OBJECTIVE

The objective of the project was to understand the water flood mechanisms underway in Monument Butte unit water flood and apply the technology, if possible to the Travis and the Boundary units. The purpose of the project was also to transfer the water flood technology to nearby units/fields/reservoirs.

SUMMARY OF TECHNICAL PROGRESS

Production Update

The cumulative productions as of June 30, 1995 for some of the project wells in the three units are listed below:

Monument Butte Unit

<table>
<thead>
<tr>
<th>Identification</th>
<th>Oil (BBL)</th>
<th>Gas (MCF)</th>
<th>Water (BBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-34</td>
<td>14,950</td>
<td>20,735</td>
<td>4,078</td>
</tr>
<tr>
<td>9-34</td>
<td>17,935</td>
<td>13,550</td>
<td>2,769</td>
</tr>
<tr>
<td>7-34</td>
<td>7,385</td>
<td>11,560</td>
<td>585</td>
</tr>
<tr>
<td>2A-35</td>
<td>4,616</td>
<td>2,246</td>
<td>192</td>
</tr>
<tr>
<td>6-34</td>
<td>2,113</td>
<td>4,901</td>
<td>1,196</td>
</tr>
<tr>
<td>Unit</td>
<td>1,044,495</td>
<td>2,205,184</td>
<td>168,061</td>
</tr>
<tr>
<td>Injection</td>
<td></td>
<td></td>
<td>3,086,765</td>
</tr>
</tbody>
</table>
DISCLAIMER

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Travis Unit

<table>
<thead>
<tr>
<th></th>
<th>Oil (BBL)</th>
<th>Gas (MCF)</th>
<th>Water (BBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-33 Unit</td>
<td>3,690</td>
<td>14,022</td>
<td>586</td>
</tr>
<tr>
<td>Injection</td>
<td>289,786</td>
<td>1,372,006</td>
<td>16,921</td>
</tr>
</tbody>
</table>

Boundary Unit

<table>
<thead>
<tr>
<th></th>
<th>Oil (BBL)</th>
<th>Gas (MCF)</th>
<th>Water (BBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-21 Unit</td>
<td>975</td>
<td>1,339</td>
<td>4,167</td>
</tr>
<tr>
<td>Injection</td>
<td>181,335</td>
<td>602,335</td>
<td>23,081</td>
</tr>
</tbody>
</table>

Geologic Characterization

Detailed isopach maps of Lower Douglas Creek (LDC), D1, D2, B1, C, A and GB6 sands were developed. These maps are on a regional scale and encompass more than one unit at a time. Data from these isopachs will be used to construct a regional-scale reservoir model.

Reservoir Analysis

Internal analysis of the Monument Butte water flood revealed the following.

- There was not sufficient pressure support on the west side of the unit to sustain high initial productions observed in wells 10-34, 9-34 and 7-34. It was found that bottom-hole-pressures in this part of the field ranged from 1200 to 1500 psia. Water injection strategies for that portion of the unit are now being investigated.

- Reservoir simulation results indicated that only about 70% of the water injected into the unit was being confined to the unit and that about 30% of the injected water or about 900,000 BBL had left the unit since the inception of the water flood.

- The B-sands were underutilized in comparison to D-sands. The recovery factors for D-sands were two times those of recovery factors for B-sands.

- An infill drilling study revealed that there was potential for infill drilling in the unit.

A compositional analysis of oil from the GB6 reservoir (in Monument Butte) revealed that the composition of this oil was not significantly different from the oil from D-sand reservoirs. Severe wax problems in a new completion in GB6 had prompted this analysis. The GB6 reservoir was shallower and was thus at a lower reservoir temperature compared to either D or B-sand reservoirs. It was thus concluded that the production problems encountered in producing the GB6 reservoir was due to the lower temperature of the reservoir and not due to the oil composition. The remedy to the wax problem in this zone was production above the oil bubble point, which was between 2300 - 2400 psia. Thus, a water flood will have to be instituted right at the start if this reservoir were to be produced effectively.

A comprehensive infill drilling study was conducted using the Infill Drilling Predictive Model developed by the U.S. DOE. Results of this model for the Monument Butte unit are summarized in Figure 1. The study was conducted on a 360 acre pilot area and the results shown in Figure 1 are for a symmetry element, which is 1/8 of the total pattern. It is seen that infill drilling would result in an additional production of about 25,000 BBL of oil for the symmetry element or a total of about 200,000 BBL for the 360 acre total pattern. A comprehensive sensitivity study was performed on model assumptions and parameters. It was determined that reservoir continuity at the current spacing was the most important model parameter. Based on the history of the water flood, this parameter was assigned a value of 0.35.
TECHNOLOGY TRANSFER

The second yearly report on the project was submitted. A presentation on the project activities was made at the U.S. DOE Contractor Meeting on June 26, 1995 at the Fountain Head resort in Oklahoma.

PUBLICATIONS

"Water Flood Project in the Monument Butte Field, Uinta Basin," presented by John D. Lomax, Annual meeting of the Interstate Oil and Gas Compact Commission, December 6-8, 1992, Salt Lake City, Utah.

"Water Flood Project in the Uinta Basin," presented by Milind D. Deo, Monthly meeting of the Salt Lake section of the Society of Petroleum Engineers, February 16, 1993, Salt Lake City, Utah.


"Green River Formation Water Flood Demonstration Project", Yearly Report to be published by the U.S. DOE, 89 pp.


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Waterflood Comparison With and Without Infill
Symmetry Element: 1/8 of the Total Pattern

- **Oil Rate: Non-infill**
- **Cumulative: Non-infill**
- **Oil Rate: Infill**
- **Cumulative: Infill**

**Infill Start**

Days

Cumulative Production (Mstb)

Oil Production Rate (stb/d)