Agenda

• Brief History of Hydraulic Fracturing

• Why is Hydraulic Fracturing Used?

• Alaska Regulations

• Fracturing Fluid Ingredients

• Fracturing Process

• Conclusions & Questions
Hydraulic Fracturing History

First commercial hydraulic fracturing job was at Velma, Oklahoma in 1949
(Courtesy of Halliburton, 2010)
Hydraulic Fracturing History

• Fracturing has been ongoing for nearly 70 years

• Alaska fracturing has a ~ 40 year history
  – Approximately >25% of Alaska wells have been fractured

• Technology in equipment and materials has improved dramatically since the first treatments in the 1950’s

• Millions of treatments have been performed worldwide without any documented groundwater contamination

• Fracturing has come into public view due to the huge increase in development of unconventional (shale) reservoirs in the Lower 48
Why is Hydraulic Fracturing Used?

- Establish or improve well productivity
  - Low quality reservoirs (shale) – required to achieve economic flow
  - Medium quality reservoirs – bypass drilling damage, accelerate oil/gas recovery
  - High quality reservoirs – bypass drilling damage, contact more formation
Why is Hydraulic Fracturing Used?

Why Fracture Stimulate?

Unstimulated Wells:
Require high reservoir permeability for sufficient hydrocarbon flow

Hydraulic Fractures:
Accumulate hydrocarbons over enormous area, achieving economic flowrates from low permeability formations

Figures not to scale!
Why is Hydraulic Fracturing Used?

Wellbore Area of 6.125” diameter by 8,000 ft long ≈ 13,000 ft²

Ideal fractured area: 80’ft thick * 8,000 ft * 2 sides = 1,280,000 ft²

Nearly 100 fold increase in exposure area

Well flow rate is directly proportional to area open to flow
AOGCC Regulations

• Chapter 5 of Title 31 of the Alaska Statues
• Title 20, Chapter 25 of Alaska’s Administrative Code
  – Recently revamped the regulations with additional data required
  – Stringent well construction requirements
  – Designed to protect underground sources of water
  – Ensure mechanical integrity during production and injection operations

“In over fifty years of oil and gas production, Alaska has yet to suffer a single documented instance of subsurface damage to an underground source of drinking water. As long as each well is properly constructed and its mechanical integrity is maintained, hydraulic fracturing should have no potential to damage any freshwater.”

Alaska Oil and Gas Conservation Commission (AOGCC) Hydraulic Fracturing White Paper
Groundwater Protection

Essentially no freshwater aquifers are present on the North Slope due to the permafrost

NOT TO SCALE
Frac Water Composition

- **Materials**

- **99%** Water & Sand

- **1%** Additives

- **0.007%** Crosslinker Also in: Soaps, Laundry Detergent
- **0.09%** Friction Reducer Also in: Water Treatment, Candy, Make-up Remover
- **0.09%** Surfactant Also in: Glass Cleaner, Antiperspirant, Hair Color
- **0.12%** Diluted Acid Also in: Household Cleaner, Swimming Pool Cleaner
- **0.06%** Gelling Agent Also in: Toothpaste, Baking Goods, Ice Cream, Sauces, Cosmetics
- **0.04%** Scale Inhibitor Also in: Household Cleansers, Deicing Agent
- **0.004%** Iron Control Also in: Food Additive, Lemon Juice, Flavoring in Food & Beverages
- **0.02%** Corrosion Inhibitor Also in: Pharmaceuticals, Plastics
- **0.01%** Breaker Also in: Hair Cosmetics, Household Plastics
- **0.06%** KCl Also in: Low Sodium Table Salt Substitute
- **0.0001%** Biocide Also in: Disinfectant, Used to Sterilize Medical Equipment
- **0.01%** pH Adjusting Agent Also in: Detergents, Washing Soda, Water Softener, Soap

Larch 2009

Alaska Oil and Gas Association
American Petroleum Institute Drilling/Frac Video
Pumping a Hydraulic Fracture Treatment
Fracturing Process

- Pump fluid at high rate (20 to 100 BPM) and pressure (5,000 to 15,000 psi)
- The rock “cracks” or fractures (fractures are vertical below ~ 2,000’ depth)
- The fracture propagates hundreds of feet with continued fluid injection
- Proppant (sand or ceramic) is then pumped to fill the created fracture
- After pumping stops, the fluid in the fracture “leaks off” into the formation and the fracture closes
- The proppant pack remains and allows oil/gas to flow more easily to the wellbore
Horizontal Wells vs. Vertical Wells
North Slope Frac at Oooguruk Island

Typical Nuiqsut Frac: 40 BPM (1,680 gallons per minute), 5,000 PSI surface pressure
2,500,000 pounds of ceramic proppant, maximum concentration of 12 pounds per gal
Fracturing is Critical for Future Caelus Projects

- Horizontal drilling and multistage fracturing is planned for all future wells
- We are now fracturing our injection wells in addition to producing wells
- The optimization of fracture design comes at a cost as job sizes increase
Fracturing is Critical for Future Caelus Projects
There is no “K” in Frac

It’s not FRACK

There is no “K” in Hydraulic Fracturing.

It was recently added by the media in part because it makes it look like another word that starts with f and ends in k.

It’s FRAC my friends
Conclusions

• Hydraulic Fracturing has been ongoing for 70 years and is a key component in the huge new oil and gas resources from shale

• Fracturing plays a key role in many North Slope developments

• There are no documented cases of groundwater contamination from fracturing

• Fracs consist mainly of water and sand or ceramic proppant

• The AOGCC closely regulates the fracturing process in Alaska

• There is no “K” in frac