Advisory

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Cenovus EnCAID* introduction and overview

This presentation was prepared in accordance with AER Directive 054 - Performance presentations, auditing, and surveillance of in situ oil sands schemes

Subsurface issues related to resource evaluation and recovery

• Directive 054, Section 3.1.1

Surface operations, compliance, and issues not related to resource evaluation and recovery

• Directive 054, Section 3.1.2
AER Dir 054 Section 3.1.1

Subsurface issues related to resource evaluation and recovery
Subsurface issues: table of contents

- Background
- Geology/geoscience
- Drilling and completions
- Instrumentation
- Scheme performance
- Future plans
Scheme background

**Directive 54**
**Subsurface section 1**

EnCAID
Approval #10440L
2017 annual performance presentation
Background

• The EnCAID project is an enhanced recovery scheme which displaces natural gas with combustion gases that are the result of combustion of residual bitumen in gas cap.
Project overview

- Combustion of residual bitumen in gas cap
- Allows for displacement and re-pressurization of gas zone
- 100% Cenovus Energy Inc.
Geological/geoscience

Directive 54
Subsurface section 2

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2017 annual performance presentation
## Summary of Wabiskaw gas properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Depth</td>
<td>465 TVD</td>
</tr>
<tr>
<td>Thickness</td>
<td>5 m</td>
</tr>
<tr>
<td>Average porosity</td>
<td>~36%</td>
</tr>
<tr>
<td>Average gas saturation</td>
<td>~50%</td>
</tr>
<tr>
<td>Average water saturation</td>
<td>~30%</td>
</tr>
<tr>
<td>Average bitumen saturation</td>
<td>~20%</td>
</tr>
</tbody>
</table>
Wabiskaw stratigraphic cross-section

A A'

Bottom water

Regional WBSK

WBSK B Valley Fill

MCMR

WBSK B VF Depositional Edge
Drilling and completion

Directive 54
Subsurface section 3

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Well layout
Drilling and completion

- No new wells were drilled
- No recompletions
- No workovers

Requirements under subsection 3.1.1 3c – wellbore schematics are included in the appendix
Instrumentation

Directive 54
Subsurface section 5

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2017 annual performance presentation
Instrumentation in wells

Observation Well: 102/05-10-73-6W4
• Equipped with three piezometers
• Equipped with 10 thermocouples

Observation Well: 100/6-10-73-6W4
• Equipped with one piezometer
• Equipped with 10 thermocouples

Requirements under subsection 3.1.1 5a – wellbore schematics 5c and 5d are included in the appendix
Observation wells bitumen pressure
102/05-10-073-06W4 – Temp history
102/05-10-073-06W4/0
Observation well temperature
Scheme performance

Directive 54
Subsurface section 7

EnCAID
Approval #10440L
2017 annual performance presentation
## Project performance history

<table>
<thead>
<tr>
<th>Year</th>
<th>Activity</th>
<th>Year</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>June: Ignition and start-up</td>
<td>2012</td>
<td>Jul: 00/6-7-76-6W4/00 startup</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oct: Primrose sales volumes flowing to Caribou gas facility</td>
</tr>
<tr>
<td>2007</td>
<td>Q1: 00/14-9-73-6W4/00 nitrogen response</td>
<td>2013</td>
<td>Feb: 00/6-6-73-6W4/00 startup of</td>
</tr>
<tr>
<td></td>
<td>Q2: 00/2-16-73-6W4/00, 00/11-15-73-6W4/00 nitrogen response. 00/14-9-73-6W4/00 shut-in</td>
<td></td>
<td>Mar: 00/7-8-73-6W4/00 shut-in</td>
</tr>
<tr>
<td>2008</td>
<td>May: Nitrogen response at 00/1-17-73-6W4/00</td>
<td>2014</td>
<td>Dec: 00/10-12-73-7W4/00 startup</td>
</tr>
<tr>
<td>2009</td>
<td>Jan: 00/6-18-73-6W4/00 gas production shut-in due to segregation repair</td>
<td>2016</td>
<td>Feb: 00/11-15-73-6W4 abandoned</td>
</tr>
<tr>
<td></td>
<td>Jun: 00/7-8-73-6W4/00 nitrogen response</td>
<td></td>
<td>Jul: 500/10-11-73-7W4/00 startup</td>
</tr>
<tr>
<td></td>
<td>Oct: Injectivity decrease observed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Q1: 00/5-10-73-6W4/00 injector stimulation treatment</td>
<td>2017</td>
<td>Mar/Apr: Production shut-in due to non-compliance event</td>
</tr>
<tr>
<td></td>
<td>Q4: 00/1-17-73-6W4/00, 00/2-16-73-6W4/00, 00/11-15-73-6W4/00 shut-in. 00/5-10-73-6W4/00 removal of thermocouple string and perform pressure fall off tests</td>
<td></td>
<td>Aug: 00/06-05-073-06/W4 shut-in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oct: 00/10-11-073-06W4 returned to production at restricted rate</td>
</tr>
<tr>
<td>2011</td>
<td>Q1: 00/5-10-73-6W4/00 injector stimulation treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar/Apr: 00/11-15-73-6W4/00 flowed N₂ 85%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Production/injection summary

Production operations

Operating for | Air injected | Bulk gas recovered | Formation gas recovered
>11 years | ~ 293 e^6m^3 | ~ 203 e^6m^3 | ~ 180 e^6m^3

Approved producers

<table>
<thead>
<tr>
<th>UWI</th>
<th>Status</th>
<th>N_2</th>
<th>UWI</th>
<th>Status</th>
<th>N_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>00/06-05-073-06W4/0</td>
<td>Shut-in</td>
<td>~ 76%</td>
<td>00/02-16-073-06W4/0</td>
<td>Shut-in</td>
<td>~ 85%</td>
</tr>
<tr>
<td>00/06-06-073-06W4/2</td>
<td>Flowing</td>
<td>&lt;1%</td>
<td>00/01-17-073-06W4/0</td>
<td>Shut-in</td>
<td>~ 85%</td>
</tr>
<tr>
<td>00/06-07-073-06W4/2</td>
<td>Flowing</td>
<td>&lt;1%</td>
<td>00/10-11-073-07W4/0</td>
<td>Flowing</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>00/07-08-073-06W4/0</td>
<td>Shut-in</td>
<td>~ 88%</td>
<td>00/10-12-073-07W4/0</td>
<td>Flowing</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>00/11-15-073-06W4/0</td>
<td>Abandoned</td>
<td></td>
<td>00/14-09-073-06W4/0</td>
<td>Shut-in</td>
<td>~ 87%</td>
</tr>
</tbody>
</table>
K3 pool production

- 7-8: ~11 e3m3/d
- 11-15: ~8 e3m3/d
- 73-7W4: ~3 e3m3/d
- 73-6W4: ~8 e3m3/d
- Injection Well
- Shut in
- SI K1 or L3 Pool

K1 - K3 Boundary

K1 Pool Boundary

Feb 2018
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History production
Voidage replacement ratio (VRR) - 2018

January to June
Steady high air injection rates

July to December
Reduce air injection rates to manage operating costs with intermittent high air injection rates to ensure that the minimum monthly VRR of 0.90 was met.
## Voidage replacement ratio

<table>
<thead>
<tr>
<th>Month</th>
<th>Monthly VRR</th>
<th>Cumulative VRR</th>
<th>VRR regulatory approved limit (Min monthly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1.10</td>
<td>1.64</td>
<td>0.90</td>
</tr>
<tr>
<td>February</td>
<td>1.20</td>
<td>1.66</td>
<td>0.90</td>
</tr>
<tr>
<td>March</td>
<td>4.50</td>
<td>1.67</td>
<td>0.90</td>
</tr>
<tr>
<td>April</td>
<td>4.40</td>
<td>1.69</td>
<td>0.90</td>
</tr>
<tr>
<td>May</td>
<td>3.00</td>
<td>1.70</td>
<td>0.90</td>
</tr>
<tr>
<td>June</td>
<td>2.10</td>
<td>1.72</td>
<td>0.90</td>
</tr>
<tr>
<td>July</td>
<td>1.10</td>
<td>1.73</td>
<td>0.90</td>
</tr>
<tr>
<td>August</td>
<td>0.90</td>
<td>1.74</td>
<td>0.90</td>
</tr>
<tr>
<td>September</td>
<td>1.00</td>
<td>1.75</td>
<td>0.90</td>
</tr>
<tr>
<td>October</td>
<td>1.10</td>
<td>1.76</td>
<td>0.90</td>
</tr>
<tr>
<td>November</td>
<td>1.30</td>
<td>1.76</td>
<td>0.90</td>
</tr>
<tr>
<td>December</td>
<td>1.20</td>
<td>1.77</td>
<td>0.90</td>
</tr>
</tbody>
</table>
VRR performance
VRR history
K3 pool pressure
Observation 6-10 well temperature
Composition of injected/produced fluids

- EnCAID does not currently sample air injected.
- EnCAID captures gas samples for analysis on the schedule located to the right and monitors compositional changes for each well.
- Cenovus samples selective wells on a more frequent basis than required under Approval 10440L.

<table>
<thead>
<tr>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>00/01-17-073-06W4/0 Annual</td>
</tr>
<tr>
<td>00/02-16-073-06W4/0 Annual</td>
</tr>
<tr>
<td>00/06-05-073-06W4/0 Semi-annual</td>
</tr>
<tr>
<td>00/06-06-073-06W4/2 Semi-annual</td>
</tr>
<tr>
<td>00/06-07-073-06W4/2 Semi-annual</td>
</tr>
<tr>
<td>00/06-10-073-06W4/2 Annual</td>
</tr>
<tr>
<td>00/06-18-073-06W4/0 Annual</td>
</tr>
<tr>
<td>00/07-08-073-06W4/0 Annual</td>
</tr>
<tr>
<td>00/10-11-073-07W4/0 Semi-annual</td>
</tr>
<tr>
<td>00/10-12-073-07W4/0 Semi-annual</td>
</tr>
<tr>
<td>00/10-36-072-07W4/2 Annual</td>
</tr>
<tr>
<td>00/11-17-073-06W4/0 Annual</td>
</tr>
<tr>
<td>00/14-09-073-06W4/0 Annual</td>
</tr>
</tbody>
</table>
Wabiskaw K-3 Pool material balance

Original Pressure – 2050 kPaa (300 psia)

Pressure Dec 03 = 662 kPaa or 96 psia
OGIP = 1129 e⁶m³ (39.9 Bcf)
Gas prod = 877 e⁶m³ (31.0 Bcf 77% RF)
Post-EnCAID RF ~ 85 - 87%

Dec/2017 Cum Prod 1,353 e⁶m³ (38.1 bcf) RF 95%

Pre-EnCAID

EnCAID
Subsurface key learnings

Presence of more than one oxidation front indicates

• fuel remaining in the region swept by the combustion front
• could be either residual oil left behind first oxidation front, or re-saturation with oil from adjacent rock or, possibly from flammable vapor produced from the oxidation and cracking reactions

Continues to be strong correlations between air-injection rate and temperature changes

• first oxidation zone at the bottom of the gas cap was truncated by a reduction in injection rate
• increase in injection rate performed in early 2013 resulted in ignition and combustion of the top of the bitumen
Future plans

Subsurface section 8

EnCAID
Approval #10440L
2017 annual performance presentation
Future plans

- No changes in overall recovery strategy are planned at this time
AER Dir 54 Section 3.1.2

Surface operations, compliance and issues not related to resource evaluation and recovery
Surface operations: table of contents

- Facility overview/modifications
- Measurement and reporting
- Environmental issues
- Compliance statement
- Future plans
Facility overview/modifications

Directive 54
Subsurface Operations section 1

EnCAID
Approval #10440L
2017 annual performance presentation
Site Layout
Process flow schematic
Plant performance - 2018

Facility is operating as expected

- Steady air injections
- Some weather related reductions
Gas usage

Usage is as fuel gas for air compressor operations

- Gas source Primrose plant fuel gas
- Total 2017 usage 1,727 m³
# Greenhouse gas emissions

<table>
<thead>
<tr>
<th>Month</th>
<th>2017 (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>498.72</td>
</tr>
<tr>
<td>February</td>
<td>450.19</td>
</tr>
<tr>
<td>March</td>
<td>486.36</td>
</tr>
<tr>
<td>April</td>
<td>463.91</td>
</tr>
<tr>
<td>May</td>
<td>490.85</td>
</tr>
<tr>
<td>June</td>
<td>473.46</td>
</tr>
<tr>
<td>July</td>
<td>307.69</td>
</tr>
<tr>
<td>August</td>
<td>294.32</td>
</tr>
<tr>
<td>September</td>
<td>307.01</td>
</tr>
<tr>
<td>October</td>
<td>325.18</td>
</tr>
<tr>
<td>November</td>
<td>317.18</td>
</tr>
<tr>
<td>December</td>
<td>343.09</td>
</tr>
</tbody>
</table>
Surface facility key learnings

- Safe operation of production and injection wells
- Geographical location provides challenges for instrumentation operations utilizing solar panels during the winter season
- Purity of injection gases plays key role in maintaining injectivity
- Marginal economics to operate in today's pricing environment
Measurement and reporting

Directive 54
Surface Operations section 2

EnCAID
Approval #10440L
2017 annual performance presentation
Measurement reporting

Field Operations record daily flow volumes for air injection and compressor usage → EnCAID Daily Volumes report spreadsheet

Gas Analysis

Gas well meters loaded to PVR via SCADA system

Production activities
1) PA updates gas analysis in PAS
2) PA enters air volumes and fuel usage volume from EnCAID Daily Report into PAS EnCAID injection facility
3) Well production PVR data uploaded to PAS
4) PAS generates PRA submission
5) PA manually updated the gas fuel usage and air injection into PRA

PVR
Environmental issues

Directive 54
Subsurface Operations section 7

EnCAID
Approval #10440L
2017 annual performance presentation
Environmental compliance

No environmental non-compliance events occurred related to EnCAID occurred in 2017
Compliance statement

Directive 54
Subsurface Operations section 8

EnCAID
Approval #10440L
2017 annual performance presentation
Compliance confirmation

Two non-compliance events related to EnCAID Approval 10440L occurred in 2017

• **10440L Section 7) (2)**
  • Non-continuous monitoring of surface pressure on 00/14-09-073-06W4/0

• **10440L Section 13)**
  • Bottom hole stabilized pressure fell below 700 kPaa
Non-compliance discussion

Directive 54
Surface operations section 9

EnCAID
Approval #10440L
2017 annual performance presentation
Non-compliance discussion

10440L Section 7) (2) - Non-continuous monitoring of surface pressure on 00/14-09-073-06W4/0

- March 17, 2017 - Shared electronic equipment was accidently removed when an adjacent well was abandoned
- March 22, 2017 - Event was detected by CVE staff
- March 22, 2017 - Mitigation to ensure compliance implemented and continued until permanent repair was carried out.
- March 23, 2017 - Disclosed to AER
Non-compliance confirmation

10440L Section 13) - Bottom hole stabilized pressure fell below 700 kPaa

• March 21, 2017 – Evaluation of static gradients revived non-compliance event
• March 24, 2017 – AER notified and deemed event low risk
• March 24, 2017 – Mitigation action to shut-in producers completed until approval of restart plan from AER
• April 20, 2017 AER approval received for restart of shut-in producers
• April 21, 217 – Producers restarted
Future plans

Directive 54
Subsurface Operations section 10

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Approval #10440L
2017 annual performance presentation
Future plans

• No major initiatives or plans that may require submission of an application are being contemplated at this time
• No changes to overall plant design or amendments are anticipated at this time
• Operate the project until it is uneconomic
Appendix
Gas composition 00/1-17-73-6W4/0
Gas composition 00/2-16-73-6W4/0
Gas composition 00/6-5-73-6W4/0
Gas composition 00/6-6-73-6W4/0
Gas composition 00/6-7-73-6W4/0
Gas composition 00/7-8-73-6W4/0
Gas composition 00/10-11-73-7W4/0
Gas composition 00/10-12-73-7W4/0
Gas composition 00/14-9-73-6W4/0
Gas composition 00/6-18-73-6W4/0
Downhole instrumentation layout

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Temperature (°C)</th>
<th>Pressure (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>7.93</td>
<td>300.0</td>
</tr>
<tr>
<td>10.0</td>
<td>75.30</td>
<td>430.0</td>
</tr>
<tr>
<td>20.0</td>
<td>416.20</td>
<td>441.0</td>
</tr>
<tr>
<td>30.0</td>
<td>339.63</td>
<td>445.0</td>
</tr>
<tr>
<td>40.0</td>
<td>159.81</td>
<td>1.0213 MPa</td>
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<td>50.0</td>
<td>704.08</td>
<td>1.94 MPa</td>
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<td>60.0</td>
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<td>70.0</td>
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<td>80.0</td>
<td>334.50</td>
<td>0.94 MPa</td>
</tr>
<tr>
<td>90.0</td>
<td>208.07</td>
<td>1.23 MPa</td>
</tr>
</tbody>
</table>

- Observation Well: 102-05-10-97-00V4
- Production and Oil Well: 100-06-19-97-00V4

- Trend: Higher AER/ES vertical isolation reading
- Above Zone comparison to Wolf Lake (10 meters above zone)
- Top of gas zone: 10.0 meters
- Heart of gas zone: 30.0 meters
- Bottom of gas zone: 159.81 meters

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100/05-10-073-06W4 wellbore schematic
102/05-10-073-06W4 wellbore schematic
103/05-10-073-06W4 wellbore schematic
Thank you