What are we proposing?

- A capacity within EORI to provide operators with low-cost, low-risk optimization of their waterflood operations.

Prompted by:

- TAB advice regarding gaps in the EORI work flow
- Recent developments
- Recent EORI projects
EORI Work Flow

• Screening
  • Technical Feasibility

• Reservoir Characterization
  • Petrography / Stratigraphy

• Analytical Method
  • Static / Dynamic

• Project Economics
Recent developments and project results

- Flood optimization technologies
  - Capacitance-Resistive Modeling, Streamline

- Economic Optimization
  - Denbury – Lockhart Crossing

- EORI Projects
  - Recent EORI project recommendations have been in relation to improving secondary recovery, before considering tertiary options.
Methods

• Flood optimization software
  • CRM vs Streamline

• Economics Software
  • AIRES
CRM vs Streamflow

• Two software packages/methods under consideration.
  • Capacitance - Resistive modeling (CRM) and Streamline analysis
  • Other methods exist but not being considered because there is no commercial package available
    • Conventional Correlation Analysis (Spearman Rank, Wavelet Analysis), Artificial Neural Network, Percolation/Geometrical/Monte Carlo
## CRM vs Streamline

<table>
<thead>
<tr>
<th>Requirements</th>
<th>CRM</th>
<th>Streamline (StreamSim)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection/production data only?</td>
<td>Y</td>
<td>requires a grid of some sort</td>
</tr>
<tr>
<td>Petrophysics required?</td>
<td>Y</td>
<td>Y, but minimal</td>
</tr>
<tr>
<td>Flux pattern map?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Pattern allocation determination?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Injector efficiency plots?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Conformance plots?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Forward looking flood optimization?</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
<th>CRM</th>
<th>Streamline (StreamSim)</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>$20K per job</td>
<td>$2,500 - $10,000 per job (Flexible, license is modular and time limited)</td>
</tr>
<tr>
<td>Other fees</td>
<td>Consulting fee set in consultation with UT, $50k subscription to CPARM (optional)</td>
<td>Our decision</td>
</tr>
</tbody>
</table>
To do:

• Study Optimization Software
  • Further examine strengths and weaknesses
  • Training
  • Develop business model
  • Collect and compare case studies

• Develop AIRES Skills
  • Training (late February)
  • Run case studies
  • Determine best cost estimate procedure
  • Integrate with optimization outputs
  • Integrate with dynamic simulation outputs
Possible business model

• Offer streamline model as EORI service.
  • Cost share on license fee and manpower costs.

• Act as referrer/agent to UT for CRM model
  • Need to better understand strengths and weaknesses of each method before we do this.
Questions?

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