GAS GATHERING COMPRESSION
ELECTRIC POWER ISSUES

North Texas Panhandle Area

Project completion: December 2013
Wheeler County, Texas - 100 miles east of Amarillo.

- New piping to serve gas and oil wells.
- Oil separation and stabilization
- Gas compression / dehydration for gas lift and final sales to third party pipeline.

New gathering system shown in blue

- Existing compressor station
- New compressor station
- New central tank battery
PROJECT SCOPE (AND POWER ISSUES)

- 75 miles of liquid line and low pressure, intermediate pressure and high pressure gas sales line, in addition to gas lift system for dehydrated, HP gas to wells.
- Three central tank battery facilities (10,000 bopd oil plus water tanks).
- Three gas compressor stations (30 MMSCFD each, 7000 hp each)
- Lean gas line added to scope for low cost gas fuel to compressor stations
- One key issue: How to supply 100-250 KW in electric power to six facilities – distributed over 20 miles?
CENTRAL REGION GATHERING SYSTEM

PROJECT VALUE

- Lower operational expenses through centralized truck sales AND pipeline tie-in’s.
- Higher reliability of redundant and centralized systems (compared to wellhead separation and compression).
- Declining cost of gas compression (decreased rate over time) for APA production.
- NGL collection and stabilization for additional revenue stream – especially advantageous in this area with high BTU content.
- Gas compression using third party, lean fuel (1000 Btu/scf) for lower cost compression to deliver gas to market.
- Ease of adding new production to high volume gas gathering system, already in the ground, up and running by 2014.
WHEELER COUNTY COMPRESSOR STATION (TYP.)

Engine-driven reciprocating compressors
(5 units, 1380 hp each)

Low pressure gas from wellhead

Inlet, liquid level control valve

Inlet scrubber

Suction gas header, \( P \approx 30-50 \) psi

Discharge gas header, \( P \approx 900-1200 \) psi

Coalescing filter

Fuel gas skid

Glycol regen / spent water drain

Contactor (Dehy system)

Condensate and water tanks + utility skid

Sales meter

Compressed gas to downstream gas processing plant

Discharge control valve
**DISCHARGE GAS SALES AND LEAN GAS SYSTEM**

- **Compressed gas**
  - 6” line
  - 1st coalescing filter

- **Dehy contactor tower**
  - 6” line

- **Gas lift line**
  - 6” gas sales meter with check valves

- **PCV 1104**
  - 2” make-up gas to fuel skid

- **ESV 1104**
  - Sales

- **ESV 1103A**
  - 2” make-up gas to fuel skid

- **ESV 1103B**

- **2” make-up gas to fuel skid**

- **PCV 1600**
  - Lean gas line
  - 2” line

- **ESV 1600**
  - 2” line

- **PCV 1700 (same as PCV 400A)**
  - 2” line

- **Filter Sep**
  - 2” line

- **PV 1400**
  - Fuel gas skid with parallel second cut PCV-400A and PCV-400B

- **To recip engine fuel, btex fuel and tank gas blanket for fuel**

- **To micro-turbine / emer. generator**
SCHEMATIC OF PRIMARY EQUIPMENT AT CENTRAL TANK BATTERY

- **Oil + water from wellhead**
- **3-phase separator**
- **Oil stabilizer**
- **Flash gas compressor**
- **Fuel gas scrubber + regulator**
- **Crude oil tanks & delivery pumps**
- **NGL Tank**
- **Liquid meter**
- **Gas meter**

**To Intermediate Pressure line and compressor station**
- **To fuel line**

**To crude pipeline or truck sales**
- **To water take-off (by truck)**
- **NGL sales**
ELECTRIC POWER CHALLENGES

- Two power suppliers in area – one cooperative and one larger power provider. Power contract depended on location within this network.
- Relatively low power requirement per site: 100-250 kw
- Distributed sites without connected pre-existing utility power lines
- Variable demand at compressor stations: 30 kw +/- 60 kw
- High btu field gas (1300-1400 Btu/scf)
- Cold weather (November-February, averages 30-40 degF)
- Fast track schedule (no extra time allowed for electrical easement, ROW, or to wait on utility to run power lines)
EXAMPLE OF SITE DISTRIBUTION – TWO SITES WITH EXISTING UTILITY POWER, THREE NEW SITES

- Compressor station, Needs 30-90 kw
- Tank Batteries, Need 120-150 kw

Red lines show new gathering lines laid by project.

Existing compressor station with utility power

Existing compressor station with utility power
TECHNOLOGIES CONSIDERED FOR SELF-GENERATED FACILITY POWER

- Diesel powered engine (150 kw)
- Gas powered engine (100 kw)
- Gas powered engine with load bank
- Micro-turbine (250 kw)
- Pipeline sized turbine (2-3 MW) with Apache run distributed power lines
### Best option for project - to be used as emergency backup and interim power prior to utility power

<table>
<thead>
<tr>
<th>Power option</th>
<th>Available within 4-6 weeks</th>
<th>Packaging for cold weather</th>
<th>Ability to handle high BTU fuel</th>
<th>Handles variable load</th>
<th>Reliability</th>
<th>Cost (Initial + operating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel engine</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Fair</td>
<td>$$$ fuel cost is high by comparison</td>
</tr>
<tr>
<td>Gas engine</td>
<td>Yes</td>
<td>Fair</td>
<td>Fair</td>
<td>No</td>
<td>Poor</td>
<td>$ initial cost + low field gas fuel cost very good</td>
</tr>
<tr>
<td>Gas engine with load bank</td>
<td>Yes</td>
<td>Fair</td>
<td>Fair</td>
<td>Yes</td>
<td>Good</td>
<td>$ initial cost + low field gas fuel cost very good</td>
</tr>
<tr>
<td>Micro-turbine</td>
<td>10-12 wks</td>
<td>No</td>
<td>Good</td>
<td>With proper design – high GBR heat</td>
<td>??</td>
<td>$$, high cost of add-on’s + maintenance after initial purchase</td>
</tr>
<tr>
<td>Pipeline size turbine + power lines</td>
<td>No</td>
<td>Good</td>
<td>Good</td>
<td>With proper design</td>
<td>Good</td>
<td>$$$, running our own power lines not economic or workable</td>
</tr>
</tbody>
</table>
LESSONS LEARNED

- When sizing up the facility power needs, determine intermittent power and constant power required.
- Oversizing power is almost as bad as undersizing.
- With utility power agreements and running new lines and substations – MORE TIME is NECESSARY. Estimate 6-10 months more on total project timeline.
- Micro-turbines initially looked to be the best for high Btu fuel gas – but packaging and variable load were major challenges.