Beaver Creek Field Update
Madison CO₂ Flood

Veronica Chodur, Reservoir Engineer
Devon Energy Co.
EORI Conference June 29, 2010
Presentation Outline

• General Field Info and History

• Brief CO₂ Project Evaluation

• Performance & Reservoir Management
CO₂ Floods in Wyoming

- Devon Beaver Creek Field
- Anadarko Salt Creek Field
- Anadarko Patrick Draw Monel Unit
- Merit Energy Wertz/Lost Soldier
**Beaver Creek Madison Structure**

**Geologic Characteristics**
- Limestone/Dolomite Matrix
- Approx. Prod. Area = 974 Acres
- Approx. Oil Column Height = 820’
- Avg. Net Pay Thickness = 212’
- Avg. Depth to Madison Top = 11,100’

**Reservoir Characteristics**
- Porosity = 10%
- Permeability = 9 md
- Reservoir Temp = 234°F
- BHPi = 5301 psia
- GORi = 288 scf/bbl
- Bubble Pt. = 673 psia
- Swi = 10%
- Oil Gravity = 39.5° API

**Type Log**
**Madison Log Section**

**GR/Bulk Density**

**BCU #127 Well**
Top @ 11224’ MD
Bottom @ 11723’ MD
Beaver Creek Madison
Pre-CO₂ Flood Production History

- OOIP = 109 MMbo
- Cum Oil (Prim + Sec) = 42.5 MMbo
- Waterflood initiated in 1962
- Developed with 36 completions

- Discovered January 1954
- Rock (Target)
Beaver Creek Madison
Pressure History

![Graph showing pressure history over time]
CO₂ Project Evaluation

Initial Screening Phase I: 2005
- Analogs & Screening
- Basic Reservoir & Geology Study
- Risk & Economics

Testing & Sector Model Phase II: 2006
- Perform Testing (MMP, MCM, PVT, Core, etc.)
- Build Sector Model
- Update Risk & Economics

Full Field Model Phase III: 2007
- Full Field Simulation
- Develop Flood Strategy
- Finalize Economics (D&C, Facilities, CO₂ Purchase)
Full Field Field Model
Phase III: 2007

- Full Field Simulation
- Develop Flood Strategy
- Finalize Economics
  (D&C, Facilities, CO₂ Purchase)
CO₂ Project Evaluation

Initial Screening Phase I: 2005
- Analogs & Screening
- Basic Reservoir & Geology Study
- Risk & Economics

Testing & Sector Model Phase II: 2006
- Perform Testing (MMP, MCM, PVT, Core, etc.)
- Build Sector Model
- Update Risk & Economics

Full Field Model Phase III: 2007
- Full Field Simulation
- Develop Flood Strategy
- Finalize Economics (D&C, Facilities, CO₂ Purchase)

Execution Phase IV: 2007-2008
- Finalize Flood Strategy
- Contract CO2
- Drill & Complete
- Facilities
Execution Phase

- Build CO₂ supply pipeline
- Construct production & injection recycling facilities
- Drill 7 new producers & 5 new injectors
- Install new flowlines for producers & injectors
- Rework or reconnect 9 producers & 7 injectors
- Convert 2 wells from producer to injector
BCU Madison CO\textsubscript{2} Flood
Original EOR Flood Strategy

Flood Strategy
Combo Peripheral + Gravity Stable
Best Modeled Recovery
Most Flexible Well Plan
BCU Madison CO₂ Flood
Production Results

Initiated CO₂ Injection 7/3/08

Pre-Flood
320 Bopd
32000 Bwpd

Current Rate
3500 Bopd
25000 Bwpd

Oil Cut Increase from 1% to 12%
BCU Madison CO₂ Flood
Reservoir Management

Maintain Reservoir Pressure > 2600 psi MMP

Choked / SI Center Producers
BCU Madison CO$_2$ Flood
Reservoir Management

Began WAG in 5 Down-dip Injectors

Converted 2 Wells to Injection
BCU Madison CO₂ Flood

Reservoir Management

Current Reservoir Pressure > 3000 psi

Balance Injection with Production

CO₂ + Water Inj. Rates >= Production Rates
BCU Madison CO2 Flood
Reservoir Management

IWR > 1 for Full Field & Individual Patterns

Pattern 1
Pattern 2
Pattern 3
Pattern 4
Pattern 5
BCU Madison CO₂ Flood
Other Adjustments

Added D Zone Perfs
Reprocessed existing 3-D Seismic
Madison CO$_2$ flood
Simulation updates

Updates:
- Structural Re-interpretation
- New Infill Wells
- History Match Actual CO$_2$ Flood Performance

Optimize Flood Performance:
- Rate and Reserve Forecasting
- Reservoir & Operating Pressures
- Forecast Impact of Various Operating Scenarios
  (WAG Ratio, Slug Size, CO$_2$ Utilization, Conformance)
Actual vs. Modeled Oil Production

GROSS OIL PRODUCTION FORECAST

8-12% OOIP Recovery Anticipated
Tertiary Recovery

Tertiary Oil Recovery vs HCPV CO2 Inj

![Graph showing Tertiary Oil Recovery vs HCPV CO2 Inj]
Thank You.