



OVERCOMING TECHNICAL HURDLES TO ECONOMICALLY CAPTURE FLARED ASSOCIATED GAS

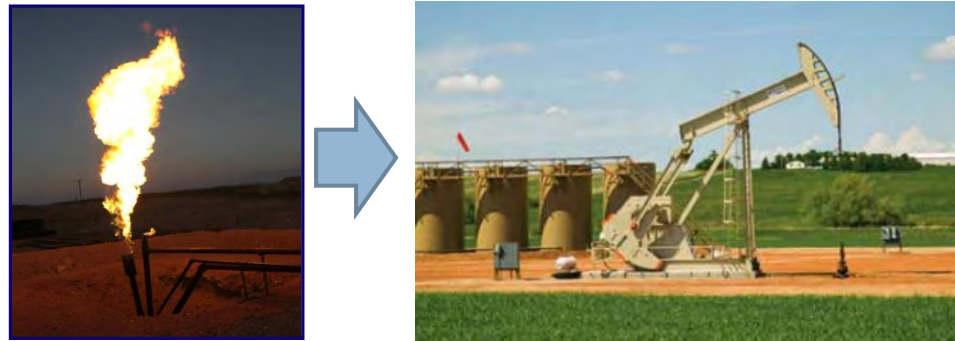
May 2, 2011

Tim Maloney – Bakken Express LLC
Pedro Santos – OsComp Systems Inc.

Benefits To Capturing Flare Gas

2

- Reduce flaring & conserve energy
- Monetize wasted gas and liquids
 - ▣ Revenue for Producer, Mineral Owner and Government
 - Gas & NGL represents 20% of total value
 - ▣ Add bookable reserves (20% uplift to oil alone)
- Optimize infrastructure investment timing



Technical Hurdles

3

□ Capture

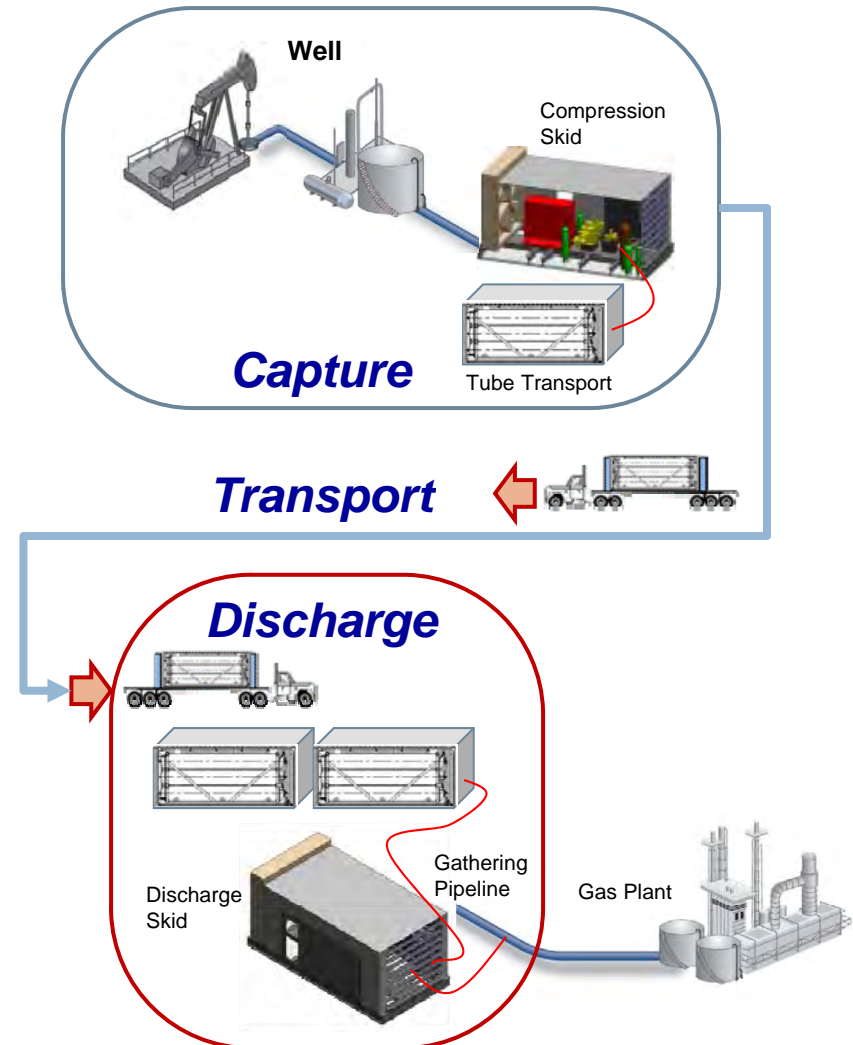
- Compression Capital
- Rich, Saturated Gas
- Cold Ambient Temperatures
- No On-Site Electricity

□ Transport

- Reduce Round Trip Time
- CNG Tube Trailer Capacity

□ Discharge

- Speed Up Discharge Time
- Manage Extreme J-T Cooling



May 2, 2011

Compression Capital

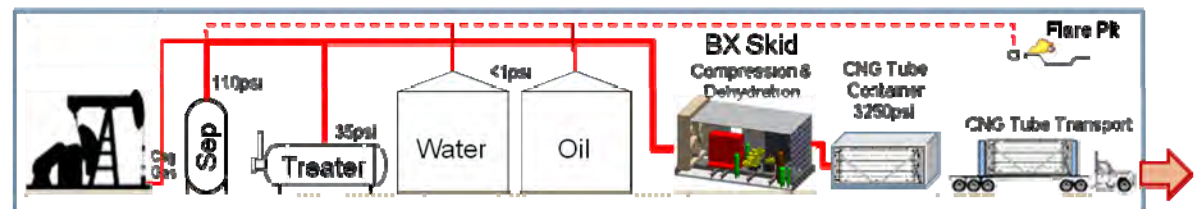
4

□ Hurdles

- Many low volume/high pressure compressors
- Capturing last 10% of stream is expensive

□ Solutions

- Accept “one size fits all” approach and no H2S
- Use standard component sizes...engine, compressor, dryer, cooler
- Don't capture 100% of gas...return excess to flare



May 2, 2011

Rich, Saturated Gas

5

□ Hurdles

- Bakken gas has ~40% C2+
- CNG requires dehydration to 0.5 #/mmscf

□ Solutions

- Shift most hydrocarbon liquid recovery from capture skid to discharge skid
- Desiccant dryer using non-electric 'pressure swing absorbent' regeneration

Cold Ambient & No Electricity

6

□ Hurdles

- Unmanned equipment in -40 F ambient
- During initial well production electricity is usually insufficient or unavailable

□ Solutions

- Remote telemetry and monitoring
- Enclosure with air flow modeled/optimized
- High efficiency cooler with low leak/heat loss
- Natural gas driven engines
- Engine alternator & battery backup power for PLC

Reduce Round Trip Time

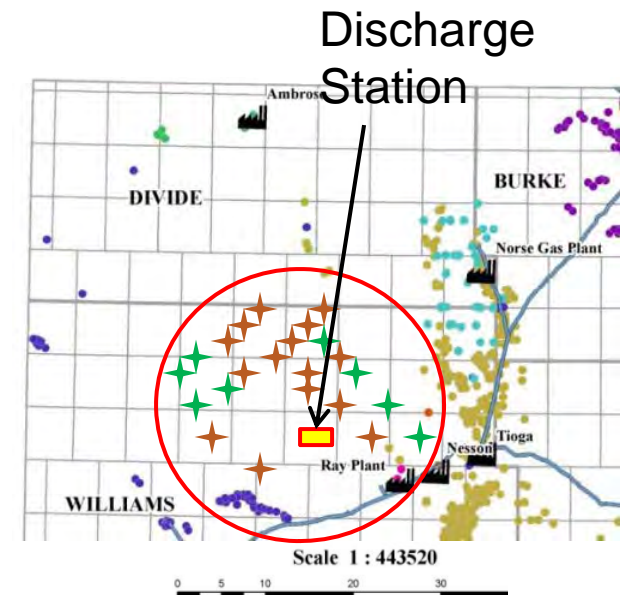
7

□ Hurdles

- Largest operating cost component is truck driving
- Second largest operating cost is diesel fuel

□ Solutions

- Hub & spoke system and fast swap outs to minimize drive time
- Dual fuel diesel truck engines using captured CNG to reduce fuel expense



May 2, 2011

CNG Tube Trailer Capacity

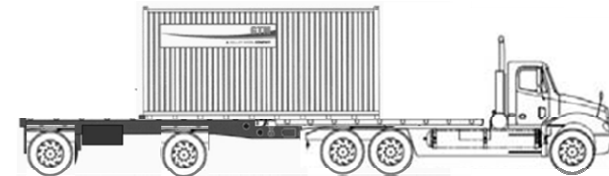
8

□ Hurdles

- Varied materials used in CNG transport, requiring different CNG specifications
- High capital cost per MCF capacity

□ Solutions

- Design for most stringent tube specification
- Use hub & spoke system and fast discharge times to minimize number of tube trailers required



Speed Up Discharge Time

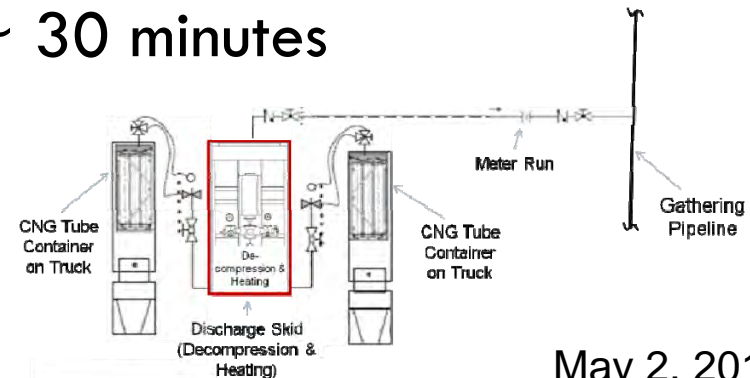
9

□ Hurdles

- Typical CNG industry tube trailer discharge times exceed 2-4 hours

□ Solutions

- Specify manifolds, connectors and fittings for high capacity discharge
- Manage variable J-T effect during discharge cycle to maximize overall flowrate ~ 30 minutes



May 2, 2011

Manage Extreme J-T Cooling

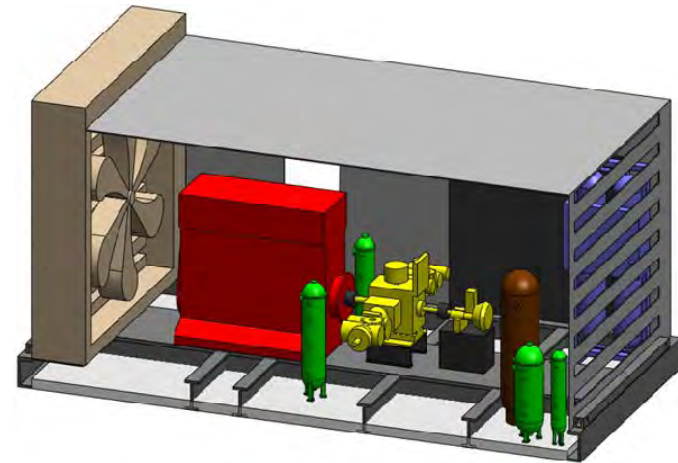
10

- Hurdles
 - ▣ Expansion causes temperature drop of -150 F
- Solutions
 - ▣ Developed two Discharge Station options:
 - Low pressure gathering systems (variable BTU rate catalytic heater)
 - High pressure pipelines (compressor heat exchanger)
 - ▣ Utilize J-T cooling to separate lean gas (C1 /C2) from liquids (C3+)

Key Technologies

11

- CNG Compressors
 - ▣ Leveraged standardized CNG fill stations, but toughened them up for remote oil field sites.



- Desiccant Dryers
 - ▣ Remove water as low as 0.5 lb/mmcf for tube transport.



Key Technologies

12

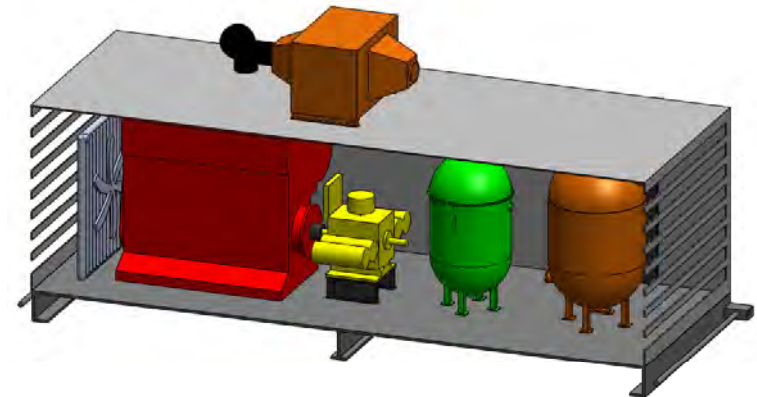
□ CNG Tube Transport

- Extensive testing before DOT approval.
- Long history in CNG industry.



□ De-Compression

- Manage extreme cooling (-150 F) during rapid discharge.
- Enable capture of natural gas liquids for dry gas pipelines.



Summary

13

- Overcame Technical Hurdles
 - Gas Capture
 - Gas Transport
 - Gas Discharge
- Economic Results
 - Able to capture stranded gas for under \$2/mcf to capture gas during the first year or so of production (while waiting for infrastructure)