PHMSA - 2016 R&D Forum

Working Group #4

Underground Natural Gas Storage

Overview of Technical and Integrity Issues

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Initial Thoughts on What to Consider

• Design standards
• O&M Standard Practices
  – Monitoring, evaluation tools and standards
• Integrity Management
  – Risk Assessment Tools
• Leak Detection
• Health Effects
Aliso Canyon - Well SS25

- October, 2015, SoCal Gas’ Aliso Canyon Well SS25 developed a natural gas leak
- Well plugged in mid-February 2016
- ~ 5 billion cubic feet of natural gas was released into the atmosphere
- ~ 5,790 households were relocated due to the co-release of natural gas with odorant (mercaptans).
- Cost over $X00-million
- Aliso Canyon Field has 115 wells
Underground Gas Storage

- ~ 400 interstate and intrastate underground natural gas storage facilities currently operate in the U.S.
- ~ 17,000 UGS wells
- ~ 4.7 trillion cubic feet of natural gas working capacity in U.S.

SoCal Gas – Aliso Canyon Field, CA
Underground Gas Storage

• ADB–2016–02
• Safe Operation of Underground Storage Facilities for Natural Gas

• Operators of underground storage facilities should review their O&M and ER activities to ensure the integrity of underground storage facilities are properly maintained

Aliso Canyon, CA Field - leak
• O&M processes and procedures should be reviewed and updated at least annually, unless inspections for integrity warrant shorter review periods.

• O&M processes and procedures should include:
  – data collection and integration,
  – risk assessments,
  – monitoring,
  – operational limits,
  – mitigation measures, and
  – record keeping for any underground storage facility threat that could impact public safety, operating personnel, or the environment due to leakage, failure, or abnormal operating conditions.
Underground Gas Storage

- **After Aliso Canyon Leak – What’s next?**
  - CA has strengthened their well regulations
  - Rulemaking by PHMSA
    - API RP 1170 and 1171
  - Public Workshops were conducted
  - Task Force issued report on Underground Storage
    - Department of Energy
    - Department of Transportation – PHMSA
    - Others
API RP 1171 and/or 1170 standards

• Reservoir design
  – maximum operating pressures and geologic formation and environmental effects
• Well drilling and completion -
  – well control practices
• Operations and Maintenance
• Integrity Management
• Emergency Preparedness and Response
• Training
How are reservoir/well maximum operating pressures established/maintained?

• A must----

• Are they maintained through-out well life
  – injection,
  – withdrawal and
  – stimulation processes?
How are well design and maximum well operating pressures established?

- **Design factors** –
  - How should they be established?
  - What are they? Do you know?
- **Production casing and tubing** –
  - should they have robust design factors and be maintained for well life?
  - last line of defense to protect from a leak or blow-out?
- **Cementing practices** –
  - Height of cement above producing zones
  - Evaluation of integrity
Are well standards established and maintained?

• Establish and maintain:
  – Maximum well operating pressure
  – Design safety factors – are they known?
  – Diameter, weight/wall thickness, Grade, coupling type, packer locations, production perforations, internals, and wellhead rating, etc.

• When maintenance is performed – is data maintained?
Should wells flow through?

• Tubing only,
• Production casing w/no tubing, or
• Through tubing and production casing

• When is it safe to flow through any of these examples?
  – How should be the well casing and/or tubing condition/standards for maintaining safety?
How is well production casing and tubing designed for hoop stresses?

• What is the well design safety factor?
• Is it a set safety factor maintained for the life of the well?
• Should wells have different safety factors for:
  – flow in tubing only?
  – flow in production casing?
  – For integrity management assessments?
  – For populated or high consequence areas?
Safety Valves

• How many wells have safety valves?
  – Surface safety valves
  – Subsurface safety valves
• When are these safety valves needed?
• How often should they be tested?
Mechanical Integrity Test

• How often should a well production casing and tubing mechanical integrity test be conducted?
  – ≤ 5-years, ≤10-years, ≤ 15-years, ≤-20 years, other

• What type tests should be conducted?
  – Noise and temperature logs:
  – Caliper log:
  – HR-MFL log (corrosion)
  – Cement Bond
  – Pressure test – at what pressure range and when?
Safe Operating Pressures?

• How should safe operating pressures be established or evaluated from a caliper log, HR-MFL Log or pressure tests?
  – Using design factors of casing or tubing
  – Remaining wall thickness or Other Methods

• Should safe pressures be established based upon some form of Barlow’s Equation, B31G or R-STRENG, when an accurate corrosion log is used to find corrosion or other casing/tubing defects?

• What should be the pressure and hold time for a pressure test?
Overview of PHMSA July Public Workshop

• **Integrity Management Principles (importance of):**
  – Risk assessments (with valid system information)
  – Design factors – needed based upon casing string type
  – Anomaly evaluation – how should they be evaluated?
  – Documentation

• **Assessment tools:**
  – Numerous ones are available;
  – Need to use them; and in particular, the correct tool for the threat;
  – Currently, there are varying degrees of use.
R&D Efforts/Priorities
CA PUC Perspective

• Subsurface leak prediction and detection
  – Tools/Logs
  – Evaluation and safe pressure
• Efficacy of subsurface safety valves or a replacement device
• Through-tubing casing evaluation
• Health effects of exposure to methane and odorants
Final Thoughts

• **Design standards**
  – Safety factors
  – Single or Dual Barriers
  – Subsurface safety valves

• **O&M evaluation tools and standards**
  – Logging Tools – MFL, Cement Bond, Temperature, etc.
  – Safe pressure, safety factors
  – Remediation Tools

• **Integrity Management**
  – Risk Assessment Tools
    • High versus Low Pressure Wells
    • High Volume versus Low Volume Wells

• **Leak Detection**
  – Surface, Well head and Tubing Strings

• **Health Effects** - exposure to methane and odorants
Thank You