Use of subsea Multiphase pumps as an alternative to ESP workover in a mature field development

Kia Katoozi
Agenda

• The Otter Field
• ESP History
• Otter production & Injection scenarios
• MPP Feasibility study – Objectives
• Production profiles
• MPP Technical feasibility summary
• ESP v MPP in Otter
• Commercial assessment
• Recommendation
The Otter Field

- Block 210/15a
- 93 miles NE of Shetland in 180 meter water depth
- 1st Oil in 2002
- Subsea tie-back to Eider platform via 21 km pipeline
- 3 ESP lifted production wells
- 2 water injection wells
- Expected field life 4 years!
- 6,000 bopd @ 77% watercut

May 2016
The Otter Field – Production & Injection (Current status)

Otter Sep.
Pressure: 26bar

ESP:
- P1
- P2
- P3

OTTER

EIDER

TERN

NORTH CORMORANT

Pressure: 26bar
ESP History

Assumption for the failure date of the current systems:
P1: 01/01/2018 for both systems; primary and back-up.
P2: 01/09/2016 for both systems; primary and back-up. The primary ESP already has 81 number of starts.
Otter Production & Water Injection
(Base case)

ESP

01/01/2018
01/09/2016

01/01/2018
01/09/2016

ESPs

P3 P1 P2

 OTTER

EIDER

WINJ REPAIR

WINJ REPAIR

NORTH CORMORANT

TERN
Otter Production & Water Injection (Base case + ESP)

ESP replacement

May 2016
Otter Production & Water Injection (Base case + MPP)

MPP 01/06/2018

Otter Production & Water Injection
(Base case + MPP)
To demonstrate that multiphase subsea pumping is a feasible technology for the Otter field to boost production from all 3 wells. The key areas of focus have been:

- System deliverability and flow assurance
- Pump suitability and expected time to failure
- Electrical power supply
- Subsea installation
- Controls, instrumentation and barrier fluid
- Commercial feasibility

May 2016
Assumptions
- ESP failures:
  - P1: 01/01/2018
  - P2: 01/09/2016
- Separator P: 26bar
- Shaft power: 750kW
- Suction P: ~5bar
- Pump dp: 45bar
- MPP Option: 01/06/2018
- ESP Option:
  - P1 w/o: 01/07/2018
  - P3 w/o: 01/07/2017
MPP Technical feasibility summary

- Modelling shows that MPP can deliver at least 50% more than 2 x ESP workover, based on 5 barg suction, 45 bar head, 750kW power, 26 barg arrival pressure.

- There is a type of helico-axial pump available that can perform the required service and has a MTTF of 5-6 years. (anticipated life is 3.5 years)

- It is expected that a single VSD (Variable Speed Drive) could deliver 920 kW to a subsea booster pump. Modelling performed during feasibility is based on 750 kW. Pump power to be optimised in next phase of the project- consider risk/reward of pairing VSDs.

- Pump can be integrated into existing facilities well and installation is relatively straightforward.
ESP v MPP in Otter (Pros & Cons)

ESP

- Pros
  - Proven technology
  - Pumping from deeper depth (system can be operated with a lower reservoir pressure)
  - There is a redundancy if a pump fails

- Cons
  - Workover is expensive and time consuming
  - Time to repair is long (rig requirement, weather dependant)

MPP

- Pros
  - MPP boost the full field production
  - MTTF 5 to 6 years and Repair cost is low
  - Time to repair is short (vessel requirement, less weather dependant)

- Cons
  - Initial installation cost is high
  - Need to flush & connect into flowline for installation
  - Requires positive wellhead pressure
  - Single point failure for the field

- Power, cable, umbilical and barrier fluid are already in place for either system
## Commercial Assessment

### Install MPP Decision

<table>
<thead>
<tr>
<th>Well</th>
<th>ESP Failure Dates</th>
<th>ESP Repairs</th>
<th>MPP Installation</th>
<th>NPV</th>
<th>PV CAPEX</th>
<th>Branch Probability</th>
<th>EMV</th>
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### Fail ESP P1

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### Continue with ESP Decision

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### Fail ESP P1 & P2

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Decision to install MPP generates greater NPV, but requires additional risked CAPEX.
Recommendation

- Multiphase pump technology for Otter is feasible and allows Otter to continue to produce beyond the failure of the existing ESPs.
- Water injection availability is a pre-requisite to longer term production and/or development of Otter / Eider.
- MPP installation takes the uncertainty away and present reasonable NPV. ESP work over may generate higher NPV but presents high level of uncertainty. Need to have capability to react to ESP failures.