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RECENT DEVELOPMENTS IN OFFSHORE HEAVY LIFT AND PIPELAY INSTALLATION

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TURKISH OFFSHORE ENERGY CONFERENCE – Istanbul, 19-21/06/2013

SCOPE OF PRESENTATION

- A Brief Introduction of SAIPEM
- Offshore Heavy Lift Operations
 - Design and Operational Issues
 - Case Study: Heavy Lift & Installation onto Truss Spar (Multi-Floating Body Operations)
- Pipelay Installations
 - Design and Operational Issues
 - Shallow Water Operations: DP Propeller-Wake Induced Scour
 - DP pipelay in Deep Water
- Discussion & Conclusions



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COMPANY PROFILE – Saipem Ltd.

- Main Contractor in Offshore Oil & Gas Sector
- Large Complex Projects
- Multi-disciplinary Engineering
- Design
- Project Management (EPIC)

Offshore Transport





Installation / Decommissioning



Pipeline and Subsea Construction





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OFFSHORE HEAVY LIFT AND TRANSPORT – DESIGN AND OPERATIONAL ISSUES





Load Out

Transportation







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Lift Off

17755 S

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OFFSHORE HEAVY LIFT AND TRANSPORT – DESIGN AND OPERATIONAL ISSUES



Set Down





Jacket Upending, Docking & Set Down/Removal



Pile Stabbing, Driving & Grouting

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RECENT HEAVY LIFT APPLICATIONS- LIFT & INSTALLATION ONTO TRUSS SPAR

- Horizontal excursion due to wave drift, wind and current
- Sensitive to weight changes due to small waterplane area
- Tilting due to load transfer
- DP Heavy Lift Vessel is ideal to keep track of the truss spar movements





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RECENT HEAVY LIFT APPLICATIONS- LIFT & INSTALLATION ONTO TRUSS SPAR

Removal/Installation from Truss Spar Platform



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RECENT DEVELOPMENTS IN OFFSHORE HEAVY LIFT AND PIPELAY INSTALLATION

TECHNICAL ANALYSIS – MULTI-BODY HYDRODYNAMICS



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TECHNICAL ANALYSIS – INSTALLATION AIDS

Removal/Installation Aids

- Motions induced by interaction (SSCV/Spar/Module)
- Stiffness and damping derived from load/deflection (non-linear)



Fixed Boundary Condition

with shell elements

TECHNICAL ANALYSIS – OPERABILITY ANALYSIS

2:10

1.4:103 8571

285.7

- 285.7 - 8571

-14×103

- 2×10

2:10

1.44103 857.1

285.1 - 285.7 - 857.1

-1.4-103

33

The time-domain nonlinear 6-DOF numerical models is used to produce the operability rosette





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OPERATIONAL METHOD – TRANSFER OF MODULE(S) WEIGHT ONTO THE TRUSS SPAR

- Operational Issues
 - Approach to the Platform and Positioning
 - DP Vessel Movements
 - Allowable riser movements (elevation)
 - Tilting of the spar platform (with respect to the Module Weight and COG)
 - The different approach for the lifting and installation onto the Truss spar
 - Hoisting speed
 - Rapid ballasting of the SSCV
 - Tilting of the spar platform







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OPERATIONAL METHOD – PRE-LIFT&INSTALLATION STAGES

Monitoring Truss Spar Movements



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OFFSHORE PIPELAY INSTALLATION- DESIGN AND OPERATIONAL ISSUES

- Typical pipeline design activities:
 - Deep-water and shallow water Lay
 - Upheaval / Lateral Buckling
 - Trenching and Backfilling; Deepwater and shallow water





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PROPELLER-WAKE SCOURING DURING OPERATIONS IN SHALLOW WATER

- Shallow Water Trenching and Backfilling:
 - Alternative to dredging in shallow water and cost effective
 - Key consideration in shallow water is awareness of potential seabed erosion
 - Possible Reasons:
 - Slow speed , high force for hard-going soils in shallow water
 - Station keeping due to environmental effects
 - Slow/speed manoeuvring and move/stop operations due to obstacle
- Shallow Water Pipelay Operations with DP S-Lay Vessel:
 - Possible Reasons:
 - Slow Speed as required for laying pipes
 - Station keeping due to environmental effects i.e. strong currents



Scour observed during trench trials

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RECENT DEVELOPMENTS IN OFFSHORE HEAVY LIFT AND PIPELAY INSTALLATION

PROPELLER-WAKE SCOURING DURING OPERATIONS IN SHALLOW WATER

- Parameters:
 - Tow Force / Residual Lay Tension
 - Ploughing / Vessel Speed
 - Soil Parameters
 - Water Depth
- Numerical Model:
 - Turbulent flow models (CFD) for propeller-wake induced velocities on seabed
 - Correlating CFD with the axialmomentum theory numerical model
 - Velocities from the correlated numerical model to soil erosion numerical model for the estimation scour (erosion) depth and width

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Maximum Sea Bed Velocity (Water Depth=11.2m, Tow Force= 350t)



- Position of seabed (distance of propeller axis), zb
- Sediment transport per unit width (S)







PROPELLER-WAKE SCOURING DURING OPERATIONS IN SHALLOW WATER





- □ Static Vessel
- □ 350t tow force
- 20m water depth

- □ Static Vessel
- □ 350t tow force
- □ 27m water depth

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 CastorOne is designed to lay pipelines in S-Lay mode in deep/shallow waters, including shore pulls, and continue in ultra deep waters in J-Lay mode.

 CastorOne, as a vessel is suitable for laying large diameter, long distance, ultra deep pipelines economically.

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- CastorOne complies with ABS DPS-3 Class Notation
- Main engines: 8xWartsila 12V38B
- Tunnel thrusters: 3x2500kW
- Azimuth thrusters: 6x5500kW
- Main propellers: 2x6000kW
- Class Notation: +A1 (E), pipelaying vessel, +ACCU, +DPS-3, CRC, TCM, CM, ice class A0 (IA Baltic)
- Sensors: 2xDGPS, 2xTaut wires, 2xHiPAP 500, 3xGyrocompasses, 3xMRUs, 3xWind sensors



Length = 325m Accommodations = 702 Welding Stations = 4 Working station = 6 Lays Triple Joints (120'), as well as double or single as required Tension Capacity = 750t A&R System = 750t

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- External Forces assigned directly to Controller (feed forward):
 - Wind Force (through wind velocity and heading measured by anemometer, filtered)
 - Pipe Force (static residual lay tension assigned explicitly from Pipe Lay Guidance (PLG) Software, or directly from tensioner)

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MAIN DP STUDIES

- Assessment of CastorOne DP performances and laying capabilities in harsh environments
- Assessment of CastorOne DP performances in case of failure of thruster(s), power generator(s), bus bar(s)
- Study of DP Control System improvements, to increase the vessel performances
- Assessment of the interaction between vessel, tensioner, and pipe (shallow waters)
- Simulation of the "true" DP Control System installed on board the vessel (using FIPLA Advanced Version)
- Preparation of a DP Operating Manual Section, including a proposal for the DP Operator in terms of setting of the DP parameters, according to the weather forecast.

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- More challenging design and operational conditions in line with new technological developments on vessel design i.e. DP systems requires more sophisticated analysis and engineering methods for offshore heavy lift and pipelay installations.
- The detailed numerical analysis to study the interaction as well as the independent movements of floating structures is essential
- The validation of numerical model with real-time motion data and the realistic loading conditions. The FEA models provide realistic understanding of non-linear behavior during impact/interactions between multi-floating bodies.
- Analytical techniques and powerful numerical models (CFD) with good soil data provide robust and cost effective solutions for pipelay operations
- The controlled stage-by-stage lifting and installation method can be devised in line with the detailed numerical analysis for heavy lift operations.
- By implementing the limitations and alternative solutions identified by detailed numerical and engineering analysis during planning and operation phases of a project the potential risks are significantly reduced.



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