Murphy Oil Company LTD.

Seal Polymer Project
Scheme Approval No. 11320B
Annual AER Progress Presentation

March 12, 2014
• Subsurface

• Surface
- Background
- Geology
- Drilling & Completions
- Flood Performance
- Injection Pressures
- Future Plans
Background

Geology

Drilling & Completions

Flood Performance

Injection Pressures

Future Plans
Background – Map of Seal Central

- Polymer injection located in Central Seal
- Sections 3, 4, 9, 10 & 15-83-15W5
- Utilizing Pads 14-10, 13-10, 13-03, 4-10
- Terminology
  - Area 1 – Approval 11320B
  - Pilot & 3 Phases within Area 1
Background – Map of Seal Central

- Pilot + 3 Phases of expansion
- Pilot operational Oct, 2010
- Phase 1 operational Sept, 2012
- Phase 2 operational Dec, 2012
- Phase 3 on hold
- Background
- Geology
- Drilling & Completions
- Flood Performance
- Injection Pressures
- Future Plans
Bluesky Sand

- Unconsolidated, quartz-rich sandstone
  - fine-medium grained
  - moderate sorting
- Depth of ~625m TVD
- Net Pay Range ~4 - 8m in Polymer area
- Porosity 22 - 30%
- Permeability 500 - 2000mD in Polymer area
- Reservoir temperature 19 °C
- Water Saturation < 25%, typically 15-20% in reservoir
- Oil Viscosity (dead oil) 5,000 – 50,000 cp @ 20 °C
- Initial Reservoir Pressure 4500 - 5000kPa
Murphy Seal
11-10-83-15W5

Spud: 1/29/2011
RR: 2/4/2011
Geology - Net Bitumen Pay Cutoffs

- Gamma: <65API
- Porosity >22%
- $S_o > 60\%$ (oil zone), from Resistivity
Geology - Bluesky Structure Map

Polymer Phase 1

Polymer Phase 2

Polymer Phase 3
Geology - Bluesky Net Pay Map
Background

Geology

Drilling & Completions

Flood Performance

Injection Pressures

Future Plans
Pilot + Expansion Locations:

- Lowest viscosity compared to other locations
- <10 m net pay
- Murphy 100% working interest
- Flowline production

Well Placement Criteria:

- Well placement within the top 5 meters of the Bluesky due to low viscosity and high permeability
Original well spacing was 140 meters with infills drilled at 70 meters.

Injector and producing wells are at 70 meter spacing.
**D&C - Typical Completion Details**

- **Surface Casing**
  - 339.7mm, 81.1 kg/m, J-55, ST&C

- **Intermediate Casing (311mm Hole)**
  - 219.1mm, 35.72 kg/m, J-55

- **KOP**: Approximate 367m with Builds of 9°/30m

- **88.9 mm Tubing**
  - J55 EUE

- **Slotted Production Liner (200mm Hole)**
  - 1600 m of 139.7mm, 20.83 kg/m, J-55, ST&C
Background

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Injection Pressures

Future Plans
First Polymer Injection in October 2010
Hydrating polymer concentrations: 1000-1500 ppm
Polymer trace in produced water: >900 ppm within pilot
Pilot consists of 3 injectors and 4 producers.

Approval No. 11320B to downspace on the East side of the pilot.

70 meter spacing

Injection started Q4 2010, production response has been observed since Q3 2011
- Increased production >70 m³/day
- Maintained “plateau” for 2.5 years
- Observed that: Reduced injection pressure = Reduced production rates
Phase 1 consists of 2 injectors and 2 producers.

- 70 meter spacing

- Injection started Q3 2012, water cuts increased Q4 2012
Performance – Phase 1 Prod./Inj. Profile

- Increased water cuts: 15% to 60%
- No response recorded
Phase 2 consists of 9 injectors and 11 producers.

- 70 meter spacing

- Injection started Q4 2012 on the south pad & Q2 2013 on the north pad, water cuts increased Q3 2013 on the north pad
Positive results from 13-03 Pad: Low water cuts & increasing reservoir pressure

Increased water cuts on 4-10 Pad: 10% to 40%

No production response recorded
Pilot has best production results within the project

Mixed results from Phases 1 & 2

Maintaining reservoir voidage within Pilot
  - Volume of injected polymer to date 221.1 E3m3

Expected incremental recovery factor after polymer flood 8.8%

Produced solution gas from the pilot & expansion is captured and tied in to 4-33 battery.

Minor response has been observed in the expansion phases.
Injectivity is a non-issue with wells on vacuum at the start of injection.

Higher injection pressures yield better production.

Start injection before or soon after infill producers are drilled.

Avoid existing overlapping wellbores and areas with known above average sand production.
Performance – Existing Multi-laterals

- Original primary producer W1330 00/13-15 was drilled as a barefoot multilateral
- Believed to have collapsed with numerous sand bridging issues while on primary production
- Both existing well and infill were drilled and completed with slotted liner throughout the horizontal section
- Conformance has been an issue with this well pair
Background

Geology

Drilling & Completions

Flood Performance

Injection Pressures

Future Plans
Injection Pressures

- Polymer Injection Approval Pressure (Approval # 11320)
  - MAWHIP 3,780 kPa
  - MABHIP 9,800 kPa

- Monitoring Injection Pressure
  - Surface pressure recorded daily and monitored to ensure MAWHIP is not exceeded
Continued shut down of injection due to MAWHP.

Pressure drop when rates are slowed down to maintain 1:1 injection/production ratio.
Injection Pressure – Phase 1

- No steady build of pressure due to conformance issues
Mixed results with build up occurring on the 13-03 pad and conformance issues on the 4-10 pad
Background
Geology
Drilling & Completions
Flood Performance
Injection Pressures
Future Plans
Murphy has commissioned 2 of 3 Phases of the commercial Area 1 expansion.

- Phase 3 injection is currently on hold

Murphy has submitted an application (App. # 1769709) to the AER for the Area 2 expansion of the polymer project.
Future Plans - Expansion

- Located in Central Seal just North of existing pilot and expansion.
- Similar reservoir characteristics and viscosities.

Application Area
Agenda

- Subsurface
- Surface
- Facilities
- Non-Saline Water Use and Conservation
- Regulatory
- Conclusion
Facilities

Non-Saline Water Use and Conservation

Regulatory

Conclusion
- Located in Central Seal
- All producing well from the polymer pilot and Area 1 are flowlined to the 4-33 CPF
- Polymer scaling a concern within heater treaters due to high processing temperatures
Facilities

Non-Saline Water Use and Conservation

Regulatory

Conclusion
Water Usage - Paddy Formation

- **UWI: 1F1/14-10-083-15W5/0**
  - Murphy currently has term license 00289082-00-00 with Alberta Environment for the diversion of up to 164,250 m³ of Paddy water for injection with an expiry date of 2018-03-05

- **UWI: 1F1/15-03-083-15W5/0**
  - No TDL necessary with TDS testing >4000 ppm
Water Usage - Notikewan Formation

- UWI: 1F1/4-10-083-15W5
- TDL’s are not needed for Notikewan wells with TDS >4000 ppm
Murphy is currently developing a water management program for the entire Seal field
Water Usage - WSW Locations

- 14-10 Paddy
- 4-10 Notikewan
- 15-3 Paddy
Water Usage - Paddy Well Location

105/14-10-83-15W5/0 Observation Well

1F1/14-10-83-15W5/0 Paddy Water Source Well
Water Usage – Produced Volumes

- Produced volumes are reported from test tanks located at the well site (tested weekly)
- From the start of the polymer flood there has been a recorded 22,341 m³ of water produced from the producing wells
- Water volumes are calculated through BS&W tests conducted simultaneously with the well test
- Proration factors for production volumes are calculated using standard accounting procedures which are outlined in Murphy Oil’s MARP according to Directive 17
- Produced water is currently being injected into disposal wells 102/06-33-082-15W5/0, 100/10-04-083-14W5/3 and 100/11-28-082-15W5/2

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# Water Usage – Injected Volumes

## Pilot & Phase 1

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**Total Polymer (m³)**

| Pilot & Phase 1 | 11,731.3 | 11,182.2 | 13,488.2 | 9,218.6 | 50,982.1 |

## Phase 2

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**Total Polymer (m³)**

| Phase 2 | 2,611.80 | 0.00 | 1,265.40 | 194.80 | 2,077.30 |

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For more detailed information, please refer to the Murphy Oil Company Ltd. database.
- Facilities
- Non-Saline Water Use and Conservation
- Regulatory
- Conclusion
Murphy is not aware of any outstanding compliance issues regarding the current approvals.

Murphy is in compliance with other regulatory bodies (SRD, AENV, DFO).
- Facilities
- Non-Saline Water Use and Conservation
- Regulatory
- Conclusion
Murphy is committed to maximizing the value of the resource for both itself and the province of Alberta through it’s royalty interest.

Observations made over the past year will be applied to future polymer project within Seal Lake.

Compliance with all AER regulations continues to be a top priority.