GRIEVE FIELD CO$_2$ PROJECT: 2011 STATUS REPORT

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Thanks to Glen Murrell with EORI for invitation
Outline

- Field Background/History
- Production History
- Tertiary Recovery Options
- Current Plans for CO$_2$ Flood
- 2010-2011 Milestones
- Conclusions
Elk Petroleum History

- Company incorporated in 2005

- Company strategy
  - Acquire and redevelop mature oil fields in USA using conventional and improved extraction techniques

- Two Offices
  - Corporate Office in Sydney, Australia
  - USA office in Casper, Wyoming

- Current Assets
  - Grieve field
  - South Sand Draw field (sold in 2010)
  - Ash Creek Field (put on production in March 2011)
  - Other leases in Wyoming and Montana
Grieve Field Key Parameters

- Producing Formation: Cretaceous Muddy “Grieve Sand”
- Porosity: 20.4% Average Core
- Permeability: 220 md Average Core
- Average Thickness: 45 feet
- Original Oil/Gas Column: Oil – 700 feet; Gas – 900 feet
- Original Gas/Oil/Water Contact: G/O +628; O/W –70 (Hurd, 1970)
- Gas Oil Ratio: 861:1
- Initial Pressure: 2950 psi SIP DST (datum +106)
- Drive Mechanism: Gas expansion and partial water drive
- Character of oil and gas: Oil gravity –37° API, Gas 1168 BTU
- Cumulative Production 05/2011: 29,951 MBO, 71,440 BCFG, 34,912 MBW
- Total Reservoir Volume: 75,356 Acre-Feet (based on gross pay map)
- Average Dip: 15°
Discovered in 1954 by Forest Oil Corporation

Discovery well was the Morton 1-22-1 well.

- Planned as a Tensleep test but encountered oil in the Muddy Sandstone.
- Initial flow of 1,220 BOPD, 36.3° API Oil.

By 1956, 24 wells were drilled in Grieve Unit.

First water production in 1959.

Gas injection for pressure maintenance in 1960.

Gas cap blow down began in 1977.
Structure with 15° dips and a well defined reservoir pinch-out.

Muddy Sandstone represents an estuarine incised valley fill deposit with sand sourced from highlands to the east.

Net sand contour interval = 5’
Structure contour interval = 200’
Thick, highly permeable sandstone.

Maximum reservoir thickness is greater than 80 feet.

Well confined sandstone
Thick shales provide top, bottom and lateral seals.
Maximum core permeability > 2 Darcies

Samples above 15% porosity and 100 md dominate the sample distribution
Production History
Grieve Field Historical Production

- **OIL**: 29,951,858 (BBL)
- **GAS**: 103,908,451 (MCF)
- **WTR**: 34,912,429 (BBL)
- **INJ_GAS**: 32,468,393 (MCF)
1954 Original Fluid Contacts

- Gas shown in red, Oil in green.
- 900 feet original gas column
- 700 feet original oil column
1960 Start of Gas Injection

Pressure maintenance program initiated to produce the oil column.
Gas injection drives the crude oil column down the structure.

As oil is withdrawn, the gas cap expands.

Oil wells are shut in as gas cut increases until the reservoir is depleted of oil.

Water incursion begins as pressure is reduced.
The gas and water columns meet and the oil column is minimized.

Gas injection continues for 7 years and liquids are stripped.

In 1977 the oil column has been effectively depleted, blow down starts. (field production down to 300 bopd)

Additional wells were drilled to produce from the gas cap.
Water has encroached above the original oil/gas contact.

The reservoir has been pressure depleted, bottom hole pressure at +500’ sea level is 750 psi by fluid level measurement at #9.
Grieve Field History

- 2005 Elk Petroleum acquires Grieve Field from Wold Oil Corp.

- Elk begins planning a CO$_2$ flood
  - 2007 study with EORI
    - Stratigraphic core study
    - Developed facies model
    - Reservoir petrology
    - Geologic model
    - Reservoir history match and simulation
  - 2008 NITEC study using EORI geologic model
    - Multiple scenarios and flood patterns
    - Recommends Gravity Stable CO$_2$ flood
    - 7 CO$_2$ Injectors along top of structure, 7 water injectors, and 22 oil producers.

- Due to unavailable CO$_2$, Elk begins planning an ASP chemical flood for Grieve.
  - 2009 SURTEK ASP chemical flood study
  - Elk Petroleum begins work on design and permitting for ASP flood.

- Late 2010 Elk Renews focus on CO$_2$ Flood at Grieve
**Thermopolis Shale**

**Shell Creek/Mowry Shale**

- Marine Muddy Sandstone
- Facies C: Bay mouth sands
- Facies B: Upper fluvial-estuarine point bar
- Facies A: Main fluvial channel

**Thermopolis Shale**

- NASA photograph of Rio de la Plata estuary, (Uruguay and Argentina)
Facies C: Main Channel Facies, Vf-grained muddy bioturbated sandstone.

Facies B: Main Channel Facies, Vf-grained rippled sandstone.

Facies A: Main Channel Facies, med-grained cross-stratified sandstone.

Facies D: Older Estuarine Valley Fill, cuts primary incision.
NITEC Recommendation for Gravity Stable CO₂ Injection Pattern

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<thead>
<tr>
<th>Category</th>
<th>Number</th>
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<tbody>
<tr>
<td>Inactive Wells</td>
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<tr>
<td>Injectors</td>
<td>14</td>
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<tr>
<td>CO₂ Injectors</td>
<td>7</td>
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<tr>
<td>Water Injectors</td>
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<tr>
<td>Producers</td>
<td>22</td>
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<tr>
<td>Active Wells</td>
<td>36</td>
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<tr>
<td>Existing Active Wells</td>
<td>33</td>
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<tr>
<td>New Wells</td>
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<tr>
<td>New CO₂ Injectors</td>
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<tr>
<td>New Water Injectors</td>
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<tr>
<td>New Producers</td>
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</tbody>
</table>

Legend:
- Inactive Wells
- CO₂ Injectors
- Producers
- Water Injectors
- New Wells
- Approx. Res. Boundary

Source: ELK PETROLEUM, Inc.
# Reservoir Study Comparisons

<table>
<thead>
<tr>
<th>Reservoir Parameter</th>
<th>Hurd 1970</th>
<th>Wo and Yin 2007¹</th>
<th>NITEC 2008²</th>
<th>SURTEK 2009</th>
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<tbody>
<tr>
<td>Oil volume (acre-ft.)</td>
<td>45,210</td>
<td>62,092</td>
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<td>57,630</td>
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<tr>
<td>Ave. porosity (%)</td>
<td>20.4</td>
<td>20.4</td>
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<td>20.4</td>
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<tr>
<td>Ave. Swi (%)</td>
<td>6.5</td>
<td>6.5</td>
<td>~11.2⁸</td>
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<tr>
<td>Res. oil pore volume (MB)</td>
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<td>91,207</td>
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<td>STOOIP (B/AF)</td>
<td>1080</td>
<td>1080</td>
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<tr>
<td>ST Soi</td>
<td>0.6824</td>
<td>0.6824</td>
<td></td>
<td>0.6824</td>
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<tr>
<td>STOOIP (MB)</td>
<td>48,780</td>
<td>66,995</td>
<td>67,600</td>
<td>62,240</td>
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<tr>
<td>Solution gas GOR</td>
<td>780</td>
<td>724</td>
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<td>780</td>
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<tr>
<td>Solution GIP (MMcf)</td>
<td>38,048</td>
<td>48,502</td>
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<td>48,547</td>
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<td>Gas Volume (acre-ft.)</td>
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<td>15,900</td>
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<td>Gas cap OGIP (Mcf/AF)</td>
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<td>Gas cap OGIP (MMcf)</td>
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<td>Total OGIP (MMcf)</td>
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<td>81,073</td>
<td>77,500</td>
<td>75,816</td>
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<td>Oil Prod (MB)³</td>
<td>29,932</td>
<td>29,932</td>
<td>29,932</td>
<td>29,932</td>
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<tr>
<td>Gas Prod. (MMcf)⁴</td>
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<td>63,000⁵</td>
<td>~71,000</td>
<td>76,250</td>
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<td>Water Prod. (MB)</td>
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<td></td>
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<td>32,000+</td>
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<td>Gas Injection (MMcf)</td>
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<td>46,000</td>
<td>32,000+</td>
<td>34,556</td>
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<tr>
<td>Oil RF (%)</td>
<td>61.4</td>
<td>43.2⁶</td>
<td>44.3</td>
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<td>Gas RF (%)</td>
<td>125.2</td>
<td>67.6⁶</td>
<td>~91.6</td>
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<td>Est. current OIP (MB)</td>
<td>18,621</td>
<td>38,000⁷</td>
<td>36,900</td>
<td>32,309</td>
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</table>
The EORI and NITEK CO₂ simulations show that 18 to 23 million barrels are recoverable with a CO₂ miscible flood. These CO₂ studies show that the more “front end loaded” the injection is the faster we see returns and ultimately the more oil the project makes.

Based on these CO₂ studies Ryder Scott certified reserves at 18.6 MMBO and an EOR project value of $305 million (NPV₁₀).

SURTEK Study determined that chemical flooding will recover around 6 MMBO.
Oct 2010 - ExxonMobil renews negotiations with Elk Petroleum for CO₂.

Nov 2010 - Elk Petroleum begins preliminary work on Environmental Assessment (EA) at Grieve for installing CO₂ Pipeline and field infrastructure.

Dec 2010 - Taylor Environmental contracted to work on EA.

Jan 2011 – Elk finalized contract with ExxonMobil for purchase of CO₂.
  - Feb 1, 2011 is the effective date for CO₂ contract.
Grieve CO2 Project: Milestones Oct 2010 to June 2011

- **Feb 2011**
  - Elk Petroleum began corporate discussions with Anadarko on transportation of CO$_2$ to Grieve.
  - Elk had a meeting with the BLM Lander office to inform them of intentions to move forward with CO$_2$ project.

- **Mar 2011**
  - Elk submitted proposed action to the BLM Lander Office on Grieve CO$_2$ project.
  - Elk submitted funds to Western Area Power Administration (WAPA) for Power Impact Study.
  - Elk purchased the North Grieve Oil Pipeline.

- **April 2011** – Finalized negotiations and signed contract with Anadarko on CO$_2$ transportation agreement.
April/May 2011

- Began environmental and cultural surveys for EA (Sage Grouse, Raptors, Archeology, etc.)
- Began preparing permits (SF299, APD’s, Sundries, etc.)
- Purchased West Casper Oil Pipeline System from Chevron that runs from Grieve Field to the Platte Station
- Epic Integrated Services selected for surveying, ROW, and engineering support.

June 2011

- Signed joint venture with Denbury Inc. for Grieve Field development.
- Submitted permits to BLM Lander Office.
- Held on-site visit at Grieve Field with BLM on June 15, 2011.
Elk purchased the North Grieve Oil Pipeline.  
- This was done to enable a right-of-way access across federal, state, and private land for surveying and designing a CO2 pipeline that may run parallel to the old oil pipeline.

Elk purchased the West Casper Pipeline system that runs from Grieve Field to the Platte Station near Casper.  
- This pipeline will be used to transport produced oil from Grieve, minimizing truck traffic on Poison Spider road.

A meter station will be built at the tie-in point to the Anadarko CO2 pipeline.
ACTUAL AND PROPOSED PIPELINES
Elevation Profile Along Proposed CO₂ Pipeline.
Challenges at Grieve

- **Topography**
  - Elevation ranges from 6700 ft at base of Grieve to 7300 ft on top of plateau.

- **Rough Terrain**
  - Difficult to build new pads, directional drilling will be utilized to minimize surface disturbance.

- **Severe Winters**
  - Strong winds, deep snow drifts.
New Well Pads
Elk/Denbury will drill new wells
- Final development plan being determined

New flow lines will be installed to all existing and new well locations.
- Main trunk lines will run along a common corridor and will stay within existing disturbance areas
- CO₂ header will be stationed in central facility area and one header on top of Horse Heaven

Old infrastructure such as tanks, manifolds, compressors, etc. will be removed and replaced with new equipment.
Insufficient capacity on existing in-field power system for necessary CO₂ infrastructure.

Western Area Power Administration (WAPA) has 230 KV and 115 KV power lines 3 ½ miles west of Grieve Field.

Elk has funded WAPA to do an impact study to determine the effects of tying into the WAPA line.

Elk is working with Tri-State Power to design and construct the high-capacity power lines.

- High Plains Power is the local utility co-op that will maintain the lines.
Elk Petroleum and Denbury Resources are continuing to work on progressing the Environmental Assessment.

Elk and Denbury are reviewing the previous simulation studies and may modify the flood pattern based on those conclusions.

Work continues on design of pipeline, overhead power-lines, and in-field distribution system of electricity and flow lines.

Well work is scheduled to begin this summer pending permitting.

Plans are to begin construction of pipeline early next year and to begin CO\textsubscript{2} injection by early 2012.
Elk Petroleum and Denbury are moving rapidly forward with plans to CO2 flood the Grieve Field.

Elk and Denbury have executed contracts with ExxonMobil and Anadarko for purchase and transportation of CO2.

Elk has purchased the West Casper Pipeline which will be used for transporting oil out of Grieve.

Elk/Denbury is working on permitting and is working with the BLM to minimize the surface disturbance from the project.

Simulation work is ongoing and may result in changes to the injection/production patterns.