At Scale Deployment of Enhanced Oil Recovery in BP

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Global Energy Trends

Demand

Supply

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Source: Energy Outlook 2030 (BP 2012)
Some Issues to Manage.....

- Getting EOR in early into the project cycle
- Managing the perception of technical and operability risk
- Broadening applicability of EOR solutions
- Accelerating development Cycle time for new EOR

[Diagram showing salinity vs. temperature with stages: Design, Field Trials, Lab work, Time]
Developing Proof

Typical Costs

- Deploy: 10 - 100s $m
- Inter Well Trials: 1 - 10 $m
- Multiple Single Well Chemical Tracer Tests: 100s $k
- Multiple Corefloods: 100 - 200 $k
Example EOR Development Time Line

- **LoSal** EOR response measurements


- **First LoSal** EOR Core-flood
- **First LoSal** EOR SWCTT*
- **Log-Inj-Log**
- **Evaluation of first (unsuccessful) LoSal EOR project**
- **Mechanism Paper**
- **Simulation Paper**
- **Field Trial**

Support for University of Wyoming research into Wettability Impacts on Oil recovery

Recognised significance of salinity
# LoSal EOR Project Evaluation: Typical Requirements

<table>
<thead>
<tr>
<th></th>
<th>New Field Offshore</th>
<th>Existing Field</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recovery method</strong></td>
<td>Secondary, possibly combined with tertiary</td>
<td>Tertiary (usually)</td>
</tr>
<tr>
<td><strong>Supporting data</strong></td>
<td>Coreflood (usually)</td>
<td>Single well chemical tracer test, and/or coreflood, and/or interwell trial</td>
</tr>
<tr>
<td><strong>Evaluation methods</strong></td>
<td>As simple as appropriate</td>
<td>Requires quality history match, needs to address optionality</td>
</tr>
<tr>
<td><strong>Impact of low salinity technology</strong></td>
<td>Usually enhances, rarely enables</td>
<td>Often enables project commerciality</td>
</tr>
</tbody>
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### LoSal EOR: Some Risk Management Considerations

<table>
<thead>
<tr>
<th></th>
<th>Offshore</th>
<th>Onshore</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology risk</strong></td>
<td>Space and weight; integration of <em>LoSal</em> facilities package</td>
<td>Integration of <em>LoSal</em> facilities package</td>
</tr>
<tr>
<td><strong>Clay swelling risk</strong></td>
<td>Coreflood</td>
<td>Coreflood or interwell trial</td>
</tr>
<tr>
<td><strong>Water sourcing</strong></td>
<td>Usually seawater</td>
<td>Local aquifer or desalination of make-up water</td>
</tr>
<tr>
<td><strong>Produced Water Management</strong></td>
<td>May require dual injection system to avoid water overboard</td>
<td>May require cycling of low salinity water</td>
</tr>
</tbody>
</table>

**Benefits** - control of reservoir scaling and souring
Introduction

Examples of BP’s Worldwide EOR Activity

UK North Sea
- Magnus - Miscible Gas EOR
- Clair Ridge - LoSal EOR sanctioned
- Quad 204 Polymer

World’s first sanctioned offshore low salinity project (Clair Ridge)
Leading the industry in Bright Water deployment (78 treatments)
World’s largest hydrocarbon miscible gas project

Norway
- Ula Miscible Gas EOR

W. Siberia
- Bright Water (TNK-BP)

Azerbaijan
- Gas Injection
- Bright Water

Gulf of Mexico
- One new field – LoSal EOR internally approved, in design stage
- Two other fields – LoSal EOR under evaluation

Argentina
- Bright Water (PAE)

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Closing Messages

- Making EOR work requires deep capability, strong relationships and a focused approach to deployment
- Sustained investment and effort is required to drive EOR to the top of the ‘pyramid of proof’
- There are opportunities to
  - drive EOR earlier into the project cycle,
  - shorten the development timeline for new EOR solutions and to broaden their application
Acknowledgements

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