NATURAL GAS FOR USE IN E&P OPERATIONS

MIDLAND, TX

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1. **LNG**
   - Can be economically transported long distances
   - Large onsite storage, similar to diesel, minimizes fuel deliveries
   - Highly mobile solution
   - Relatively complex & expensive storage /vaporization equipment onsite

2. **CNG**
   - Less complicated storage and delivery system than LNG
   - Economical if a high volume fill station is in the area
   - Onsite storage volume is limited compared to LNG, requiring more deliveries

3. **Pipeline Sales Gas**
   - Spec gas - consistent

4. **Field Gas**
   - Least expensive fuel
   - No transport concerns but supply volume is critical
   - Requires conditioning, uninterrupted supply and long term planning
THE ENGINE

Schematic of Dynamic Gas Blending Components

Halliburton Q10 Frac Pump w/ DF DGB Technology

Engine Gas Manifold
DRILLING WITH NATURAL GAS

Apache has operated 4-5 rigs over the past year in our Central Region using natural gas in Dual-Fuel (DF) or Dedicated Engines using LNG, CNG, pipeline & field gas.

LNG Storage (5,900 DGE) & Vaporizer

2 Alcor Energy Services Turbines for Rig Power: 1 Operating, 1 Standby

Cactus 131 – LNG DF

Ensign 766 – Field Gas
FRACTURING WITH NATURAL GAS

Apache has operated 2 frac spreads over the past year in our Central Region using LNG or CNG to provide the required natural gas to drive the DGB (Dynamic Gas Blending) DF frac pumps.
THE EQUIPMENT – LNG

- LNG Storage Trailer – 9,500 DGE
- Full-Scale Vaporizer
  1800 LNG GPH Capacity
- Reel Trailer
- Engine Gas Manifold
THE EQUIPMENT – CNG

CNG Storage & Offloading Trailers

CNG Trailer – 2,700 DGE Capacity

Loading Tube Trailer, Wheeler, TX
Fill Rate - 34 DGE/min.

High Rate Fill Station Compressors
Wheeler, TX
THE RESULTS

- Reliable equipment and deliveries
- Seamless & safe operation
- Maximum substitution rates in transient conditions without loss of power or response
- Achieve 18% to 25% reduction in fuel costs
- Achieve substitution rates between 50% & 65%
ECONOMIC DRIVER – WHAT YOU CAN EXPECT TO SAVE TODAY!

DRILLING

Basis:
• Blended Fuel at 50% Diesel Substitution
• 1,900 gpd - Average Diesel Consumption per Rig
• $1/DGE Savings Using Natural Gas Delivered as LNG or CNG
• All-in Cost Including Equipment Rental & Mob/Demob Charges
• After Market Kit Conversion

Projected Cost Savings/Rig/Yr $345,000
Payout for Conversion 4 – 5 months

FRACTURING

Basis:
• Blended Fuel at 50% Diesel Substitution
• 30,000 gal - Average Diesel Consumption per Frac
• $1/DGE Savings Using Natural Gas Delivered as LNG or CNG
• All-in Cost Including Equipment Rental & Mob/Demob Charges
• After Market Kit Conversion

Cost Savings/Frac $15,000
Projected Cost Savings/Frac Spread/Yr $1,000,000
Payout for Conversion 6 months
SUPPLY NEEDS TO MOVE THE NEEDLE

- Regional High Rate CNG Stations (field gas or pipeline quality)
- Regional LNG Liquifaction & Loading Facilities
- Gas Conditioning Equipment for Field Gas Use
- Transportation Trailers & Offloading Onsite Equipment
- 3rd Party Transportation Providers
- Next Generation Dedicated Natural Gas Engines to Provide the Same HP & Transient Response to Maximize the Benefits of Natural Gas
WHAT HAVE WE LEARNED?

- Need Upper Management Support
- Have to overcome “Resistance to Change” mentality
- All service providers need to share the same enthusiasm and urgency
- All service providers (drillers, completion crews, engine manufacturers, after-market kit suppliers, OEM engine suppliers, fuel suppliers and offloaders) need to work together & communicate – lots of pieces to this puzzle & it’s NOT as easy as diesel
- E&P needs to be engaged in the well planning & operations on a daily basis...& coordinate training
- Make sure the well pad is large enough to accommodate the additional room required for natural gas equipment & deliveries
- It’s NOT easy so be prepared to dedicate resources
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