jet
- Towing tanker to a safe location
- Rig up & operate oil spill Dispersant System
- Boom deployment to trap & curtail oil spill
- Recover, store & dispense recovered oil
Marine support is needed for:

- Environmental protection & Fire Fighting
- Surface equipment inspection maintenance and repair
- Sub-surface inspection maintenance and repair
Duties during Diving Support

- Hold vessel in position (4 anchors if needed)
- Diving gear launch & retrieve
- Dive control & supervision
- Handle diving emergency
Custom built boats may not be readily available on Time charter

Minor modifications on commonly available tugs / OSV’s can meet specific needs of the Terminal
Primary Vessel’s Specs

- LOA 45.70m, Beam 11.22m, Aft Draft 4.5m.
- Bollard Pull 50.00 ton (m)
- Speed 11.3 kn, Engine 2x2000 bhp
Mezzanine deck built for fitting diving support container

- Fire line modified for hose flushing
Slops tray and tank to prevent spillage whilst splitting hose flanges
“A” Frame fitted to lift hose over the stern roller
Gun gates enlarged & rollers fitted
TURNTABLE

BUOY
TURRET
CASE STUDY OF SBM REPAIR VERSUS REPLACEMENT

BACKGROUND

- ADMA-OPCO exports crude oil & condensate through two SPM loading terminals, TB3 & TB6, at Das Island.

- The new TB6 SPM was successfully commissioned in Dec. 2005, as a replacement to the old fixed tanker berth No. 2 (TB2).

- The old TB3 SPM was due for a major overhaul in 2005, however, it was kept in service until June 2006, to allow for installation & commissioning of TB6.

- TB3 buoy was a SOFEC turntable type, which requires a major overhaul every seven (7) years. However, the new TB6 buoy is a Bluewater turret type, designed to operate for 25 years in water without any major overhaul (dry docking or in situ).
LIFE CYCLE COST STUDY

BASED ON EXPERIENCE GAINED DURING TB6 DESIGN (FEED), DETAILED ENGINEERING (EPC) & FABRICATION, AND FOLLOWING THE REVIEW OF TURRET BUOYS IN SERVICE FOR OVER 20 YEARS WORLDWIDE, ADMA-OPCO COMMISSIONED A STUDY TO REVIEW THE LIFE CYCLE COSTING OF OVERHAULING OLD TB3 BUOY VS. REPLACEMENT WITH A NEW TURRET BUOY, IDENTICAL TO TB6.
LIFE CYCLE COST STUDY

THE OUTCOME OF THE STUDY WAS VERY FAVOURABLE FOR THE REPLACEMENT OF TB3, BASED ON THE FOLLOWING ADVANTAGES:

- COST SAVING (CAPEX & OPEX)
- NO BUSINESS INTERRUPTION FOR 25 YEARS
- SAFE OPERATION FOR MAINTENANCE PERSONNEL
- MINIMAL LIFETIME SPARES
- OPERATIONAL BENEFITS (TWO IDENTICAL BUOYS)
- AVAILING SAFE AREA FOR TELEMETRY EQUIPMENT
- MAXIMIZING SPACE FOR SOLAR POWER PANEL
- LOW MAINTENANCE
- SINGLE UMBILICAL (HYDRAULIC & ELECTRIC)
SPM TERMINAL
LESSONS LEARNT

- AVOID BAD WEATHER WINDOW FOR OFFSHORE INSTALLATION WORKS.
- UTILIZE JACK UP BARGE INSTEAD OF FLOATING BARGE FOR BUOY INSTALLATION WORK, FOR PRACTICAL & ECONOMICAL REASONS.
- RE-TEST PLEM VALVES (2 NOS.) AND BUOY ISOLATION VALVES (4 NOS.) PRIOR TO INSTALLATION, IN ORDER TO AVOID UNFORESEEN SURPRISES.
- ENSURE THAT HOSE FLANGES ARE MATCHING WITH BUOY AND PLEM FLANGES, I.E HAVING THE SAME RATING.
- REPLACEMENT OF COMPLETE PLEM WITH NEW VALVES, IS TECHNICALLY & COMMERCIALLY MORE ATTRACTIVE AS COMPARED WITH REFERBISHMENT OF THE OLD PLEM & VALVES.
- UTILIZATION OF METALIC REDUCER IN LIEU OF REDUCER HOSE (20” TO 16”) HAS GREATER ADVANTAGE/ FLEXIBILITY.
- DE-OILING AND DE-WATERING OF PIPELINE SHOULD BE WORKED OUT IN FULL DETAILS, WELL AHEAD OF THE ACTUAL CAMPAIGN.
- COMPREHENSIVE CONTENGENCY MEASURES, INCLUDING PROVISION OF SELECTED INSTALLATION MATERIALS, SHOULD BE PUT IN PLACE TO CATER FOR ALL UNFORESEEN EVENTUALITIES.
CONCLUSION

SUCCESSFUL COMMISIONING OF A NEW, FIT FOR PURPOSE SPM LOADING TERMINAL, WHICH IS SUITABLE FOR 25 YEARS CONTINUOUS OPERATION, AS A REPLACEMENT FOR OLD TB3 TERMINAL. THIS WAS ACCOMPLISHED WITHIN BUDGET, ON TIME, WITH HIGH QUALITY AND EXCELLENT SAFETY RECORD.
PROBLEMS & SOLUTIONS

- **DE-OILING OF TB3 EXISTING LOADING LINE.**
  
  100,000 BBL OF SEAWATER WERE INTRUDUCED INTO PIPELINE BY TANKER TO FLUSH BACK THE OIL TO A NOMINATED TANK ON DAS ISLAND.

- **POSITIONING OF NEW PLEM IN PLACE OF OLD PLEM.**
  
  DREDGING WAS REQUIRED TO ALIGN PLEM WITH EXISTING PIPELINE. ALSO SHIFTING OF NEW PLEM WAS REQUIRED TO AVOID ANY DAMAGE TO EXISTING PIPELINE FLANGE.

- **FIXATION OF NEW UMBILICAL TO SUBSEA HOSE.**
  
  NEW BRACKETS WERE DESIGNED BY BLUEWATER TO SUITE EXISTING SUBSEA HOSE AND FABRICATED & INSTALLED BY NPCC.

- **REPLACEMENT OF DEFECTIVE D-SHAKLE DURING EXTENSION OF CHAIN #2.**
  
  AVAILABILITY OF SPARE D-SHAKLES (AS CONTENGENCY MEASURE) HAS PAID OFF.

- **DE-WATERING OF TB3 COMPLETE LOADING SYSTEM.**
  
  100,000 BBL OF OIL WERE TAKEN FROM TB6 BERTH AND UTILIZED TO FLUSH THE WATER BACK TO A NOMINATED TANK AT DAS ISLAND.
CHALLENGES

- REPLACEMENT OF PLEM WITHOUT CAUSING ANY DAMAGE TO PIPELINE END.

  This was achieved by keeping/reusing existing tie-in spool and making necessary adjustment for installation of PLEM (shifting PLEM center by 1.5m away from old C/L).

- ENSURING SUFFICIENT CHAIN LENGTH, ESPECIALLY AFTER SHIFTING OF BUOY CENTER BY 1.5M.

  This was successfully accomplished through pre-installation survey to inspect the available slack in each chain, which confirmed suitability of chains except Chain #2. Recommendation made by buoy manufacturer to extend this chain by 10m.

- CONNECTION OF EXISTING 150-LBS HOSE FLANGES TO BUOY & PLEM 300-LBS FLANGES.

  This was managed by utilization of suitable adaptors and reducers, as applicable.
CHALLENGES

THE MAIN CHALLENGES FACED BY THE PROJECT MANAGEMENT TEAM (PMT) WERE AS FollowS:

- UTILIZING JACK-UP BARGE INSTEAD OF FLOATING BARGE. THIS SELECTION HAS SIMPLIFIED THE INSTALLATION WORK BY AVOIDING ANY POTENTIAL DAMAGE TO SURROUNDING PIPELINES THROUGH MINIMIZING RUNNING TOO MANY ANCHORS.

- INTERFACE OF NEW BUOY TO EXISTING ANCHOR LEGS (PILES & CHAINS). THIS WAS SUCCESSFULLY CONFIRMED THROUGH MOORING ANALYSIS CARRIED OUT BY THE MANUFACTURER (BLUEWATER).

- INTEGRITY ISSUES REGARDING EXISTING PILES, CHAINS & PIPELINE. THIS WAS CONFIRMED BY INTEGRITY INSPECTION CARRIED OUT BY ADMA-OPCO FOR EXISTING FACILITIES.
LESSONS LEARNT

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VIEW OF TB3 FROM LOADING TANKER
Using Dynamic Positioning in reducing risk of Human factor in offshore accidents

**Background**

- In the mid eighties over 40 Indian Flag OSVs and other offshore vessels were inducted in the national offshore Fleet.
- As per the prevalent practice, the OSV’s operated and maneuvered in the oil fields using the practical ship handling skills of the Master/ Captain
- Similarly offshore drilling units and Diving support used Marine anchor mooring systems to keep the vessels in position during operations.
- It was observed that the vessel handling skills of the Vessel’s captains /masters varied from
Induction of DP Vessels

- With the passage of time, the technology of using multiple thrusters operated by computer controls brought in enhanced safety in the Drilling, diving and other offshore support services. It also brought in unsurpassed accuracy while maneuvering very close to offshore installations... The vessels using this technology are termed as dynamically positioned vessels and are classed as DP – 1, DP -2, DP -3 based on the factor of redundancy inbuilt in the vessel
Environmental forces acting on a vessel and balancing thruster forces
A brief outline of the system

- Sensors monitor the environmental effects on the vessel such as effects of swell and wind and use these errors to compensate the reference systems such as Taut wire systems, Microwave (Artemis) and propulsive power units.
- Propulsive power units take the form of main propulsion units, thrusters and steering gear (in conjunction with propulsive unit). These units can be mounted fore and aft and may either be fixed or steerable.
- The number of reference systems, sensors and propulsion units is determined by the duties of the vessel.
Conclusion

Based on the high level of accuracy in station keeping by the use of DP and keeping in mind the findings of accident investigating agencies it may be concluded that the accidents in the offshore industry due to the human factor can be greatly reduced, by use of DP.