Cadotte

CSS Project
Agenda

► Subsurface
► Surface
► Conclusions
Subsurface

- Background
- Geology
- Wells
- Performance
- Future Plans
Subsurface

► Background
  ► Geology
  ► Wells
► Performance
► Future Plans
Blue: Polymer Potential
Red: Thermal Potential
Yellow: Murphy Acreage

Cadotte Pilot
Sections 8, 9 & 17-8517W5
Cadotte CSS – History

► Intent - test the viability of HCSS in Cadotte with 3 wells
► First steam - May 2013
► 3 existing wellbores used – presented challenges
  ▪ Cum of 12,758 m³ before first steam
  ▪ Well placement not ideal – geology & reserves
  ▪ Existing wellbores not ideal for thermal injection/production
    • 04-17 suspect mechanical damage or obstructions hindering steam conformance this may be as a result of too much expansion and contraction of the non thermal casing/tubing/liner
    • 04-17 build section not ideal for placement of reciprocating pump – severe doglegs which gave us production challenges
    • Wells drilled in lower perm (Upper Bluesky) which is not the ideal placement for thermal exploitation in this reservoir.
    • Future plans are to use thermally lined and cased wells capable of standing up the the temperature changes.
► To date only 2 wells tested (00/16-09-085-17W5/0 & S0/04-17-085-17W5/0)
► Steam generator – 7,320 kWh
  ▪ 250m³/day
## Approvals History

<table>
<thead>
<tr>
<th>Application Number</th>
<th>Project Summary</th>
<th>Approval Number</th>
<th>Approval Date</th>
<th>Expiry Date</th>
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<td>1685253</td>
<td>3 well CSS pilot</td>
<td>11778</td>
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<td>1769634</td>
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<td>1781023</td>
<td>add two wells to project</td>
<td>under review</td>
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Map of Scheme
First 3 wells - Pilot

Surface 13-9 (Well 1)
S0/04-17-085-17W5/0
Cum Oil – 3,602 m³

Surface 16-8 (Well 2)
00/16-09-085-17W5/0
Cum Oil – 8,004 m³

Surface 12-9 (Well 3)
00/12-08-085-17W5/0
Cum Oil – 1,152 m³
Horizontal CSS Design

- Inject ~80% quality steam at wellhead
- Injection rates up to 250 m$^3$/d CWE equivalent
- Injection volume typically increases with successful cycles and mobilizes more oil farther into the reservoir
- Post injection - soak for 5 to 15 days to allow latent heat of vaporization from steam to deliver energy into reservoir (condensation)
- Post soak – produce until minimum rate/temperature
  - 1.6 m$^3$/d or rod hangup
  - ~40°C – Upper Bluesky (lower viscosity)
  - ~60°C – Lower Bluesky (higher viscosity)
- Repeat process
Cap rock integrity

- Mini frac test conducted on the Wilrich Shale in well 1-18-85-17W5
- Additional lab tests were conducted on the Wilrich Shale to measure its geomechanical properties
- Both sets of results were fed into an analytical model
- Results of this evaluation gave a conservative MOP of 12.4 Mpa
- This ensures that operation remains within the shear and tensile strength limits of the overlying Wilrich Shale formation
Geology

i) Depositional Overview

ii) Type Log

iii) Seismic

iv) Top Bluesky Structure

v) Base Bluesky Structure

vi) Structural Cross Section & Average Reservoir Parameters

vii) Bluesky Net Pay & OBIP

viii) Bluesky Mineralogy

Geologic Time Scale

Slightly modified after Hubbard et al. 2004
Depositional Overview

- Mississippian low filled with Gething sand & mud (coastal plain material)
- Sea level low-stand cuts valley and erodes Gething
- Reworked sands deposited in to valley as Bluesky
- Flood tidal delta and shallow water estuarine facies deposited (lower facies)
- Tidal Inlet sediments deposited next in deeper water environment (upper facies)
- Rapid sea level flooding event leads to capping by Wilrich shales
Type Log

**MURPHY CADOTTE 11-8-85-17**

**Net Pay Criteria**
- Gamma Ray < 65 API
- Porosity > 22%
- Water Saturation (Archie) < 40%
  
  RW = 0.294
Seismic
Top Bluesky Structure

- Project area sits in relative structural low
- Bluesky elevation change is 10 meters
  - Average structural dip is 0.4°
Base Bluesky Structure

- Shows Bluesky accommodation
- Base structure elevation change of 24 m
- Average structural dip of 0.9°
- Bottom water seen in three wells at similar subsea depths
Structural Cross Section & Average Reservoir Parameters

- Average reservoir thickness is 20 meters
- Average depth is 600 m TVD
- Average Core Porosity: 30%
- Viscosity Range: 20,000-500,000 cP
- Average Permeability Upper Facies (KMAX): 0.7D
- Average Permeability Lower Facies (KMAX): 4.0D
- Average grain size: Fine-Medium
# Bluesky Net Pay & OBIP

## OBIP Table

<table>
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<tr>
<th>Project Area</th>
<th>Rock Volume (m³)</th>
<th>Avg Sw</th>
<th>Avg Por</th>
<th>B</th>
<th>OIP (m³)</th>
<th>OIIP (bbl)</th>
<th>Area (m²)</th>
<th>Sections</th>
<th>OIP Per Section</th>
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<td>Bluesky Upper Facies OBIP Project Area</td>
<td>3.34E+07</td>
<td>0.16</td>
<td>0.3</td>
<td>1.02</td>
<td>8.25E+06</td>
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<td>1.5</td>
<td>66,273,777</td>
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## OIP Calculation

\[ N = \frac{V_o \phi (1 - S_w)}{B_w} \]

## Net Pay Criteria

- Gamma Ray < 65 API
- Porosity > 22%
- Water Saturation (Archie) < 40%
- \( RW = 0.294 \)
Bluesky Mineralogy

- XRD analysis in three wells:
  - 05-17-085-17W5, 06-16-085-17W5, 09-08-085-17W5
  - Quartz Content is approximately 55–80%
  - Dolomite Content is approximately 4–31%
  - Clay Content is approximately 13% to 23% (approximately $\frac{2}{3}$ Kaolinite, $\frac{1}{3}$ Illite)
  - XRD calculated grain densities are between 2670 to 2720 kg/m$^3$

- Lower core grain densities and core porosities reading lower than standard sandstone density porosity suggest the possibility of a very “light” material being present
  - Upper Bluesky Core Grain Density Average: 2640 kg/m$^3$
  - Lower Bluesky Core Grain Density Average: 2623 kg/m$^3$
  - Carbonaceous material is assumed as the mineral responsible for lowering the grain density
  - Carbonaceous material can be seen in core
Subsurface

► Background

► Geology

► Wells

► Performance

► Future Plans
Current Well Placement

16-8 Pad
13-9 Pad

Wilrich Shale

Upper Bluesky Facies

Future Steam Well 3
Steam Well 1

Gething

Lower Bluesky Facies

Mississippian

Bluesky Net Pay

4-17
12-8
16-9

Bottom H2O

Steam Well 2
Wellbore Diagram

- Fiber optic temperature measurement
- Bubble tube pressure measurement
- Surface casing
  - OD: 339.7 mm
  - J-55
- Intermediate casing
  - OD: 219.1 mm
  - L-80
- Production string
  - OD: 139.7 mm
  - J-55
- Slotted Liner
  - OD: 139.7 mm
  - J-55
Artificial Lift

► Surface Pumping Equipment
  ▪ 00/16-09-085-17W5/0
    • Tundra Solutions SSi 400 hydraulic pump jack
      ◆ 40,000# lift
      ◆ 88.3 kW motor
      ◆ 7.3 m stroke length
  ▪ S0/04-17-085-17W5/0
    • Weatherford VSH2 hydraulic pump jack
      ◆ 40,000# lift
      ◆ 51.5 kW motor
      ◆ 3 m stroke length

► Down hole Pumps
  ▪ Weatherford rod insert reciprocating rod pumps
    • 63.5 mm barrel OD pumps
    • Pumping capabilities between 20 m$^3$/d to 180 m$^3$/d
Subsurface

► Background
► Geology
► Wells
► Performance
► Future Plans
1st Well (04-17) - performance

- Unable to inject the slug sizes initially predicted as a result, the performance was lower than predicted.
- Cycle #1 - experimented with 2 different pump systems and had low oil production.
- Cycle #2 - standardized on the pump jack we had similar injection volumes but were able to mobilize more bitumen. Good indicator that we are improving with time.
- Cycle #3 - able to get more steam injected ~ 1,128 m³ however we lost downhole temperature measurements and produced only 145 m³ oil.
- Cycle #4 - essentially started at original reservoir temperature due to work over to replace fiber optics.
- Cycle #5 & #6 – showing progressive improvement in terms of steam volumes but we are not heating the reservoir efficiently so our productivity is suffering.
- Next step is to suspend and begin producing “3rd Well” (00/12-08-085-17W5/0).
1st Well - Poor Steam Conformance

- Loss of communication with downhole fiber optic on cycle 3 resulted in the need to perform a workover upon completion of the cycle to replace temperature measurement.
- Discovered the coil containing the fiber optic had been mechanically damaged.
- Replaced fiber optic down to top of the liner hanger, could not pump into the lateral section.
- Production inflow performance relatively poor on each cycle.
- Downhole temperature measurements indicate high rate of temperature loss during production cycle.
- We believe there may be some mechanical wellbore damage resulting in limited entry and poor steam conformance in the reservoir.
  - Poor injectivity and higher pressures in the heel is resulting in lower quality steam/hot water in the lateral and also a steady decline in temperature throughout starting at ~950m.
The temperature drop along the lateral section is as a result of poor steam conformance during injection. We are unable to get steam into the reservoir as we move towards the toe of the well.
1\textsuperscript{st} Well (04-17) - Steam distribution
04-17 Cum to Date Production Profile

Cumulative Values to Date
Steam Injected = 5,901 m³
Oil Produced = 1,070 m³
Water Produced = 3,125 m³
Cum SOR = 5.5

Steam Injection (m3/d) | Oil Production (m3/d) | Water Production (m3/d) | BHT (Deg. C) | BHP (kPa) - Secondary Axis
## 04-17 Cumulative Summary

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Steam Injected (m$^3$)</th>
<th>Emulsion (m$^3$)</th>
<th>Oil (m$^3$)</th>
<th>Produced Water (m$^3$)</th>
<th>SOR</th>
<th>WOR</th>
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<tr>
<td>1</td>
<td>704</td>
<td>454</td>
<td>150</td>
<td>303</td>
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<td>2.0</td>
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<td>2</td>
<td>759</td>
<td>552</td>
<td>200</td>
<td>352</td>
<td>3.8</td>
<td>1.8</td>
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<td>3</td>
<td>1,128 (NOTE 1)</td>
<td>717</td>
<td>147</td>
<td>570</td>
<td>7.7</td>
<td>3.9</td>
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<td>4</td>
<td>669 (NOTE 2)</td>
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<td>340</td>
<td>7.2</td>
<td>3.6</td>
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<td>5</td>
<td>1,056 (NOTE 3)</td>
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<td>198</td>
<td>666</td>
<td>5.3</td>
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<td>6</td>
<td>1,585 (NOTE 3)</td>
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<td>282</td>
<td>894</td>
<td>5.6</td>
<td>3.2</td>
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<tr>
<td>Cum to Date</td>
<td>5,901</td>
<td>4,204</td>
<td>1,070</td>
<td>3,125</td>
<td>5.5</td>
<td>2.9</td>
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</table>

### NOTES:
1) Accounts for primary steam slug = 920 m$^3$ CWE and secondary steam slug = 208 m$^3$ CWE
   2nd steam slug was injected in an attempt to get more volume of steam cumulatively in the reservoir. A soak time was allowed to let the pressure drop below maximum followed by another injection. This did not work well.
2) Cycle 4 bottom hole temp started back at native reservoir temp due to coil retrieval
3) Cycle 5 and 6 had received approval for increasing max allowable bottom hole pressure from 10 MPag to 12.4 MPag – resulting BHP was 11.8 MPag and 12.2 MPag respectively
4) Reported SOR's do not account for any primary production
5) In cycle 5 we had extreme cold conditions at surface and when we started steam it shocked the fiberoptic and we lost temperature measurements but managed to splice the fiber at surface and get it functional again
2nd Well (16-09) performance

- Very good injectivity in this well along with good steam conformance based on downhole temperature profile in the lateral section
- Attributed to the significant amount of voidage in this well which produced over 7,950 m³ oil on cold production
- Have not needed to increase the MOP in order to achieve injectivity and we can run at the highest rates of 250 m³/d
- Able to inject a larger steam slug and get more energy into the reservoir, seeing better results than the 1st well
- Forward plan is to continue producing as per plan CSS design plan, inject at 250 m³/d, and soak 5-15 days, and produce until min rate/temperature
Temperature profile (fiber-optic)

00/16-09-085-17W5/0
2nd Well (16-09) - Steam distribution
16-09 Cum to Date Production Profile

Cadotte CSS 00/16-09-085-17W5/0 Cumulative to Date

Cumulative Values to Date
Steam Injected = 11,248 m$^3$
Oil Produced = 3,050 m$^3$
Water Produced = 5,101 m$^3$
Cum SOR to Date = 3.7

- Steam Injection (m$^3$/d)
- Oil Production (m$^3$/d)
- Water Production (m$^3$/d)
- BHT (Deg. C)
- BHP (kPa) - Secondary Axis
# 16-09 Cumulative Summary

<table>
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<th>Cycle</th>
<th>Steam Injected (m³)</th>
<th>Emulsion (m³)</th>
<th>Oil (m³)</th>
<th>Produced Water (m³)</th>
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<th>WOR</th>
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<td>949</td>
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<td>1,954</td>
<td>3,088</td>
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<td>1.6</td>
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<td>Cum to Cycle</td>
<td>5,656</td>
<td>8,152</td>
<td>3,050</td>
<td>5,102</td>
<td>1.9</td>
<td>1.7</td>
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<td>4 (Note 1)</td>
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<td>0</td>
<td>0</td>
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<td>-</td>
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<tr>
<td>Cum to Date</td>
<td>11,249</td>
<td>8,152</td>
<td>3,050</td>
<td>5,102</td>
<td>3.7</td>
<td>1.7</td>
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</table>

**NOTES:**

1) Cycle 4 has completed its injection phase where we injected total volume 5,593 m³ (production has not yet been brought online)

2) Approval for increasing max allowable bottom hole pressure from 10 MPag to 12.4 MPag – no significant result as max BH pressure on well was 4.5 mPag on Cycle 3 and 5.0 MPag on Cycle 4

3) Reported SOR’s do not account for any primary production
Agenda

► Background
► Geology
► Wells
► Performance
► Future Plans
Building 3D geomodel for Cadotte which will cover the entire developable area

Geomodel integrates geology, geophysics, petrophysics and reservoir engineering

Simulate geomodel to *forecast* production with Horizontal CSS in Cadotte.

Determining most accurate OOIP and the optimal exploitation plan going forward
Future plans

► Based on log interpretations and the seismic data we collected we recognize that the Bluesky is separated into the Upper and Lower layers.

► The separation is a sand on sand contact with the differences mainly in the Permeabilities Saturations and Viscosities.

<table>
<thead>
<tr>
<th>Upper Sand</th>
<th>Lower Sand</th>
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<tr>
<td>Core Permeability ~ 0.7 D</td>
<td>Core Permeability ~ 4.0 D</td>
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<tr>
<td>Porosity ~ 28%</td>
<td>Porosity ~ 30 %</td>
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<tr>
<td>Oil Saturation ~ 83 %</td>
<td>Oil Saturation ~ 82 %</td>
</tr>
<tr>
<td>Viscosity ~ 63 k cP</td>
<td>Viscosity ~ 280 k cP</td>
</tr>
<tr>
<td>Sand is massive</td>
<td>Sand is cross bedded</td>
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</table>

► We plan to drill 2 wells in this Lower sand in order to test CSS to determine its viability to go commercial.

► We plan to stay 4m from the bottom water

► Timing for this is dependant on Application approval from AER which we are estimating to be March-April 2014

► Well #3 (12-08) started April 2014
  - Due to the economics of tie in for well 3 the intent was to test viability of CSS using Wells #1 and 2 in the upper bluesky
  - Based on the complications and results of Well #1, decision was made to use Well #3
Expected Recoveries for each Well

- Well 1 (S0/04-17-085-17W5/0) is currently suspended
- Well 2 (00/16-09-085-17W5/0) expected EUR ~ 32,000 m³
  - OOIP = ~ 185,284 m³
  - Recovery Factor = ~ 17%
- Well 3 (00/12-08-085-17W5/0) expected EUR ~ 20,000 m³
  - OOIP = ~ 345,418 m³
  - Recovery Factor = 5.7%
- These wells are not placed in the optimum location to maximize the recoveries the future planned wells will be placed lower in the reservoir to allow for better recoveries.
Cadotte Pilot wells

**Surface 13-9 (Well 1)**
S0/04-17-085-17W5/0

**Well 5**
Drilled into the lower Bluesky (Proposed)

**Surface 16-8 (Well 2)**
00/16-09-085-17W5/0

**Surface 12-9 (Well 3)**
00/12-08-085-17W5/0

**Well 4**
Drilled into the lower Bluesky (Proposed)
Future Well Placement

- **Wilrich Shale**
- **Upper Bluesky Facies**
- **Lower Bluesky Facies**
- **Mississippian**

**Steam Well Locations**:
- Steam Well 1
- Steam Well 2
- Future Steam Well 3
- Future Steam Wells 4 & 5

**Well Numbers and Pads**:
- 16-8 Pad
- 13-9 Pad
- 4-17
- 12-8
- 16-9

**Color Legend**:
- Bluesky Net Pay

**Geological Features**:
- Bluesky Net Pay
- Bottom H2O

**Map Features**:
- Map inset showing well locations and pay zones.

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*Image credit: MURPHY OIL CORPORATION*
Future Horizontal Well Placement

Wilrich Shale

Upper Bluesky Facies

Lower Bluesky Facies

Mississippian Carbonates

Gething

Bottom Water

22 m

4 m

180 m

13-9 Surface

Future Wells 4 & 5

Base Bluesky Structure
Current CSS type well forecast was based on simulations and ongoing history matching work

Expected to cum over 50,875 m³ oil over a 10 year period

Well spacing for future development will be at 50 m
Pilot Expansion Wells 4 & 5

- **Reason for expansion to deeper zone**
  - Allow us to understand the injectivity of the Lower Bluesky for future drills
  - Understand if the higher perms will help our injection and production in this zone
  - Understand what the higher mobile water saturation will do for heat transfer or heat loss
  - This will provide new data in the lower zone to compare with the upper zone of Bluesky
  - This will help tell us if we can increase our recoverable reserves by developing the Lower Bluesky
  - Thermally completed wells will be able to perform better thus eliminating many wellbore issues we currently have
Surface
Surface

- Facilities
- Facility Performance
- Measurement and Reporting
- Water Uses
- Sulphur Production
- Summary of Environmental Issues
- Compliance
Facilities

Murphy Cadotte CSS Pilot – Plot Plan
Facilities

Plant Modifications

► No facility modifications
Facility Performance

► Bitumen Treatment
  ▪ Each production well can be pumped to either the group or test system
    • Each system is comprised of an emulsion cooler and a 2-phase separator and associated instrumentation
  ▪ Emulsion is then sent to one of 3 emulsion tanks (159 m³ each)
    • Heat + retention time used to dry oil to 1-10% BS&W
    • Off-spec oil is trucked to 1-26-083-15 W5M Oil Cleaning Facility
    • Produced water is trucked to 4-22-084-18 W5M salt water disposal well

► Water Treatment
  ▪ Package designed to treat fresh water and produce BFW suitable for a 7,320 kWh OTSG
    • Includes 2 x 100% trains encompassing iron removal, softener and polisher

► Steam Generation
  ▪ Maximum output of OTSG = 250 m³/d CWE steam @ 80% quality
Facility Performance - Power

► POWER CONSUMPTION – Import

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<th>MONTH</th>
<th>Consumption kWh</th>
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<td>Jan-13</td>
<td>60,051</td>
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<td>Feb-13</td>
<td>51,303</td>
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<td>Mar-13</td>
<td>59,022</td>
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<td>Apr-13</td>
<td>58,626</td>
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<td>May-13</td>
<td>56,833</td>
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<td>Jun-13</td>
<td>51,108</td>
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<td>Jul-13</td>
<td>54,687</td>
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<td>Oct-13</td>
<td>57,436</td>
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<td>Nov-13</td>
<td>60,773</td>
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<td>Dec-13</td>
<td>65,027</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>682,908</strong></td>
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► No power generation
## Facility Performance - Gas

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<tr>
<th>Year</th>
<th>Month</th>
<th>Total Gas Production (e³m³)</th>
<th>Total Purchased Gas (e³m³)</th>
<th>Vented Gas (e³m³)</th>
<th>Total Flared Gas (e³m³)</th>
<th>Total Recovered Gas (e³m³)</th>
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<td>0</td>
<td>0</td>
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<td>10.4</td>
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<td></td>
<td>October</td>
<td>30</td>
<td>93.5</td>
<td>0</td>
<td>30.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>24</td>
<td>191.1</td>
<td>0</td>
<td>24.6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>29</td>
<td>349.3</td>
<td>0</td>
<td>30.5</td>
<td>0</td>
</tr>
<tr>
<td>2014</td>
<td>January</td>
<td>56</td>
<td>154.5</td>
<td>0</td>
<td>57.0</td>
<td>0</td>
</tr>
</tbody>
</table>
Facility Performance

- Actual Performance vs. Design (Steam Injection)

Data:
- Total Steam Injected (04-17 and 16-09) = 17,149 m³
- OTSG Design Capacity = 250 m³/d
- Average Steam Injected = 59 m³/d
Facility Performance

► Actual Performance vs. Design (Production)

**Data**
- Oil Produced (04-17 & 16-09) = 4,180 m³
- Water Produced (04-17 & 16-09) = 8,226 m³
- Cum SOR = 4.1
- Average Emulsion Production = 21 m³/d
- Plant Design Capacity = 318 m³/d

![Graph showing oil and water production](chart)

- **Oil Production (m³/d)** - Green
- **Water Production (m³/d)** - Blue

Facility Performance

► Operating Issues
  ▪ OTSG – Initial challenges encountered with control philosophy

► Reliability
  ▪ Were unable to meet target steam slugs on 16-09 initially due to OTSG reliability issues

► Downtime
  ▪ OTSG
    • No building leading to shutdowns due to cold weather
  ▪ Major Equipment Failures Due to Poor Design
    • No major equipment failures
  ▪ Operator Error
    • SOP’s for draining steam line were not followed following an OTSG trip
  ▪ Unexpected process conditions
    • None
Updated MARP submitted March 19, 2014 – Revision 2

- No major changes
- MARP to be updated and submitted to include wells 4 and 5 once scheme amendment is approved

Production Volumes

- Wells tested using a 2-phase separator and prorated on facility actuals
  - Coriolis meter and water cut analyzer used on the liquids dump for tested oil volume
  - Oil production volumes credited back to facility at receipt point (1-26)
- Casing gas measured by orifice meters
- Steam injected volumes measured by BFW into OTSG (vortex and turbine meters) as well as wellhead venturi meter
- Source water measured by turbine meter
### Source Water

- **WSW: F1/16-08-085-17W5/0**
- **Paddy formation (fresh)**
- **Cum extracted: 13,035 m³ water**

<table>
<thead>
<tr>
<th>Month</th>
<th>Water (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun-13</td>
<td>760</td>
</tr>
<tr>
<td>Jul-13</td>
<td>900</td>
</tr>
<tr>
<td>Aug-13</td>
<td>35</td>
</tr>
<tr>
<td>Sep-13</td>
<td>1,602</td>
</tr>
<tr>
<td>Oct-13</td>
<td>1,075</td>
</tr>
<tr>
<td>Nov-13</td>
<td>2,093</td>
</tr>
<tr>
<td>Dec-13</td>
<td>4,478</td>
</tr>
<tr>
<td>Jan-14</td>
<td>2,092</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,035</strong></td>
</tr>
</tbody>
</table>
Source Water Volumes

F1/16-08-085-17W5/0 WSW Production

<table>
<thead>
<tr>
<th>Month</th>
<th>Production (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun-13</td>
<td>800</td>
</tr>
<tr>
<td>Jul-13</td>
<td>900</td>
</tr>
<tr>
<td>Aug-13</td>
<td>100</td>
</tr>
<tr>
<td>Sep-13</td>
<td>1600</td>
</tr>
<tr>
<td>Oct-13</td>
<td>1100</td>
</tr>
<tr>
<td>Nov-13</td>
<td>2200</td>
</tr>
<tr>
<td>Dec-13</td>
<td>4500</td>
</tr>
<tr>
<td>Jan-14</td>
<td>2000</td>
</tr>
</tbody>
</table>
# Injected / Produced Volumes

**00/16-09-085-17W5/0**

<table>
<thead>
<tr>
<th>Month</th>
<th>Oil (m³)</th>
<th>Gas (e³m³)</th>
<th>Produced Water (m³)</th>
<th>Steam (m³)</th>
<th>CSOR</th>
<th>Battery Oil Proration</th>
<th>Battery Water Proration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun-13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul-13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug-13</td>
<td>23</td>
<td>0</td>
<td>477</td>
<td>0</td>
<td>0</td>
<td>1.03</td>
<td>1.14</td>
</tr>
<tr>
<td>Sep-13</td>
<td>6</td>
<td>3</td>
<td>63</td>
<td>150</td>
<td>25</td>
<td>1</td>
<td>1.14</td>
</tr>
<tr>
<td>Oct-13</td>
<td>219</td>
<td>18</td>
<td>601</td>
<td>939</td>
<td>5</td>
<td>1.02</td>
<td>0.82</td>
</tr>
<tr>
<td>Nov-13</td>
<td>604</td>
<td>23</td>
<td>1,389</td>
<td>1,295</td>
<td>3</td>
<td>0.94</td>
<td>1.12</td>
</tr>
<tr>
<td>Dec-13</td>
<td>144</td>
<td>14</td>
<td>205</td>
<td>3,030</td>
<td>6</td>
<td>1.49 (Note 1)</td>
<td>1.08</td>
</tr>
<tr>
<td>Jan-14</td>
<td>1,386</td>
<td>53</td>
<td>2,038</td>
<td>218</td>
<td>2</td>
<td>0.95</td>
<td>0.94</td>
</tr>
<tr>
<td>Totals</td>
<td>2,381</td>
<td>110</td>
<td>4,772</td>
<td>5,632</td>
<td>2.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Test oil production input to PVR incorrect for the month of Dec. Actual proration is 1.03. Amendment to be made
00/16-09-085-17W5/0 Produced Volumes

- **Oil**
- **Water**
- **Steam**
- **CSOR - Secondary Axis**

Months:
- Jun-13
- Jul-13
- Aug-13
- Sep-13
- Oct-13
- Nov-13
- Dec-13
- Jan-14

Monthly Volumes (m³)
- 00/16-09-085-17W5/0 Produced Volumes
### Injected / Produced Volumes

**S0/04-17-085-17W5/0**

<table>
<thead>
<tr>
<th>Month</th>
<th>Oil (m³)</th>
<th>Gas (E³M³)</th>
<th>Produced Water (m³)</th>
<th>Steam (m³)</th>
<th>CSOR</th>
<th>Oil Proration</th>
<th>Water Proration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun-13</td>
<td>0</td>
<td>0</td>
<td>411</td>
<td>760</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Jul-13</td>
<td>81</td>
<td>4</td>
<td>127</td>
<td>834</td>
<td>20</td>
<td>1.03</td>
<td>1</td>
</tr>
<tr>
<td>Aug-13</td>
<td>187</td>
<td>0</td>
<td>392</td>
<td>0</td>
<td>6</td>
<td>1.14</td>
<td>1.14</td>
</tr>
<tr>
<td>Sep-13</td>
<td>15</td>
<td>7</td>
<td>488</td>
<td>1,167</td>
<td>10</td>
<td>1</td>
<td>1.14</td>
</tr>
<tr>
<td>Oct-13</td>
<td>143</td>
<td>12</td>
<td>175</td>
<td>0</td>
<td>6</td>
<td>1.02</td>
<td>0.82</td>
</tr>
<tr>
<td>Nov-13</td>
<td>20</td>
<td>1</td>
<td>352</td>
<td>669</td>
<td>8</td>
<td>0.94</td>
<td>1.12</td>
</tr>
<tr>
<td>Dec-13</td>
<td>150</td>
<td>15</td>
<td>802</td>
<td>1,056</td>
<td>8</td>
<td>1.49 (Note 1)</td>
<td>1.08</td>
</tr>
<tr>
<td>Jan-14</td>
<td>82</td>
<td>3</td>
<td>177</td>
<td>1,584</td>
<td>9</td>
<td>0.95</td>
<td>0.94</td>
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<tr>
<td>Totals</td>
<td>678</td>
<td>42</td>
<td>2,923</td>
<td>6,070</td>
<td>8.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Test oil production input to PVR incorrect for the month of Dec. Actual proration is 1.03. Amendment to be made.
Injected/Produced Volumes – S0/04-17-085-17W5/0

S0/04-17-085-17W5/0 Produced Volumes

- Oil
- Water
- Steam
- CSOR

Monthly Volumes (m³)

Disposal Well

- **04-22-084-18W5** – salt water disposal well
- **12-24-085-19W5** – Tervita sand and waste disposal well

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Produced Water (m³)</th>
<th>Waste Water (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>June</td>
<td>411</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>127</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>869</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>551</td>
<td>305</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>776</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>1,741</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>1,007</td>
<td>346</td>
</tr>
<tr>
<td>2014</td>
<td>January</td>
<td>2,215</td>
<td>290</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>7,695</td>
<td>1,587</td>
</tr>
</tbody>
</table>
## Sulphur Balance

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Sulphur In Produced Gas (tonne/d)</th>
<th>Sulphur in Flare (tonne/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>June</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>YTD Total Sulphur Produced</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2014</td>
<td>January</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>YTD Total Sulphur Produced</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Environmental Issues

- EPEA approval 322432-00-00 received to operate its Cadotte thermal project September 5, 2013

- Monitoring
  - Disturbance and Stockpile Report – Submitted March 5, 2014
  - Passive Air Monitoring and Reporting – Measures NO$_2$, SO$_2$ and H$_2$S monthly
    - Reports submitted monthly starting Oct. 2013
    - No limits exceeded to date
  - Ground Water Monitoring – submitted March 28, 2014
Compliance

► Self Disclosures

- Flaring – rolling average of 0.9 e³m³/d for a consecutive 3 month period was exceeded
  - Economic evaluation to be submitted for review by April 30, 2014
- F1/16-08-085-17W5/0 Source Water Well – submitted Feb. 7, 2014 for late submission of Water Use Report on previous temporary license (00340354)
  - Water Use Report submitted Feb. 21, 2014
  - Extension approved to June 5, 2014
Future Plans

► Subsurface
  ▪ 2 additional wells (4 and 5) drilled in the Lower Bluesky

► Surface
  ▪ Addition of wells 4 and 5 requires no addition to surface equipment
  ▪ Maximize current surface capacities