Air injection and displacement for recovery with oil horizontal (AIDROH) project Approval #11618 Performance presentation

Alberta Energy Regulator offices
Calgary
February 2017
Advisory

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Total bitumen initially-in-place (BIIP) estimates, and all subcategories thereof, including the definitions associated with the categories and estimates, are disclosed and discussed in our July 24, 2013 news release, available on SEDAR at sedar.com and at cenovus.com. BIIP estimates include unrecoverable volumes and are not an estimate of the volume of the substances that will ultimately be recovered. Cumulative production, reserves and contingent resources are disclosed on a before royalties basis. All estimates are best estimate, billion barrels (Bbbls). Total BIIP (143 Bbbls); discovered BIIP (93 Bbbls); commercial discovered BIIP equals the cumulative production (0.1 Bbbls) plus reserves (2.4 Bbbls); sub-commercial discovered BIIP equals economic contingent resources (9.6 Bbbls) plus the unrecoverable portion of discovered BIIP (81 Bbbls); undiscovered BIIP (50 Bbbls); prospective resources (8.5 Bbbls); unrecoverable portion of undiscovered BIIP (42 Bbbls). Any contingent resources as at December 31, 2012 that are sub-economic or that are classified as being subject to technology under development have been grouped into the unrecoverable portion of discovered BIIP. Petroleum initially-in-place (PIIP) estimates for Pelican Lake are effective December 31, 2012 and were prepared by McDaniel. All estimates are best estimate discovered PIIP volumes as follows: Mobile Wabiskaw total PIIP (2.11 Bbbls); discovered PIIP (2.11 Bbbls); cumulative production (0.11 Bbbls); reserves (0.25 Bbbls); contingent resources (0.03 Bbbls); unrecoverable discovered PIIP (1.72 Bbbls); undiscovered PIIP (0 Bbbls). Mobile Wabiskaw development area total PIIP (1.62 Bbbls); discovered PIIP (1.62 Bbbls); cumulative production (0.11 Bbbls); reserves (0.25 Bbbls); contingent resources (0 Bbbls); unrecoverable discovered PIIP (1.26 Bbbls); undiscovered PIIP (0 Bbbls). Immobile Wabiskaw total PIIP (1.33 Bbbls); discovered PIIP (1.33 Bbbls); cumulative production (0 Bbbls); reserves (0 Bbbls); contingent resources (0 Bbbls); unrecoverable discovered PIIP (1.33 Bbbls); undiscovered PIIP (0 Bbbls).

Certain natural gas volumes have been converted to barrels of oil equivalent (BOE) on the basis of one barrel (bbl) to six thousand cubic feet (Mcf). BOE may be misleading, particularly if used in isolation. A conversion ratio of one bbl to six Mcf is based on an energy equivalency conversion method primarily applicable at the burner tip and does not represent value equivalency at the well head.

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AIDROH* 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 Directive 054 Section 3.1.1

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

- Background
- Geology/geoscience
- Drilling and completion
- Artificial lift
- Instrumentation
- Scheme performance
- Future plans
Scheme background

Subsurface section 1

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2016 annual performance presentation
Background

The AIDROH project uses gravity drainage as a bitumen recovery process to recover bitumen that has been passively heated by the Cenovus EnCAID combustion project.
Geological/geoscience

Directive 54
Subsurface section 2

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### Summary of reservoir properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Depth (TVD)</td>
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<tr>
<td>Thickness</td>
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<tr>
<td>Average porosity</td>
<td>35%</td>
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<tr>
<td>Average bitumen saturation</td>
<td>65%</td>
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<tr>
<td>Average permeability</td>
<td>1,350mD</td>
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<tr>
<td>OBIP (project area)</td>
<td>3,302 e³m³</td>
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<tr>
<td>Oil viscosity @ 13°C</td>
<td>~25,000 cP</td>
</tr>
<tr>
<td>Oil viscosity @ 60°C</td>
<td>~600 cP</td>
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<tr>
<td>API oil gravity</td>
<td>10.3 - 10.8</td>
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</table>
Wabiskaw bitumen thickness

Type log cut offs:
- <75 api gamma ray
- >20 ohm resistivity
- >27% porosity

OBIP under gas cap = 159,000 e³m³

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Wabiskaw structural map
Wabiskaw stratigraphic cross-section

WBSK B Valley Fill

WBSK D Valley Fill

Regional WBSK

Bottom water

MCMR

WBSK B VF

Depositional Edge
Horizontal production well 104/5-10

Producer drilled 15m below G/B interface:
- avoid hitting concretion
- avoid missing heated zone

Learnings:
- drill lower to optimize reserves recovery

Drilled in 2011 east of injector well at surface location 6-10
300m of horizontal leg landed 30m north of injector well and 
~15m into heated zone
Drilling and completion

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Subsurface section 3

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Well layout

Drilled 103/5-10-73-6W4 post burn vertical well September 2011

• Drilled 11m northwest of 102/5-10-73-6W4
• Successfully cored 44m from top Wabiskaw to top of McMurray – no lot core
  • extensive core ad oil analysis program completed
  • core routine core analysis, SEM, XRD
  • oil API, viscosity, composition

Drilled 104/5-10-73-6W4 horizontal producer well September 2011

• Drilled 300m east-west horizontal section, landed 30m north of 102/5-10-73-6W4 injector well and 15m below Wabiskaw gas/bitumen interface
• Well equipped with 20 thermocouples in horizontal length
Completion

Installed tail pipe to toe

- divert hot crude to toe
- encourage warming near toe

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

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Subsurface section 4

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Artificial lift

Artificial lift technology information

• Progressive cavity pump (PCP), temperature tolerance of elastomer 150°C
• Lift capacity range: 34-50 m3/D
• Operating temperature range 44°C to 108°C
Artificial lift performance

No production activity during 2016 reporting period

- Well suspended on February 13, 2015
Instrumentation

Directive 54
Subsurface section 5

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Instrumentation in wells

104/05-10-73-6W4/00

- Equipped with 10 thermocouples

Requirements under subsection 3.1.1 5a – wellbore schematics 5c and 5d are included in the appendix
Thermocouple temperature vs. depth
Scheme performance

Directive 54
Subsurface section 7

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Production history

No production activity during 2016 reporting period
Heated oil volume

Calculated using analytical geometry-based method

Combustion front heats bitumen by conduction in the shape of a sphere cap

- Thermally affected radius ~ 270m

Chemically affected

- 57,000m³

Thermal affected*

- 665,000m³

* Based on horizontal well depth 15m below gas/bitumen interface
Historical oil quality

Original oil ~45,000 cP at reservoir conditions (dead)

No oil quality analysis undertaken during 2016 reporting period

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No analysis conducted in 2013
No production activity during 2016 reporting period

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<td>Q4</td>
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Subsurface key learnings

No production activity during 2016 reporting period

EnCAID conductive heating effects observed following suspension of well operations from 2015

- TC 1-5  ~6°C temperature increase
- TC 6-11  ~12°C temperature increase
- TC 12-15  ~5°C temperature increase
Future plans

Directive 54
Subsurface section 8

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Future plans

Continue the following:

- Monitor downhole temperatures
- Continued suspension of AIDROH well operations
AER Directive 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
- Water, water disposal well and landfill waste
- Sulphur production
- Environmental issues
- Compliance statement
- Non-compliance discussion
- Future plans
Facility overview/modifications

Directive 54
Surface operations section 1

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Site layout
Process flow schematic

No changes to facility or process undertaken during 2016 reporting period
Facility performance 2016

No production activity during 2016 reporting period

- Suspended facility February, 2015
Gas usage

No gas usage activity during 2016 reporting period
Greenhouse gas emissions

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<td>December</td>
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No production operations or gas usage activity during 2016 reporting period
Measurement and reporting

Directive 54
Surface operations section 2

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Measurement reporting

Field operations take daily tank readings, enter into daily tracking

Field operations enter truck tickets into EC: total fluid volume with known average BSW

Gas (vent, fuel, casing gas) meters loaded to EC via SCADA system

Receiving BSW from Foster Creek labs

Daily AIDROH tracking spreadsheet

Production Accounting Activities
1) BSW cuts are determined based on the Foster Creek labs analysis results. These are entered into EC.
2) Production is determined based on closing inventory-open inventory-receipts+ dispositions.
3) Battery production and gas meter reports from EC used to create PRA uploaded file.
4) PRA submission is completed.

EC

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Water, water disposal wells and landfill waste

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Surface operations section 5

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Water and waste disposal

No production operations during 2016 reporting period

• No processing occurred at the site
• No produced water
Sulphur production

Directive 54
Surface operations section 6

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Sulphur production

No production operations during 2016 reporting period

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<th>2016</th>
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Environmental issues

Directive 54
Surface operations section 7

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Environmental issues

No environmental issues related to the AIDROH occurred in 2016
Compliance statement

Directive 54
Surface operations section 8

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Compliance confirmation

No non-compliance events related to the AIDROH occurred in 2016
Non-compliance discussion

Directive 54
Surface operations section 9

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2016 annual performance presentation
Non-compliance confirmation

No non-compliance events related to the AIDROH occurred in 2016
Future plans

**Directive 54**
**Surface operations section 10**

AIDROH
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2015 annual performance presentation
Future plans

Continue suspension of AIDROH well and facilities
Appendix
Thank you