

Working Group #4

Underground Gas Storage

Leaders: Steve Knapp – National Fuel Gas Supply Corp.
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Attendance Breakdown

Approximate total attendance	20 persons
Federal Regulators	1 person
State Regulators	0 persons
International Regulators	0 persons
Pipeline Industry/Service Providers	12 persons
Standard Developing Organizations	0 persons
Researchers	5 persons
Academics	1 person
Other	1 person

Top 5 Identified R&D Gaps

Gap #1 – Wellhead Seals – Design and Monitoring
(Technology)

Gap #2 – Incorporating Fiber Optics into Wellbore Design and Monitoring
(Technology)

Gap #3 – Through Tubing Inspections
(Technology)

Gap #4 - Cement as a Barrier
(General knowledge)

Gap #5 - Cathodic Protection as Applied to Storage Wells
(General knowledge)

Wellhead Seals – Design and Monitoring (Gap #1)

1. New or Improved Technology

- a. What pipeline type(s) or LNG/UGS operations does the technology target? **Wellhead Seal technology**
- b. What pipeline operating environment(s) must the technology operate in (inside/outside-pipe, above/under-ground etc.)? **Surface Equipment -Underground gas storage well**
- c. What are any functionality and or performance requirements? 1)**Lack of monitoring methodology for energized seal. 2)Current wellhead designs are leading to false indications of annular leaks. New technology is needed both for monitoring and for the seal design itself.**
- d. Does the gap address any regulatory, congressional, or NTSB drivers? **PHMSA UGS Final Rule annulus monitoring**
- e. Does the gap address related consensus standards? **API RP1170 & RP1171, API 90-2 API 6A**
- f. What are anticipated targets or timeframes to complete this research?
Short term: monitoring devices.
Short to long term: new designs.

Incorporating Fiber Optics into Wellbore Design and Monitoring (Gap #2)

1. New or Improved Technology

- a. What pipeline type(s) or LNG/UGS operations does the technology target? **Wellbore safety barrier**
- b. What pipeline operating environment(s) must the technology operate in (inside/outside-pipe, above/under-ground etc.)? **Underground gas storage - downhole**
- c. What are any functionality and or performance requirements? **Can fiber optics be deployed as an alternative method to mechanical testing and inspection logging without creating a leak path. Goal to continuously monitor the wellbore for potential leaks via temperature, strain and acoustic profiles.**
- d. Does the gap address any regulatory, congressional, or NTSB drivers? **To address the PHMSA final rule for monitoring the annulus and assessing the well's integrity.**
- e. Does the gap address related consensus standards? **API RP1170 & RP1171**
- f. What technical or regulatory roadblocks or barriers prevent the technology deployment? **Adoption as an alternative means to MIT. Lifespan of the fiber optic cable.**
- g. What are anticipated targets or timeframes to complete this research? **Short term both:**
 1. **ability to install in a cemented liner.**
 2. **ability to strap externally to tubulars.**

Through Tubing Inspections (Gap #3)

1. New or Improved Technology

- a. What pipeline type(s) or LNG/UGS operations does the technology target? **Wellbore safety barrier**
- b. What pipeline operating environment(s) must the technology operate in (inside/outside-pipe, above/under-ground etc.)? **Underground gas storage-downhole**
- c. What are any functionality and or performance requirements? **Ability to assess multiple strings of casing as an alternative inspection method. Reduces risk from performing a workover.**
- d. Does the gap address any regulatory, congressional, or NTSB drivers? **To address the PHMSA final rule for assessing the well's integrity.**
- e. Does the gap address related consensus standards? **API RP1170 & RP1171**
- f. What technical or regulatory roadblocks or barriers prevent the technology deployment? **Adoption as an alternative means to determine casing integrity. Can this technology be used to extend timeframe between MFL runs/workovers.**
- g. What are anticipated targets or timeframes to complete this research? **Long term**

Cement as a Barrier

(Gap #4)

2. Creation and Dissemination of General Knowledge

- a. What pipeline type(s) or LNG/UGS operations does the general knowledge target?
Underground Gas Storage well annulus
- b. Does the gap address any regulatory, congressional, or NTSB drivers? ***To address Risk of a single point of failure in a gas storage well.***
- c. Does the gap address related consensus standards? ***API RP1170 & RP1171***
- d. What technical details or scope items are necessary and recommended? ***Is the cement capable of providing isolation for short and long term.***
- e. What are anticipated targets or timeframes to complete this research? **Short term.**
 - i. ***Future phase 2 would include the quantification of combined compressive strength of cement and tubulars.***

Cathodic Protection as Applied to Storage Wells (Gap #5)

2. Creation and Dissemination of General Knowledge

a. What pipeline type(s) or LNG/UGS operations does the general knowledge target?

Underground gas storage well tubulars

b. Does the gap address any regulatory, congressional, or NTSB drivers? ***Preventing external corrosion and metal loss of well tubulars***

c. Does the gap address related consensus standards? ***API RP1170 & RP1171***

d. What technical details or scope items are necessary and recommended? ***The Blade Report recommended the application of CP to underground gas storage wells.***

1. Assess technology used to monitor CP on underground gas storage well tubulars and specifically surface casing

2. Assess the overall effectiveness of CP throughout the entire length of production casing

3. Is the CP reaching the desired casing strings

e. What are anticipated targets or timeframes to complete this research? ***Short term***