Husky Oil Operations Limited
Tucker Thermal Project
Commercial Scheme No. 9835

Annual Performance Presentation
Alberta Energy Regulator

September 15, 2015
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1. Brief Background
Project Overview

- AER Commercial Scheme Approval No. 9835
- 30,000 BOPD SAGD Project
- Clearwater and Grand Rapids Reservoirs
- 9-10º API Bitumen
- Integrated with Husky Pipeline & Upgrader
- Project completed in 24 months
- First Steam August 20, 2006
- First Production November 29, 2006
Husky Tucker Project Development Area

- Approval Area:
  - Sections 28, 29, 32 and N/2 of 21 in 064-04 W4M
  - SE ¼ Section 23, SW ¼ Section 21, Section 17 LSD 16 and Section 16 LSD 13
- Initial SAGD development area (Clearwater):
  - Pads A, B, and C
- Project Life Development:
  - Over 140 well pairs
  - 35 year life
- Lower Grand Rapids (LGR):
  - Pad GA - 6 well pairs
- Pad D East:
  - Completed drilling remaining 10 well pairs
  - 15 well pairs in total
- Pad Colony (CN):
  - Completed drilling 6 SAGD well pairs and 7 infill producers
Site Overview

- 86 horizontal well pairs:
  - 32 original well pairs
  - 8 well pairs added in Pad C East 2007
  - 3 well pairs added in Pad B Infills 2009-2010
  - 16 well pairs added in Pad A Infills & Replacements (2010/2011)
    - 1 well pair added in Pad GA 2011
  - 5 well pairs added in Pad GA 2012-2013
  - 15 well pairs added in Pad D East 2014
  - 6 well pairs added in Pad CN 2015
- 7 infill producers added to Pad CN in 2015
- Field Facilities – six well pads, infield pipelines & central pump station
- Central Plant:
  - Emulsion treating
  - Water Treatment – 120,000 bbl/day
  - Steam Generation – 90,000 bbl/day CWE
  - Utilities and Offsites
- Water Source & Disposal Wells
- Metering and Export Pipelines to Cold Lake Terminal
2. Geology / Geosciences
### Average Reservoir Characteristics and OBIP

<table>
<thead>
<tr>
<th>CLEARWATER</th>
<th>OBIP (X10^6 m^3)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
<th>Original Pressure (kPa)</th>
<th>Original Temperature (°C)</th>
<th>Depth (m)</th>
<th>Vertical Permeability (mD)</th>
<th>Horizontal Permeability (mD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approval area</td>
<td>72</td>
<td>45</td>
<td>0.31</td>
<td>0.57</td>
<td>3,200</td>
<td>16</td>
<td>440</td>
<td>1800</td>
<td>3000</td>
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<tr>
<td>Operating portion</td>
<td>27</td>
<td>45</td>
<td>0.31</td>
<td>0.56</td>
<td>3,200</td>
<td>16</td>
<td>440</td>
<td>1800</td>
<td>3000</td>
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</table>

<table>
<thead>
<tr>
<th>LOWER GRAND RAPIDS</th>
<th>OBIP (X10^6 m^3)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
<th>Original Pressure (kPa)</th>
<th>Original Temperature (°C)</th>
<th>Depth (m)</th>
<th>Vertical Permeability (mD)</th>
<th>Horizontal Permeability (mD)</th>
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<tbody>
<tr>
<td>GA Approval Area</td>
<td>3.7</td>
<td>33</td>
<td>0.29</td>
<td>0.55</td>
<td>2,600</td>
<td>14</td>
<td>370</td>
<td>1300</td>
<td>1800</td>
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<table>
<thead>
<tr>
<th>COLONY</th>
<th>OBIP (X10^6 m^3)</th>
<th>Thickness (m)</th>
<th>Φ</th>
<th>So</th>
<th>Estimated Initial Pressure (kPa)</th>
<th>Original Temperature (°C)</th>
<th>Depth (m)</th>
<th>Vertical Permeability (mD)</th>
<th>Horizontal Permeability (mD)</th>
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</thead>
<tbody>
<tr>
<td>CN Approval Area</td>
<td>2.8</td>
<td>10</td>
<td>0.3</td>
<td>0.79</td>
<td>2,600*</td>
<td>12</td>
<td>305</td>
<td>2400</td>
<td>4000</td>
</tr>
</tbody>
</table>

**Notes:**
* Original pressure pending installation of downhole instrumentation (completion scheduled Q4 2015)

**Calculation:** OBIP interval: Top of Formation → oil water contact

OBIP = Area x Thickness x Φ x So
Regional Stratigraphy

- Marginal marine deposits consisting of stacked incised valley and shoreface deposits
Isopach Map of Clearwater SAGD Net Pay

Definition of Net Pay:
Top Clearwater – Top of Transition Zone
(So > 50%, Φ > 27%)  C.I. = 5 m
Structure Map of the Clearwater Base of Net Pay

- Clearwater Approval Boundary
- Lower Grand Rapids Approval Boundary
- Colony Approval Boundary
- Lease Boundary
- 2014 / 2015 well

C.I. = 5 m
Isopach of Clearwater Bottom Water

- Clearwater Approval Boundary
- Lower Grand Rapids Approval Boundary
- Colony Approval Boundary
- Lease Boundary
- 2014 / 2015 well

C.I. = 5 m
Isopach of Clearwater Transition zone

C.L. = 5 m

Clearwater Approval Boundary
Lower Grand Rapids Approval Boundary
Colony Approval Boundary
Lease Boundary
2014 / 2015 well
Isopach Map of Lower Grand Rapids SAGD Net Pay

Definition of Net Pay:
Top Sparky – Base of Pay
(So >50%, Φ >27%)
C.I. = 5 m
Structure Map of the Lower Grand Rapids

- Clearwater Approval Boundary
- Lower Grand Rapids Approval Boundary
- Colony Approval Boundary
- Lease Boundary
- 2014 / 2015 well

C.I. = 5 mASL
Structure Map of the Lower Grand Rapids Base of Net Pay

Clearwater Approval Boundary
Lower Grand Rapids Approval Boundary
Lease Boundary

C.I. = 5m
Isopach Lower Grand Rapids Bottom Water

C.L. = 5m
Isopach Map of Colony SAGD Net Pay

**Definition of Net Pay:**
Colony Top Pay – Colony Channel Base Pay (So >50%, Φ>27%)
C.I. = 2 m
Clearwater Formation Type Log

**Grand Rapids sand and shale**

**D Valley**
- Dominated by tidal-fluvial channel facies

**C Valley**
- Dominated by sand flat facies

**B Valley**
- Dominated by sand flat facies

**Bitumen Zone**

**Transition Zone**

**Bottom Water**

**McMurray Silt, Sand, Clay**

**Cored Interval**

**Calcite cemented zones**

**Top**

**Bottom**

**100/14-28-064-4W400**
- KB 619.5m

- **Correlation**
  - GR
  - TV/D

- **Depth**
  - 350 m
  - 340 m
  - 330 m
  - 320 m
  - 310 m
  - 300 m
  - 290 m
  - 280 m
  - 270 m
  - 260 m
  - 250 m

- **Resistivity**
  - 2000 mΩm
  - 1000 mΩm

- **Porosity**
  - 2000 mΩm

- **Calcite cemented zones**
  - 0.75 m
Sparky Formation Type Log

Correlation

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Depth</th>
<th>Resistivity</th>
<th>Permeability</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR</td>
<td>GRAPR</td>
<td>150</td>
<td>KB = 623.7 m</td>
</tr>
<tr>
<td>SP</td>
<td>100/00 MV</td>
<td>50/00</td>
<td>KB = 623.7 m</td>
</tr>
<tr>
<td>CAL, ECHAL,</td>
<td>125</td>
<td>969</td>
<td>KB = 623.7 m</td>
</tr>
</tbody>
</table>

103/10-32-064-04W400

103/10-32-064-04W400

Top

Bottom

0.75 m

Water sand

Calcite

Transition

Bitumen saturated channel sand

Bitumen saturated channel sand

Cored Interval
Cored Wells & Special Core Analysis

Lease Boundary
Colony Approval Boundary
Cored wells

2014-2015 Petrographic Analysis
General Petroleum Formation is a massive, poorly consolidated, moderately sorted, fine grained feldspathic litharenite with subangular to rounded grains and point-short grain contacts.

Rex Formation is a massive, unconsolidated, moderately sorted, fine grained feldspathic litharenite with subangular to rounded grains and point-short grain contacts.
Representative Structural N-S Cross-section through the Approval Area

Pad A  Pad B  Pad C  Pad D

B Valley  D Valley  C Valley  Transition Zone  Bottom Water  Wabiskaw  D Marine
Representative Strike Cross-section through the Sparky Channel
Representative Strike Cross-section through the Colony Channel
## Capping Shale Properties

<table>
<thead>
<tr>
<th>Pad</th>
<th>Capping Shale Issues to date</th>
<th>Capping shale Fracture Pressure Exceeded</th>
<th>Shale Depth (m)</th>
<th>Measured Fracture Gradient (kPa/m)</th>
<th>Measured Fracture Pressure (kPa)</th>
<th>Fracture Regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colony</td>
<td>First Steam Q1 2016</td>
<td></td>
<td>305</td>
<td>17.0</td>
<td>6,100</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Lower Grand Rapids</td>
<td>No</td>
<td></td>
<td>357</td>
<td>19.9</td>
<td>7,120</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Clearwater</td>
<td>No</td>
<td></td>
<td>426</td>
<td>21.8</td>
<td>9,280</td>
<td>Horizontal</td>
</tr>
</tbody>
</table>

## Sand Properties

<table>
<thead>
<tr>
<th>Pad</th>
<th>Sand Depth (m)</th>
<th>Measured Fracture Gradient (kPa/m)</th>
<th>Measured Fracture Pressure (kPa)</th>
<th>Fracture Regime</th>
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</thead>
<tbody>
<tr>
<td>Lower Grand Rapids</td>
<td>375</td>
<td>17.0</td>
<td>6,360</td>
<td>Vertical</td>
</tr>
<tr>
<td>Clearwater</td>
<td>446</td>
<td>16.0</td>
<td>7,140</td>
<td>Vertical</td>
</tr>
</tbody>
</table>
• Pad A original (A1 – A8 drilled 2005) injectors were converted into producers in 2015

• Pad A replacement producers (A9 – A24 drilled 2010/2011) are 10m - 15m directly above Pad A original producers

• Pad A infill producers are 10m - 15m above and mid distance from Pad A original producers
• Pad B North injectors (B9 – B12 drilled 2005/2006) converted into producers in 2014

• Pad B North infill producers (B9 – B11 drilled 2009/2010) are 10m - 15m above and mid distance from Pad B North
# Pad Interwell Spacing

<table>
<thead>
<tr>
<th>Pad</th>
<th>Interwell Spacing (m)</th>
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</thead>
<tbody>
<tr>
<td>A Original</td>
<td>100</td>
</tr>
<tr>
<td>A Infills and Replacements</td>
<td>50</td>
</tr>
<tr>
<td>B West</td>
<td>100</td>
</tr>
<tr>
<td>B North</td>
<td>100</td>
</tr>
<tr>
<td>B North Infills</td>
<td>100</td>
</tr>
<tr>
<td>C North</td>
<td>100</td>
</tr>
<tr>
<td>C West</td>
<td>100</td>
</tr>
<tr>
<td>C East</td>
<td>100</td>
</tr>
<tr>
<td>D East</td>
<td>50</td>
</tr>
<tr>
<td>GA (LGR)</td>
<td>75</td>
</tr>
<tr>
<td>Colony (SAGD)</td>
<td>75</td>
</tr>
<tr>
<td>Colony Infills</td>
<td>37.5*</td>
</tr>
</tbody>
</table>

* Spacing to SAGD producer
Surface Heave Monitoring Programs

- No surface heave monitoring programs have been conducted
- Operating near reservoir pressure, therefore unlikely to be any surface heave
- Husky is committed to further investigate the possible extent of surface heave if a change in operating conditions warrant
3D Seismic Data

- No New Seismic Data in 2014 - 2015
3. Drilling and Completions
2014/2015 Drilling Results

Pad D East:
- Remaining 10 SAGD well pairs drilled Q4 2014
- 3 Pad D East observations wells drilled Q4 2014 and Q1 2015

Pad CN:
- 6 SAGD well pairs and 7 Producer infills drilled Q2 2015
**SAGD WELL AS-BUILT STICK DIAGRAM - PRODUCER**

**Well Name:** HUSKY A14P COLD LK 13-32-64-4  
**Updated by:** GJ Shomody - June 19, 2011

### Wellhead Data
- **KB elevation:** 624.53 m
- **Ground elevation:** 619.77 m
- **GL to KB:** 4.76 m
- **Wellhead Flange:**

### Drilling Data
- **True vertical depth (TVD):** 477.41 m
- **Total measured depth (TMD):** 1765 m
- **Reservoir zone:** Clearwater
- **License No.:** 0415233

### Downhole Equipment

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>OD (mm)</th>
<th>ID (mm)</th>
<th>Weight (kgm)</th>
<th>Grade</th>
<th>X Type</th>
<th>Top (m)</th>
<th>Bottom (m)</th>
<th>Length (m)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6.0</td>
<td>338.7</td>
<td>320.4</td>
<td>61.11</td>
<td>J55</td>
<td>BTC</td>
<td>4.76</td>
<td>175.37</td>
<td>170.01</td>
<td>13</td>
</tr>
<tr>
<td>6.0-7.5</td>
<td>234.5</td>
<td>223.4</td>
<td>59.53</td>
<td>K55</td>
<td>Blue</td>
<td>4.76</td>
<td>718.34</td>
<td>713.58</td>
<td>55</td>
</tr>
<tr>
<td>7.5-12.0</td>
<td>157.1</td>
<td>140.4</td>
<td>8.33</td>
<td>K55</td>
<td>Blue</td>
<td>719.00</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.0-15.0</td>
<td>157.1</td>
<td>140.4</td>
<td>8.33</td>
<td>K55</td>
<td>B-SAGD</td>
<td>697.97</td>
<td>699.97</td>
<td>1.00</td>
<td>1</td>
</tr>
<tr>
<td>15.0-17.0</td>
<td>157.1</td>
<td>140.4</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>690.97</td>
<td>724.12</td>
<td>25.15</td>
<td>2</td>
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<tr>
<td>17.0-22.0</td>
<td>157.1</td>
<td>140.4</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>724.12</td>
<td>1752.83</td>
<td>1025.51</td>
<td>82</td>
</tr>
<tr>
<td>22.0-24.0</td>
<td>157.1</td>
<td>140.4</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>1752.83</td>
<td>1752.53</td>
<td>0.30</td>
<td>0</td>
</tr>
<tr>
<td>24.0-25.0</td>
<td>157.1</td>
<td>140.4</td>
<td>43.16</td>
<td>K55</td>
<td>B-SAGD</td>
<td>1752.53</td>
<td>1752.03</td>
<td>0.37</td>
<td>1</td>
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</table>

**Tubing Strings:**

- **Primary string:** 66.9 76.0 13.68 L-60 Hydrol 511, 4.76 to 1734.09 1719.22 176
- **Secondary string:** 73.0 62.0 3.55 L-60 Hydrol 511, 4.76 to 642.80 641.63 66
- **Combo coil:** Gaslift/LX Data, 40 sensor points from 729.0 to 1739.0 mBar every 25 m. Gaslift port 613.0 mBar

**NOTES:**
- 0.014" x 7" LINER HANGER @ 699 m
- 0.014" x 7" LINER HANGER @ 699 m
- Wire wrapped screen land @ 1753.00 m

**Project:** Tucker Project
SAGD Well As-Built Diagram: Injector with VIT

- **Tapered Injection String**
  - 114.3x76.0 mm, 30.95 kg/m, Hunting VIT to ~30 m afrom ICP
  - 114.3 mm 17.26 kg/m, Tenaris BTL to ~40 m from FTD

- **Short Steam Circulation String**
  (Will not be used after steam circulation phase)
  - 73.0 mm (2 7/8”) 9.52 kg/m, J-55 HYDRIL 511
  - Wedge, c/w Perforated Pup at ~8.5m TVD above ICP, Landed ~30m MD above ICP

- **Weatherford Shiftable GDA Subs**
  - 114.3m (4 1/2”) x 88.9mm landed at ~40 m & ~35 m MD past ICP

- **Weaver 39.7 mm (1 3/8”), 81.1 kg/m J-55 Surface csg. Landed at +/- 170 m KB

- **244.5 mm (9 5/8”), 59.53 kg/m, L-80, Intermediate csg. set at 700 m KB +/- 50 m.**

- **244.5 mm x 177.8 mm Weatherford Liner Hanger**
  - Top Landed at +/- xxx m KB

- **177.8 mm (7”) 34.2 kg/m, K-55 Tenaris**
  - Blue Slotted liner from 718 to 1450 m KB (0.020” Straight Cut Slots)

- **20 ports**
  - TVD: ~467 m KB
  - MD: ~1510 m KB

- **4-1/2” 40/40 box X 4-1/2” Tenaris pin Cross-over.**
Proposed Colony Completion – SAGD Injector

Surface Casing
359.7 mm (13 3/8"), 81.1 kg/m, L-66 LT&C Landed at 155.00 mKB

Intermediate Casing
244.5 mm (9 5/8"), 59.53 kg/m, L-66, Tenaris Blue Landed at 365.80 mKB

Circulation String
73.0 mm (2 7/8"), 9.62 kg/m, J-65 Tenaris BTL Tubing Landed at 512.80 mKB MD

Long Injection String
114.3 mm x 88.3 mm Vacuum Insulated Tubing Surface to 304.60 mKB MD
114.3 mm, 17.62 kg/m, J-65 Tenaris BTL Tubing 534.60 - 1,294.00 mKB MD

Weatherford Shiftable GDA Sub Steam Splitters
114.3 mm x 114.3 mm landed at 625.00 mKB MD & 871.00 mKB MD

177.8 mm (7") Wire Wrapped Screen
0.254mm (0.010") slots

744.5 mm x 177.8 mm Import Liner Hanger
Top Landed at 569.06 mKB

Tucker Thermal Colony Project
SAGD Steam Injection Well
June 24, 2015 (Proposed Completion)

CNS2 Colony SAGD Injection Well

<table>
<thead>
<tr>
<th>Formation Top</th>
<th>MD (mKB)</th>
<th>TVD (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second White Specks</td>
<td>191</td>
<td>184</td>
</tr>
<tr>
<td>Belle Pourche</td>
<td>202</td>
<td>193</td>
</tr>
<tr>
<td>Maze Fish Scales</td>
<td>235</td>
<td>219</td>
</tr>
<tr>
<td>West Gate</td>
<td>245</td>
<td>225</td>
</tr>
<tr>
<td>Viking</td>
<td>539</td>
<td>266</td>
</tr>
<tr>
<td>Jolis Pou</td>
<td>551</td>
<td>270</td>
</tr>
<tr>
<td>Colony</td>
<td>506</td>
<td>310</td>
</tr>
</tbody>
</table>

TVD: 316.53 mKB
MD: 1,334.00 mKB
Proposed Colony Completion – SAGD Producer

Surface Casing
339.7 mm (13.34"), 81.4 kg/m, J-55 L&T
Landed at 155.00 mKB

Intermediate Casing
244.5 mm (9.60"), 59.53 kg/m, L-60,Tenaris Blue
Landed at 696.00 mKB

Long Injection String
(to remain in the hole after steam circulation)
73.0 mm, 9.62 kg/m, J-55 Tenaris BTL Tubing
From Surface to 1,317.00 mKB MD

Production String
114.3 mm, 17.62 kg/m, J-55 Tenaris BTL Tubing,
Tubing drain
Tubing Pump 40-475-10HS-34-4-0 set on the
bottom of the tubing string
Tubing landed at 340.68 mKB MD
Pump landed at 361.56 mKB MD

Rod & Pump
36.1 mm (.14") stainless steel polished rod
60.3 cm (24") sinker bar
25.4 mm (1") 900 MJ Pro-rod o/w 48% shear pump on-off tool

177.8 mm (7") Wire Wrapped Screen
9.254 mm (0.364") slots

744.5 mm x 177.8 mm Import Liner Hanger
Top Landed at 581.36 mKB

TVD: 259.45 mKB
MD: 1,357.0 mKB

Formation Top
<table>
<thead>
<tr>
<th>MD (mKB)</th>
<th>TVD (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second White Specks</td>
<td>190</td>
</tr>
<tr>
<td>Belle Fourche</td>
<td>201</td>
</tr>
<tr>
<td>Base Fish Scales</td>
<td>232</td>
</tr>
<tr>
<td>West Gate</td>
<td>241</td>
</tr>
<tr>
<td>Viking</td>
<td>326</td>
</tr>
<tr>
<td>Joli Fou</td>
<td>336</td>
</tr>
<tr>
<td>Colony</td>
<td>451</td>
</tr>
</tbody>
</table>

Tucker Thermal Colony Project
SAGD Producer Well
June 25, 2015 (Proposed Completion)
CNP2 Colony SAGD Well Design - Production
Proposed Colony Completion – ISS Producer

Surface Casing
339.7 mm (13.36”), 81.1 kg/m, J-55 L T&C
Landed at 154.00 mKB

Intermediate Casing
244.5 mm (9 5/8”), 89.53 kg/m, L-60, Tenaris Blue
Landed at 530.00 mKB

Long Injection String
73.0 mm, 9.52 kg/m, J-55 Tenaris BTL Tubing
from Surface to 1,468.6 mKB MD

Production String
114.3 mm, 17.62 kg/m, J-55 Tenaris BTL Tubing,
Tubing drain
Tubing landed at 341.42 mKB MD
Pump landed at 362.42 mKB MD

Rods & Pump
38.1 mm (1.5”) stainless steel polished rod
80.8 m of 50.8 mm (2”) sinker bar
26.4 mm (1”) 960 MPa rod/c/w 40k phoar
Insert pump 40-326-RWA-DR-34-4-0

244.5 mm x 177.8 mm Import Liner Hanger
Top Landed at 591.46 mKB

Tucker Thermal Colony Project
ISS Producer Well
June 25, 2015 (Proposed Completion)
CN7 Colony ISS Well - Production

Formation Top | MD (mKB) | TVD (mKB)
---|---|---
Second White Specks | 130 | 185
Belle Fourche | 230 | 194
Base Fish Scales | 280 | 219
West Gate | 328 | 225
Viking | 315 | 274
Joli Fou | 322 | 278
Colony | 407 | 312

177.8 mm (7”) Wire Wrapped Screen
0.254 mm (0.01”) slots

TVD: 325.22 mKB
MD: 1,530.0 mKB
Proposed Colony Completion – Infill Producer

**Surface Casing**
- 244.5 mm (9 5/8"), 48.07 kgf/m, H 40 LT&C
- Landed at 152.00 mKB

**Intermediate Casing**
- 178.8 mm (7"), 34.2 kgf/m, L-69, Tenaris Blue
- Landed at 608.00 mKB

**Production String**
- 114.3 mm, 17.62 kgf/m, J-66 Tenaris R/L Tubing
- Tubing drain & pump setting nipple
- Tubing landed at 341.07 mKB MD
- Pump landed at 352.00 mKB MD

**Rods & Pump**
- 38.1 mm (1.5") stainless steel polished rod
- ~ 80.8 m of 50.8 mm (2") sinker bar
- 25.4 mm (1") 980 MPR rod w/ W4K shear insert pump 49-325-024-WA-PR-34-4-6

**Tucker Thermal Colony Project**
**Infill Producer Well**
Revised: June 16, 2015 (Proposed Completion)

**CN1 Colony infill Well Design - Production**

<table>
<thead>
<tr>
<th>Formation Top</th>
<th>MD (mKB)</th>
<th>TVD (mKB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second White Specks</td>
<td>190</td>
<td>184</td>
</tr>
<tr>
<td>Belle Fourche</td>
<td>200</td>
<td>194</td>
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<tr>
<td>Base Fish Scales</td>
<td>230</td>
<td>218</td>
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<td>West Gate</td>
<td>259</td>
<td>225</td>
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<td>Viking</td>
<td>315</td>
<td>275</td>
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<td>Joli Fou</td>
<td>322</td>
<td>276</td>
</tr>
<tr>
<td>Colony</td>
<td>415</td>
<td>309</td>
</tr>
</tbody>
</table>

**114.3 mm (4.5") Wire Wrapped Screen**
0.254 mm (0.010") slots

**177.8 mm x 114.3 mm Import Liner Hanger**
Top Landed at 659.83 mKB

TVD: +/- 318.11 mKB
MD: +/- 1,438.00 mKB
Colony Completion – Additional Information

- Two infill producers (CN11 and CN13) completed with semi-premium verses premium couplings in the intermediate casing
- These infill producers are placed at the bottom of the reservoir, adjacent to SAGD well pairs
- As per Directive 020, thermal cement used and cement bond logs show good to very good cement bond
- Tenaris verified the casing is appropriate for service:
  - Thread cut & quality of semi-premium couplings are identical to premium couplings
  - Semi-premium couplings have moderate to high seal-ability verses premium couplings which have the highest seal-ability due to the metal-to-metal radial connection
  - Torque records reviewed and coupling make-up for wells determined to be good
- Noetic Engineering 2008 Inc. verified the strength of the casing:
  - The semi-premium coupling connections have 100% structural strength for thermal stress cycling in both compression and tension
  - The semi-premium couplings meet IRP 3 strength efficiency requirements and have a low probability to fail due to strength
  - The semi-premium couplings are not considered a strength risk
- The Directive 051 application was submitted August 27, 2015 with the additional information noted above
4. Artificial Lift
Artificial Lift

• All producer wells equipped with gas lift:
  • Gas-lift operational parameters:
    • Pressure: 2,400 kPa – 4,000 kPa
    • Bottom hole temperature: 200 – 240 °C
    • Gas injection rate: 1,200 – 10,800 m³/day

• Future producers:
  • Rod pumps planned for Colony
5. Instrumentation in Wells
42 OBS wells within approved area:
- 38 OBS Wells with Instrumentation
- 4 Planned OBS Wells in 2015/2016 (converting existing wells)

Clearwater Approval Boundary
Lower Grand Rapids Approval Boundary
Colony Approval Boundary
Lease Boundary
Instrumentation in OBS & SAGD Wells

- **38 OBS Wells with Instrumentation:**
  - 30 Wells: thermocouple only
  - 8 Wells: both thermocouple & piezometer

- **4 Planned OBS Wells** (convert existing wells):
  - 4 Wells for Colony – thermocouple only

- **SAGD Injectors** – wells use blanket gas to measure pressure and for insulation

- **SAGD Producers** – equipped with combo instrumentation coil (gas lift & thermocouple or fiber)
  - A combo coil is installed in the long production string to measure temperature
6. 4D Seismic
• No 4D seismic in 2014 - 2015
7. Scheme Performance
Current performance prediction built on:

- Observation of actual performance
- Analysis of analogous SAGD projects
- Updated geological model supplemented with simulation and analytical models
Production vs. Approval Capacity Variance

- 32 Original well pairs had poor performance due to:
  - Placement in the transition zone where oil saturation is low
  - Poor start-up strategy
  - Variable steam chamber development

- All new well pairs drilled to the base of SAGD net pay
  - Pad C East
  - Pad B North Infill
  - Pad A Infills and Replacement Wells
  - Pad GA
  - Pad D East
  - Pad CN

- Initial startup strategy (bull-heading) was not adequate
  - All new wells were circulated
Production vs. Approval Capacity Variance

- Revised completion of new wells
  - Dual string completions in both injector and producer
  - Injectors completed with VITs and steam splitters for Pads D East and CN
  - Wire-wrapped screens for all new producers to increase open area
  - Blanket gas installed on all wells to provide
    - Insulation
    - Casing protection
    - Down hole pressure measurement
Pad C West Performance - Low Recovery Example
Pad C West Heel Observation Well
Pad C West Mid Observation Well

Tucker Observation Well Temperature vs Depth
105/11-29-064-04W4/00

BH Temperature (deg. C)

Vertical Depth (m)

GAMMA RAY (API)

Clearwater Top

OWC

Clearwater Base
Pad C West Toe Observation Well
Discussion of Pad C West Performance

- The OBS well 22 m south of C3 Heel showing good steam chamber development

- Pad C West performance indicators as of July 31, 2015:
  - Cum. Oil: 397,940 m³
  - Cum. Steam Injected: 3,644,524 m³
  - Cum. Water Produced: 2,833,320 m³
  - CSOR: 9.2

- Pad C West performance for the reported period:
  - Cum. Oil: 56,797 m³
  - Oil Rate per Well: 19.5 m³/day
  - SOR: 7.4
Pad A Infills and Replacement Wells Performance - Medium Recovery Example
Pad A Infills and Replacement Wells Heel Observation Well
Pad A Infills and Replacement Wells Mid Observation Well
Discussion of Pad A Infills and Replacement Wells Performance

- The OBS well 14.5 m north of A9 heel showing minimal steam chamber development

- Pad A performance indicators as of July 31, 2015:
  - Cum. Oil: 773,390 m³
  - Cum. Steam Injected: 5,187,417 m³
  - Cum. Water Produced: 5,879,223 m³
  - CSOR: 6.7

- Pad A performance for the reported period:
  - Cum. Oil: 189,061 m³
  - Oil Rate per Well: 32.4 m³/day
  - SOR: 6.6
Pad C East Mid-Section Observation Well

Tucker Observation Well
Temperature vs Depth
100/14-28-064-04W4/00

BH Temperature (deg. C)

Vertical Depth (m)

GAMMA RAY (API)

Clearwater Top
OWC
Clearwater Base

8 meter North of C13 mid
Pad C East Toe Observation Well
Discussion of Pad C East Performance

- The OBS well 11 m north of C13 toe is showing very good steam chamber development in both horizontal and vertical directions

- Pad C East performance indicators as of July 31, 2015:
  - Cum. Oil: 1,036,277 m³
  - Cum. Steam Injected: 5,053,815 m³
  - Cum. Water Produced: 5,352,192 m³
  - CSOR: 4.9

- Pad C East performance for the reported period:
  - Cum. Oil: 148,465 m³
  - Oil Rate per Well: 46.9 m³/day
  - SOR: 5.7

- The well placement was mainly above the transition zone

- Circulation start-up strategy was successfully implemented
Pad Lower Grand Rapids (LGR) Performance

- 2012 plant shut down for maintenance
- 2013 plant shut down for maintenance
- 2015 plant shut down for maintenance

Graph showing daily rates vs. date with different markers for Cal Dly Oil, Cal Dly Water, Cal Inj Steam, ISOR, and Well Count.
Discussion of Pad GA Performance

- Pilot well started in September 2011
- Remaining 5 Well Pairs started by September 2013

- Pad GA performance indicators as of July 31, 2015:
  - Cum. Oil: 198,823 m³
  - Cum. Steam Injected: 1,036,651 m³
  - Cum. Water Produced: 1,407,278 m³
  - CSOR: 5.2

- Pad GA performance for the reported period:
  - Cum. Oil: 101,391 m³
  - Oil Rate per Well: 42.7 m³/day
  - SOR: 4.6
Pad B North Performance

- 2009 plant turnaround
- 2011 plant shut down for maintenance
- 2013 plant shut down for maintenance
- 2015 plant shut down for maintenance
- 2007 plant turnaround

Graph showing Daily Rates (m3/d) and ISOR, Well Count over time from Apr-2006 to Apr-2016.
Pad B North Infill Performance

2011 plant shut down for maintenance
2012 plant shut down for maintenance
2013 plant shut down for maintenance
2015 plant shut down for maintenance

Daily Rates (m3/d)

ISOR, Well Count

Date

- Cal Dly Oil
- Cal Dly Water
- Cal Inj Steam
- ISOR
- Well Count

Apr-2010  Apr-2011  Apr-2012  Apr-2013  Apr-2014  Apr-2015  Apr-2016
Pad B West Performance

Date

Daily Rates (m³/d)

2007 plant turnaround
2009 plant turnaround
2010 plant turnaround
2011 plant shut down for maintenance
2012 plant shut down for maintenance
2013 plant shut down for maintenance
2015 plant shut down for maintenance
Begin perforation

Cal Dly Oil
Cal Dly Water
Cal Inj Steam
ISOR
Well Count
Pad C North Performance

- 2007 plant turnaround
- 2009 plant turnaround
- 2010 plant turnaround
- 2011 plant shut down for maintenance
- 2012 plant shut down for maintenance
- 2013 plant shut down for maintenance
- 2015 plant shut down for maintenance

Graph showing daily rates (m3/d) and ISOR, Well Count over time from April 2006 to April 2015.
Pad B North and Original Pad A: Injectors Converted to Producers

- Pad B North Injectors Converted to Producers – B10, B11, B12:
  - AER Approval (No. 9835N) received August 18, 2014
- Original Pad A Injectors Converted to Producers - A01, A02, A03, A04, A05, A06, A07, A08:
  - AER Approval (No. 9835O) received December 19, 2014

- Pad B North (Converted October 2014):
  - Cum. oil produced: 9,476 m³
  - Average oil production per well: 20.7 m³/d
  - Production range per well: 5 m³/d to 50 m³/d
  - Variable production rates due to challenging reservoir conditions

- Original Pad A (Converted January 2015):
  - Cum. oil produced: 11,898 m³
  - Average oil production per well: 9.8 m³/day
  - Production range per well: 1 m³/d to 45 m³/d
  - Initial rates showing good results
New Pads: D East and CN

- Pad D East (15 SAGD well pairs):
  - All injectors are equipped with VIT and steam splitters
  - All producers are completed with dual string
  - Circulation of the first 5 well pairs started on March 15, 2015
  - Circulation of remaining 10 well pairs started on June 1, 2015
  - The first 5 well pairs converted into SAGD operations on August 1, 2015
  - The remaining well pairs will be converted to SAGD by end of September 2015

- Pad CN (6 SAGD well pairs and 7 infill producers):
  - Drilling was completed in June 2015
  - Scheduled for startup in Q1 2016
OBIP and Recoveries by Pad

- OBIP for each pad is calculated from the formula:

\[
OBIP = L \times W \times H \times (1 - S_w) \times \Phi \times 1/B_o
\]

Where

- \( L \) = Effective Average Length of wells
- \( W \) = Lateral Width covered by the wells
- \( H \) = Thickness from the top of pay to the producer elevation
- \( \Phi \) = Average Porosity in the Pay zone
- \( S_w \) = Average Water Saturation in the Pay zone
- \( B_o \) = Oil Volume factor/Shrinkage factor (taken as 1)
### OBIP and Recoveries by Pad

<table>
<thead>
<tr>
<th>PAD</th>
<th>OBIP (10^6 m³)</th>
<th>Recovery to date July 31, 2015 (10^3 m³)</th>
<th>Recovery Factor %</th>
<th>Estimated Ultimate Recovery (10^6 m³)</th>
<th>Ultimate RF %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (24 wells)</td>
<td>5.6</td>
<td>831.2</td>
<td>15%</td>
<td>3.1</td>
<td>54%</td>
</tr>
<tr>
<td>B (15 wells)</td>
<td>7.1</td>
<td>713.5</td>
<td>10%</td>
<td>3.0</td>
<td>42%</td>
</tr>
<tr>
<td>C (20 wells)</td>
<td>11.6</td>
<td>1492.8</td>
<td>13%</td>
<td>5.3</td>
<td>46%</td>
</tr>
<tr>
<td>GA (6 wells)</td>
<td>2.0</td>
<td>198.8</td>
<td>10%</td>
<td>0.8</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26.3</strong></td>
<td><strong>3236.3</strong></td>
<td><strong>12%</strong></td>
<td><strong>12.2</strong></td>
<td><strong>47%</strong></td>
</tr>
</tbody>
</table>
5-Year Outlook of Expected Pad Abandonment

- No pad abandonment is anticipated in the next 5 years
Temperature, Pressure and Quality of Steam

- High pressure steam separator delivers steam at a 100% quality
- Steam quality losses are experienced during transportation to the pads
- Steam quality at the wellhead is estimated to be 95%
Composition of Other Injected/Produced Fluids

- Not applicable to Tucker Thermal Project
Summary of Key Learnings

• Well placement is a critical factor for well performance

• Circulation is the optimum startup procedure for establishing thermal communication in a SAGD process

• Wire-wrapped screens are better for avoiding scaling problem of the production liner

• Steady operating conditions are key to obtaining good steam chamber conformance

• Operating pressure should be constant and close to bottom water pressure to prevent water inflow and steady operations

• Pad A original injectors converted to producers were successful
8. Future Plans
Future Plans (2015/2016)

- **Pad D East Development:**
  - Complete circulation/start-up and commence SAGD operations

- **Pad CN Development:**
  - Commission & start-up facilities (Q1 2016)
  - Circulate/start-up and commence SAGD operations (Q2 2016)

- **Pad C West Replacement Wells:**
  - Drill & complete 3 replacement wells and tie-into existing facilities (Q1 2016)
  - Circulate/start-up and commence SAGD operations (Q2 2016)

- **Pad D North Amendment:**
  - Submit amendment to drill 8 SAGD pairs

- **SAGD Operations:**
  - Continue to optimize SAGD operations
  - Temperature surveillance
  - OBS wells monitoring

- **Pad C North Future Development:**
  - Based on performance at Pads A infills and replacement wells, B North infill wells, B West and C West replacement wells
  - Evaluate and propose a development strategy for optimizing the resource recovery
3.1.2. Surface Issues - Table of Contents

1. Facilities – slide 89
2. Facilities Performance – slide 100
3. Measurement and Reporting – slide 111
4. Water Production, Injection and Uses – slide 124
5. Sulphur Production – slide 138
6. Environmental Issues – slide 144
7. Compliance Statement – slide 154
8. Non-Compliance Events – slide 157
9. Future Plans – slide 161
1. Facilities
Layout (Looking South)
Layout (Looking North)

- Pad B
- Pad C
- Pad A
- CPF
- Pad D
- Pad CN
Central Processing Facility (CPF)
CFF (Located at Pad B)
Husky Tucker Facility Schematic

Emulsion from Pads

Diluent

Free Water Knock Out

Diluent

Oil Treaters

Dilbit Storage Tanks

Sales Pipeline

CFF Separator

Separator Free Water

Knock Out

Diluent

Oil

Treaters

Desand Tank

Sand Trucked Out

Skim Tanks

Induced Gas Flotation Unit

De-Oiled Produced Water Tank

Lime & MagOx

Oil Removal Filter

De-Oiled

Produced Water Tank

Warm Lime Softener

After Filters

Weak Acid Cation Unit

Lime Sludge Ponds

Disposal

BFW Tank

OTSGs

900# 600#

Disposal Wells

Wells

Brackish Makeup Water

HP Steam to GR Pad

HP Steam to A/B/C/D Pads

LP Utility Steam

LP Steam Separator

600# HP Steam Separator

900# HP Steam Separator

HP Steam to A/B/C/D Pads

LP Steam Separator

600# HP Steam Separator

900# HP Steam Separator
Facility Modifications

• Pad D East commissioning:
  • Commissioned in March 2015 with first steam to the pad on 14 March 2015

• Pad CN construction:
  • Drilling completed Q2 2015
  • Surface facility construction on-going with completion expected in Q1 2016

• Addition of a 6th OTSG:
  • Construction in the CPF started Q1 2015
  • Commissioning to begin Q4 2015

• Modifications to the WLS to increase throughput:
  • Adjustable weirs installed on the WLS outlet flow
  • Required to accommodate the 6th OTSG

• Outlet gas nozzle on CFF Emulsion Separator changed to 30” diameter

• Replacement of the Produced gas scrubber
Pad CN and Pipeline to CPF
Facility Modifications – 6th OTSG Addition
2. Facilities Performance
Operating issues:

- Facilities experienced corrosion under insulation (CUI) on two tank roofs, as well as on the underside of the tank floor. The corroded components have been repaired and long term solutions are being worked.
- Two produced water disposal lines had liner failures. The liners were repaired and additional safeguards put in place to prevent further failures.
Operating Limitations

Water Disposal Limitation:

- Proactively worked with AER to amend the disposal factors in Directive 081 to ensure compliance
- New factors were considered based upon the poor water chemistry of the brackish make-up and produced water
- Adjustments to produced water and brackish water disposal factors granted April 2015:
  - $D_f =$ the disposal factor for fresh water = 0.03 (no change)
  - $D_b =$ the disposal factor for brackish water = 0.525 (from 0.350)
  - $D_p =$ the disposal factor for produced water = 0.125 (from 0.100)
- Discussions with AER regarding Directive 081 compliance:
  - No fresh water consumed in steam production
  - Maximize recycle OTSG blow-down while maintaining operational stability and equipment limitations
  - Brackish water, high TDS (20,000+)
  - Historical and current WSR above 1.05
  - All produced water treated and used for steam generation
- Testing included:
  - Increased OTSG blow-down with limited brackish water = high pH in WLS, high alkalinity and turbidity
  - Increased brackish water to dilute blow-down to WLS = high TDS in BFW
- Testing concluded adjustments to OTSG blow-down recycle and brackish water could not sustain water process
Process Water De-Oiling

- The de-oiling process consists of 2 Skim Tanks (in series), IGF and 2 Oil Removal Filters

- The performance of the de-oiling equipment has been close to spec and is performing well

- De-Oiling KPI’s are:
  - FWKO – 1,000 ppm (average 441 ppm)
  - IGF Inlet – 100 ppm (average 92 ppm)
  - IGF Out – 40 ppm (average 53 ppm)
  - ORF Outlet – 20 ppm (average 27 ppm)
WLS - Warm Lime Softener

- Primary water treatment to produce boiler feedwater
- Feed sources:
  1. De-oiled produced water
  2. Brackish water make-up
  3. Sludge pond water
- Reduces water contaminants:
  1. Hardness - primarily Calcium and Magnesium
  2. Silica - main contaminant due to thermal recovery process
  3. Turbidity - suspended solids
- Produces sludge as waste product - stored in ponds
- Mechanical turbine, rake drives
- Main zones: Mixing, Reaction, Settling
- Produces water effluent with hardness ~20 ppm and silica ~50 ppm
WLS Chemistry

- Lime – primary hardness control
- Magnesium Oxide (MagOx) – primary silica reduction
- Caustic – water pH control, aids softening
- Sodium Carbonate (soda ash) – permanent hardness removal
- Polymer – coagulants and flocculants establish sludge bed control
WLS Performance

- The WLS has performed very well to date

- Key KPIs:
  - Soluble Hardness – 30 ppm (average 10 ppm)
  - Silica – 50 ppm (average 48 ppm)
  - Turbidity – 20 NTU (average 20 NTU)
Power Consumption

![Graph showing power consumption from August 2014 to July 2015.]
Flaring and Venting

- After start up from the May 2015 turnaround, both the 4 hour duration and 30,000 m³ volume were exceeded. Numerous problems during start up contributed to this. Discussion was held with the Bonnyville Field Center and a Notification was submitted in DDS.

- No Venting

<table>
<thead>
<tr>
<th>Date</th>
<th>Gas flare (E³m³)</th>
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<tbody>
<tr>
<td>Aug-14</td>
<td>2.80</td>
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<tr>
<td>Sep-14</td>
<td>0.49</td>
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<td>Oct-14</td>
<td>12.31</td>
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<td>Nov-14</td>
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<td>140.85</td>
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<tr>
<td>Jun-15</td>
<td>8.60</td>
</tr>
<tr>
<td>Jul-15</td>
<td>0.21</td>
</tr>
</tbody>
</table>
Green House Gas (GHG)

- Emission sources considered include stationary combustion associated with steam generators and glycol heaters, flaring, venting and fugitive emissions

- 610,708.91 tonnes of Carbon Dioxide Equivalent were emitted in 2014 (information taken from the Tucker Thermal 2014 report submitted to AESRD under the Specified Gas Emitters Regulation)
3. Measurement and Reporting
OIL & DILUENT METERING

<table>
<thead>
<tr>
<th>LABEL</th>
<th>TAG</th>
<th>P&amp;ID#</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>1P</td>
<td>FD032</td>
<td></td>
<td>LACT DILBIT SALES FLOW TOTALIZER</td>
</tr>
<tr>
<td>2P</td>
<td>LI3130S</td>
<td>30MF02</td>
<td>DILBIT STORAGE TANK VOLUME</td>
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<tr>
<td>3P</td>
<td>LI3131S</td>
<td>30MF03</td>
<td>DILBIT STORAGE TANK VOLUME</td>
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<tr>
<td>1D</td>
<td>FD031</td>
<td></td>
<td>DILUENT TO PLANT FLOW TOTALIZER</td>
</tr>
<tr>
<td>2D</td>
<td></td>
<td></td>
<td>DILUENT FLASH VOLUME LOSS (CALCULATED)</td>
</tr>
<tr>
<td>3D</td>
<td></td>
<td></td>
<td>DILUENT SHRINKAGE VOLUME (CALCULATED)</td>
</tr>
</tbody>
</table>

OIL PRODUCTION TOTAL = (PIPELINE METER ± INVENTORY CHANGE) - NET DILUENT VOLUME ADDED + (SHRINKAGE AND FLASH VOLUME LOSS)  
(1P * (1 - (AI-095/100))) + (2P + 3P - 10 + (20 + 3D))

NOTE: OIL VOLUMES REPORTED TO THE AER ARE CORRECTED FOR SHRINKAGE AND FLASH IN ACCORDANCE WITH DIRECTIVE 17 SECTION 14.3  
BY PRODUCTION ACCOUNTING

NOTE: AI-095 MEASURES SALES BS&W
Estimating Well Production

- **Oil and Water Estimated by Well Test:**
  - Battery level measurement prorated to wells based on the estimates

- **Two Test Separator Designs (Well Tests):**
  1. **Blow-Case (Pads A Original, B, C East, C West):**
     - Loadcell or level
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
     - Steam fraction calculated (from $P_{\text{sat}} / P_{\text{meas}}$)
  2. **Conventional (Pads B North, A Redrill & Replacement Wells, GA, D East):**
     - Coriolis meter for liquid
     - Vortex for steam + natural gas
     - AGAR water-cut analyzer
     - Steam fraction calculated (from $P_{\text{sat}} / P_{\text{meas}}$)

- **Gas Measured at the Battery (proration = 1):**
  - GOR for August 1, 2014 to July 31, 2015 = 48.1 m$^3$/m$^3$

- **Steam Injection:**
  - Heel and toe vortex meters per well
  - Total steam to field measured at the battery
  - Steam Proration = 1.020 m$^3$/m$^3$
Water Balance

- **Water Proration Factors (see next slide):**
  - Average 12-Month Rolling Proration Factors
    - Water = 1.14
    - Oil = 1.03

- **Water / Steam Meter Calibrations:**
  - Metering equipment inspected / calibrated annually
  - Annual well steam injection meters inspection per Directive 017
  - AGAR water cut analyzer calibration program reviewed and updated
  - AER Directive 041 annual submission

- **Metering Accuracy:**
  - Accounting meters conform to Directive 017 single point measurement accuracy
## Well Test Averages

<table>
<thead>
<tr>
<th>Test Separator</th>
<th>Well Group</th>
<th>Average Test Duration (hours/test/month)</th>
<th>Average Test Frequency (well/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-151/2</td>
<td>A9-16 (Aug - Dec) A1-8 (Jan - Apr)</td>
<td>4.3 4.9</td>
<td>13.7 8.2</td>
</tr>
<tr>
<td>V-251/2</td>
<td>B1-12</td>
<td>3.9</td>
<td>6.2</td>
</tr>
<tr>
<td>V-351/2</td>
<td>C1-9</td>
<td>4.2</td>
<td>9.1</td>
</tr>
<tr>
<td>V-391/2</td>
<td>C13-20</td>
<td>3.6</td>
<td>15.2</td>
</tr>
<tr>
<td>V-170</td>
<td>A9-16 (Jan - Jul) A17-20 (Aug - Dec) A17-20 (Jan - Jul)</td>
<td>4.5 9.2 5.5</td>
<td>7.8 19.5 11.1</td>
</tr>
<tr>
<td>V-171</td>
<td>A21-24</td>
<td>7.3</td>
<td>19.6</td>
</tr>
<tr>
<td>V-213A</td>
<td>B9EP</td>
<td>23.4</td>
<td>26.2</td>
</tr>
<tr>
<td>V-214A</td>
<td>B10EP</td>
<td>23.4</td>
<td>26.4</td>
</tr>
<tr>
<td>V-540</td>
<td>GR01-06</td>
<td>6.4</td>
<td>14.5</td>
</tr>
<tr>
<td>V-440</td>
<td>D24-28</td>
<td>5.1</td>
<td>8.6</td>
</tr>
</tbody>
</table>
Solvents and Condensable Gas

- Bitumen production accounts for diluent flash and volumetric shrinkage
- No solvent injection to reservoir
- There is no non-condensable gas injection
Measurement Initiatives – Continuous Improvement

• Measurement, Accounting and Reporting Plan (MARP) submitted with new primary produced water proposed

• No technical issues identified with measurement equipment:
  • Meter accuracy verified

• Implemented improvements:
  • Detailed review of measurement schematics to include:
    • Pad D East test separator and steam injection
    • Injectors Converted to Producers: Pads A1-8, B10-12
    • Steam injection schematics 600# and 900# steam
  • Produced water orifice plate bypass, new isolation valve installed during turnaround
  • Radar level detection on Dilbit sales tanks
  • Monthly ultrasonic meter servicing

• Future opportunities:
  • Produced water meter installation (magnetic flow tube upstream of WLS)
  • Detailed review of steam calculation in overhead test separator gas
4. Water Production, Injection and Uses
Brackish Water

• Make-up water for steam generation

• McMurray Formation

• 3 Source Wells:
  • 1F1/11-30-064-04 W4M
  • 100/12-30-064-04 W4M
  • 1F1/08-25-064-04 W4M
Water Usage

- Using brackish water ~20,000 ppm Total Dissolved Solids (TDS) for steam generation (when required)

- Normally no fresh water is used in our process

- Temporary fresh water license granted for start-up from turnaround:
  - License WTH-2006 #00365945
  - 4,118 m³ used of 69,000 m³ allowable
  - Used from May 1, 2015 to July 31, 2015
Fresh Water

- Domestic use only:
  - Safety showers / eye-wash stations
  - Cleaning water
  - Washroom / kitchen uses

- Bonnyville Aquifer

- 100/12-28-064-04-W4
Fresh Water Consumption

Volume (m³) / Month

- Aug-14
- Sep-14
- Oct-14
- Nov-14
- Dec-14
- Jan-15
- Feb-15
- Mar-15
- Apr-15
- May-15
- Jun-15
- Jul-15

May-15 saw the highest consumption.
Water Disposal Limits

Disposal Limit

Actual Disposal
Monthly Injection Water Balance

Imbalance %: \[
\frac{(\text{Total Water IN} - \text{Total Water OUT})}{\text{Total Water IN}} \times 100
\]
OTSG Blow-down Recycle

- OTSG blow-down is recycled to the Warm Lime Softener (WLS) at a percentage that allows the total dissolved solids, out of the OTSG, to remain below 50,000 uS/cm.

- Brackish water make-up has a very high TDS and affects OTSG blow-down recycle.

- Recycle approximately 41% of our blow-down back to the WLS.
Disposal Wells

- AER Class 1 Wastewater Disposal Wells

- Boiler blow-down disposal:
  - AA/12-21-064-04 W4M (AER Approval 10591)
  - 1F1/11-28-064-04 W4M (AER Approval 10591)
  - 00/04-28-064-04W4/0 (AER Approval 10591A) – licensed

- Water treatment process disposal:
  - 00/14-29-064-04 W4M (AER Approval 10591)
Landfill Waste Handling

- No landfill within facility
- All landfill waste streams disposed offsite at licensed facilities
<table>
<thead>
<tr>
<th>AER Waste Code</th>
<th>Waste Description</th>
<th>Location Sent To</th>
<th>Final Handling Method</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACID</td>
<td>Acid Solutions (unneutralized)</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.002</td>
<td>m3</td>
</tr>
<tr>
<td>BATT</td>
<td>Batteries Wet and Dry Cell</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>1.405</td>
<td>m3</td>
</tr>
<tr>
<td>CAUS</td>
<td>Caustic Solutions Unneutralized, Spent</td>
<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
<td>0.04</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.002</td>
<td>m3</td>
</tr>
<tr>
<td>COEMUL</td>
<td>Condensate/ Crude Oil Emulsions</td>
<td>Tervita - Lindbergh</td>
<td>Recycling Facility (excluding used oil)</td>
<td>1715.42</td>
<td>m3</td>
</tr>
<tr>
<td>DOMWST</td>
<td>Garbage Domestic Waste</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>78.7</td>
<td>m3</td>
</tr>
<tr>
<td>EMTCN</td>
<td>Aerosol Cans Empty</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.41</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td>Empty Container Plastic Drums (Non rbw)</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>2.255</td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td>Empty Container Plastic</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>21.305</td>
<td>m3</td>
</tr>
<tr>
<td>FILLUB</td>
<td>Filters Lube Oil</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.205</td>
<td>m3</td>
</tr>
<tr>
<td>FILOTH</td>
<td>Filters Other (Raw Fuel Gas, NGL’s)</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.7</td>
<td>m3</td>
</tr>
<tr>
<td>FILWTT</td>
<td>Cav Filter (Media) Water Treatment</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>57.33</td>
<td>m3</td>
</tr>
<tr>
<td>LUBOIL</td>
<td>Lubricating Oil Hydrocarbon &amp; Synthetic</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.205</td>
<td>m3</td>
</tr>
<tr>
<td>NORM</td>
<td>Naturally Occurring Radioactive Materials NORMs</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>1.4</td>
<td>m3</td>
</tr>
<tr>
<td>OILABS</td>
<td>Absorbents</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>1.26</td>
<td>m3</td>
</tr>
<tr>
<td>OILRAG</td>
<td>Rags Oil</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>2.08</td>
<td>m3</td>
</tr>
<tr>
<td>ORGCHM</td>
<td>Chemicals Organic</td>
<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
<td>0.338</td>
<td>m3</td>
</tr>
<tr>
<td>PIGWST</td>
<td>Piggging Waste Liquid and Wax</td>
<td>Rbw Waste Management Ltd</td>
<td>Class la Landfill</td>
<td>0.205</td>
<td>m3</td>
</tr>
<tr>
<td>SAND</td>
<td>Stung Sand</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>33.96</td>
<td>m3</td>
</tr>
<tr>
<td>SLGEML</td>
<td>Sludge - Cavern</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>20.1</td>
<td>m3</td>
</tr>
<tr>
<td>SLGHYD</td>
<td>Sludge - Cavern</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>636.9</td>
<td>m3</td>
</tr>
<tr>
<td>SLGLIM</td>
<td>Lime Sludge</td>
<td>Tervita - Bonnyville Landfill</td>
<td>Class II Landfill</td>
<td>23175.13</td>
<td>Tonnes</td>
</tr>
<tr>
<td>SMETAL</td>
<td>Metal Scrap</td>
<td>Rbw Waste Management Ltd</td>
<td>Recycling Facility (excluding used oil)</td>
<td>0.42</td>
<td>m3</td>
</tr>
<tr>
<td>SOILCO</td>
<td>Contaminated Debris and Soil Crude Oil Condensate</td>
<td>Clean Harbors - Ryley Class la</td>
<td>Class la Landfill</td>
<td>4</td>
<td>m3</td>
</tr>
<tr>
<td>THPROT</td>
<td>Thread Protectors Casing Tubing</td>
<td>Clean Harbors - Ryley Class la</td>
<td>Class la Landfill</td>
<td>2</td>
<td>m3</td>
</tr>
<tr>
<td>WSHWTR</td>
<td>Cav Wash Fluid Water</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>77.97</td>
<td>m3</td>
</tr>
<tr>
<td>WSTFLQ</td>
<td>Waste Flammable Liquid</td>
<td>Rbw Waste Management Ltd</td>
<td>Other (specify)</td>
<td>0.02</td>
<td>m3</td>
</tr>
<tr>
<td>WWOFLD</td>
<td>Waste Water</td>
<td>Tervita - Lindbergh</td>
<td>Cavern</td>
<td>20</td>
<td>m3</td>
</tr>
</tbody>
</table>
5. Sulphur Production
Sulphur Dioxide ($SO_2$) Sources

- Five Once-Through Steam Generators (OTSG)
- One High Pressure Flare Stack
- One Low Pressure Flare Stack
# Quarterly SO$_2$ Emissions

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Period</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3 2014</td>
<td>(August 2014 – October 2014)</td>
<td>53.17 tonnes</td>
</tr>
<tr>
<td>Q4 2014</td>
<td>(November 2014 – January 2015)</td>
<td>64.82 tonnes</td>
</tr>
<tr>
<td>Q1 2015</td>
<td>(February 2015 – April 2015)</td>
<td>41.91 tonnes</td>
</tr>
</tbody>
</table>
SO₂ Emissions Trends

SO₂ Emission Limit - 1.96 t / d

![SO₂ Emissions Graph]

- Months: Aug-14 to Jul-15
- Emission Levels: 0.0 to 1.8 t / d

- Highest emissions in Nov-14
- Lowest emissions in May-15
Peak and Average SO$_2$ Emissions

- August 1, 2014 to July 31, 2015:

<table>
<thead>
<tr>
<th>SO$_2$ Emissions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily (highest)</td>
<td>0.62 tonnes</td>
</tr>
<tr>
<td>Maximum Daily (highest)</td>
<td>0.76 tonnes</td>
</tr>
</tbody>
</table>

- Limit under EPEA Approval is 1.96 tonnes/day
- No exceedences
Ambient Air Monitoring

- Ambient air quality is currently monitored by the Lakeland Industry and Community Association (LICA) - Air Shed committee. LICA is under contract from the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) to provide these services.

- No exceedences were recorded during the last reporting period

- Airshed quality results available on LICA website or Clean Air Strategic Alliance (CASA) Data Warehouse

- [http://www.lica.ca/](http://www.lica.ca/)

- [http://www.casadata.org/](http://www.casadata.org/)
6. Environmental Issues
Environmental – Compliance to Approvals

- **EPEA Approval:**
  - No compliance issues during this reporting period

- **AER:**
  - No compliance issues during this reporting period

- **DFO:**
  - No compliance issues during this reporting period
Environmental - Amendments to EPEA Approval

• New EPEA approval 147753-01-00 was received July 24, 2015. This approval has an expiry date of June 30, 2025
Environmental – Wildlife

- As part of the regulatory approval, Husky has developed and implemented a Wildlife Monitoring Program (WMP) for:
  - Canadian toad distribution, abundance and population status
  - Above Ground Pipeline (AGP) monitoring to ensure wildlife can cross under the lines
  - Wildlife Habitat Enhancement Program (WHEP)

- Annual WMP report describes the observations and results collected during the previous year
Environmental - Industrial Wastewater

- **Disposal Locations:**
  - Water treatment process disposal 14-29-064-04W4M
  - 316,985 m³ was disposed

- **Domestic Wastewater:**
  - Domestic waste sludge is disposed of at the Cold Lake Municipal Treatment Facility or the Bonnyville Municipal Treatment Facility

- **Industrial Run-off (from 2014 Annual Waste Water Report):**
  - Total of five discharge locations (Pads: A, B, C, GA and run-off retention pond located on CPF)
  - A total of 42,047 m³ surface water was discharged due to a very wet year
  - All discharges were in compliance with EPEA approval
• The objective in 2014 was to delineate impacts identified as part of the 2013 soil monitoring program (SMP; Matrix 2014b) before developing a remediation plan for the site.

• The scope of work included:
  • Completing a thorough ground disturbance program to locate and mark all underground utilities and infrastructure within the subject areas prior to the start of the drilling program
  • Collecting soil samples from various locations at the site to assess soil conditions
  • Submitting soil samples to the laboratory for analysis of specified parameters
  • Preparing a report summarizing the program results
• Air related monitoring, reporting and studies are conducted by LICA under contract from AEMERA

• The LICA airshed monitoring network consists of 4 continuous monitoring stations, 26 passive monitoring stations, 2 volatile organic compound and polycyclic aromatic hydrocarbon samplers, and 2 soil acidification monitoring plots
Environmental – Ground Water

- **Groundwater monitoring program includes:**
  - CPF Groundwater: monitors shallow groundwater quality beneath the CPF
  - Pad Specific Groundwater: monitors possible impacts to groundwater quality
  - Regional Groundwater: monitors possible effects on regional groundwater quality between the project areas and the local lakes and streams

- **2015 Expansion to Groundwater Monitoring Program at the Pad Colony:**
  - Addition of two new groundwater monitoring wells in the Bonnyville Unit 1 and Muriel Lake aquifers
  - No additional aquifers were present on the pad
Environmental – Initiatives

• Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)

• Participation in the Lakeland Industry and Community Association (LICA)
  • Board of Directors
  • Beaver River Watershed Alliance (BRWA)
  • Airshed

• Participation in Alberta Biodiversity Monitoring Institute (ABMI)
  * Requirement of the new EPEA Approval
Environmental – Reclamation

- Objectives of the Annual Report (demonstrate and document):
  - Compliance with the development and reclamation approval
  - Site conditions and successful reclamation
  - General project development (surface disturbances) and reclamation activities
  - Problem areas and resolution

- Site Clearing and Timber Salvage:
  - Pipeline ROW for Pad Colony
  - Pad C to Pad D 10 m expansion
  - Pre Disturbance Assessment (PDA) completed for Pad C to Pad D 10 m expansion (December 17, 2014)

- Vegetation Monitoring:
  - Annual weed monitoring and control as per Husky’s best practices

- Reclamation Activities:
  - No permanent reclamation activities were completed during the last reporting period
7. Compliance Statement
Compliance

- **AER**
  - All conditions of AER License F-32143 as well as all scheme approvals for the project were met during the past reporting period
  
  - All conditions of the EPEA approval 147753-00-00 and amendments were met during the last reporting period
  
  - New EPEA approval 147753-01-00 was effective July 24, 2015
Self Declarations

- No self declaration were made for this reporting period
8. Non-Compliance Events
Non-Compliance Issues

- **Reportable Pipeline incident – Above ground Glycol pipeline release due to pin hole:**
  - Reported August 3, 2014
  - Release contained in catch tray temporary clamp installed until replacement of failure during May 2015 turnaround
  - Final report to determine cause send to AER August 13, 2015

- **Reportable spill – A18S well blowout when setting up for servicing work:**
  - Reported May 2015
  - Cleanup complete June 30, 2015

- **Reportable spill – tank overflow:**
  - Reported June 9, 2015
  - Clean up complete June 10, 2015
  - Check valve failed causing fluid to flow into Warm Lime Softener Overflow tank
  - Roughly 10 m$^3$ release into containment

- **Reportable release – 12-21 pipeline liner replacement:**
  - Report June 24, 2015
  - Clean up complete June 24, 2015
  - During pigging operation surge occurred causing splashing of produced water out of containment
SCVF/GM Update – Summary

- No new SCVF/GM issues
- On-going, yearly monitoring of existing, non-serious vent flows

C13S SCVF Update:
- No SCVF
- Monthly monitoring of H₂S and SCVF
- Quarterly monitoring of temperature
- Temperature log trend deviation in June 2015

Background Information:
- Installation of VIT and temp monitoring, December 20, 2013
- Resumed steaming to test remediation, December 24, 2013
- Results: No SCVF nor H₂S since December 23, 2013
  - Update presentation to AER on May 29, 2014
  - Commitment:
    » Monthly monitoring of H₂S and SCVF
    » Quarterly monitoring of temperature
    » Update in annual performance presentation
Temperature log trend deviation between 55-65 m and reached approx. 145 °C

No SCVF at C13S

Increased temperature due to loss of insulation to a single joint in the VIT

Plan:

- Continue quarterly temperature monitoring and increase frequency of SCVF and H₂S monitoring to twice a month
- Next Temperature Log (September 2015)
- Husky will notify AER of any changes
8. Future Plans
Future Plans (2015/2016)

• Install, commission & start-up 6th OTSG and 3rd HP BFW pump
• Construct, commission & start-up Pad CN wells
• Construct, commission & start-up Pad C West replacement wells