Indonesia: KLA-SHIELD System Performs Similarly to an Invert Emulsion Mud Offshore East Kalimantan

“The M-I SWACO KLA-SHIELD* water-base system helped the operator successfully drill the 8 ½-in. hole and run a 7-in. liner in lost circulation zones, staying within the AFE in terms of both cost and time, thus avoiding the need for a non-aqueous drilling fluid system.”

Julies Iswandy, M-I SWACO Project Engineer

Well Information
Location ................................................................. Offshore East Kalimantan, Indonesia
Spud Date ............................................................... June, 2010
Well Type ............................................................... Directional @ 60°
Interval ........................................................................ 8 ½-in.
Interval drilled ........................................................ Total of 5718 ft (1733 m) drilled from 2000 ft to 7718 ft (606 to 2339 m)
Density ................................................................. 9.0 – 9.3 lb/gal (1.08 – 1.12 sg)
Disposal Method ...................................................... Discharged overboard

The Situation
During planning of the 8 ½-in. section in this directional well, the operator identified a number of technical challenges. These included the presence of reactive shale throughout the section and the high potential of encountering lost-circulation zones in the fractured carbonate of the lower deltaic sequence. With a high directional difficulty index (DDI) and maximum inclination of 60° increasing, hence the risk of high torque and drag, the operator planned to use a non-aqueous drilling fluid system in order to drill effectively to casing point within the cost and time frame established in the Authorization For Expenditure (AFE).

The Solution
M-I SWACO recommended the KLA-SHIELD water-base drilling fluid system as opposed to a non-aqueous mud. By employing the aqueous system, the operator was expected to stay within the programmed cost, while effectively drilling to casing point in the event of total lost circulation in this interval. The KLA-SHIELD system has been shown to deliver relatively low coefficients of friction (CoF) in similar well profiles while providing excellent shale inhibition. The proprietary Virtual Hydraulics* program was used to predict and monitor hole cleaning during the entire interval.

The Results
• Higher-than-expected ROP up to 160 ft/hr (49 m/hr)
• Good hole cleaning as per analysis by the Virtual Hydraulics software
• Drilling fluid cost was reduced significantly compared to the cost of an invert emulsion fluid. This was further magnified when experiencing mud losses of 30 – 40 bbl/hr.
• The overall CoF was less than 0.25 with the addition of StarGlide* and G-Seal* Plus additives.
• Drilled to casing point within AFE cost and time
• Completed formation evaluation, liner, and cement operation as programmed

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The Details
As illustrated in the first chart below, the Kla-Shield system achieved a low coefficient of friction in the 8 ½-in. interval which improved its drilling performance. The system also delivered economic benefits as shown by the time vs. depth lines in the second chart.

![Drilling Drag Chart](chart1.png)

![Graph of Time vs. Depth](chart2.png)

<table>
<thead>
<tr>
<th>System Components</th>
<th>Mud Properties</th>
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</thead>
<tbody>
<tr>
<td>0.5 lb/bbl Soda Ash</td>
<td>Fluid Density</td>
</tr>
<tr>
<td>0.25 lb/bbl Safe-Cide*</td>
<td>10 sec Gel</td>
</tr>
<tr>
<td>1.5 lb/bbl Duo-Vis*</td>
<td>30 min Gel</td>
</tr>
<tr>
<td>3.0 lb/bbl PolyPac* UL</td>
<td>6 RPM</td>
</tr>
<tr>
<td>2.5% v/v Kla-Stop*</td>
<td>API FL</td>
</tr>
<tr>
<td>8-10% by weight NaCl for inhibition</td>
<td>MBT</td>
</tr>
<tr>
<td>5 lb/bbl G-Seal Plus and 1-3% Starrlide was added into the active to improve lubricity. Pumped hi-vis sweep every 2 – 3 stands to aid in hole cleaning</td>
<td>Average ROP 50-80 ft/hr (15-24 m/hr)</td>
</tr>
<tr>
<td></td>
<td>3 EA of linear motion shale shakers</td>
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Questions? We’ll be glad to answer them.
If you’d like to know more about the Kla-Shield system, and how it’s performing for our other customers, please call the M-I SWACO office nearest you.