# Underground Natural Gas Storage

## Government & Industry Pipeline R&D Forum

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November 17, 2016

# Disclaimer

The ideas and concepts presented are those of Anders Johnson and may not represent those of Kinder Morgan or the Underground Natural Gas Storage Industry

# Executive Summary

- Industry and Government are aligned in wanting safe, reliable, and efficient Underground Natural Gas to support the energy needs of our friends and families.
- The Natural Gas industry is highly reliable and safe but could be more reliable and safer if we all raise our standards and implement a risk based continuous improvement program.
- We need to understand where we are and how we are going to get where we want to be in terms of reliability.
- PHMSA-sponsored R&D efficiently pools resources and makes information available to all interested parties that no one company could do on its own.
- In this divisive political environment we need to work together, list our successes, quantify the value we add, and communicate it up, down, and across our business, our community, and our government.
- We need to limit overreaching statements such as: “no single point of failure”, “DHSVs & Tubing and Packer in every well”, “we cannot do that”, “it costs too much”.

# Safe, Reliable, and Efficient

- Where we are in the process
- Where we want to be
- How do we get there
  - Focused R&D with documented results
  - List of successes and failures
  - Quantify the value, did the effort justify the result
  - Communicate up, down, across all organizations and to the public and legislature

# R&D Opportunities

**PHMSA & Industry are committed to continuing and enhancing safe underground natural gas storage operations by:**

- Working with DOE, Industry, NGOs, PHMSA to raise the standards ensuring public, operations personnel safety, and protection of the environment through R&D
  - Identify material strength with non-destructive tools that can draw on a database of information and match compositional analysis of steels
  - Identify the life cycle risks of DHSVs and Tubing and Packer, including risk of installation, operation, losses, removal, impact to a well kill
  - Low cost transmitters and information networks for measurement
  - Tool for analyzing integrity of multiple strings
  - Value of internal and external coating of casing and tubing
  - Provide a public data source based on independently verified facts
  - Library of specifications and procedures for the public domain

# Concerns with Tubing and Packers in Existing Wells

Existing storage wells were not designed to accommodate tubing and packer in many cases. WH master valves cannot be closed if the tubing is hung above the master valve.

**Design and Construction**

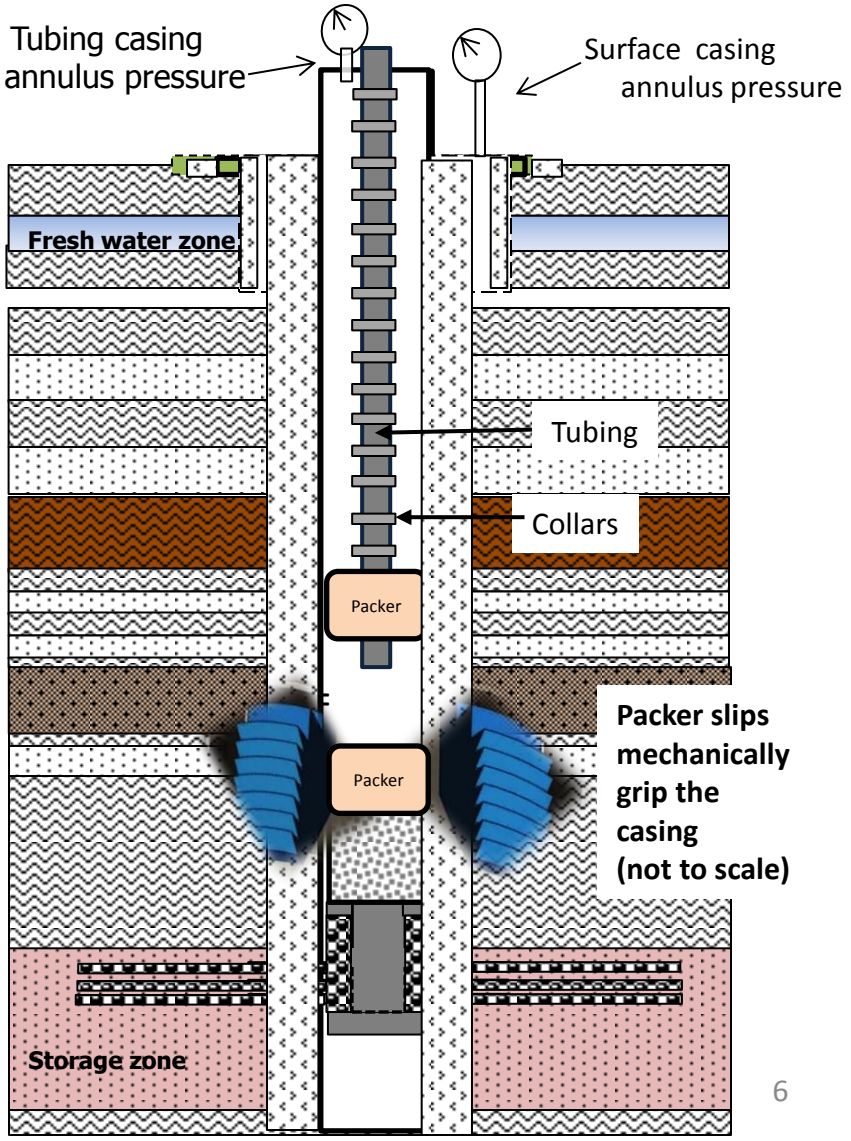
- Wellheads must be replaced and/or rebuilt to accommodate the dimensional changes of tubing hangers, wells will be out-of-service, and loss of delivery must be replaced.

**Risk**

- Greatest risk for an accident is during intervention
- Advanced tools such as High Resolution Vertilog cannot be used to analyze the condition of the casing when tubing is present
- Packer slips apply thousands of pounds of force into the casing and may leave indications in the pipe wall
- Scale and ovality allow gas to leak around the packer
- Velocity induced erosion must be monitored

**Deliverability**

- Well flow on the peak day may be reduced >60% in some wells, resulting in the inability to meet peak demand without drilling new wells, which increases the number of leak points and future interventions



# Example of a Workover Rig


Matting

Installing /removing tubing from a well usually requires site preparation and workover rigs to handle thousands of pounds of steel. One of the greatest risks to people and the environment is the installation and removal of the tubing and the packer. Tubing must be removed to inspect the casing integrity. Packers, like all components, can fail and thus should be installed when and where a risk based analysis indicates.

# Conclusion

- Underground Natural Gas Storage (UGS) Facilities are more important than ever for improving people's lives and ensuring reliable operations of our energy needs.
- The $4^{+}$ Tcf of working gas in storage is the equivalent of 480,000,000 MWh. The largest battery installation is 80 MWh.
- Natural Gas Storage facilities have provided reliable service for 100 years and can provide emergency power capability 24/7 for days.
- It is highly unlikely that an observation well completed above the cap rock requires tubing and packer or DHSV to be safe.
- We need to document, quantify and communicate our successes. PHMSA has raised the bar for all UGS operators, and today we are all safer and more efficient than we were one year ago.
- Single points of failure are okay – we have one heart and one brain. Let's use them together to figure out how to make the most of what we have and to recognize and mitigate substantial risks.

# Questions?