



Characterizing Cost-Effective Engine Emissions Control & Monitoring for Field & Gathering Engines

Kirby S. Chapman, Ph.D.
Sarah Nuss-Warren
DOE Research Team

National Gas Machinery Laboratory
Kansas State University College of Engineering
245 Levee Drive
Manhattan, KS 66502

NGML Contact Information

www.ngml.ksu.edu

Kirby Chapman

Email: chapman@ksu.edu

Office: 785-532-2319

Mobile: 785-565-2345

Address: 245 Levee Drive

Manhattan, KS 66502



Presentation Outline

- Who are we?
- Overview of NGML Ajax efforts
- Proposed 4-Corners Field Test Program

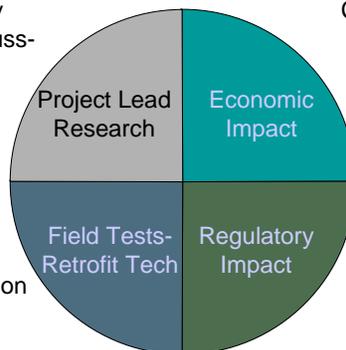
Field Test Characterization of Gathering and Production Engines



DOE-Sponsored Research Team

K-State NGML (Kirby Chapman and Sarah Nuss-Warren)

Collaborative Research Associates (Mike Whelan)



Advanced Engine Technologies Corporation (Greg Beshouri)

Innovative Environmental Solutions (Jim McCarthy and Jeff Panek)



National Gas Machinery Laboratory

- Founded in 1995
- A Kansas Board of Regents-sanctioned research institute
- Advised by a 12-member advisory committee from various backgrounds

Field Test Characterization of Gathering and Production Engines



KSU NGML Ajax Engine Project

Ajax Low-Emissions Strategies

- PCC designs
 - Eco-Jet and Diesel Supply Company
 - Compare different fuel ratios (fuel orifice size)
 - Find optimal operating fuel pressure for each
- Electronically controlled fuel valves
- Increased ignition energy (Altronic providing high-energy ignition system for the Ajax)
- Exhaust gas recirculation

Field Test Characterization of Gathering and Production Engines



KSU NGML Ajax Engine Project

Electronically Controlled Fuel Valve



Tested at fuel pressures of 180 psig and 500 psig

Emissions data at various timings still needs to be analyzed

Fuel Valve installed in Ajax, January, 2006

Field Test Characterization of Gathering and Production Engines



4-Corners Field Test Objectives

- Answer the questions...
 - What NO_x emission performance can be expected in the real world?
 - How effectively do air-fuel ratio controllers perform on smaller/older engines?
 - How significant is the NH_3 produced by NSCR and the NO_x/NH_3 Trade-Off?
- Test “ion sense” control system
- Potentially test other NO_x reduction solutions

Field Test Characterization of Gathering and Production Engines



NSCR...

- We knew there were some issues
- Recently...
 - LAER and BACT engines that were candidates for field tests in Southern California...
 - ...showed that the magnitude of the issues is much larger than we expected
- For stringent NO_x limits in California
 - NSCR cannot push NO_x to sub-1 g/bhp-hr levels
 - Four-Corners region, task is to identify emission levels that can be reliably achieved
 - NH₃ generation and the NO_x/NH₃ trade-off is an issue

Field Test Characterization of Gathering and Production Engines



Procedure/Plans for Field Tests

Characterization Field Tests

- Representation of the complete engine inventory from the area (at least six engines, preferably more)
- Select engines with and without NSCR and AFR controllers
- Retrofit engines as needed
- Install monitoring devices/systems
 - Engine speed/fuel flow rate
 - Throughput and gas pressures
 - NO_x, O₂, CO, NH₃
- Run engines for several months, covering hot and cold seasons
- Analyze data and furnish report to stake-holders

Field Test Characterization of Gathering and Production Engines



Expected Outcomes of Field Tests

- Characterize NSCR system performance at sub 2 g/bhp-hr levels
 - Where does it start to fail?
 - What is the ammonia production rate?
 - Determine variable-load impact on NSCR performance
- Assess technologies that may help determine how to maintain performance
- Data will provide information for EIS emissions mitigation strategies and permitting actions

Field Test Characterization of Gathering and Production Engines



Good Candidate Engines...

- Four-stroke cycle rich burn engines
- As small as gas powered pump jack engines to engines as large as 1,500 bhp
- Accessibility
- Close proximity to each other
- Electricity to power data acquisition systems
- Data transmission through automation systems

Field Test Characterization of Gathering and Production Engines



Specifically, We Need Company Participants to...

- Retrofit selected engines with emission reduction technologies as needed
 - NSCR
 - Ion sense
 - Pre-combustion chamber
 - Improved AFR controllers
 - Fuel meter
- Support field test activities
- All efforts cost-share the DOE project

Field Test Characterization of Gathering and Production Engines



Current Commitments

- BP
- PRCI (consortium of gas pipeline companies)

Field Test Characterization of Gathering and Production Engines

