AER Directive 054 - Annual Performance Presentation
MacKay River Commercial Project
Approval No. 11715

Presented on June 20, 2017

Reporting Period: November 2013 – March 2017
Outline

• Introductions

• 3.1.1 Subsurface Issues Related to Resource Evaluation and Recovery: (Kim Mohler)
  • Project Background
  • Geology and Geoscience
  • Drilling and Completions
  • Artificial Lift
  • Instrumentation in Wells
  • Scheme Performance
  • Future Plans

• 3.1.2 Surface Operations, Compliance, and Issues Not Related to Resource Evaluation and Recovery: (Dale Schneider; Devin Newman)
  • Facilities
  • Facility Performance
  • Discussion of Measurement and Reporting
  • Discussion of Water Production, Injection, and Uses
  • Sulphur Production
  • A Summary of Environmental Issues
  • Compliance Statement
  • Non-compliance Events
  • Future Plans

AER Performance Presentation (2017)
3.1.1 SUBSURFACE ISSUES RELATED TO RESOURCE EVALUATION AND RECOVERY

PROJECT BACKGROUND
PART (1)
Project Background

- Brion Energy Corporation ("Brion") owns and operates the MacKay River Commercial Project ("MRCP")

- The MRCP is a bitumen recovery project located within the Regional Municipality of Wood Buffalo ("RMWB") in northeast Alberta; approximately 30 km northwest of Fort McMurray

- The MRCP utilizes steam-assisted gravity drainage (SAGD) technology

- MRCP is planned for phased development to peak capacity of 150,000bbl/d bitumen
MRCP Phase 1 Overview

- Phase 1 has a bitumen capacity of 35,000 bpd
- Construction is complete and steaming began in December, 2016.
- The Phase 1 development area (DA) includes:
  - 8 SAGD surface well pads and associated subsurface drainage patterns
  - 42 SAGD Horizontal well pairs
  - 850m long horizontals
  - 125m well spacing
  - The Central Processing Facility (“CPF”)
  - Water source wells and associated pipelines
  - Observation wells
  - Borrow areas
  - Access roads
  - Camps
Summary of Activities

• Activities since last Progress Report in Nov. 2013:
  – Finished drilling and completion of all 42 wellpairs for Phase 1 in 2014
  – Pad Al Deferred – 4 wellpairs not drilled and pad facility not installed
  – Observation well network installed 45 wells
  – Phase 1 facility and infrastructure construction completed in 2016
  – Commissioning and start-up of Phase 1 in 2016 and early 2017
  – First steam to well pairs started in December 2016
  – 40 well pairs are in circulation by end of reporting period March 2017
  – 2 well pairs delayed for start-up for FUSE™ (Fast and Uniform SAGD Start-up Enhancement) Dilation test
3.1.1 SUBSURFACE ISSUES RELATED TO RESOURCE EVALUATION AND RECOVERY

GEOLOGY/GEOSCIENCE
PART (2)
Scheme Approval Area Overview: Pre-2013

- **Pre-2013 Delineation:**
  - Total wells in Project Area (PA)
    - 106 wells
    - 47 cored wells
    - 1 caprock core
  - Total wells in Initial Development Area (IDA)
    - 48 wells
    - 19 cored wells
    - 1 caprock core
  - Specialty Logs in PA
    - 17 resistivity image logs
    - 12 dipole sonic logs
    - 5 formation pressure test logs
- **Seismic:**
  - 47.6 km of 2D seismic within PA
  - 5.1 km2 3D seismic over Phase 1 IDA in 2009
  - 31.5 km2 3D seismic in 2013
Scheme Approval Area Overview: Current

- 274 total vertical wells in PA
- 109 total vertical wells in MRCP IDA
- 42 horizontal well pairs in MRCP IDA
- 68 vertical wells drilled in PA since Brion Nov 2013 Annual Performance Presentation
- 33 vertical wells drilled in MRCP IDA since Brion Nov 2013 Annual Performance Presentation
MRCP1 New Wells – Vertical & SAGD

- 109 vertical wells in MRCP IDA
- 42 horizontal well pairs in MRCP IDA
- 33 vertical wells drilled in MRCP IDA since Brion Nov 2013 Annual Performance Presentation

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Wells</th>
<th>Cored Wells</th>
<th>Speciality Logged</th>
<th>Petrographically Analysed</th>
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<tbody>
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<td>7</td>
<td>2</td>
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<tr>
<td>2009</td>
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<td>2010</td>
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<td>1</td>
<td>0</td>
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<tr>
<td>2011</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>2012</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2013</td>
<td>29</td>
<td>13</td>
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<td>5</td>
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<tr>
<td>2014</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>3</td>
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<tr>
<td>2015</td>
<td>19</td>
<td>19</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>2016</td>
<td>7</td>
<td>5</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>109</td>
<td>62</td>
<td>45</td>
<td>26</td>
</tr>
</tbody>
</table>
MacKay River Stratigraphy

- Caprock is Argillaceous Lower Clearwater
- Wabiskaw sand above McMurray across IDA
- Target reservoir is Upper McMurray
# Brion Oil Sands Pay Facies

**MRCP Upper McMurray Facies**

<table>
<thead>
<tr>
<th>Facies</th>
<th>Description</th>
<th>Vsh over 50cm interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>F8b</td>
<td>Bioturbated Heterolithic Sands with Continuous Mud Beds (Core Scale)</td>
<td>15-70%</td>
</tr>
<tr>
<td>F8a</td>
<td>Bioturbated Herolithic Sands with Discontinuous Mud Beds</td>
<td>15-40%</td>
</tr>
<tr>
<td>F9</td>
<td>Bioturbated Wavy-Bedded Sands</td>
<td>&lt;15%</td>
</tr>
<tr>
<td>F10</td>
<td>Ripple Cross-Laminated to Cross-Bedded Sands</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>F11</td>
<td>Cross-Bedded Sands</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>F12</td>
<td>Bioturbated Hummocky Cross-Stratified Sands (Lam-Scram)</td>
<td>5-15%</td>
</tr>
<tr>
<td>F13</td>
<td>Bioturbated Muddy Sands</td>
<td>&gt;15%</td>
</tr>
</tbody>
</table>

**Pay Facies:**
- Includes Facies F9, F10, F11, F12
- Typically >30% Porosity
- Weight percent bitumen >8%
- Permeability ~0.9-2.7 Darcy’s
Bitumen Net Pay Map – Project Area

- Pay color fill cut-off at $\geq 10m$
- Thickness ranges from 10-25m in the IDA
- Upper McMurray reservoir shows strong NW-SE trend
- IDA lies 2km South of AER Oil Sands Shallow Thermal Area
Bitumen Net Pay Map – Development Area

- Pay color fill cut-off at $\geq 10m$
- Thickness ranges from 10-25m in the IDA
- Upper McMurray reservoir shows strong NW-SE trend
- Central processing facility located Southwest of development area
- Majority of 8 drainage boxes are in $>20m$ bitumen pay

Contour Interval = 5m
Base of Pay Structure Map

- Base of pay is reasonably flat across existing 8 drainage boxes
- Base of pay elevation rises on Southwest side of IDA
Top of Pay Structure Map

- Top of Pay is relatively consistent over the 8 drainage boxes in the IDA
- The Top of Pay fluctuates only ~6m between 308-314m SS across the entire IDA
### Geologic and Reservoir Properties – OBIP FOR OPERATING AREA

<table>
<thead>
<tr>
<th>Drainage Box</th>
<th># Well Pairs</th>
<th>Drainage Box Area (m²)</th>
<th>Average $S_o$ (frac)</th>
<th>Average $\Phi$ (frac)</th>
<th>Average $K_h$ (D)</th>
<th>Average $K_v$ (D)</th>
<th>Average Bitumen Pay Thickness (m)</th>
<th>Drainage Box OBIP (10⁶ bbl)</th>
<th>Estimated RF (%)</th>
<th>Estimated Drainage Box RBIP (10⁶ bbl)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>6</td>
<td>698,200</td>
<td>0.83</td>
<td>0.34</td>
<td>2.7</td>
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<td>21.3</td>
<td>26.4</td>
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<tr>
<td>AB</td>
<td>5</td>
<td>562,600</td>
<td>0.8</td>
<td>0.34</td>
<td>2.7</td>
<td>1.1</td>
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<td>21.8</td>
<td>57</td>
<td>12.4</td>
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<tr>
<td>AC</td>
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<td>1</td>
<td>21.9</td>
<td>16.7</td>
<td>63</td>
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<tr>
<td>AD</td>
<td>5</td>
<td>560,100</td>
<td>0.77</td>
<td>0.33</td>
<td>2.6</td>
<td>1</td>
<td>20.8</td>
<td>18.6</td>
<td>54</td>
<td>10.1</td>
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<tr>
<td>AE</td>
<td>6</td>
<td>674,700</td>
<td>0.76</td>
<td>0.33</td>
<td>2.2</td>
<td>0.9</td>
<td>20.8</td>
<td>22.1</td>
<td>53</td>
<td>11.7</td>
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<tr>
<td>AF</td>
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<td>675,400</td>
<td>0.82</td>
<td>0.34</td>
<td>2.6</td>
<td>1</td>
<td>22</td>
<td>26.1</td>
<td>62</td>
<td>16.2</td>
</tr>
<tr>
<td>AH</td>
<td>5</td>
<td>594,300</td>
<td>0.77</td>
<td>0.34</td>
<td>2.6</td>
<td>1</td>
<td>20.4</td>
<td>20</td>
<td>48</td>
<td>9.6</td>
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<tr>
<td>AJ</td>
<td>5</td>
<td>562,300</td>
<td>0.75</td>
<td>0.34</td>
<td>2.5</td>
<td>0.9</td>
<td>20.5</td>
<td>18.5</td>
<td>57</td>
<td>10.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>4,746,300</strong></td>
<td><strong>0.79</strong></td>
<td><strong>0.34</strong></td>
<td><strong>2.6</strong></td>
<td><strong>1</strong></td>
<td><strong>21.3</strong></td>
<td><strong>170.2</strong></td>
<td><strong>56</strong></td>
<td><strong>11.9</strong></td>
</tr>
</tbody>
</table>

**OBIP** = Original Bitumen In-Place and measured in 10⁶m³ units and converted to 10⁶ barrels using conversion factor of 6.2898

**NRV** = Net Rock Volume in 10⁶m³ derived from deterministic mapping of SAGDable net pay, or from geomodel calculations

**SO** = Average bitumen saturation from the SAGD exploitable reservoir interval generated from 1-SWT (in fractions)

**PORT** = Average porosity from the SAGD exploitable reservoir interval generated from PORT (in fractions)

**OBIP** = (NRV x PORT x SO)
### Geologic and Reservoir Properties – OBIP

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Operating Area</th>
<th>Project Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of Reservoir Depth (mTVD)</td>
<td>176</td>
<td>175</td>
</tr>
<tr>
<td>Top of Reservoir Depth (TVD masl)</td>
<td>315</td>
<td>311</td>
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<tr>
<td>Base of Reservoir Depth (mTVD)</td>
<td>197</td>
<td>193</td>
</tr>
<tr>
<td>Base of Reservoir Depth (TVD masl)</td>
<td>294</td>
<td>293</td>
</tr>
<tr>
<td>Net Pay Thickness (m)</td>
<td>21.3</td>
<td>12.8</td>
</tr>
<tr>
<td>Porosity (frac)</td>
<td>0.34</td>
<td>0.33</td>
</tr>
<tr>
<td>Bitumen Saturation (frac)</td>
<td>0.79</td>
<td>0.75</td>
</tr>
<tr>
<td>OBIP (10^6 bbl)</td>
<td>170.2</td>
<td>2890.8</td>
</tr>
<tr>
<td>OBIP (10^6 m³)</td>
<td>27.1</td>
<td>459.6</td>
</tr>
<tr>
<td>Initial Pressure (kPaa)</td>
<td>220 (top) – 400 (bottom)</td>
<td>220 (top) – 400 (bottom)*</td>
</tr>
<tr>
<td>Original Reservoir Temperature (°C)</td>
<td>6</td>
<td>6*</td>
</tr>
</tbody>
</table>

*Extrapolated from operating area*
Structural Cross-Section across MRCP

- Good reservoir quality with continuity along Initial Development Area
- Minor structural variation at base of pay
- Thick and laterally continuous caprock with consistent lithology

From Brion Nov 21, 2013 Annual Performance Presentation (Approval No. 11715B)
NW–SE Structural Cross-Section: Drainage boxes: AF, AC, AA, AB

- Clean and consistent reservoir thickness over the 4 drainage boxes
- Bitumen thickness ranges from 15 to 20+m
- Producer wells placed 1m from base of pay
- Injector wells placed 5m above producer
NW–SE Structural Cross-Section: Drainage boxes: AB, AD, AE, AH

- Clean and consistent reservoir thickness over the 4 drainage boxes
- Bitumen thickness ranges from 15 to 20+m
- Producer wells placed 1m from base of pay
- Injector wells placed 5m above producer
W–E Structural Cross-Section: Drainage boxes: AB, AJ

- Bitumen thickness ranges from 10 to 20+m
- Producer wells placed 1m from base of pay
- Injector wells placed 5m above producer

Injectors in Red
Producers in Green
MRCP Seismic

Coverage Across MRCP includes:
- ~96 km of 2D
- ~58.4 km² of 3D
- ~3.9 km² of 3D baseline for 4D

3D acquired in MRCP to help:
- Assess Caprock
- Plan/drill horizontal well trajectories
- Assess McMurray reservoir

4D seismic survey may be acquired at MRCP in 2018:
- Will monitor steam chamber growth in IDA
- 3D baseline for 4D was shot in 2016
Special Core Analysis – Petrographic Analysis

- Brion Energy has conducted a combination of different studies on 26 cored wells in the Initial Development Area.

- Studies done on highlighted wells include:
  - CT Scan - 1
  - XRF - 2
  - SEM - 17
  - XRD - 26
  - Thin sections - 24
  - Grain size analysis - 24
Reservoir Pressure Update

- Initial Upper McMurray Reservoir Pressure:
  - Prior to 2015, pressure data collected indicated an initial reservoir pressure of 1,100 kPaa
  - In 2015-2017, further evaluation of additional data sources provided clarification of pressure regime in MRCP
    - Baseline pressure measurements were collected from FMT logs and observation wells
  - McMurray Formation is at low pressure:
    - Initial pressure of 200 kPaa at the top of reservoir
    - Initial pressure of 400 kPaa at the base of reservoir
  - All data shows a good seal at top:
    - Pressure of 1,000 kPaa in Wabiskaw sand above reservoir indicates competent isolation
Brion has collected the following dataset for caprock characterization from delineation and coreholes within the IDA:

**From 2008 to 2013**
- Formation Image logs for 5 wells
- Cored 33 wells
- 1 Caprock core

**From 2014 to 2017**
- Formation Image logs for 27 wells
- Cored 29 wells
- 3 Caprock cores
MRCP Geomechanics: Mini-frac tests

- Mini-frac tests were conducted between 2009-2016
- The results are in agreement with local and regional trends
- The average caprock fracture gradient measured for the MRCP region within the argillaceous Clearwater is 21.5 kPa/m
- Approved maximum operating pressure (MOP):
  - Based on the methodology detailed in Application 1635432
  - MOP of 2,300 kPa calculated from base of Clearwater caprock in Phase 1 area of 156 mTVD and a gradient of 14.7 kPa/m
  - Represents a conservative safety factor of 68% below the caprock fracture closure gradient

<table>
<thead>
<tr>
<th>Well</th>
<th>Year</th>
<th>Formation</th>
<th>Fracture Gradient (kPa/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/04-23-90-14W4M</td>
<td>2009</td>
<td>McMurray Oil Sand</td>
<td>16.7</td>
</tr>
<tr>
<td>1AA/06-07-90-13W4M</td>
<td>2009</td>
<td>Clearwater Caprock</td>
<td>21.5</td>
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<tr>
<td>1AA/14-28-90-14W4M</td>
<td>2013</td>
<td>McMurray Oil Sand</td>
<td>14.9</td>
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<tr>
<td></td>
<td></td>
<td>Clearwater Caprock</td>
<td>20.6</td>
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<tr>
<td></td>
<td></td>
<td>Wabiskaw shale</td>
<td>21.3</td>
</tr>
<tr>
<td>100/03-14-090-15W4</td>
<td>2016</td>
<td>McMurray Oil Sand</td>
<td>16.9</td>
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<tr>
<td></td>
<td></td>
<td>Clearwater Caprock</td>
<td>22.3</td>
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<tr>
<td></td>
<td></td>
<td>Wabiskaw shale</td>
<td>18.8</td>
</tr>
</tbody>
</table>
MRCP Geomechanics

• Caprock integrity testing and geomechanical
  – Caprock core testing were done in well 1AA/06-07-090-13W4: tri-axial laboratory testing, and X-ray diffraction analysis.
  – Field measured in-situ stress conditions and fracture criteria were also inputs to the geomechanical model, minifrac: 1AA/06-07-090-13W4 / 100/04-23-90-14W4M
  – Geomechanical simulations using ABAQUS, a commercial finite element stress analysis software, ran by BitCan were conducted to provide confirmation that SAGD operations at MRCP will not pose any risk to the caprock integrity.

• Update from 2013 reporting period:
  – Brion has collected new minifrac data between 2013-2016 that is consistent with previous results, i.e., there is no change in the geomechanical interpretation.
Caprock Monitoring

- Monitoring caprock pressure and temperature in 9 vertical wells
- Electromagnetic Resonating Element (ERE) gauges for pressure and temperature on exterior of production casing or interior with perforation.
- Wabiskaw Sand Monitoring:
  - 2 vertical wells drilled to base Wabiskaw (isolated from McMurray reservoir): 102/16-14-090-14W4/00 and 108/05-23-090-14W4/00
  - Equipped with interior pressure/temperature ERE
- Caprock Monitoring – Wabiskaw and Clearwater:
  - 7 vertical wells drilled to Devonian: 100/16-14-090-14W4/0, 111/13-12-090-14W4/0, 1AB/14-22-090-14W4/0, 102/01-12-090-14W4/0, 100/09-14-090-14W4/00, 100/11-12-090-14W4/00 and 102/04-13-090-14WA.
  - Pressure and temperature in one to four layers within the caprock intervals on the exterior of production casing.
Caprock Monitoring – Pressure and Temperature

- Caprock average pressures and temperatures:
  - Pressure 938-1,130 kPag
  - Temperature 5-6 °C
  - No changes seen after steaming started

- Caprock observation well data pressure and temperature is reviewed bi-weekly.
3.1.1 SUBSURFACE ISSUES RELATED TO RESOURCE EVALUATION AND RECOVERY

DRILLING AND COMPLETIONS, ARTIFICIAL LIFT, AND INSTRUMENTATION IN WELLS
PARTS (3), (4), (5)
MRCP Wellpair Layout

- **Drilling Timeline:**
  - Pad AA wells were drilled between April 24, 2013 and July 17, 2013
  - Pad AB wells were drilled between July 18, 2013 and September 17, 2013
  - Pad AC wells were drilled between March 3, 2014 and April 23, 2014
  - Pad AD wells were drilled between September 18, 2013 and November 18, 2013
  - Pad AE wells were drilled between January 20, 2013 and April 21, 2013
  - Pad AF wells were drilled between April 23, 2014 and July 8, 2014
  - Pad AH wells were drilled between November 21, 2013 and February 25, 2014
  - Pad AJ wells were drilled between September 30, 2012 and January 15, 2013

- **Interwell spacing for the 42 well pairs in the MRCP Development Area is 125 m**

AER Performance Presentation (2017)
MRCP Standard Injector Schematic

Casing:
- 16” Surface casing at 40 - 45° spud angle (406.4 mm, 96.73 kg/m, K-55, Hydril 521, ~90 mMD).
- 11 3/4” Intermediate casing (298.5 mm, 80.36 kg/m, TN80TH, Tenaris Blue, ~400-455 mMD)

Liner:
- 8 5/8” slotted Liner (219.1 mm, 47.62 kg/m, TN55TH, Tenaris Blue Thermal Liner, ~1250-1305 m MD to TD)

Tubing:
- 4 1/2” (114.3mm) Heel string, swedged down to 3 1/2” (88.9mm) at 20 m before the liner hanger top for 250 m
- 3 1/2” (88.9mm) toe injection string to the toe
MRCP Standard Producer Schematic

Casing:
- 16” Surface casing at 40 - 45° spud angle (406.4 mm, 96.73 kg/m, K-55, Hydril 521, ~90 mMD).
- 11 3/4” Intermediate casing (298.5 mm, 80.36 kg/m, TN80TH, Tenaris Blue, ~400-455 mMD)

Liner:
- 8 5/8” slotted Liner (219.1 mm, 47.62 kg/m, Tenaris Blue Thermal Liner, ~1250-1305 mMD to TD)

Artificial Lift and Instrumentation:
- Metal-to-Metal PCP is the base case artificial lift method with 5.3” OD, 8.8 m pump length
- 3 1/2” utility string to toe
- P/T gauge above pump with ¼” capillary line clamped to the 4 ½” Heel string.
- 1/4” Capillary line clamped onto the 4 1/2” Heel string for redundant bubble gas BHP measurement.
- 1 1/4” coil tubing with fibre optic instrumentation string

Some wells will have different liners, instrumentation, or different artificial lift (See section 3.5 – Well Matrix)
## Summary of Alternate Completions

<table>
<thead>
<tr>
<th>System</th>
<th>Principle</th>
<th>Use in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam control devices</td>
<td>Reduction of pressure gradient in the liner- better distribution of steam</td>
<td>AA02I, AB02I and AD02I</td>
</tr>
<tr>
<td>Inflow control devices</td>
<td>Reservoir inflow equalization</td>
<td>AC01P and AD02P</td>
</tr>
<tr>
<td>Alternative sand control using wire wrap screens</td>
<td>Maximization of opened flow area to reduce completion drawdown</td>
<td>AE03P</td>
</tr>
<tr>
<td>Alternative sand control using precision punched screens</td>
<td>Improved filter media resistance to wearing using: better metallurgy and change of fluid momentum. Reduced tendency to plugging minimizing the thickness of the slots.</td>
<td>AD03P and AF02P</td>
</tr>
</tbody>
</table>
Steam Control Devices Test

Test conducted on 3 steam injection wells

- The injector wells that have steam control devices installed are: AA02I, AD02I and AB02I.
- These wells have a full fibre optic temperature sensor in the injector to allow better monitoring of the steam chamber growth.
Inflow Control Devices Test

- Brion is conducting two field trials with ICDs in production wells AD02P and AC01P.
- This trial may allow Brion to improve or optimize future phase SAGD well designs with reduced liner/casing sizing which means the ability to drill longer wells at a lower capital cost per well pair.
Artificial Lift - Metal to Metal PCP

Completion for steam circulation- PCP rotor out of the stator

Completion for SAGD operation- PCP rotor spaced out

Metal to metal PCPs installed:

PAD AA: 6 pumps
Capacity: 300 m³/d at 100 RPM
Lift: 600 m of water

On PADs:
AB: 5 pumps
AD: 5 pumps
AE: 6 pumps
AF: 6 pumps
AJ: 5 pumps
AH: 5 pumps
Capacity: 220 m³/d at 100 RPM
Lift: 750 m of water
Artificial Lift - Alternative Artificial Lift

Completion for steam circulation

Completion for SAGD operation- Expected conversion to SAGD by July 2017

Electrical Submersible pumps to be installed on PAD AC: 4 pumps
Observation Well Overview

- Total of 45 observation wells for MRCP
- This network has been designed to monitor the following themes:
  1. Caprock Monitoring
  2. Reservoir Top Gas
  3. Bottom Transition Zone
  4. Baffles/barriers above injector
  5. Baffles/barriers between producer/injector
  6. History Match / Chamber Development
     - Early Stage (< 10 m)
     - Late Stage (> 10 m)
  7. Lateral Regional Monitoring (> 100m)
- According to their design, they are classified as:
  1. Obs Wells w/ Just Thermocouples
  2. Obs Wells w/ Thermocouples and EREs
  3. Perforated Obs Wells w/ Thermocouples and/or EREs
Typical Observation Well Design

Example of the types of observation well design and instrumentation configurations at MRCP:

Vendor provided diagrams: Petrospec Engineering Ltd. and Packers Plus

Type of gauge reading:
- (T) Only temperature
- (P/T) Temperature & Pressure
# Summary of Downhole Instrumentation

<table>
<thead>
<tr>
<th>System</th>
<th>Principle</th>
<th>Use in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure and temperature sensor at the heel</td>
<td>Optic sensor</td>
<td>Installed in every producer and on injectors AE02I and AJ03I.</td>
</tr>
<tr>
<td>DTS well bore temperature sensing system</td>
<td>Fibre optic DTS</td>
<td>Installed in every producer on PADs: AA, AD, AF, AJ and AH. Installed on injectors: AA02I, AA03I, AD02I, AJ02I and AJ03I.</td>
</tr>
<tr>
<td>LxData well bore temperature sensing system</td>
<td>Fibre optic FBG</td>
<td>Installed in every producer on PADs: AB, AC and AE. Installed on injector AB02I.</td>
</tr>
<tr>
<td>Pressure sensor at the toe of the well</td>
<td>Fibre optic FBG</td>
<td>On AB02P, AC01P, AE03P and AE04P</td>
</tr>
</tbody>
</table>
Injection Well Instrumentation

Standard instrumentation in injector

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Instrument / Signal</th>
<th>Type of Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down hole pressure</td>
<td>kPag</td>
<td>PIT 0Y02</td>
<td>Blanket gas / Pressure Transmitter</td>
</tr>
<tr>
<td>Blanket gas injection rate</td>
<td>Sm3/d</td>
<td>FIT 0Y02</td>
<td>Coriolis meter</td>
</tr>
<tr>
<td>Toe string steam injection rate</td>
<td>m3/d CWE</td>
<td>FIT 0Y00</td>
<td>Vortex meter</td>
</tr>
<tr>
<td>Toe string well head pressure</td>
<td>kPa</td>
<td>PIT 0Y00</td>
<td>Pressure transmitter</td>
</tr>
<tr>
<td>Heel string steam injection rate</td>
<td>m3/d CWE</td>
<td>FIT 0Y01</td>
<td>Vortex meter</td>
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<tr>
<td>Toe string well head pressure</td>
<td>kPag</td>
<td>PIT 0Y01</td>
<td>Pressure transmitter</td>
</tr>
</tbody>
</table>
## Production Well Instrumentation

### Standard instrumentation in producers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Units</th>
<th>Instrument / Signal</th>
<th>Type of instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down hole pressure</td>
<td>kPag</td>
<td>PIT OY55</td>
<td>Optic pressure sensor</td>
</tr>
<tr>
<td>Down hole pressure</td>
<td>kPag</td>
<td>PIT OY52</td>
<td>Blanket gas/ Pressure transmitter</td>
</tr>
<tr>
<td>Blanket gas injection rate</td>
<td>Sm3/d</td>
<td>FIT OY52</td>
<td>Coriolis meter</td>
</tr>
<tr>
<td>Toe string steam rate</td>
<td>m3/d CWE</td>
<td>FIT OY01</td>
<td>Vortex meter</td>
</tr>
<tr>
<td>Toe string well head pressure</td>
<td>kPag</td>
<td>PIT OY01</td>
<td>Pressure transmitter</td>
</tr>
<tr>
<td>Well bore temperature profile</td>
<td>°C</td>
<td>From TI OY65A to TI OY65G</td>
<td>DTS or FBG fibre optic system</td>
</tr>
<tr>
<td>Returns well head pressure</td>
<td>kPag</td>
<td>PIT OY50</td>
<td>Pressure transmitter</td>
</tr>
<tr>
<td>Returns well head temperature</td>
<td>°C</td>
<td>TIT OY50</td>
<td>Temperature transmitters</td>
</tr>
<tr>
<td>Returns rate</td>
<td>sm3/d</td>
<td>FIT OY50</td>
<td>Coriolis meter</td>
</tr>
</tbody>
</table>
3.1.1 SUBSURFACE ISSUES RELATED TO RESOURCE EVALUATION AND RECOVERY

SCHEME PERFORMANCE AND FUTURE PLANS
PARTS (6), (7)
Actual Performance to March 31, 2017

- First steam to wellpairs started in December 2016
  - Winter operation for start-up was managed successfully

- Actual circulation rates and volumes are consistent with the Brion type curves and forecast

- All well pairs were able to build pressure and circulate
  - Some wells/pads required longer period of bullheading until reservoir pressure increased
  - Required a temporary waiver to unload fluid from some wells and establish circulation

- The ability to see the pressure increase across the field indicates fluid mobility in the reservoir
Summary of MRCP Operating Wells

<table>
<thead>
<tr>
<th>Pad</th>
<th># of Well Pairs</th>
<th>First Steam to Pad</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>6</td>
<td>Dec-2016</td>
</tr>
<tr>
<td>AB</td>
<td>5</td>
<td>Jan-2017</td>
</tr>
<tr>
<td>AC</td>
<td>4</td>
<td>Feb-2017</td>
</tr>
<tr>
<td>AD</td>
<td>5</td>
<td>Jan-2017</td>
</tr>
<tr>
<td>AE</td>
<td>6</td>
<td>Feb-2017</td>
</tr>
<tr>
<td>AF</td>
<td>6</td>
<td>Dec-2016</td>
</tr>
<tr>
<td>AH</td>
<td>5</td>
<td>Jan-2017</td>
</tr>
<tr>
<td>AJ</td>
<td>5</td>
<td>Dec-2016</td>
</tr>
</tbody>
</table>

- First steam to Pad AJ wellpairs on December 1, 2016
- 40 wellpairs in circulation by end of reporting period
Well Pair Performance - Steam Circulation

<table>
<thead>
<tr>
<th>Pad</th>
<th>First Steam Date</th>
<th>Average Pressure (Mar-31-2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA (5 wells)</td>
<td>Dec-13-2016</td>
<td>2016</td>
</tr>
<tr>
<td>AB (5 wells)</td>
<td>Jan-15-2017</td>
<td>2063</td>
</tr>
<tr>
<td>AC (4 wells)</td>
<td>Jan-25-2017</td>
<td>2024</td>
</tr>
<tr>
<td>AD (5 wells)</td>
<td>Jan-20-2017</td>
<td>1950</td>
</tr>
<tr>
<td>AE (6 wells)</td>
<td>Feb-01-2017</td>
<td>1994</td>
</tr>
<tr>
<td>AF (6 wells)</td>
<td>Dec-23-2016</td>
<td>2034</td>
</tr>
<tr>
<td>AH (5 wells)</td>
<td>Jan-11-2017</td>
<td>1617</td>
</tr>
<tr>
<td>AJ (5 wells)</td>
<td>Dec-07-2016</td>
<td>1878</td>
</tr>
</tbody>
</table>

- Bottom hole pressure in each production well was measured by pressures sensor at the heel before first steam.

- After first steam both producer and steam injection wells bottom hole pressure was also estimated by blanket gas injection:
  - Approved MOP is 2200 kPag
  - Alarm set at 2125 kPag
  - Shut down at 2175 kPag
  - By March 31 2017, the target BHP was 2120 kPag

- The estimated bottom hole pressure from blanket gas injection is used by the control system to regulated the steam injection to keep a target downhole pressure.
Well Pair Performance - Steam Circulation Pads AA and AB

<table>
<thead>
<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Injector Cumulative Steam</th>
<th>Producer Cumulative Steam</th>
<th>Cumulative Steam</th>
<th>Injector BHP</th>
<th>Producer BHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA01</td>
<td>13-Dec-16</td>
<td>7498 ± 0.001</td>
<td>10281 ± 0.001</td>
<td>17779 ± 0.001</td>
<td>1990 ± 0.001</td>
<td>2016 ± 0.001</td>
</tr>
<tr>
<td>AA02</td>
<td>16-Dec-16</td>
<td>6530 ± 0.001</td>
<td>9249 ± 0.001</td>
<td>15779 ± 0.001</td>
<td>1951 ± 0.001</td>
<td>2034 ± 0.001</td>
</tr>
<tr>
<td>AA03</td>
<td>13-Dec-16</td>
<td>7837 ± 0.001</td>
<td>9540 ± 0.001</td>
<td>17376 ± 0.001</td>
<td>2100 ± 0.001</td>
<td>2156 ± 0.001</td>
</tr>
<tr>
<td>AA04</td>
<td>14-Dec-16</td>
<td>7554 ± 0.001</td>
<td>10685 ± 0.001</td>
<td>18239 ± 0.001</td>
<td>1990 ± 0.001</td>
<td>2000 ± 0.001</td>
</tr>
<tr>
<td>AA05</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA06</td>
<td>21-Dec-16</td>
<td>6554 ± 0.001</td>
<td>11146 ± 0.001</td>
<td>17701 ± 0.001</td>
<td>1800 ± 0.001</td>
<td>1874 ± 0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Injector Cumulative Steam</th>
<th>Producer Cumulative Steam</th>
<th>Cumulative Steam</th>
<th>Injector BHP</th>
<th>Producer BHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB01</td>
<td>18-Jan-17</td>
<td>7963 ± 0.001</td>
<td>8216 ± 0.001</td>
<td>15579 ± 0.001</td>
<td>2040 ± 0.001</td>
<td>2058 ± 0.001</td>
</tr>
<tr>
<td>AB02</td>
<td>16-Jan-17</td>
<td>7193 ± 0.001</td>
<td>8440 ± 0.001</td>
<td>15633 ± 0.001</td>
<td>2040 ± 0.001</td>
<td>2104 ± 0.001</td>
</tr>
<tr>
<td>AB03</td>
<td>17-Jan-17</td>
<td>9309 ± 0.001</td>
<td>8958 ± 0.001</td>
<td>18267 ± 0.001</td>
<td>2040 ± 0.001</td>
<td>2011 ± 0.001</td>
</tr>
<tr>
<td>AB04</td>
<td>15-Jan-17</td>
<td>10704 ± 0.001</td>
<td>10118 ± 0.001</td>
<td>20822 ± 0.001</td>
<td>2040 ± 0.001</td>
<td>2088 ± 0.001</td>
</tr>
<tr>
<td>AB05</td>
<td>28-Jan-17</td>
<td>6515 ± 0.001</td>
<td>7534 ± 0.001</td>
<td>14050 ± 0.001</td>
<td>2041 ± 0.001</td>
<td>2052 ± 0.001</td>
</tr>
</tbody>
</table>

**Legend:**
- **Pad AA (excl. AA05) Average BHP**
- **Pad AA Cumulative Injection**
- **Pad AB Average BHP**
- **Pad AB Cumulative Injection**
Well Pair Performance - Steam Circulation Pads
AC and AD

**PAD AC**

- **Well Pair**: AC01, AC02, AC03, AC04
- **First Steam Date**: 5-Feb-17, 25-Jan-17, 25-Jan-17, 25-Jan-17
- **Steam (m³ CWE)**: 4554, 6150, 5125, 5503
- **BHP (kPa)**: 5088, 5964, 6301, 5071
- **Cumulative Steam (m³ CWE)**: 9643, 12114, 11426, 14574
- **Injector DHP**: 2040, 2038, 2040, 2038
- **Producer BHP**: 2034, 2021, 2024, 2019

**PAD AD**

- **Well Pair**: AD01, AD02, AD03, AD04, AD05
- **First Steam Date**: 22-Jan-17, 22-Jan-17, 20-Jan-17, 20-Jan-17, 6-Feb-17
- **Steam (m³ CWE)**: 5379, 10365, 7985, 5855, 4269
- **BHP (kPa)**: 9266, 16714, 7359, 8512, 6880
- **Cumulative Steam (m³ CWE)**: 14645, 1851, 15343, 14367, 11150
- **Injector DHP**: 1850, 1851, 2039, 2041, 1990
- **Producer BHP**: 1852, 1825, 2061, 1970, 2041

---

AER Performance Presentation (2017)
Well Pair Performance - Steam Circulation Pads AE and AF

### PAD AE

- **Date**: 1-Dec-16 to 31-Mar-17
- **Graph**:
  - Pad AE Average BHP
  - Pad AE Cumulative Injection

### PAD AF

- **Date**: 1-Dec-16 to 31-Mar-17
- **Graph**:
  - Pad AF Average BHP
  - Pad AF Cumulative Injection

### Table

<table>
<thead>
<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Injector Cumulative Steam (m³ CW)</th>
<th>Producer Cumulative Steam (m³ CW)</th>
<th>Cumulative Steam (m³ CW)</th>
<th>Injector BHP (kPa)</th>
<th>Producer BHP (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE01</td>
<td>3-Feb-17</td>
<td>4211</td>
<td>7505</td>
<td>11716</td>
<td>1986</td>
<td>2048</td>
</tr>
<tr>
<td>AE02</td>
<td>2-Feb-17</td>
<td>4301</td>
<td>6359</td>
<td>10560</td>
<td>1990</td>
<td>2059</td>
</tr>
<tr>
<td>AE03</td>
<td>2-Feb-17</td>
<td>4221</td>
<td>6953</td>
<td>11183</td>
<td>1991</td>
<td>2034</td>
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<tr>
<td>AE04</td>
<td>1-Feb-17</td>
<td>5248</td>
<td>8436</td>
<td>13744</td>
<td>1991</td>
<td>2037</td>
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<tr>
<td>AE05</td>
<td>1-Feb-17</td>
<td>5044</td>
<td>8655</td>
<td>13699</td>
<td>1850</td>
<td>1865</td>
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<td>4454</td>
<td>6853</td>
<td>11318</td>
<td>1850</td>
<td>1922</td>
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<table>
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<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Injector Cumulative Steam (m³ CW)</th>
<th>Producer Cumulative Steam (m³ CW)</th>
<th>Cumulative Steam (m³ CW)</th>
<th>Injector BHP (kPa)</th>
<th>Producer BHP (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF01</td>
<td>9-Jan-17</td>
<td>6830</td>
<td>8044</td>
<td>14874</td>
<td>2040</td>
<td>2020</td>
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<tr>
<td>AF02</td>
<td>9-Jan-17</td>
<td>8651</td>
<td>9404</td>
<td>15455</td>
<td>2040</td>
<td>2017</td>
</tr>
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<td>AF03</td>
<td>8-Jan-17</td>
<td>5675</td>
<td>6780</td>
<td>12455</td>
<td>2040</td>
<td>2032</td>
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<td>25-Dec-16</td>
<td>5790</td>
<td>6651</td>
<td>12441</td>
<td>2040</td>
<td>2045</td>
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<td>AF05</td>
<td>23-Dec-16</td>
<td>7257</td>
<td>7267</td>
<td>14524</td>
<td>2040</td>
<td>2045</td>
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<td>AF06</td>
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<td>7681</td>
<td>6562</td>
<td>14243</td>
<td>2040</td>
<td>2044</td>
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</tbody>
</table>

AER Performance Presentation (2017)
Well Pair Performance - Steam Circulation Pads

AH and AJ

### Chart: PAD AH
- **Legend:**
  - **--- Pad AH Average BHP (excl. AH02)**
  - **--- Pad AH Cumulative Injection**

### Chart: PAD AJ
- **Legend:**
  - **--- Pad AJ Average BHP**
  - **--- Pad AJ Cumulative Injection**

### Table: Well Pair Performance

<table>
<thead>
<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Inject steam Cumulative m3 (CWE)</th>
<th>Prod Cumulative m3 (CWE)</th>
<th>Cumulative Steam m3 (CWE)</th>
<th>Inject BHP kPag</th>
<th>Prod BHP kPag</th>
</tr>
</thead>
<tbody>
<tr>
<td>AH01</td>
<td>11-Jan-17</td>
<td>7472</td>
<td>10543</td>
<td>18015</td>
<td>1651</td>
<td>1700</td>
</tr>
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<td>AH02</td>
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<td></td>
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</tr>
<tr>
<td>AH03</td>
<td>12-Jan-17</td>
<td>8113</td>
<td>11565</td>
<td>19679</td>
<td>1601</td>
<td>1682</td>
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<tr>
<td>AH04</td>
<td>13-Jan-17</td>
<td>7512</td>
<td>9163</td>
<td>16675</td>
<td>1449</td>
<td>1451</td>
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<tr>
<td>AH05</td>
<td>13-Jan-17</td>
<td>6746</td>
<td>10246</td>
<td>18993</td>
<td>1580</td>
<td>1658</td>
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<table>
<thead>
<tr>
<th>Well Pair</th>
<th>First Steam Date</th>
<th>Inject steam Cumulative m3 (CWE)</th>
<th>Prod Cumulative m3 (CWE)</th>
<th>Cumulative Steam m3 (CWE)</th>
<th>Inject BHP kPag</th>
<th>Prod BHP kPag</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJ01</td>
<td>12-Dec-16</td>
<td>9160</td>
<td>12375</td>
<td>21536</td>
<td>2000</td>
<td>1928</td>
</tr>
<tr>
<td>AJ02</td>
<td>11-Dec-16</td>
<td>10936</td>
<td>12449</td>
<td>23385</td>
<td>2040</td>
<td>2055</td>
</tr>
<tr>
<td>AJ03</td>
<td>9-Dec-16</td>
<td>9556</td>
<td>15191</td>
<td>24747</td>
<td>1839</td>
<td>1711</td>
</tr>
<tr>
<td>AJ04</td>
<td>19-Dec-16</td>
<td>10890</td>
<td>12568</td>
<td>23458</td>
<td>1950</td>
<td>1879</td>
</tr>
<tr>
<td>AJ05</td>
<td>7-Dec-16</td>
<td>9241</td>
<td>14648</td>
<td>23890</td>
<td>1850</td>
<td>1814</td>
</tr>
</tbody>
</table>
Well and Reservoir Surveillance Program

• Integrated approach to reservoir and well surveillance

• Includes collection of data from multiple monitoring sources

• Frequency of evaluation depends on data source, some is daily, some is less frequently

• MRCP is early time in circulation, therefore most data sources are not showing valid or relevant data to end of reporting period
  – Piezometer data plots are not provided for the current report
Steam Chamber Monitoring Example: Observation Well AF06E

- Associated to Wellpair: AF06 toe (3 m away)
  - AF06 Wellpair active since Dec 2016
  - 14,000 m³ of steam circulated at 2,000 kPag as of March 31, 2017
- Data from observation wells, along with producer temperature profiles, pressure communication tests, and semi-SAGD determine when the well pair is ready for conversion to SAGD

Strong evidence of conductive heating in this well pair
Surface Displacement Monitoring

- Brion has an extensive network installed for surface displacement and heave monitoring
- **Summary**
  - Detection and measurement of ground motion by InSAR technology – processing stacks of images acquired by multiple radar missions

**2014**
- Installed & calibrated 104 corner reflectors (CRs)
  - 6 CRs per well pad
  - Maximum distance of 250 m
- Baseline data gathered

**2015-2016**
- Baseline Study issued (Sept 2015)

**2017**
- First Semi-Annual report (March 2017)
Actual Performance to March 31, 2017

- Calendar Day forecast includes a 12% downtime factor in first year
- Low oil content in circulated fluids to the end of March
- Reported monthly oil production during circulation (not shown on chart as daily rates are below scale):
  - February – 253.7 m³
  - March – 257.7 m³
Injected Fluids

• Only steam has been injected into the injection and production wells as of March 31, 2017

• Planning to use Brion MRCP synbit as a load fluid when converting to PCPs

• Have approval for the FUSE™ test using a viscosity modifying water and polymer mixture on two well pairs
Key Learnings To-Date

• In circulation, the reservoir has built pressure from original reservoir pressure of 400 kPag to 2,000 kPag as expected, but some wells required additional measures
  – Bullheading was introduced to address high reservoir mobility in 19 wells for short term with success in meeting target pressures and switching back to circulation
  – Approved MOP of 2,300 kPaa is not sufficient to overcome the fluid column at a TVD of 220 m
  – An application was made and approved to unload wells with a temporary elevated pressure (2,650 kPaa) to establish circulation

• Multi-Phase Pump (MPP) at the pads are critical equipment for circulation
  – Used to drawdown the surface pressure for the returns during circulation
Steam Strategy

• MRCP operation is still in early time

• The wellpair requirement for steam in the next year is expected to be well below the steam capacity of the CPF

• Brion is managing steam distribution to the wellpairs based on prioritization methodology

• There are no plans to expand the current steam or water treating capacity
Future Initiatives

• Appraisal Program:
  – 2017/2018 Winter Appraisal program is currently being prepared
    • May include vertical delineation wells

• New Wellpair Additions:
  – MacKay Phase 1A:
    • Brion received regulatory approval for 17 downspaced wellpairs in 2015
    • Currently planned for field construction to start in 2018
  – Next Wellpair additions
    • Initiating internal project development process for the first group of sustaining wellpairs
    • Application to AER planned for end of 2018

• FUSE™ (Fast and Uniform SAGD Start-up Enhancement) process
  – Amendment to apply FUSE™ dilation with viscosity enhancing polymer in well pairs AH02 and AA05
    • Approval received March 3, 2017
    • Execution planning currently in progress
    • Planning to execute dilation test in July and August 2017

• Pad/Well Abandonments:
  – There are no pad or well abandonments planned in the next reporting cycle
3.1.2 SURFACE OPERATIONS, COMPLIANCE AND ISSUES NOT RELATED TO RESOURCE EVALUATION

FACILITY PERFORMANCE, MEASUREMENT AND REPORTING PARTS (1), (2), (3)
MRCP Central Processing Facility Phase 1 Plot Plan
MRCP Central Processing Facility – Aerial View

Photo Taken November 8, 2016
MRCP CPF General Block Flow Diagram
Bitumen Production (2017 - YTD)

*No production prior to 2017*
Water Treatment Technology

• High pH Vertical Tube Falling Film Mechanical Vapor Compression (MVC) Evaporators for produced water treating:
  – First Stage Evaporators x (2)
  – Second Stage Evaporator x (1)

• Forced Circulation MVC driven Concentrator for further concentrating of evaporator blowdown to Reduced Liquid Discharge (RLD)
Water Treatment Successes and Challenges

- **Successes:**
  - The water balance during startup, specifically the make-up water and disposal water volume is meeting expectations.
  - The performance of evaporators and concentrator are meeting design expectations in general.

- **Challenges:**
  - Off-spec BFW conditions are encountered, continue to optimize the chemical treating program for improved BFW quality.
  - Equipment scaling due to hard non saline water as service water, plan in place to mitigate.
Steam Generation Technology

• Natural circulation elevated drum steam generators designed for sub-ASME feed water quality
  – (4) x steam generators
  – Low NOx combustion system

• Steam Generation Success:
  – Boilers are successfully commissioned and operating. The steam generated is meeting the field steam demands.

• Steam Generation Challenge:
  – Boiler water off spec. results in higher blowdown rate.
Steam Produced (2016 - Date)

Note: Steam Quality from Drum Boilers is maintained at 99%.
AER Performance Presentation (2017)
Power Imported/Consumed (2015 to Date)

Gas Consumption (2016 - Date)

- Graph showing gas consumption from January to December of 2016 and 2017.
- The x-axis represents the months from January to December.
- The y-axis represents gas consumed in $\text{E}^3\text{M}^3$.
- March 2017 has the highest gas consumption.

AER Performance Presentation (2017)
Measurement Accounting & Reporting Plan (MARP)

• AER Audit - MARP submitted in March, 2017

• Mackay River Report Codes:
  – Production Battery AB BT 0142085
  – Injection Facility AB IF 0142086
  – Meter Station (Fuel Gas) AB MS 0136386
  – Custody Transfer Point (Diluent) AB PL 0142114
  – Custody Transfer Point (Product) AB PL 0144307
3.1.2 SURFACE OPERATIONS, COMPLIANCE AND ISSUES NOT RELATED TO RESOURCE EVALUATION

DISCUSSION OF WATER PRODUCTION, INJECTION, AND USES PART (4)
Non-Saline Water

Source Water Wells
• Water Act Licence No. 00266369-01-03:
  – Approved Annual Withdrawal Volume = 2,116,964 m³/year from the Empress Channel
    • 13-10-90-15W4, max rate 2,930 m³/d
    • 14-11-90-15W4M, max rate 3,000 m³/d
    • 02-13-90-15W4M, max rate 2,900 m³/d
    • 08-13-90-15W4M, max rate 3,100 m³/d

Domestic Water Wells
• Water Act Licence No. 00316276-00-00:
  – Approved Annual Withdrawal Volume = 82,125 m³/yr from the Grand Rapids 4
    • 16-02-90-14W4M North, max rate 400 m³/d
    • 16-02-90-14W4M South, max rate 360 m³/d

Annual Withdrawal Limit 2117 E³M³

Volume Withdrawn (E³M³)

2016

2017

Monthly

Annual Cumulative

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

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

AER Performance Presentation (2017)
Produced Water (2016 - Date)
Steam Injected (2016 - 2017)
Water Disposal % (2017)

*No water disposal prior to 2017

AER Performance Presentation (2017)
Blowdown, Waste and Disposal Wells

Blowdown Recycle
- Continuous blowdown from boilers is injected into the HP steam line.
- Intermittent blowdown from boilers is recycled to Water Treatment.

Waste and Disposal Wells
- Waste Tracker software and AER manifests are used to track and submit data to AER.
- No disposal wells are associated with MRCP Phase 1.
Off-Site Brine Water Disposal

• Concentrated brine reject from water treatment is disposed of off-site.

• Location of disposal site:
  – Tervita Lindbergh
  – ABBT-100/06-12-090-14-W4/00

• Sources of brine water:
  – Evaporator Waste Water Tanks
  – Concentrator Feed/Waste Tanks
Off-Site Brine Water Disposal (2017)

*No off-site brine water disposal prior to 2017*
3.1.2 SURFACE OPERATIONS, COMPLIANCE AND ISSUES NOT RELATED TO RESOURCE EVALUATION

FUTURE PLANS
PART (9)
Future Plans – Surface Facilities

• Brion is currently focused on the successful start up of MRCP Phase 1. No changes to surface facilities are proposed at this time.

• Routine maintenance may require temporary shutdowns of equipment
3.1.2 SURFACE OPERATIONS, COMPLIANCE AND ISSUES NOT RELATED TO RESOURCE EVALUATION

REGULATORY AND ENVIRONMENT PARTS (5), (6), (7), (8)
### Directive 078 - Scheme Approval Amendments

<table>
<thead>
<tr>
<th>Amendment No.</th>
<th>Application No.</th>
<th>Purpose</th>
<th>Approval Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>11715A</td>
<td>1712804</td>
<td>Drainage patterns AF and AG were combined into a single subsurface drainage pattern (AF)</td>
<td>12-Jun-12</td>
</tr>
<tr>
<td>11715B</td>
<td>1762244</td>
<td>Equipment reconciliation and design changes at the MRCP CPF</td>
<td>5-Sep-13</td>
</tr>
<tr>
<td>11715C</td>
<td>1834479</td>
<td>Amalgamation of MacKay Operating Corporation and Brion Energy Corporation into a single corporate entity.</td>
<td>15-Sep-15</td>
</tr>
<tr>
<td>11715D</td>
<td>1838850</td>
<td>Addition of 17 down-spaced well pairs in four subsurface drainage patterns (AA, AB, AC and AF) and deferral of the development of AI drainage pattern.</td>
<td>9-Nov-15</td>
</tr>
<tr>
<td>NA</td>
<td>1875952</td>
<td>Temporary exceedance of the approved Maximum Operating Pressure in order to unload liquid from the bottom of the MRCP wells and induce returns.</td>
<td>21-Dec-16</td>
</tr>
<tr>
<td>11715E</td>
<td>1877223</td>
<td>Approval to test the FUSE™ process on two SAGD well pairs in order to evaluate its applicability to future well pairs at MRCP.</td>
<td>03-Mar-17</td>
</tr>
</tbody>
</table>
Application 1848515 – Minor Facility Design Changes

- Brion submitted a Directive 078 application on December 30, 2015 to reconcile final Central Processing Facility (CPF) design with the assumptions made in the original integrated application for the MRCP.

- The application was closed by the AER and Brion was requested to provide this information in its next AER Directive 54 Scheme Presentation.

- Detailed descriptions of changes can be found in AER application No. 1848515. Highlights are as follows:
  - Tank sizes were updated
  - Vapour recovery units were updated
  - Process buildings were updated
  - Lab building locations were updated
  - The number of evaporator/concentrator packages decreased from 4 to 3
  - Updated MW for glycol heater and steam generators
  - Increased flare stack height
  - Updated process flow diagrams
  - Updated material balance
  - Updated project energy balance
  - Updated chemical consumption rate
# EPEA and Water Act Amendments

## Amendments to Water Act Licence No. 266369

<table>
<thead>
<tr>
<th>Amendment No.</th>
<th>Purpose</th>
<th>Approval Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>266369-01-00</td>
<td>Licence Renewal</td>
<td>10-Sep-14</td>
</tr>
<tr>
<td>266369-01-01</td>
<td>Replaced two of the three existing wells in the licence with three new wells</td>
<td>23-Feb-15</td>
</tr>
<tr>
<td>266369-01-02</td>
<td>Rewording of approval for operational clarity</td>
<td>6-Aug-16</td>
</tr>
<tr>
<td>266369-01-03</td>
<td>Changes to monitoring well network and report submission dates</td>
<td>16-Feb-17</td>
</tr>
<tr>
<td>266369-01-04</td>
<td>Changes to reporting measurement intervals</td>
<td>17-May-17</td>
</tr>
</tbody>
</table>

## Amendments to EPEA Approval No. 254465

<table>
<thead>
<tr>
<th>Amendment No.</th>
<th>Purpose</th>
<th>Approval Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>254465-00-01</td>
<td>Updates to equipment layout, size and type</td>
<td>28-Feb-14</td>
</tr>
<tr>
<td>254465-00-02</td>
<td>Updates to equipment sizing, emission sources and changes to regional initiatives</td>
<td>18-Mar-16</td>
</tr>
</tbody>
</table>
Compliance Statement

To the best of our knowledge, Brion’s MRCP is compliant with all regulatory approvals and regulations with the exception of the following:

• Building trench primary containment failure, leakage into interstitial space in Unit 002 Water Treatment and Unit 003 Steam Generation buildings
  - Voluntarily self disclosed on Feb. 1, 2017
  - Corrective Actions are underway
## Regulatory Compliance Issues

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Details</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/9/2013</td>
<td>Pipelines/Pipelines Installations</td>
<td>Failure to file a licence amendment application to reflect a change in the pipeline parameters which does not result in a cat/type change or a change in level designation. Change in pipe specifications, segment locations, and status of the pipeline (permitted from operational) for the below-ground freshwater gathering pipeline system.</td>
<td>Coming into compliance actions completed.</td>
</tr>
<tr>
<td>1/8/2014</td>
<td>Pipelines/Pipelines Installations</td>
<td>Failure to file a licence amendment application to reflect a change in the pipeline parameters which does not result in a cat/type change or a change in level designation. Change in pipe specifications, segment lengths, and status of the pipeline (permitted from operational) for the above-ground fuel gas pipeline system.</td>
<td>Coming into compliance actions completed.</td>
</tr>
<tr>
<td>1/26/2015</td>
<td>Wells Technical and Well Abandonment Audits</td>
<td>Failure to file a licence amendment application when required, and failure to complete surface abandonment within specified timeframe. Due to a recent regulatory change (AER Manual 008: Oil Sands and Coal Exploration Application Guide), in order to convert oil sands exploration wells to observation wells, Public Lands Act dispositions (Mineral Surface Lease) need to be secured prior to AER Directive 056: Energy Development Applications and Schedules well licence application submission - 22 wells.</td>
<td>Coming into compliance actions completed.</td>
</tr>
<tr>
<td>5/22/2015</td>
<td>Well Abandonment Audits</td>
<td>Failure to report surface abandonments through the DDS system (Licence Abandonment: Well Licence Abandonment) within 30 days of completing the operation. (Section 2.3 and 4.6). Eight Oil Sands Evaluation Wells.</td>
<td>Coming into compliance actions completed.</td>
</tr>
<tr>
<td>2/1/2017</td>
<td>Crude Bitumen Group Battery</td>
<td>Building trench primary containment failure, leakage into interstitial space in Unit 002 Water Treatment and Unit 003 Steam Generation buildings.</td>
<td>Coming into compliance actions still ongoing and expected to be completed by June 2017.</td>
</tr>
</tbody>
</table>
# Reportable Spills

<table>
<thead>
<tr>
<th>Date</th>
<th>Type</th>
<th>Details</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/3/2014</td>
<td>Onsite (SAGD Drilling)</td>
<td>During the cementing of the intermediate section of SAGD well 3 (SAGD Well Pad AH), a vacuum truck was transferring excess cement returns were the rig to a cement storage bin. 2.5m³ of cement leaked onto the rig matting due to a poor seal of the end-dump door.</td>
<td>Spill cleaned up, area remediated, and contaminated material disposed of at an authorized waste management facility.</td>
</tr>
<tr>
<td>3/8/2014</td>
<td>Onsite (SAGD Drilling)</td>
<td>During the drilling of 2P intermediate, 5.5m³ of gel-chem drilling fluids was released onto the rig matting due to a 6” value (Mud Tank #8) being left in an open position during the transfer of drilling fluids from one mud tank to another. 5.0 m³ recovered and returned to mud system.</td>
<td>Spill cleaned up, area remediated, and contaminated material disposed of at an authorized waste management facility.</td>
</tr>
<tr>
<td>7/7/2015</td>
<td>Offsite (Site-wide Services - AOSTRA/Sunc or Road)</td>
<td>Near 4 km of the AOSTRA/Suncor Road, the Prairie North Construction Limited (Prairie North) driver lost control of the service truck and rolled the vehicle into the ditch. During the accident, a barrel of used engine oil and containers of lubricants became detached from the service truck and was released into the ditch. At the time of the accident, the Suncor Energy Response Team created an earthen berm to keep the spilled material contained. Absorbent pads and Oil Gator absorbent were used to absorb some of the released material. Equipment and waste bins were mobilized to the site of the incident. Debris from the accident were removed and disposed of. Two 15m³ contaminated soil bins were used in the cleanup of all impacted soils, and the contaminated soils have been transported to Tervita’s Edmonton Sludge Facility.</td>
<td>Spill cleaned up, area remediated, and contaminated material disposed of at an authorized waste management facility.</td>
</tr>
<tr>
<td>2/11/2017</td>
<td>Onsite (Operations - SAGD Pad AD) F44287</td>
<td>SAGD Pad AD (Pad AD) was running in start up mode (lower than design pressure for sparging steam). A 6m³ release of well returns (approximately 98% water, 2% bitumen) at the Pad AD multi-phase pump recycle cooler. Steam traps were not functioning to maintain consistent flow and were removed from service. As minimum heat could not be maintained within the cooler building, the established standard for using temporary heat or process fluid for heating was not sufficient to prevent freeze-up. Of all the SAGD pads, Pad AD had been in service the least amount of time, had the lowest returns, and there were extremely cold temperatures a few days prior (-30°C), all of which may have played a part in the release. It is believed that there was a blockage in the coil tubing as a result of either gummy returns, or cold weather and freezing.</td>
<td>Spill cleaned up, area remediated, and contaminated material disposed of at an authorized waste management facility.</td>
</tr>
</tbody>
</table>
## AER Inspections

<table>
<thead>
<tr>
<th>Date</th>
<th>Inspection Type</th>
<th>Location / Licence No.</th>
<th>Results</th>
<th>Resolution (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/6/2013</td>
<td>Well Site Lease</td>
<td>09-06-094-17W4M W 0387299</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>11/6/2013</td>
<td>Well Site Lease</td>
<td>13-26-094-17W4M W 0392383</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>2/12/2014</td>
<td>Pipeline Construction</td>
<td>05-14-090-14W4M P54003</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>2/20/2014</td>
<td>Drilling Operations</td>
<td>13-06-090-13W4M W 0460669</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>2/20/2014</td>
<td>Drilling Operations</td>
<td>12-30-089-13W4M W 0461998</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>3/19/2014</td>
<td>Pipeline Construction</td>
<td>05-14-090-14W4M P54003</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>1/22/2015</td>
<td>Drilling Operations</td>
<td>11-23-090-14W4M W 0472784</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>6/7/2016</td>
<td>Lease Inspection (Oil/Bitumen Satellite)</td>
<td>16-22-090-14W4 F44294</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Follow-up inspection of Brion Energy vegetation clearing as a result of the Horse River Wildfire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/23/2016</td>
<td>Exhaust Stack Emissions</td>
<td>06-12-090-14W4 F44287</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Inspection of the MacKay Central Plant Continuous Emissions Monitoring System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/2/2017</td>
<td>Seismic</td>
<td>093-12W4 MRCP 2017 2D Seismic Program GEO160029</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>2/11/2017</td>
<td>Crude Bitumen Group Battery</td>
<td>06-12-090-14W4 F44287</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
<tr>
<td>2/11/2017</td>
<td>Oil/Bitumen Satellite</td>
<td>05-13-090-14W4M F44295</td>
<td>Satisfactory</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- 12 AER inspections since the last progress report
- All satisfactory with no issues identified

AER Performance Presentation (2017)
## EPEA Monitoring Programs

### Monitoring Programs required under EPEA Approval

<table>
<thead>
<tr>
<th>Program</th>
<th>Progress and Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater Monitoring</td>
<td>- 12 monitoring wells installed at Plant and 5 monitoring wells installed at Pad AJ</td>
</tr>
<tr>
<td></td>
<td>- All EPEA required pre-operational baseline sampling events have been conducted</td>
</tr>
<tr>
<td></td>
<td>- Additional baseline sampling also collected</td>
</tr>
<tr>
<td></td>
<td>- Post start-up sampling events will commence in 2017</td>
</tr>
<tr>
<td>Wetland Monitoring</td>
<td>- Comprehensive report submitted on Dec. 16, 2016</td>
</tr>
<tr>
<td></td>
<td>- Annual Monitoring has been occurring since 2013</td>
</tr>
<tr>
<td>Wetland Reclamation Trial</td>
<td>- Authorized Mar. 24, 2015</td>
</tr>
<tr>
<td></td>
<td>- Two wetland reclamation trials proposed, Trial #2 is currently underway</td>
</tr>
<tr>
<td>Wildlife Mitigation and Monitoring</td>
<td>- First comprehensive report submitted to AER on May. 15, 2015 (Due every 3 years)</td>
</tr>
<tr>
<td></td>
<td>- All wildlife mitigations and monitoring programs have been implemented and are ongoing</td>
</tr>
<tr>
<td>Caribou Mitigation and Monitoring</td>
<td>- First comprehensive report submitted to AER on May. 15, 2015 (Due every 3 years)</td>
</tr>
<tr>
<td></td>
<td>- All mitigations and monitoring programs have been implemented and are ongoing</td>
</tr>
<tr>
<td></td>
<td>- Caribou Habitat Restoration Trials conducted in 2014</td>
</tr>
<tr>
<td>Soil Monitoring</td>
<td>- Due Jan. 31, 2019</td>
</tr>
<tr>
<td>Project-Level Conservation, Reclamation and Closure Plan</td>
<td>- Currently under development</td>
</tr>
<tr>
<td></td>
<td>- Due Oct. 31, 2017</td>
</tr>
<tr>
<td>Reclamation Monitoring Program</td>
<td>- Authorized Dec. 10, 2015</td>
</tr>
<tr>
<td></td>
<td>- No permanent infrastructure to reclaim at this time</td>
</tr>
<tr>
<td></td>
<td>- Ongoing Reclamation at Borrow Areas 12, 38 and 118</td>
</tr>
<tr>
<td></td>
<td>- Annual summary included in the annual Conservation &amp; Reclamation report submitted to AER</td>
</tr>
</tbody>
</table>
Caribou Habitat Restoration Trial

Mounding Application on OSE Well

Lichen Transplant
Ambient Air Quality Monitoring

- One continuous air monitoring station ("Brion-MacKay River Monitoring Station")
  - The Wood Buffalo Environmental Association (WBEA) completes the collection, validation and reporting of emissions data from the Brion-MacKay River Monitoring Station
  - Measured parameters include Hydrogen Sulphide (H₂S), Nitrogen Dioxide (NO₂), Sulphur Dioxide (SO₂), Total Hydrocarbons (THC), wind speed and wind direction
  - Air monitoring began in January 2016, no significant trends in ambient air monitoring observed

- Four passive exposure air monitoring stations
  - Measured parameters include Sulphur Dioxide (SO₂), and Hydrogen Sulphide (H₂S)
  - Data collection began in October 2016, no significant trends in ambient air monitoring observed

- As of 31-Mar-2017 there have been no exceedances of the Alberta Ambient Air Quality Objectives (AAAQO)
Sulphur Production

• No sulphur emissions as of 31-March-2017

• Total inlet sulphur for the MacKay Central Plant is expected to be less than 1 tonne/day
  – A sulphur recovery unit is not anticipated
  – Current maximum daily design = 0.26 tonne/day
  – Brion will analyze produced gas on a monthly basis to determine sulphur content

• Sulphur emission trends will be monitored and reported throughout operations
Greenhouse Gas (GHG) Emissions

• Brion has been voluntarily reporting to Alberta Environment and Parks (AEP) and Environment Canada since 2012

• Total Emissions (tonnes CO₂e):
  – 2014 = 17,442
  – 2015 = 16,177
  – 2016 = 16,002

• Total Emissions for 2017 (as of 31-Mar-2017) = 148,916 tonnes CO₂e

*Data to be verified in 2018
Regional Monitoring and Initiatives

Brion participates and/or funds the following initiatives:

- Oil Sands Environmental Monitoring Program (OSEMP)
- Canada’s Oil Sands innovation Alliance (COSIA) Monitoring Working Group
- Wood Buffalo Environmental Association (WBEA)
- Alberta Biodiversity Monitoring Institute (ABMI)
- Black Bear Partnership Project
- Alberta Upstream Petroleum Research Fund (AUPRF)
Future Plans – Regulatory Applications

• No Scheme, EPEA or Water Act Licence amendments are proposed for the remainder of 2017

• Winter drilling and seismic programs are anticipated
  – Subject to Shareholder approval

• MacKay Phase 1A:
  – Brion has received Scheme approval for 17 downspaced wellpairs
  – Field construction planned to start in 2018
  – Public land amendments, D56 and D51 applications to be filed

• Sustaining wellpairs
  – Scheme application to AER planned for end of 2018
SUPPLEMENTAL INFORMATION REQUESTS
Top Gas Isopach Map

- Top gas zone present in the upper McMurray over the IDA
- Ranges in thickness from approximately 0 to 3 meters

Contour Interval = 1m
Lower Transition Zone Map

- **Criteria:**
  - Porous & clean sandy facies with >50% water saturation (GR \( \leq \) 75API, DPSS \( \geq \) 27%, RT<20ohmm, sandy facies)
  - In communication with and below pay zone

- **Characteristics:**
  - Thin: <1.0m over most of the Phase 1 drainage boxes
  - Limited Lateral Extent: thins toward edges of geomodel area
Upper Transition Zone Map

- **Criteria:**
  - Porous & clean sandy facies with >50% water saturation (GR ≤ 75API, DPSS≥27%, RT<20ohmm, sandy facies)
  - In communication with and above pay zone

- **Characteristics:**
  - Thin: <1.5m over most of the Phase 1 drainage boxes
  - Limited Lateral Extent: thins toward edges of geomodel area

Contour Interval = 0.5m
### Geologic and Reservoir Properties – OBIP

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Operating Area</th>
<th>Project Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of Reservoir Depth (mTVD)</td>
<td>176</td>
<td>175</td>
</tr>
<tr>
<td>Top of Reservoir Depth (TVD masl)</td>
<td>315</td>
<td>311</td>
</tr>
<tr>
<td>Base of Reservoir Depth (mTVD)</td>
<td>197</td>
<td>193</td>
</tr>
<tr>
<td>Base of Reservoir Depth (TVD masl)</td>
<td>294</td>
<td>293</td>
</tr>
<tr>
<td>Net Pay Thickness (m)</td>
<td>21.3</td>
<td>12.8</td>
</tr>
<tr>
<td>Porosity (frac)</td>
<td>0.34</td>
<td>0.33</td>
</tr>
<tr>
<td>Bitumen Saturation (frac)</td>
<td>0.79</td>
<td>0.75</td>
</tr>
<tr>
<td>OBIP (10^6 bbl)</td>
<td>170.2</td>
<td>2890.8</td>
</tr>
<tr>
<td>OBIP (10^8 m^3)</td>
<td>27.1</td>
<td>459.6</td>
</tr>
<tr>
<td>Initial Pressure (kPaa)</td>
<td>220 (top) – 400 (bottom)</td>
<td>220 (top) – 400 (bottom)*</td>
</tr>
<tr>
<td>Original Reservoir Temperature (°C)</td>
<td>6</td>
<td>6*</td>
</tr>
</tbody>
</table>

* Extrapolated from operating area
## Summary of Slide Updates

<table>
<thead>
<tr>
<th>Slide Number</th>
<th>Description of Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Replaced the cross-section with an updated one</td>
</tr>
<tr>
<td>22</td>
<td>4D seismic survey to <em>may</em> be acquired at MRCP in 2018</td>
</tr>
<tr>
<td>25</td>
<td>Slide replaced as original was misleading</td>
</tr>
<tr>
<td>47</td>
<td>Column for average initial reservoir pressure removed</td>
</tr>
<tr>
<td>57</td>
<td>2,550 Kpaa was corrected to 2,650 Kpaa</td>
</tr>
</tbody>
</table>
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