Abstract

The Alaska North Slope is a prolific hydrocarbon basin that has produced billions of barrels of light oil. As the basin matures and production declines, it is necessary to investigate other means by which to extend field life. As a result, BP Alaska has appraised the fluvial-deltaic Ugnu reservoir and associated heavy oil fluids in order to demonstrate the technical viability of producing heavy oil on the North Slope. In 2011 and 2012, the large heavy oil resource (approximately 18Bn bbls) has been tested via a four-well-production pilot. Due to limited surface locations and permafrost issues, two horizontal wells with surface-drive progressive cavity pump were selected for appraisal of the Ugnu Formation. Acquisition of quality data and a proactive approach to well management allowed up to 20% sand production to be sustained over the test period. Data is shown to demonstrate the improvement in performance relative to conventional horizontal predictions and how the sand production is enhancing oil rates through wormhole extension. An update on continued production results is shared herein. Note: the heavy oil resources face significant technological and investment challenges in the current Alaska fiscal system. As such, in late 2012, BP announced it is scaling back its heavy oil efforts and will stop the pilot program in 2013.
Topics:

• Introduction
• Pilot Objectives
• Pilot Results
• Forward Plan
Alaska Heavy Oil - Why Now?

- Low hanging fruit (light oil) is becoming more challenged
- Heavy oil technology has been utilized globally for decades
- Oil price has stabilized in recent years around $60 - $100
- Diluent is running out (North Slope decline is 6-8% per year)

Trans-Alaska Pipeline Throughput
Alaska Light, Viscous and Heavy Oil

Beaufort Sea

Legend
- 'Light' Oil Production
- 'Viscous' Oil Dev./Appraise
- 'Heavy' Oil Appraise
- Undeveloped Oil
- Undeveloped Gas
Ugnu Structure & Fluid Quality

Minimum Case GRV

Maximum Case GRV

8 – 10 API
10 - 12 API (20,000 – 2,000 cp)
12 - 14 API

Temperature

0°C
11°C
27°C

35 Miles

Minimum Case GRV
Maximum Case GRV
Heavy Oil Depletion Mechanisms

- **COLD &/or THERMAL**
  - 5,000-20,000 cP

- **THERMAL**
  - (>20,000 cP)

- **COLD**
  - (2,000 - 20,000 cP)

- **BP’s Milne Point Heavy Oil Pilot**
Alaska Heavy Oil Production Begins!

Heavy oil production begins on North Slope

April 27, 2011

A new project that could herald the future for Alaska's mature oil industry has begun pumping oil from one of the North Slope's most difficult reservoirs.

BP Alaska's "heavy oil" pilot project - a director calls on "fingers," "wet liver" and "wet sand" -

Eric Viertel, the heavy oil first of five in a "plains" of producing the billions of barrels of oil.

The project's more than 10 years

The project is no longer a test well - it's a "plains" to the north.

BP heavy-oil pilot well starts production

by Ken Cooper

Published April 26, 2011, 12:10 AM

Long Beach, Ala. - The heavy oil pilot project has started production.

Alarına Daily News

BP starts up first heavy oil test production well on North Slope

M. Cooper

Published April 27, 2011, 1:10 AM

BP has started production on North Slope.

The company has produced about 300 barrels of oil per day, which is about 140 million barrels of oil.

BP Alaska has produced about 150 million barrels of oil.

The company has been working on the project for several years.

The project is part of a larger effort to develop heavy oil fields in Alaska.

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CHOPS Elements

**CHOPS**
(Cold Heavy Oil Production with Sand)

- Foamy oil
- Sand production
- PCP pump
- Surface drive
- Heated separation tank
- Sand disposal

Heavy drawdown against perforations deliberately draws sand into the wellbore along with oil. As sand production continues “wormholes” form in the reservoir collectively representing a multi-fold increase in surface area. Sand production diminishes after an initial pulse but continues at about 5 to 10% by volume for the life of the well.
Heavy Oil Pilot Objectives

**Objective #1: Producibility**
- Foamy Oil – demonstrate solution gas drive present in the reservoir
- Sand Production – demonstrate significant and sustained sand production

**Objective #2: Repeatability**
- Other wells, reservoir zones, other hydraulic units

**Objective #3: Sustainability**
- Longterm Trends - oil rate, GOR, sand cut, water, well integrity

**Objective #4: Commerciality**
- Production profiles, peak rate, capex/opex profiles, well spacing & design, recovery factor

Foamy Oil  +  Sand Cut  =  Wormholes
• Characterization of the resource is a key part of our remit
• Ugnu consists of fluvial-deltaic sands deposited in large, meandering rivers
• Reservoir is laterally discontinuous
What Should We Expect From Seismic?
Stratigraphic Column

Under Evaluation: No Wells

Horizontal Wells: MPS-41A & MPS-39

Vertical Wells: MPS-43 & MPS-37
Milne Point S-pad Ugnu Depth Map

M80T Depth Horizon
Contour Interval = 50'
Red “+” symbol = depth point
Light Blue “x” symbol = slots

Regional OWC = -4050 TVDSS
MPS-41A versus MPS-39 Horizontal Profiles

**MPS-41A**
- **Peak Rate:** 550 bopd (not fully ramped up)
- **Lateral Length:** 2700’ (not constrained by faulting)
- **Drilling Operations:** sidetracked twice to stay in high quality sand
- **Slotted Length:** 1800’
- **Slot Size:** .125”

**MPS-39**
- **Peak Rate:** 500 bopd (not fully ramped up)
- **Lateral Length:** 1400’ (constrained by fault near heel & toe)
- **Drilling Operations:** bit drilled out bottom of UM80, no sidetracks
- **Slotted Length:** 720’
- **Slot Size:** .028”
Production Results: Net Oil & Sand Cut

MPS-41A Oil Production

- Net Oil Production (BOPD)
- Days On Production
- Various MPU facility restrictions

MPS-39 Oil Production

- Net Oil Production (BOPD)
- Days On Production
- Tubing hole repair & sim-ops issues

MPS-41A Sand Cut

- Sand Cut [%]
- Dates: 04/07/11 to 08/25/11

MPS-39 Sand Cut

- Sand Cut [%]
- Dates: 4/1/12 to 3/17/13
Heavy Oil Pilot Performance

**MPS-41A (P&A’d 2012)**
- 117 day pilot production run
- Peak rate ~550 gross (500 net of sand)
- 35,000 bbls cumulative production
- Foamy oil drive established
- Sand production variable at 5 - 20%

**MPS-39 (currently shut-in)**
- 177 day pilot production run
- Peak rate ~500 gross (430 net of sand)
- 40,000 bbls cumulative production
- Foamy oil drive repeated
- Sand production variable at 5 – 40%
How do Alaska Heavy Oil Wells Compare?

- **Pressure:** Ugnu reservoir pressure is much greater than Canadian analogs
- **GOR:** Ugnu gas oil ratio is optimum for solution gas drive
- **Fluids:** Ugnu viscosity is poorer than Venezuela, but typically better than Canada
- **Rocks:** thickness, porosity and permeability between Venezuela & Canada
Key Messages

1) BP Heavy Oil Pilot has exceeded expectations:
   - CHOPS extraction technique is viable
   - On-pad processing works
   - Production rates for horizontal wells are >500bpd
   - 75,000 barrels produced to date, shipped via TAPS, refined at Cherry Point and sold to market

2) Forward Plans:
   - Produce deviated wells until mechanical failure
   - Pilot project shutdown
   - Document results

3) Heavy oil is technically and commercially challenged
Thank You

- BP Alaska for permission to share our progress and the vision to step into a challenging resource
- All past and current employees involved with the project
- Heavy Oil Advisory Board, AITF, Weatherford, C-FER, and many others in the Canadian & Venezuelan oil industry
Questions