Subsurface Agenda

1. Background
2. Geology / Geoscience
3. Drilling & Completions
4. Artificial Lift
5. Well Instrumentation
6. Scheme Performance
1. Background
Project Overview

Approved Development Area as per ERCB Scheme Approval No. 11522E

CORED Wells
BLACKPEARL OIL SANDS
LEASE HOLDINGS
Project Summary

• AER Scheme Approval No. 11522E
• Two (2) SAGD Pilot Well Pairs
• Portage area on Oil Sands Lease 7407060158
• Pilot site located in 02-36-076-18W4
• Target formation is the Lower Grand Rapids Unit 1 (L.GR1)
• Initial reservoir data:
  – Pressure: 1700 KPA
  – Temperature: 13°C
  – Depth: 300m
• Traditional SAGD recovery process
• BlackPearl is the 100% W.I. Owner
Blackrod Pilot Site
Project Milestones – 10-36 WP2

- **Feb 2012**: AER Approval No. 11522C for 10-36 WP2 and facility expansion
- **Feb 2013**: Drill 10-36 WP2
- **Oct 2013**: Commission Phase 2 Pilot Facility Expansion
- **Nov 2013**: Commence Circulation Phase
- **Mar 2014**: Convert to SAGD Production Phase
- **Apr 2015**: Production surpasses commercial rate of 400 bopd
- **Dec 2016**: 21 consecutive month of +500 bopd with an iSOR of <3.0
- **Dec 2017**: Produce 645,000 cumulative barrels of oil
2. Geology / Geoscience
Original Bitumen in Place

\[ \text{OBIP}_{\text{WP2}} = A_2 \times h_2 \times So_2 \times \phi_2 \times Bo \]
\[ = (100 \text{ m} \times 1050 \text{ m}) \times 25 \text{ m} \times 0.63 \times 0.34 \times 1.0 \]
\[ = 562,275 \text{ m}^3 \]

Where:
- OBIP = Original Bitumen In Place
- A = Drainage Area
- h = Thickness
- So = Oil Saturation
- \( \phi \) = Average Porosity
- Bo = Expansion Factor
- WP2 = 2\textsuperscript{nd} Pilot Well Pair drilled at 10-36-076-18W4
• Existing lease and access selected for Pilot surface location

• Bottom hole locations for both Pilot Well Pairs selected based on offsetting well control

• L. GR is a Shoreface deposit consisting of three (3) coarsening-upward parasequences:
  – L. GR Unit 1 = upper to middle shoreface bitumen target zone
  – L. GR Unit 2 = middle to lower shoreface transition zone
  – L. GR Unit 3 = bottom H2O saturated aquifer

LOG CUTOFFS
• Gamma Ray < 75 API
• Resistivity > 20 Ohm.m
• Porosity > 33%
L. GR Unit 3 Bottom Water Isopach Map
**LOG CUTOFFS**

- Gamma Ray < 75 API
- Resistivity > 20 Ohm.m
- Porosity > 33%
**L.GR1** Core Characteristics:
- Oil saturation: 0.60
- Bitumen weight: 11%
- Net pay thickness: 26 m
- Porosity: 36%
- Vertical permeability: 3024 mD
- Horizontal permeability: 3450 mD
- $K_v/K_h$: 0.88
- API Gravity: 9.8 (at 15.6 °C)
Cross Section Through 10-36 WP2

- To maximize oil recoveries, 10-36 WP2 placed deeper and drilled longer than 13-25 WP1
Seismic

3D X-Line along 13-25 WP1

3D Seismic Area Coverage
Structure Map

L.GR1 TOP

L.GR1 BASE

Legend
- PILOT PROJECT STUDY AREA
- ORIGINAL SAGD PILOT WELL PAIR
- SECOND BLACKROD SAGD WELL PAIR
- BLACKPEARL OIL SANDS HOLDINGS
- 2m
Primary Cap Rock

- MFS (Maximum Flooding Shale)
- Directly overlays Lower Grand Rapids formation
- Regionally extensive
- 3 m average thickness
- Mini Frac Analysis:
  - Performed on the 13-25-076-18W4 OSE Core Hole
  - Initial Breakdown Pressure = 8500 kPa
  - Closure Pressure Gradient = 13.7 kPa/m
MFS Cap Rock Isopach Map
MFS Cap Rock Structure Map
MFS Cap Rock Base Depth Map
Secondary Cap Rock

• Joli Fou formation
• 45 m above Lower Grand Rapids formation
• Regionally extensive
• 20 m average thickness
• Mini Frac Analysis:
  – Performed on the 01-36-076-18W4 OSE Core Hole
  – Initial Breakdown Pressure = 12,750 kPa
  – Closure Pressure Gradient Range = 19.4 kPa/m
Joli Fou Cap Rock Isopach Map
Joli Fou Cap Rock Structure Map
3. Drilling and Completions
Blackrod Pilot Well Network
10-36 WP2 - Injector
10-36 WP2 – Producer (Prod. Phase)
• Injector Well:
  – No modifications

• Producer Well:
  – No modifications
4. Artificial Lift
Electrical Submersible Pump

• Fluid production via “Ultra Temp” Electrical Submersible Pumps (ESP)

• ESP advantages:
  – Operate and lift fluids at controlled downhole pressures
  – Maintain continuous fluid production

• Variable Flow Drive (VFD) utilized to control pump speed and production rates

• Current ESP has +1000 days of runtime
5. Well Instrumentation
10-36 WP2 – Obs Wells

• Toe Obs Well:
  – 100/07-36-076-18W4
  – 17.5 m West of WP2
  – Thermocouples to monitor temperature above, below, and within L.GR1
  – Thermocouple profile indicating early stages of steam chamber development
  – P/T gauge to monitor pressure & temperature within L.GR3 aquifer

• Heel Obs Well:
  – 100/02-36-076-18W4
  – 16.1 m East of WP2
  – Thermocouples to monitor temperature above, below, and within L.GR1
  – Thermocouple profile indicating early stages of steam chamber development
  – P/T gauge to monitor pressure & temperature within L.GR3 aquifer
10-36 WP2 – Instrumentation Overview
Groundwater Monitoring Wells

• 100/03-36-076-18W4 GWM:
  – Directionally drilled from 14-25 lease
  – PCP to sample/analyze non-saline L.GR3 \( \text{H}_2\text{O} \)
  – P/T gauge to monitor pressure & temperature within L.GR3 aquifer

• 100/14-25-076-18W4 GWM:
  – Directionally drilled from 14-25 lease
  – PCP to sample/analyze non-saline L.GR3 \( \text{H}_2\text{O} \)
  – P/T gauge to monitor pressure & temperature within L.GR3 aquifer

• 100/15-25-076-18W4 GWM:
  – PCP to sample/analyze non-saline Viking \( \text{H}_2\text{O} \)
  – P/T gauge to monitor pressure & temperature within Viking aquifer

* Annual Groundwater Monitoring Summary Report Submitted to the AER in Q1 2016
6. Scheme Performance
10-36 WP2 Performance as of Dec 31, 2017

• 47 months of SAGD Production Phase
• Maturing steam chamber / Oil production beginning to decline
• Oil production currently averaging 74.5 m³/d
• Applied Learnings:
  • Improved well design (i.e. longer HZ section and WWS for sand control)

• Objective(s):
  • Evaluate SAGD performance from a commercial well pair prototype
  • Target 100% up-time

• Well Placement:
  • “Cautious” placement above L. GR Unit 3 Bottom Water
10-36 WP2 Key Learnings

• Longer ramp-up periods now expected at Blackrod
• WWS favorable to the Blackrod L. GR reservoir
• Scab liner effective in protecting ESP and facilitating heat conformance across HZ section
• Heat conformance can be achieved across 950+ m HZ section
10-36 WP2 Oil Production as of Dec 31, 2017

- Cumulative Production = 100,000 m³
- Recovery = 17.8%
- Ultimate Recovery = 55 - 60%
- CSOR including Circ. Phase = 3.37
- CSOR during Prod. Phase only = 3.04
- Average Rate during Prod. Phase = 71.85 m³/day (451.86 bopd)
- Current Rate = 74.6 m³/day (469 bopd)
• Average Steam Chamber Pressure = 2170 kPa

• Average Surface Steam Temperature = 265 °C

• Wellhead Steam Quality = 95 – 100%
10-36 WP2 Performance Plot

Blackrod 10-36 WP2 - Performance Plot

Fluid rate (m³/d)

SOR

Produced Crude Oil/Bitumen
Produced Water
Injected Steam
ISOR
CSOR

Pulled Scab Liner
Blackrod Surface Operations
Surface Operations Agenda

1. Facilities
2. Measurement & Reporting
3. Water Source
4. Disposal
5. Environmental
6. Compliance Statement
1. Facilities
Pilot Facility Overview
Pilot Facility Performance

- No issues with bitumen treatment, water treatment, or steam generation
- Pilot Facility uptime 98% in 2017
- Generated steam, produced bitumen, produced water, and produced gas volumes reported to Petrinex
- Purchased gas volumes reported to Petrinex
- Flared gas volumes reported to AER and Petrinex
- SO$_2$ & NO$_x$ emissions and ambient air quality data submitted to AER both monthly and annually as per terms of EPEA Approval 00264736-00-00
- GHG emissions reporting not required for Blackrod Pilot Facility as per terms of EPEA Approval 00264736-00-00
• No modifications in 2017
2. Measurement & Reporting
BlackPearl remains compliant with AER Directive 017 as well as Directive 042 as per the terms of our approved MARP (Measurement, Accounting, and Reporting Plan)

To validate compliance with Directive 017 and Directive 042, BlackPearl performs a detailed EPAP (Enhanced Production Audit Program) review annually as per Directive 076 with an independent consulting group
Process Flow Diagram
Process Flow Diagram (cont.)
Blackrod Surface Operations

3. Water Source
Blackrod Water Source(s)

- 1F1/14-24-076-18W4 L.GR3 WSW:
  - Non-saline (~3700 TDS)
  - AER Water Act Licence No. 00308617-01-00 valid until Jun 2019
  - Approved for 109,500 m³ annually
  - Production volumes reported to AER and Petrinex
  - 100/14-24-076-18W4 monitoring well 20 m North of 1F1/14-24 WSW
  - No issues with water softening process

- 1F1/15-25-076-18W4 Grosmont Member D WSW:
  - Saline (~12,800 TDS)
  - No issues with saline treatment process
Blackrod Water Source(s)

Monthly Source Water Volumes

- LGR (14-24-36-76W4)
- Grossmont (15-25-76-16W4)
4. Disposal
Blackrod Disposal

• Produced Water:
  – 100/02-25-076-18W4 Class 1b Disposal Well
  – AER Scheme Approval No. 11703A
  – Disposal into Grosmont Members B, A
  – Maximum wellhead injection pressure of 6300 kPa
  – This well continues to operate on vacuum with no pressure at the wellhead
  – All disposal volumes reported to Petrinex

• Waste:
  – Waste fluids (i.e. sewage, sludge, etc.) trucked out to third party disposal facilities.
Blackrod Disposal

100/02-25-076-18W4 Disposal Well

- 02:25 Disposal Well continues to operate on vacuum

Month
5. Environmental Issues
• No environmental issues to date

• BlackPearl remains compliant with the terms of AER Approval No. 264736-00-00:
  – CPP (Caribou Protection Plan)
  – Air Monitoring
  – Groundwater Monitoring
  – Soil Monitoring
  – Etc.
6. Compliance
Blackrod Compliance

• To the best of BlackPearl’s knowledge, the Blackrod SAGD Pilot Project is currently in full compliance with all conditions and regulatory requirements related to AER Scheme Approval No. 11522E
1. Ongoing Pilot Objectives
• Continue to produce 10-36 WP2

• Trial new water treatment technology
2. SAGD Commercial Development
SAGD Commercial Development

- 80,000 bbl/d (12,720 m³/d) to be developed in phases, with the first phase planned for 20,000 bbl/d; two additional phases of 30,000 bbl/d each to follow

- Commercial SAGD Application No. 1728831 submitted in Q2 2012 was approved by the AER in Q3 of 2016
Appendices

1. Pressure & Temperature Data
   - 13-25 WP1
   - 10-36 WP2
   - Heel & Toe Observation Wells