Aliso Canyon and Underground Natural Gas Storage

Organized by the NARUC/DOE Natural Gas Infrastructure Modernization Partnership with participation from PHMSA

March 28, 2017
Webinar Introduction &
DOE’s Natural Gas Modernization Initiative

James Bradbury
Senior Policy Adviser
Office of Energy Policy and Systems Analysis
U.S. Department of Energy
Interagency Task Force on Natural Gas Storage Safety

• **Structure:**
  • Co-Chaired by DOE and PHMSA
  • Included technical support from EPA, DHS, DOI, FERC, and NOAA
  • Worked closely with, State of Calif., LA County and the City of LA

• **Activities:** Task Force conducted studies and held public workshops
  • Provided recommendations for improving:
    • Energy assurance, including electricity sector reliability
    • well integrity
    • response plans
    • Public health and safe operations of storage facilities

• **Timeline:** Results were published in November, 2016
LDC-owned storage facilities are operated in 22 (out of 30) different states.

Source: EIA, ICF
DOE’s Natural Gas Modernization Initiative

- **ARPA-E** manages the $38 million MONITOR program, which is funding 11 projects developing new low-cost methane sensing technologies for the oil and gas sector and developing an independent field test site.

- **Office of Fossil Energy** has $12 million for programs on Methane Emissions Mitigation and Methane Emissions Quantification (FY 2016)

- **FERC** issued a Policy Statement on cost recovery for midstream natural gas infrastructure upgrades (April, 2015). Policy now in effect (October, 2015)

- **DOE-NARUC partnership** for technical assistance was announced (Feb, 2016)

- **Stakeholder action is also key** We continue to work with stakeholders who pursue voluntary action.
DOE-NARUC Natural Gas Infrastructure Modernization Partnership

• DOE role is to support the partnership through technical assistance and convening

• Chaired by Commissioner Diane X. Burman of New York

• Topic areas include innovative strategies and approaches to improving safety and avoiding leaks through new technologies and practices

• Activities include webinars and site visits
DOE Natural Gas Infrastructure
Modernization Partnership
Contacts

James Bradbury
James.bradbury@hq.doe.gov
Office of Energy Policy and Systems Analysis

Christopher Freitas
Christopher.freitas@hq.doe.gov
Office of Oil and Natural Gas

http://www.energy.gov/qer

http://www.energy.gov/epsa/natural-gas-modernization-clearinghouse
Natural Gas Storage
Well Integrity

NARUC/DOE Natural Gas Infrastructure Modernization Partnership Webinar

Grant S. Bromhal
Senior Technical Advisor

March 28, 2017
BACKGROUND ON ALISO AND TASK FORCE

- Leak began at Aliso Canyon October 23, 2015
  - Eight top kill attempts were made between Oct. 24 and Dec. 22
    - Increasingly aggressive attempts
    - Successive top kills caused erosion and expansion of the vent
  - Ground prep for relief well began Nov. 13 and drilling started on Dec. 4
  - ~90,000 tonnes of gas leaked in four months
- On February 17, 2016, leak was permanently plugged using relief well
- DOGGR (State of CA) consulted LBNL, LLNL, SNL in December 2015
- DOE-led Task Force initiated in April 2016 (PIPES Act)
  - Well Integrity (FE), Reliability (OE), Health and Environment (EPA & HHS)
- Well Integrity lab team formed in April 2016 with addition of NETL
  - Initiate Well Integrity Workshop
  - Analyze Aliso incident
  - Evaluate potential for broader well integrity risks
  - Provide recommendations
SS-25 WELL SCHEMATIC

- One of 114 gas storage wells
- Conversion to gas storage 1973
- Last casing inspection 1979
- T and noise logs back to 1991
- Well had tubing and packer
  - injection and production through both tubing and casing for better throughput
  - Complicated flow path due to slots in tubing from removal of subsurface safety valve

Formal root cause analysis initiated by CA Public Utilities Commission
CURRENT ALISO STATUS

- SoCal Gas has petitioned DOGGR to reopen part of field for injections
  - 41 of 114 wells have passed pressure tests

- New operating procedure for wells
  - Tubing has been replaced in the 41 wells ready for operation
  - Production will only occur through tubing
  - The 41 wells are continuously monitored for pressure

- Daily infrared thermal imaging scanning for surface leaks

- The “new” field working gas storage capacity will be capped at a lower level
WHAT ABOUT OTHER UGS SITES?

• ~415 storage facilities, ~17,500 wells
• 2 other major incidents in past 15 years:
  – Yaggy, Hutchinson, KS, 2001
  – Moss Bluff, Liberty County, TX, 2004
• Failure rates estimated only for major incidents, and not complete
• Records for most “minor” failures do not appear to be collected or maintained

<table>
<thead>
<tr>
<th></th>
<th>Salt Caverns Europe</th>
<th>Salt Caverns Worldwide</th>
<th>Oil/Gas Fields Europe</th>
<th>Oil/Gas Fields Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of well failures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Operating experience (well years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>65,000</td>
<td>83,000</td>
<td>153,000</td>
<td>860,000</td>
</tr>
<tr>
<td>Lower</td>
<td>24,000</td>
<td>59,000</td>
<td>81,000</td>
<td>603,000</td>
</tr>
<tr>
<td>Failure rate (per well year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>$1.5 \times 10^{-5}$</td>
<td>$1.2 \times 10^{-4}$</td>
<td>$6.5 \times 10^{-6}$</td>
<td>$5.8 \times 10^{-6}$</td>
</tr>
<tr>
<td>Upper</td>
<td>$1.2 \times 10^{-4}$</td>
<td>$1.7 \times 10^{-4}$</td>
<td>$1.2 \times 10^{-5}$</td>
<td>$8.3 \times 10^{-6}$</td>
</tr>
</tbody>
</table>

Health and Safety Laboratory, 2008

Yaggy, 2001
• Many wells converted from oil & gas to gas storage operations (Aliso)
• ~15% of wells older than 1921 (zonal cement isolation)
• ~80% of wells older that 1980
• Not uncommon to see gas produced through casing without tubing or through both casing and tubing
• Many O&G non-storage wells within UGS field area
• Maintenance practices vary significantly from site to site
WELL INTEGRITY WORKSHOP

• Divergent opinions and deep dive into several issues
  – Federal vs state responsibility & Interstate vs intrastate
  – Regulations (prescriptive vs “risk-based”)
  – Well construction (barriers, ISO/TS 16530)
  – API 1170 & 1171
  – Transition period (17,500 existing wells)
• Key takeaways –
  – State of California released proposed regulations (CA has all intrastate storage)
  – Formal Risk Management needed
  – Downhole safety valves need more attention (not enough hard data)
  – Uncertainty in how PHMSA will regulate and what rights states will have

www.eesa.gov/wellintegrity

| Services/Consult | 39 |
| Operators       | 65 |
| Regulators      | 34 |
| Academic/research | 51 |

<table>
<thead>
<tr>
<th>State</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>41</td>
</tr>
<tr>
<td>California</td>
<td>30</td>
</tr>
<tr>
<td>Washington DC</td>
<td>22</td>
</tr>
<tr>
<td>Colorado</td>
<td>17</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>15</td>
</tr>
<tr>
<td>West Virginia</td>
<td>7</td>
</tr>
<tr>
<td>Louisiana</td>
<td>5</td>
</tr>
<tr>
<td>Michigan</td>
<td>5</td>
</tr>
<tr>
<td>New Mexico</td>
<td>5</td>
</tr>
<tr>
<td>Ohio</td>
<td>4</td>
</tr>
<tr>
<td>Utah</td>
<td>4</td>
</tr>
<tr>
<td>Nebraska</td>
<td>3</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>3</td>
</tr>
<tr>
<td>Illinois</td>
<td>2</td>
</tr>
<tr>
<td>Kansas</td>
<td>2</td>
</tr>
<tr>
<td>Kentucky</td>
<td>2</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2</td>
</tr>
<tr>
<td>New York</td>
<td>2</td>
</tr>
<tr>
<td>Virginia</td>
<td>2</td>
</tr>
<tr>
<td>Alaska</td>
<td>1</td>
</tr>
<tr>
<td>Alabama</td>
<td>1</td>
</tr>
<tr>
<td>Missouri</td>
<td>1</td>
</tr>
<tr>
<td>Montana</td>
<td>1</td>
</tr>
<tr>
<td>Oregon</td>
<td>1</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1</td>
</tr>
<tr>
<td>Tennessee</td>
<td>1</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS

Topic 1: Well Integrity

• Operators should phase out wells with single point of failure designs.
• Operators should undertake rigorous well evaluations programs.
• Well testing must be a top priority for lowering well integrity risk.
• Well integrity testing should use a tiered approach.
• Well Integrity testing should use multiple methods.
• Storage operators should deploy continuous monitoring systems.
RECOMMENDATIONS

**Topic 2: Risk Management**
- Risk management plans should be comprehensive and reviewed periodically.
- Operators should institute complete and standardized records systems.
- Operators should implement risk management transition plans <1 year.
- Operators and regulators should account for a broad range of risk factors.

**Topic 3: Research and Data Gathering**
- A quantitative analysis of downhole safety valves (DHSV) is needed.
- Systematic study comparing the effectiveness of casing evaluation tools is needed.
- Wellbore simulation tools should be reviewed and evaluated.
- A thorough investigation of well registration, record keeping, and survey practices is needed.
- Proximity of gas wells to population centers should be investigated.
THANK YOU!

Grant.Bromhal@hq.doe.gov

Electric Reliability and Loss of Natural Gas Supplies to Generation Capacity

Webinar on Underground Natural Gas Storage

sponsored by

NARUC/DOE Natural Gas Infrastructure Modernization Partnership

March 28, 2017

David Meyer, Senior Advisor
USDOE Office of Electricity Delivery and Energy Reliability
The U.S. has almost 400 active underground natural gas storage (UGS) facilities. About 70% of them are located in depleted oil or gas reservoirs. The remainder are in dry aquifers or man-made caverns.

After the catastrophic leak at Aliso Canyon, DOE tasked electric and gas experts at Argonne NL to review all operational UGS facilities to:

- Estimate if possible the likelihood of sudden loss of functionality at a UGS site, and
- Estimate the likely impacts of such a loss.

Argonne found that generally the likelihood of such outages is very small, but they were not able to estimate the likelihood of failure at specific facilities due to lack of appropriate data.

Argonne’s report is available at https://anl.app.box.com/s/q6yqtnexfvlhyobn1dzlwncr5xc8vf88.
UGS facilities for Which Safety Incidents have been Documented

- UGS incident data collected from DOT/PHMSA, FERC, state, and public literature.
- FERC Form 576 data: seven incidents in three years → downstream impacts on natural gas customers.
- Very limited State-level incident data:
  - Most States do not collect underground well incident data on a consistent basis.
- Seven UGS facilities have experienced 3 or 4 historical incidents:
  - Aliso Canyon and Playa Del Rey in California;
  - Blue Lake 18-A and Bluewater Gas Storage in Michigan;
  - Boling and Dayton North in Texas;
  - Ryckman Creek in Wyoming (all three incidents occurred between 2013 and 2016).
- No incidents have been documented in 9 States: AK, AL, AR, MD, MN, MO, OR, VA, and WA, although 22 UGS facilities are located in these states.
Potential Electric Impacts from Disruption of UGS Operations

- Aliso Canyon is not a unique UGS facility in terms of potential electric power impact.
- Over 60 UGSs have some potential to affect available generation capacity.
- 12 UGS facilities appear to have the potential to affect 2 GW or more of available generation capacity.
- However, note: These numbers are preliminary and do not account for potential dual-fuel capability or accessibility of alternative generation.
- Largest predicted impacts are from loss of UGSs owned by independent operators, several of which are high-deliverability salt caverns.
In the context of rising gas/electric interdependence, Aliso Canyon event was a wake-up call.

We need to better understand and mitigate the risks associated with such interdependence.

DOE and Argonne are aiding NERC in an assessment of the electric reliability implications of losing key gas supply facilities of all kinds: i.e., pipelines, UGSs, compressor stations, LNG depots.

This assessment will also look in greater detail at the 12 UGS facilities flagged in Argonne’s recent study as having potential to disable 2 GW or more of gas-fired generation capacity.

NERC’s target completion date: March, 2018.
Underground Natural Gas Storage

NARUC Webinar
March 28, 2017

Alan Mayberry: Associate Administrator
Byron Coy: Senior Technical Advisor
Zach Barrett: Director, State Programs
USDOT / PHMSA
Underground Natural Gas Storage

- Critical role in our ability to have Energy Independence
- Buffers seasonal variations in supply & demand
- Significant growth in domestic shale gas has prompted renewed interest and investment
- NG Storage increased 16% between 1995 - 2014
- In 2016, value of natural gas in storage was $15+ billion
Statistics

- 124 Companies/Operators
- 4800 BCF Working Capacity
- 406 Storage Fields, 50/50 Intra/Inter
- UGS Facilities in 31 States
- 17000 Wells
- ~41 Wells/Facility
“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
Pipes Act of 2016

- Charged PHMSA to establish regulations and inspection of all underground Natural Gas storage facilities
- Interim Final Rule published on December 19, 2016, which incorporated industry-established recommended practices
- Subject to Revision...
  - PHMSA is developing inspection criteria and related inspector training for both federal and state inspectors
  - Inspection in this new area of responsibility would begin in 1Q-2018

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.

Key Sources for Inspection Objectives

- Interim Final Rule
- Aliso Canyon Task Force Report
- API RP’s 1170 & 1171
- IOGCC-States First Guidance to State Regulators
- PHMSA Advisory Bulletins
- Industry Safety Assessments & Best Practices
- Incident Reviews
- Research Forum
Implementation Elements
Timeline - Up to Now

4Q-CY2016
• Consolidate information & objectives
• Coordinate support relationships
• Interim Final Rule
• Assemble Implementation Team
• Initial FAQs Published

1Q-CY2017
• Comparative Analysis: IFR, 1170, 1171, IOGCC-States First
• Establish User Fees Structure
• Expand & Refine FAQs

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
Implementation Elements
Forward Timeline – 2017, Subject to Revision

2Q-CY2017
• Industry Safety Assessments
• Research Projects awarded
• Training Elements – Construction and OME

3Q-CY2017
• Prototype Inspections
• Public Workshop
• State Certification Program

4Q-CY2017
• Training Elements – Inspection Criteria
• Identify UGS Goals for PHMSA Strategic & Annual Plans

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
Implementation Elements
Forward Timeline – 2018, Subject to Revision

1Q-CY2018
• Inspector Training Program Launch
• Initial Training for Federal & State Inspectors
• Initial Federal & State Inspections

2Q-CY2018
• Fed/State Inspection Feedback
• Adjustments to Inspection Program

3Q-CY2018
• Inspection Outcome Analysis

4Q-CY2018
• Preliminary Analysis for Possible Round 2 Rule Development

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
States Certification

- Would begin accepting State Certifications in September 2017 for CY2018 inspection year
- Certification would allow states to inspect and enforce the federal regulations and any additional state regulations for intrastate facilities
- If a State could not Certify, usually because they have not adopted the federal regulations can enter into an Agreement to Inspect to the federal regulations – PHMSA would do the enforcement

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
Key Summary Points (1)

• Closely coordinated with PHMSA Executive Mgt
• IFR does not impact Permits, Certificates, etc.
• 3 – 8 Years for baseline well assessments with P&M
• Working on provisions for prior assessments
Key Summary Points (2)

• State Partner Program to be modeled after long-standing State Partner Program for horizontal, top-side pipe
• Inspections to start 1 year after effective date in January, 2018
• Initial State/Federal inspections under the IFR would be for procedures and implementation plans

“To protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.”
Web Links

• http://opsweb.phmsa.dot.gov
  • Operator Notifications
  • Event Reporting
• https://primis.phmsa.dot.gov/ung/index.htm
  • Major Incidents
  • Key Documents
  • FAQs
  • Pictures
  • Locations Map
Thank you for joining us.

For more NARUC webinars, please visit
https://www.naruc.org/lab/