CO\textsubscript{2} Transportation

Indiana Center for Coal Technology Research

Ken Havens
Director of Source and Transportation
Kinder Morgan CO\textsubscript{2} Company

June 5, 2008
Discussion Topics

1. Introduction - Kinder Morgan CO\textsubscript{2}

2. CO\textsubscript{2} Pipelines & Operations

3. The Future

4. Key CO\textsubscript{2} Pipeline Issues
Kinder Morgan

- Largest pipeline MLP
- Largest independent owner/operator of products pipelines
- Largest independent terminals operator
- Largest marketer and transporter of CO₂
CO\textsubscript{2} Business: Major Capital Commitment & Extensive Expertise

\textit{CO\textsubscript{2} Supply Operation}
\textit{McElmo Dome CO\textsubscript{2} Plant}

\textit{CO\textsubscript{2}-EOR Operations (SACROC)}
\textit{CO\textsubscript{2} Compression and Processing Plant}

June 5, 2008
CO$_2$ Pipelines & Operations
Permian Basin Infrastructure

Over 2000 miles of CO2 infrastructure.
A market relying on both CO$_2$m AND CO$_2$a.
The McElmo Dome field was discovered in the 1930’s

The Unit encompasses 200,000+ acres and is located in the four corners area near Cortez, Colorado

Shell and Mobil first began field development in 1976

First production was in 1983
Domestic CO₂ Industry Operational Achievements

Over the past 30+ years, the oil and gas industry has:

– Produced and safely transported more than 11 TCF of CO₂ from 7 sources.
  • 1.2 TCF of which came from sources that otherwise would have been vented.

– Constructed over 3100 miles of CO₂ mainline pipeline systems.

– Produced in excess of 1.2 billion barrels of incremental oil.

– Secured operating practices of:
  • Corrosion management, Metallurgies, Elastomers
  • Separation, Dehydration and Hydrocarbon extraction
  • Compression/pumping
  • Injection and production well completion and operation
CO$_2$ Pipelines – Gas Pipelines

- Use same steel metallurgy as Natural Gas Pipelines
  - Keep CO$_2$ dry

- Higher operating pressures
  - Gas – 600 psig to 1200 psig
  - CO$_2$ – 2000 to 3000 psig
  - Why? Maintain CO$_2$ in dense phase (>1300 psig) to allow pumping rather than compression.

- Pumps rather than compression
  - Energy savings

- CO$_2$ - PHMSA regulated under CFR Part 195, “Transportation of Hazardous Liquids by Pipeline”
Environmental Health and Safety

CO2 pipelines are:

- Designed and constructed to meet or exceed CFR 49 Part 195, Transportation of Hazardous Liquids by Pipeline
- Protected from damage by
  - 24 hour monitoring by Control Center
  - Membership in statewide one-call
  - Compliance with Common Ground Alliance Best Practices
  - Patrolled by air 26 times per year
- Protected from corrosion by:
  - Annual pipe to soil survey of pipeline
  - Five year cycle of Close Interval Surveys
  - Assessments of High Consequence Areas under Pipeline Integrity Management program
SCADA: Operational Control

- 24 hour monitoring and control of Pipeline Facilities
- Full remote control to:
  - Start/stop pump stations
  - Flow control of meter facilities to customers
  - Shut-down and closure of valves during an emergency
Pipeline Integrity Management

• Assess, evaluate, repair and validate the integrity of the pipeline systems to meet or exceed the requirements of CFR Part 195.452, Pipeline Integrity Management

• Worked with PHMSA to utilize External Corrosion Direct Assessment to assess High Consequence areas

• Worked with high-resolution Magnetic Flux Tool manufacturers to develop pig to run in CO$_2$

• Completed high-resolution Magnetic Flux Tool run in November 2007 on the oldest CO$_2$ PL
CO₂ Pipeline Specifications

Following are specifications for CO₂ pipeline quality CO₂.

9.1 Specifications. The Product delivered by Seller or Seller’s representative to Buyer at the Delivery Point shall meet the following specifications, which herein are collectively called “Quality Specifications”:

(a) **Product.** Substance containing at least ninety-five mole percent (95%) of Carbon Dioxide.

(b) **Water.** Product shall contain no free water, and shall not contain more than thirty (30) pounds of water per mmcf in the vapor phase.

(c) **Hydrogen Sulfide.** Product shall not contain more than twenty (20) parts per million, by weight, of hydrogen sulfide.

(d) **Total Sulfur.** Product shall not contain more than thirty-five (35) parts per million, by weight, of total sulfur.

(e) **Temperature.** Product shall not exceed a temperature of one hundred twenty degrees Fahrenheit (120°F).

(f) **Nitrogen.** Product shall not contain more than four mole percent (4%) of nitrogen.

(g) **Hydrocarbons.** Product shall not contain more than five mole percent (5%) of hydrocarbons and the dew point of Product (with respect to such hydrocarbons) shall not exceed minus twenty degrees Fahrenheit (-20°F).

(h) **Oxygen.** Product shall not contain more than ten (10) parts per million, by weight, of oxygen.

(i) **Other.** Product shall not contain more than 0.3 (three tenths) gallons of glycol per MMcf and at no time shall such glycol be present in a liquid state at the pressure and temperature conditions of the pipeline.
Future Possibilities
Multifaceted Issue

Key issues on parallel paths.

$120 + per bbl

EOR Expansion/ Growth

Kyoto Treaty

Kyoto GHG Reduction

Leading to some areas of mutual interest - $CO_2$ emissions.

But where, how, by whom, and when?
Future Possibilities

1. Based on CO₂ captured from industrial processes

2. Pipeline infrastructure to accommodate all needs

3. Dual Objectives
   • EOR (Commercial)
   • Storage (Kyoto compliance)

4. Complex/ New Systems

June 5, 2008
Sequestration: The Simple View
Key CO₂ Pipeline Issues

• Permitting of new CO₂ Pipelines
  – Eminent Domain
  – Environmental

• Issue of mixed gases versus current PL Quality specification

• Ownership and liability of sequestered CO₂

• Regulation of CO₂ Pipeline Tariffs should be initially avoided

• EOR fields should not be excluded from consideration as sequestration sites

• The transportation of CO₂ should qualify under the MLP structure rules