Pipeline Safety, Hydrostatic Testing and Water Management

Cost Effective and Efficient Water Management

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The nature of hydrostatic testing makes using water a necessity. The volume of water required leads us to many challenges in trying to manage that water in a way that fulfills our commitments to safely operating in accordance with our goals of being a leader in environmental stewardship.

- Requirement that all in-service natural gas transmission pipeline will be pressure tested
- Approximately 185 miles of transmission pipelines scheduled to be tested in each of the next two years (2017-18). Much of this is to occur in water-scarce Lahontan/Mojave region.
- Water is most popular medium; some tested with nitrogen
- Challenges include:
  - Sourcing
  - Permitting
  - Transportation
  - Storage
  - Transferring through stages of test
  - Contaminants
  - Characterization, Filtration, Treatment
  - Disposal
  - Use of recycled water as a testing medium
  - Ruptures
Water Management

- Water associated with pipeline testing includes:
  - Test source water (municipal, well, canal, etc.)
  - Pipeline rinse and cleaning solutions
  - Used test water
  - Excavation groundwater
  - Stormwater
  - Dust Control

- PG&E’s pipeline projects use water to clean and pressure-test pipeline segments. Groundwater often needs to be dewatered from excavations. Project volumes can range from hundreds (de minimus) of gallons to more than a hundred million gallons over the life of a project.

- Management and discharge of wastewaters requires compliance with environmental regulations and segment-specific discharge permits.

- Failure to comply may result in:
  - Violations
  - Fines/Penalties
  - Construction schedule delays

- Water must be properly handled and discharged according to applicable rules and regulations

- Water may not be discharged to streams, drainages, wetlands or storm drains unless permitted and authorized

- Water management decision will depend on water volume, project location, sanitary sewers, storm drains, traffic, permit availability, onsite storage space, cost efficiency and analytical results
Groundwater Management

• Groundwater variability presents challenges for cost-effective and compliant management.

• Risk can vary with the season (water table is shallower during rains and irrigation season) and conditions along the pipe alignment can be different than adjacent lands where publicly available information is available.
  – Need for consistent and comprehensive record keeping for risk assessment

• Off haul of groundwater to offsite disposal facilities presents compliance risk as well as implications for public infrastructure, safety and cost.

• Earlier planning and strong collaboration between Project Management, Construction Management and Environmental Management result in greatest success.
Source Water

• Sources of water- Municipal Water, Water Companies, Irrigation Wells, Private Wells
  – May contain constituents that exceed sewer limits or water quality objectives
  – Database of water sources and analytical is available

• Cost vs. Convenience

• Collect Source Water Samples

• Conveyance from source to Test Locations via truck or pipe depending on distance to source

• Storage at test head vs. directly filling pipe
  – Water reused for multiple tests must be stored, transported, and ultimately disposed of
  – Transfer from source, truck or storage tank to test head
  – Controls to limit spills: containment, valves, etc

• Flow rates from source could limit pace when filling for test
Hydrostatic Testing Water Needs

• Test Media
  – Volume Depends on Distance and Diameter
    • Small diameter, short distance = small volume (100s of gallons)
    • Large diameter, long distance = larger volumes (1,000,000 + gallons)
    • Average test
    – Staging area needed if large volume requires storage: land agreements, biological/cultural surveys, permitting, ADMP, SWPPP & traffic control issues, etc.

• Potential for release during failure
  • Geography of service territories and pipeline pathways include variety of sensitive receptors
  • Collect a sample for characterization of pipe contents in case of release
    – Water has gone through hydrant, pipe, hose, tanks, and gas pipeline… potential for cross contamination as well as pipeline contaminants
Disposal of Test Water

- Once hydrostatic testing is complete water can be transferred to storage tanks, tested and disposed of
- Disposal must adhere to permit restrictions: discharge permit, SWPPP, NPDES
- Disposal options: Municipal Water Infrastructure (storm drain, sanitary sewer, etc), discharge to land surface, trucking off-site
  - Depends on location and distance to discharge point (manhole, treatment plant, land parcel)
- Often requires filtration through activated carbon or a particulate filter
- Rate of discharge often limited by POTWs infrastructure or ability to handle large volumes of water or constituents found in water via sampling
Land Discharge Application

Groundwater Recharge Basin

Dust Control
Sources of Test Water Contamination

Any potential contamination, no matter the source, has an impact on water management decisions.

Source Water
- Metals (arsenic, boron)
- General Chemistry: specific conductance, salinity
- Volatile organic compounds (trihalomethanes)

During hydrostatic test process
- Polyurethane pigs (methylene chloride)
- Cross contamination from tanks, hoses or pipes that are reused
- Pipeline contaminants
  - Organics (liquid hydrocarbons, oil & grease, PCBs)
  - Mineral based scale: arsenic, MERCURY

Valve location from 2011 exhibiting scale buildup

Wood debris and sludge removed from natural gas pipeline during 2012
Pipeline Contamination

Solids distributed along interior walls of segment cutouts from Hydrotest 2011
Pipeline Sampling - Scrape/Wipe Sampling

- Solid mineral scale often present
  - Collecting a sample of existing scale prior to welding on test heads, or pig launchers can help drive cleaning decisions and determinations
- Solid scale is scraped in a ring
- Material is collected and analyzed
  - Laboratory Results
  - AA Spectrometer used as a screening tool in some cases (TAT of ~1 hr from time lab receives sample)
- If no mineral scale can be scraped off the pipe then the pipe could be wiped to determine presence or absence of mercury, PCBs, etc
  - Set procedure
  - Presence/absence
  - Hard to correlate to concentrations
Pipeline Contamination

- Mercury appears locally distributed in specific lines
- VOCs and SVOCs associated with Hg-impacted segments but also observed in non-impacted segments
- Mitigation (cleaning) of scale targets Hg as contaminant of concern
The objective of the current cleaning process is to effectively clean the pipeline without compromising the integrity of the pipeline to facilitate hydrostatic testing while generating a limited volume of hazardous waste.

**Combined Approach:**

1. **Wet Clearing Run**
   - Clears line of debris or liquids in pipe and conducts initial water rinse using bare durafoam polyurethane (poly) pigs separated by a slug of water

2. **Chemical Cleaning Run**
   - Brush pig(s) (Power Brush Pig or Cap and Disc Pig) suspended between poly pigs to aggressively remove mineral scale from pipe surface
   - Chemically assisted pigging for loosening, emulsifying, and holding particulates in suspension (typically use SurfSweep CLW 3060 Pipeline Cleaner or Witches’ Brew)

3. **Rinse Run**
   - Conducted following cleaning to remove any residual cleaning solution and/or solids remaining in the pipeline
   - Typical configuration includes 2,500 gallons of water suspended between two poly pigs

4. **Dry Pigging Run (as needed)**
   - Subsequent clearing runs generally conducted as intermediate steps to swab loose solids from the pipe interior using a swab pig nested between two poly pigs
Treatment options include mechanical removal, chemical removal, encapsulation/stabilization, and thermal removal, either individually or in combination.

**Mechanical Removal**
- Aggressive abrasive pigging to minimize removal time; may utilize chemicals to loosen and/or emulsify deposits; swabs and dry pigs used to extent practicable to minimize waste
- **Applicability**
  - established technology used in the pipeline industry
- **Advantages**
  - PG&E familiar with approach
  - multiple vendors (N-SPEC, T.D. Williams, Inc.), chemicals, and pigs available
- **Limitations**
  - not necessarily efficient in Hg removal with chemical addition
  - may require multiple cleaning runs (time consuming)
• **Chemical Removal**
  - Use of chemical solutions to react with the Hg to help facilitate removal; used in combination with mechanical removal (pigging); specialized solutions available for Hg cleaning or decontamination of pipelines
  
  - **Applicability**
    - Portnoy Environmental, Inc (PEI) and Mercury Technology Services (MTS) specialize in removal/decontamination of Hg from natural gas and refining process piping and vessels
  
  - **Advantages**
    - specialized cleaning chemistry available, including acid-based cleaners for inorganic removal, thiosulfate ($S_2O_3^{2-}$) for Hg leaching
    - may reduce mechanical cleaning time
  
  - **Limitations**
    - specialty solution chemistry required
    - subject to physical limitations associated with pigging
    - steel piping may consume large quantities of acid (acidic cleaning solutions)
Field Atomic Adsorption (AA)

- Liquid Sampling (Clearing, cleaning, rinse runs, etc)
  - Provide timely (<2h) and accurate analysis of liquid samples from test segments along lines of known or unknown mercury impairment
    - Sole water quality analysis for all cleaning/rinse/wet clearing after first rinse run
  - Maintain real-time communications (Outlook, SharePoint and Voice)
  - Maintain retrievable results logs and conduct studies from these as needed

- Solid Scrape Sampling analysis for
  - Strength Testing- Pre/Post cleaning
  - Retirement- cleaning: determination (24 TAT on splits) and confirmation
  - Disposal
Field Atomic Adsorption (AA)

• Scrape Solid Hg Concentrations (Analytical Lab vs Mobile AA Lab)
  – Scrapes from 40 segment cutouts (HT 2011) tested

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Waste Minimization

1. Optimization of Cleaning Process
2. Water reuse between test segments
3. Land Discharge
Optimization of Cleaning Process

- Current approach requires effectively leveraging chemical, mechanical and volumetric inputs
  - **Mechanical Pigging**
    - Compressor-driven pigs must be propelled between 2-8 mph to maintain surface contact
    - Physical characteristics (diameter, elevation and direction changes) between segment endpoints have resulted in stuck or damaged pigs, the disruption of pig train orientation, and the blow-by of liquids intended to be suspended between pigs
    - Cleaning solutions have collected in locations such as drips, valves and other sinks while passing between endpoints. This has exacerbated the number of cleaning runs required to reduce contaminant concentrations
  - **Chemical solution used during ‘Cleaning Run’ step**
    - Concentration of surfactant must be monitored (foaming increases as concentration and efficacy increase)
    - pH of cleaning solution must be monitored to mitigate potential hazardous waste stream
Optimization of Cleaning Process

Performance envelop based on 95% confidence limits of the mean slope calculated for impacted pipelines that were cleaned in 2011 and beginning of 2012.

More aggressive brush pig

Performance envelop based on 95% confidence limits of the mean slope calculated for impacted pipelines that were cleaned in 2011 and beginning of 2012.
Questions?

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