Aasta Hansteen
Operational Experiences
FFU Seminar – 28th January 2016
Tom-Erik Henriksen
Agenda

- **Introduction to Aasta Hansteen**
- Main Challenges & Risks
- Operational Experiences - 2015 Campaigns
Aasta Hansteen – Pioneer in Norwegian Deep Water

- Dry gas field
- 1300 m water depth
- Reserves 47 billion Sm3
- Process capacity 23 million Sm3/day
- Seven production wells
- New 480 km gas pipeline to Nyhamna (Polarled)

Production start up: 2018

Licence Partners:
- Statoil 51% (Operator)
- Wintershall 24%
- OMV 15%
- ConocoPhillips 10%
2015:
- LBL
- Structures
- Umbilicals / Jumpers
- Mooring Anchors
- SCR Hold-back Anchors

2016:
- Flowlines / SCRs
- Spools
- Mooring Lines
- Tie-in / RFO

2018:
- Spar Tow-out
- Mooring Hook-up
- SCR Pull-in

1 slot Snefrid Template
4 slot Luva Template
4 off Steel Catenary Risers
2 off Production Flowlines
4 slot Haklang Template
1 off Production Flowline

1 off Production Flowline

Dynamic Umbilical
Umbilical Riser Base

Gas Export PLEM & Pipeline

Jumper

17 off Mooring Lines

1 off Production Flowline

Fiber Optic Cable
Mooring system
Vessels & Assets

- Seven Artic to install Spools
- Tie-in and RFO vessel TBN + 3rd Party vessels for:
  - Towing of SPAR
  - Supply of Water/MEG

- Havila Subsea
- Normand Oceanic
- Skandi Acergy
- Skandi Skansen
- Seven Oceans
- Skandi Skansen
- Seven Viking

2015
2016
Agenda

- Introduction to Aasta Hansteen
- **Main Challenges & Risks**
- Operational Experiences - 2015 Campaigns
Challenges & Risks

• Challenges
  - Deepwater technologies are generally not designed for North Sea environmental conditions
  - Motion patterns of the SPAR
  - Fatigue of SCRs
  - Resonance
  - Seastate and current

• Risk
  - Use of local (inexperienced) subcontractors
  - Tow out of SPAR
  - Limited float between campaigns - SIMOPS
  - RFO Downline
  - Pipe buckling and walking
  - Pull-in of SCRs
  - Handling of mooring ropes / hook-up
Water Depth, Weather & Current

Pipeline Catenary Shape
70 degrees ramp angle

- Water Depth [m]
- Horizontal Distance from vessel to Touchdown [m]

1-year extreme current in the lay direction
No current
1-year extreme current against the lay direction

1300m Water Depth

Resonance

<table>
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<tr>
<th>Depth [m]</th>
<th>1st eigenperiod [s]</th>
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<tr>
<td>100</td>
<td>2.04</td>
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<tr>
<td>300</td>
<td>3.53</td>
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<tr>
<td>500</td>
<td>4.6</td>
</tr>
<tr>
<td>700</td>
<td>5.4</td>
</tr>
<tr>
<td>900</td>
<td>6.15</td>
</tr>
<tr>
<td>1100</td>
<td>6.8</td>
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<tr>
<td>1300</td>
<td>7.45</td>
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</table>
Local Infrastructure & Fabrication

• Personnel logistics and crew changes
  – Flights, accommodation, local transport

• Quayside and base facilities
  – Harbour facilities Sandnessjøen
  – Harbour facilities Mo i Rana

• Fabrication & Mobilisation support
  – Delivered on large fabrication packages
  – Seafastening
Agenda

• Introduction to Aasta Hansteen
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Marine Operations 2015
Planning for Marine Operations in 2015

• 2,5 years of planning and engineering
  – Plan, plan and plan has been essential
  – Thorough design reviews and risk assessments
  – Experience transfer from previous projects

• Short installation window due to harsh environment (May to August)
  – Robust solutions
  – Focus on effective installation

• Exceptions for installations outside window:
  – Subsea Positioning System (LBL)
  – Polarled PLEM and Tie-in operations
Weather and Current

- Strong current
  - Included as important factor during design engineering
  - Light products drifted more than expected
  - Smaller impact on installation times

- Harsh weather conditions
  - Robust schedule and efficient operations
  - Very good summer season between 1st of May and 31st of August.
  - Operations outside window more challenging with sudden changes in seastate
  - Swell and wind direction important factors together with Hs

- Polar lows
Superimposed Weather Assessment

- Skandi Acergy
- October-November 2015 campaign
- Installation and direct tie-in of 300Te Polarled PLEM

Weather window suitable for installation and wet-storage and significant peak thereafter
What we expected...
What we got...
Current

- A method was developed to check current through the full water column without bringing additional equipment on every campaign.
- Excursion data from ROV/TMS were used for current heading and strength checks.
- Approach is dependant on system properties (weight, wire stiffness, shape of ROV system) and available MetOcean data to compare excursions to.
Current

Method:
- Analyse impact of current on applicable ROV/TMS system
- Develop spreadsheet with comparison to MetOcean values: 90% probability, 1 year current, 10 year current
- Offshore: deploy ROV with HiPAP transponder on TMS
- Record offset from launch and bearing
- Insert into spreadsheet and calculate offset for deployments
- Evaluate current direction
Crane wire ‘resonance’

- Analysis: Resonance peaks may coincide with wave periods at larger depths 700m to 1250m

- Practise: Guideline for Crane operators and Shift Supervisors on how to identify ‘resonance’ and what to do:
  - Live crane load plot to track peaks and trends
  - A range of methods to tackle potential resonance: change in crane pay-out speed, engagement of AHC, vessel heading change, etc
Crane wire ‘resonance’

- Empirical evidence from deployments: existence of mild resonance can be argued, typically for lifts >200Te in water
- Increase in dynamics from 600m-700m water depth as per theoretical analysis and expectations
- Spectral analyses completed, however it does not strictly confirm that most of dynamics appear at primary swell Tp

Mild resonance period... Spectral density of the hook load shows most energy in 7s and 10s periods. Note: primary wave Tp = 7.9s

Haklang manifold deployment
247Te in air, 210Te in water
Water Depth - Pre Launch Checklists

- Important with good checklists
  - Extended testing/audit of vessel systems
  - Equipment updates – crane software/wire length
  - Ensure right tooling and set-up
  - Leak test on deck to ensure no loose fittings etc.

- Launch and Recovery of ROV’s
  - Typical time - 45min

- Deployment and Recovery of structures
  - Typical crane wire speed through water column (if no resonance): 0.5m/sec
  - Typical deployment/recovery time: 30min to 40min
Water Depth - Survey – Nasnet LBL Array

- Survey accuracy at 1300 meters
  - Use of Nasnet LBL system for more accurate positioning
  - Installed from MHS onboard Havila Subsea
Umbilicals & Jumpers – Lessons Learned

- Strong current.
- DNV approved tool to assess safe overboarding offset. Reducing offset from ROV current offset, reducing standard distance.
Umbilicals & Jumpers – Lessons Learned

- Lay speed reduced.
- Should consider to use main crane instead of whipline even though weight is less than 20Te to decrease offset.
- Possibility that umbilical have an S shape through the water column due to current in different directions à not sure where umbilical is located. See pic below.
- Subsea transfer can be challenging. Transfer rigging should be a lot longer than static distance if possible.
Umbilicals & Jumpers – Lessons Learned

• Shepherds hooks made for ROV to assist during lay (strong current vs light product).
Suction Anchors – Onshore Preparations – Mo i Rana
Suction Anchors – ROV Interfaces

• ROV docking for positioning and orientation

• Ballgrab solution for single point lifting
Suction Anchors – ROV Interfaces

- Stab and pump solution for suction penetration of anchors
- Straight and good penetration
POLARLED PLEM - Direct Tie-in

PLEM

FSP

36" pipeline
POLARLED PLEM - Direct Tie-in

- Pipe elevation
- PLEM yaw, pitch and crawl by hydraulics
POLARLED PLEM Installation / Tie-in

- Newly developed tooling packages for direct tie-in of 36” pipeline
- Big and heavy tooling
- 3 different hydraulic oil types
- Different stab types on almost all tooling

Torque Tool - 6Te
### Complex ROV hydraulic setup

<table>
<thead>
<tr>
<th>Stabs tool side</th>
<th>Hoses</th>
<th>Stabs ROV side</th>
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<table>
<thead>
<tr>
<th>Tool Description</th>
<th>Hose Length (m)</th>
<th>Pressure (bar)</th>
<th>Flow (l/min)</th>
<th>System (lit)</th>
<th>Hose Size (mm)</th>
<th>Hose Name</th>
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#### Hose Diagram

- **A**: Fill In
- **B**: Flex-In
- **C**: Flex-Out

#### Hoses

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<th>Hose Name</th>
<th>Location</th>
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#### Tool Kits

- **Subsea basket**: A
- **Subsea basket**: B
- **Subsea basket**: C

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**Note:**

- The image contains a table with various tool descriptions, hose lengths, pressures, flows, systems, hose sizes, and hose names, along with a hose diagram indicating connections and locations.

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**Seabed to Surface**
ROV work packs

- Struggled with thin oils, pump not building pressure
- Sheared spline in drive shaft. Split skid for maintenance access
- Big heavy skid, blocking altitude meter and Doppler radar.
- Last minute order, buoyancy rating
subsea 7

seabed-to-surface