



NATURAL GAS FOR USE IN E&P OPERATIONS

MIDLAND, TX

Mark Bruchman
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SOURCES OF NATURAL GAS AS AN ENGINE FUEL

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

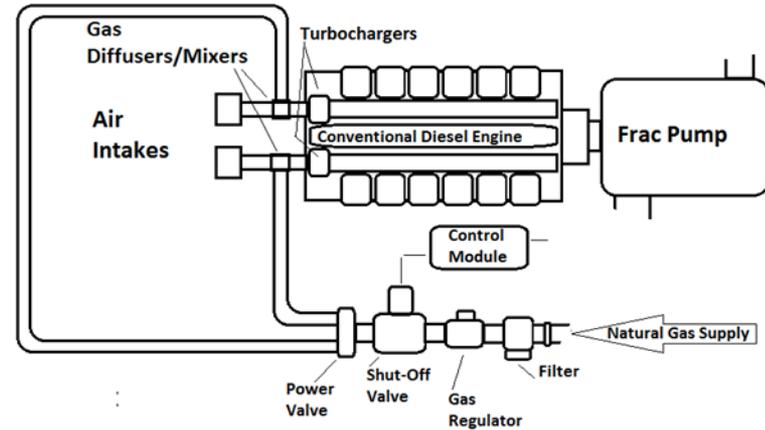
- ❑ Spec gas - consistent

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



Engine Gas Manifold

Halliburton Q10 Frac Pump w/ DF DGB Technology

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



Cactus 131 – LNG DF



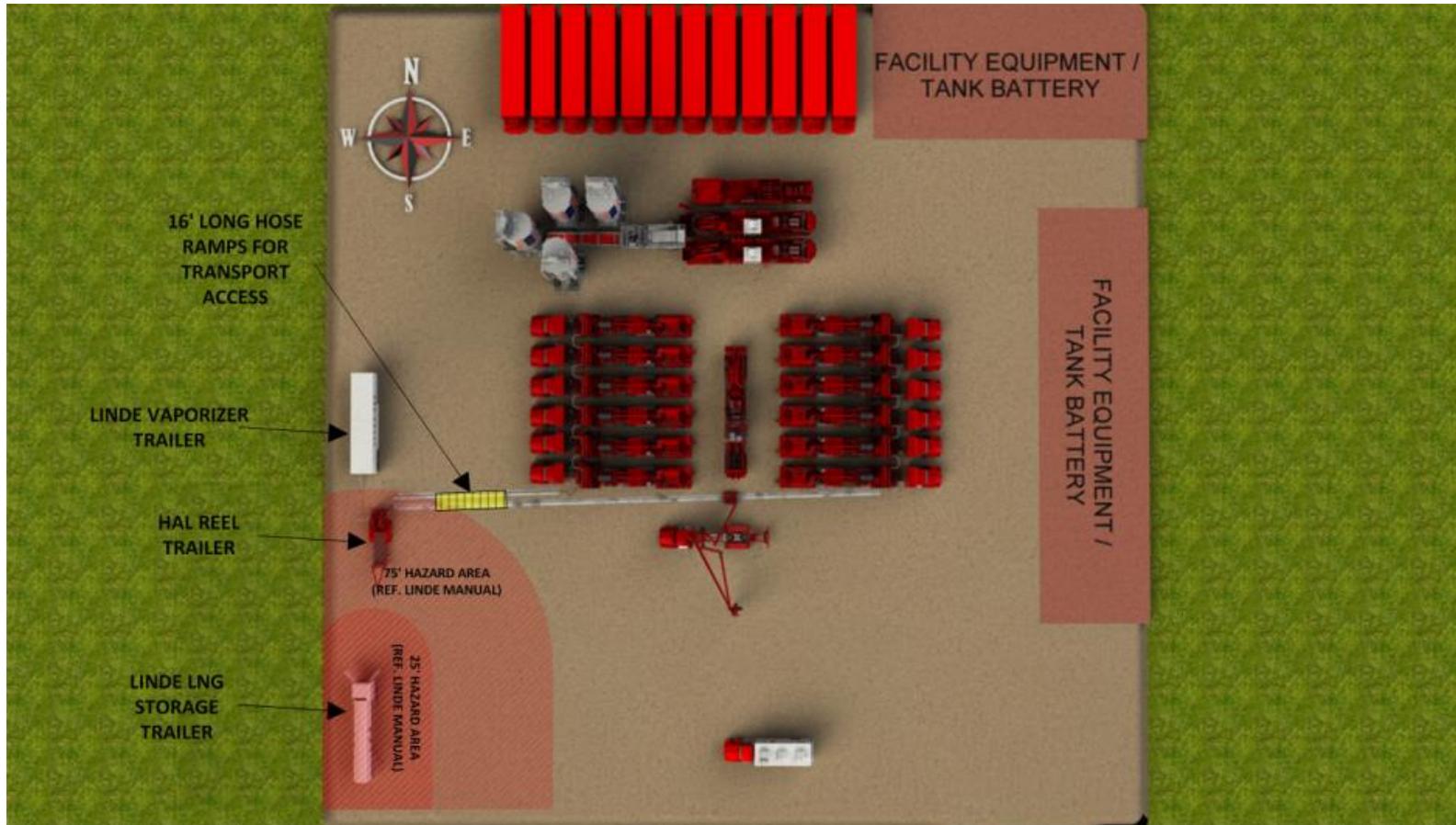
2 Alcor Energy Services Turbines for Rig Power: 1 Operating, 1 Standby



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

CLEANER SKIES

LOWER PRICE

ABUNDANT

AMERICAN

CREATES SUSTAINABLE JOBS

PROVIDES ENERGY SECURITY

