Field Experiences of Aging Infrastructure -

Sigve Halvorsen
Sep 2015

Celebrating success – Maersk Reacher onto Valhall DP

July 10th 2014 - Maersk Reacher jack-up rig successfully installed alongside Valhall DP for a two-year well decommissioning programme.

Major milestone - particularly as the Valhall decommissioning project has a global risk focus.

Significant Survey & Positioning Challenges:

- Platform not designed for jack-up drilling – platform legs “battered” and drilling slots in centre
- Need to reach 30 well slots in total, with sufficient drilling hook load capacity
- Complex seabed – infrastructure, legacy drill cuttings, buried debris, LoF seismic cables…

-This resulted in a very tight position tolerance (+0.0/-0.2m fwd/aft, ±0.5m prt/stb, ±1° heading).

Survey & Positioning Strategy

Survey & Positioning Strategy

The overall S&P strategy needed to account:

- rig / platform steel-to-steel tolerances
- drilling envelope and hook load capacity
- geometry of slot locations and platform edge
- what could / could not be removed from the platform
- seabed soils conditions
- initial rig stand-off location and temporary anchor locations
- rig inclination effects during ‘jacking up’ to drilling height
- accuracy of onboard positioning systems and existing data
- avoiding damage to seabed infrastructure (by legs or anchors)

Planned Maersk Reacher locations 2011

Valhall DP Subsea Overview 2012

> 3 year survey & planning process

- 2010 – bathymetric, geophysical surveys and environmental sampling to check for spud can location restrictions, soil contamination etc
- 2011 & 2012 – initial and detailed drill cuttings pile survey sampling and geotechnical investigation – to understand spud cans soils interaction
- 2012, 2013 – seabed surveys to confirm exact location of assets and buried debris at proposed spud can locations
- 2013 high accuracy platform dimensional control survey & definition of LAT water level – to ensure we have an accurate understanding of the physical interface / clashes between rig and platform external footprint – parts of platform had to be physically removed
- 2014 seabed dredging / remediation, buried debris removal and environmental monitoring, with further confirmation surveys
- 2010 - 2014 detailed rig move position planning, charting, disparate data integration & execution support for move and installation.

Buried Debris Survey – Pan Geo 2013

High and low frequency chirp sonar projectors

- Sub-seabed interrogation depth of 5 metres, with a 5 metre width
- Acquire volumetric sub-bottom acoustically imaged datasets of the two drill cutting survey grids

Buried Debris Survey - Pan Geo 2013

Buried Debris Survey – Pan Geo 2013

Examples of sediment related anomalies within the drill cuttings

Buried Debris and Spudcan Locations 2013

4 items close to spudcan to be reviewed

2 items close to the spudcan, to be reviewed

Pre and Post dredging - 2014

Pre dredging

Post dredging

Survey input – Topsides Preparations and MR Installation

- 2013 Valhall DP topside - Dimensional Control Survey
  - Fieldwork Fugro AS
  - Verification and revision of topsides model
  - Input into topside planning to identify obstructions to Maersk Reacher
  - Input into Animation modelling
  - Update BP charts
  - Rig airgap clarification
- 2014 Rig intake, and as-installed survey

Dimensional survey – DP West

Deck external footprint had to be accurately mapped at several levels to determine what needed to be physically removed

Dimensional survey – Block shift in 3D model

Adjusting 3D model to LAT height. Data taken from Wave radar (QP & PH)

Wave radar

Clash test

Safety distance steel to steel was 1.5 meters

Removal of Platform structures

Click picture for animation

Concept Illustration & Animation AS

Dimensional survey – DP West

Before removal of structures

Dimensional survey – used when defining final air

Data Integration – Final planning for Maersk Reacher July 2014

Click picture for animation

Pre lay of anchors.

Anchors installed close to LoFS cables

Two «hold back» anchors installed

Platform close approach

Main positioning aiding on the final approach was total stations on the platform side. Backup system was GPS system.

Combined with high accurate gyro/attitude sensor →survey error <15cm

Platform & rig using same survey geodesy (ED 50)

Rig intake

Euro drone system installed on Tugs.

Remote target tracking for navigation system

Final position

Final position

As install position was 0.2 meters in 315° from the intended position

Heading was (+)0.87° from intended heading.

TARGET BOX

Repeat the step on Valhall East side 2016

Click picture for animation

Concept Illustration & Animation AS

Conclusion and experience

- Aging structures / decommissioning requires advanced survey technics, both topside and subsea.
- Using topside 3D models in the planning and executing process is very useful for:
  - Clash test – steel to steel limitations
  - Structure impact, I.E crane limitations, crane reach, designing bridge and bridge landing area
- Collected laser scanning data should be supplied in local and global grid. We only had the scanning data in local grid.
- The data amount from scanning is very large and requires complex software (if supplied as point cloud).
- Can we use 3D modelling direct /online during rig moves?

Any Questions?

Thank you.