ALASKA GAS HYDRATE TEST WELL
DRILLING, COMPLETION, & PRODUCTION
CONSIDERATIONS

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JANUARY 22, 2009
MORGANTOWN
Well Objectives

• Meet required scientific objectives
  – Initiate gas and water production at rates that are measurable and sustainable
    • Primary: pressure depletion
    • Secondary: chemical, thermal, CO2, other
  – Collect pressure, temperature and other required data
• Optimize cost, reliability, operability
  – Flow assurance
  – Integrate into existing operations
Gas Hydrate Production Considerations

• Gas production rate
• Water production rate
• Operating pressure
• Flow assurance
  – Hydrate/freezing control
  – Sand control
  – Reservoir subsidence
  – Hydraulic isolation

• Applies to vertical and horizontal wells, regardless of location
Water Production Considerations

Dissociating 1 scf of gas hydrate releases:
- ~164 scf gas
- ~0.9 scf of water
- ~1000 bbls/MMscf
- Artificial lift required
Operating Pressure Considerations

- Gas hydrate fields will operate below the typical late-life reservoir pressure for a conventional gas reservoir.
- Compression probably required unless access available to low pressure gathering system or going directly to flare.
Flow Assurance Considerations

• Hydrate/freezing control
  – Inhibition (glycol/methanol)
  – Low dose hydrate inhibitors or cold flow technology
  – Near wellbore heating – at production zone and in permafrost zone

• Sand control
  – Premium screens or gravel packs

• Subsidence
  – Some design procedures to offset tensile failures
  – Shear failures require sidetrack or well replacement
Hydraulic Isolation Considerations

• Proximity to free water/gas contacts can prematurely end testing operations
  – Flow behind pipe
    • Free gas/water
    • Uphole gas hydrates
  – Fractures (natural, planned, accidental)
  – Breakthrough after dissociation

• Well placement critical to success of test
Comparison Mallik & Elbert Sands

![Comparison Graph]

- Mallik A Sand
- Elbert D Sand
- Elbert C Sand

Grain Size, microns

Cumulative %

C. Sand M. Sand F. Sand V. F. Sand Silts Clays
Sand Control Considerations

• Vertical well
  – 9.625” casing or 8.5” open hole
  – 5” premium screen (>20% open flow area) designed with appropriate mesh screen slot width
  – Circulate appropriate mesh gravel pack into place

• Horizontal Well
  – 8.5” open hole
  – Wire-wrapped screen required for horizontal since hole cleaning is uncertain and premium screens more prone to plugging with drill solids
Premium Screen Options

Baker: EXCLUDER 2000

Weatherford Excelflo

Rod Based Wire Wrapped Screens
Hz Shallow Well

Milne Point Hydrate Test
Typical 'E/B' Pad Well

KOP 500 ft

Surface Casing

'B' Fault

'E' Fault

Intermediate Casing

8.5" OH w/Screen

Horizontal Displacement, ft

-300-100 ft

Depth, ft TVD

0 1000 2000 3000 4000 5000 6000 7000 8000
Typical Gas Hydrate Well Completion

- Mallik equivalent
- Sand control
- ESP
- Downhole instrumentation
  - Pressure, temperature
  - Distributed temperature (DTS)
- Flow assurance
  - Chemical injection
  - Heat trace
  - Downhole heater
- Other configurations depending upon specific well & reservoir situations
Conclusions

• Vertical and horizontal drilling technology, including extended reach drilling, is available for gas hydrate test wells
• There are no apparent barriers to production using existing well completion technology
• Well placement and proximity to free gas/water layers (hydraulic isolation) critical to test success