Beaver Creek Madison
Reservoir Management and Conformance

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Presentation Outline

- General Field Info and History
- Performance & Reservoir Management
- Conformance
Basin Outline and Field Location

Wyoming

Wind River Basin

Beaver Creek area
Madison Reservoir Characteristics

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
Stratigraphic Column and Typelog

Madison is subdivided into 4 zones, with the “D” zone being the primary producing zone.
Beaver Creek Madison
Production History

10
100
1,000
10,000
100,000
Jan-50 Jan-60 Jan-70 Jan-80 Jan-90 Dec-99 Dec-09

Monthly Volumes (Bpd, Mcfd)

Oil
Gas
Water

WINJ

OOIP = 109 MMbo
Cum Oil (prim + sec) = 42.5 MMbo
Remaining Reserves (WF) = 2.6 MMbo

First Production 1955
Peak Rate 8500 bopd
Waterflood initiated in 1962
Madison CO\textsubscript{2} Flood
Production Results

- Initiated CO\textsubscript{2} Injection 7/3/08
- Pre-Flood: 300 Bpd
- Current Avg Rate: 4200 Bpd

BPD / MCFD

IWR

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Madison CO₂ Flood
Current Oil & Water Rates by Well

- Oil Rates (bopd)
- Gas Rates (Mcfd)
Madison CO₂ Flood
Current GOR & GLR Rates by Well
Madison CO$_2$ Flood
Current CO$_2$ & Water Injection Rates by Well
Major Regions

Region 1: (Up-dip Continuous CO₂ Front)

Region 2: (Central & Down-dip WAG)

Region 3: (Down-dip WAG)

Region 4: (Lower Block)
Reservoir Pressure Observation Well

Downhole Pressure

Chart showing downhole pressure from 1/1/2010 to 7/1/2011.
Madison CO$_2$ flood
Reservoir Management

- Simulation Updates
  - History match actual CO$_2$ flood performance

- Optimize Flood Performance
  - Improved rate and reserve forecasting
  - Optimize reservoir and operating pressures
  - Forecast Impact of Various Operating Scenarios
    (Well Placement, WAG Ratio, Slug Size, CO$_2$ Utilization, Conformance)
Cumulative CO$_2$ Purchase Utilization vs Time

Utilization Goal ≤ 10 Mcf/bbl
Injection Profiles vs Time (BCU 40)

2008 (pre-CO₂)  2009  2010  2011

A  B  C  D

H₂O  CO₂

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Zone D
Madison CO₂ Flood
Reservoir Management

Unexpected production response in the BCU #124

Re-evaluated Seismic & Geo-Model
Beaver Creek Seismic Coverage

3D survey outline

Riverton, Wyoming

Riverton Dome

Seismic Line A

Beaver Creek A’
Original 3D vs. Reprocessed 3D

Seismic Line A-A’

Fault was previously undefined on seismic

Fault separates upper Madison block from lower Madison block.

Primary objective (Madison LS)

Primary backthrust fault
Well 124 responds to CO$_2$ injection well 139

BCU #139 injector

BCU #124 producer
The Madison CO$_2$ zone is in the lower SE plate at both wells.

Area of Overlap

BCU #139 injector

BCU #124 producer
Thank You.