Northeast GAS ASSOCIATION

NYSEARCH

Gas Interchangeability Effects on LDC Infrastructure Components

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Background

- LDCs will continue to face diversification of gas supplies
  - Impact on the gas infrastructure is not fully understood
    - Impact depends on multiple parameters that are hard to isolate
- Relevant experience from the past indicates that impact can be substantial

Background (continued)

- National consortium (NGC+) addressing some relevant issues
- Impact of changing compositions is possible in all components of the distribution network
  - from entry point, to
  - appliances

Background (continued)

- Incidents
  - A utility in the Mid-Atlantic region experienced substantial increase in leaks following introduction of LNG into the system
    - Company attests to changing gas compositions
    - FERC citing higher pressures and encapsulation of fittings with tar as cause of incident
    - Issue still debated at the regulatory level
- NYSEARCH activities initiated in 4/05
  - Initial focus on Distribution Infrastructure

NYSEARCH Gas Interchangeability Project

- Objective
  - Study the potential effects of varying natural gas compositions on the integrity of the gas distribution system infrastructure
- Approach
  - Systematic approach designed to identify the effects on various gas components under varying operational conditions
    - On individual elastomers, and
    - On components containing elastomers

Funding Consortium

- Central Hudson
- ConEdison
- Keyspan
- NYSEG
- National Grid/NMPC
- Orange & Rockland
- Rochester Gas & Electric
- Baltimore Gas & Electric
- Enbridge
- PECO Energy
- PSE&G
- Questar Gas
- South Jersey Gas
- Washington Gas & Light
- Southern California Gas
- Pacific Gas & Electric
- Southwest Gas
- Peoples Gas (TECO)

Industry Expertise

- Contractor: Gas Technology Institute
- Managed by NYSEARCH
- A Technical Advisory Board, consisting of experts from funding companies, have responsibility for technical decisions
  - Work with staff and GTI

Phases Combine Systematic Approach & Funders' Needs

- Phase I: Identify elastomers and components to be studied – completed in May '06
- Phase II: Study effects of varying gas compositions on most common components – under way
- Phase III: Study effects of varying gas composition on elastomers – to follow phase II
- Phase IV: Study effects of varying gas compositions on components – to follow phase III

Phase I Deliverables

1. Identified range of gas compositions to be considered

2. Identified infrastructure materials and components that could be affected by these gas compositions

3. Developed laboratory testing protocols for elastomeric materials
   - These tests will determine their susceptibility to varying natural gas compositions

Gas Compositions to Be Considered

- One benchmark Gas
- Twelve (12) model gases

Gas No.	Gas Type
Gas 1	Typical (average) pipeline natural gas (baseline gas)
Gas 2	Low boundary levels of corrosive gases in the presence of 15 ppmv H_2O
Gas 3	High boundary levels of corrosive gases in the presence of 15 ppmv H_2O
Gas 4	LNG from U.A.E. (high C2, slightly high C3)
Gas 5	Natural gas blended with propane (high C3)
Gas 6	Very lean gas (Canadian or Trinidad LNG)
Gas 7	LNG from Algeria, Qatar, Oman, Malaysia (high C4, slightly high C2 and C3)
Gas 8	High level C6+, possibly from refinery gas blends
Gas 9	Baseline gas with speciated C6+ components
Gas 10	Baseline gas with high boundary level BTEX (even split of benzene + toluene)
Gas 11	Baseline gas with high boundary level cycloalkanes (as cyclohexane)
Gas 12	Baseline gas with high boundary level glycol (methylene glycol)

List of Materials Identified

	Material Name	Other Names	Type	Acronym	Function
1	Butadiene-styrene	Buna-S; GR-S	Styrene-butadiene Rubber	SBR	1
2	Butadiene-acrylonitrile	Buna-N; Nitrile; Perbunan; Nytek	Acrylonitrile-butadiene Rubber	NBR	1, 2, 3, 5, 6
3	Natural Rubber	Gum	Natural Rubber	NR	1
4	Polychloroprene	Neoprene; Bayprene; Chloroprene	Synthetic Rubber	CR	1, 2
5	Ethylene-propylene	Nordel; Royalene; Dutral	Synthetic Rubber	EPM &EPDM	1,2,3
6	Polyamide 11 & 12 (*elastomers*)	Rilsan; Vydyne; Plaskin; Nylon	PA 11 & PA 12 Elastomer	PA 11 & PA 12	1,3
7	Silicone & Fluorosilicone	Polysiloxanes; Cohrlastic; Green-Sil; Parshiled; Baysilone; Blue-Sil	Silicone Rubber/Polysiloxane	SI & FSI	1
8	Fluoroelastomer	Viton; Fluorel; Technoflon	High Performance Synthetic Rubber	FKM	1,2
9	Perfluoroelastomer	Kalrez; Chemraz; Kel-F	High Performance Synthetic Rubber	FPM	2
10	Polypropylene	PP	Thermoplastic/Polyolefin	PP	2
11	Polytetrafluoroethylene	Teflon; Halon	Fully Fluorinated Thermoplastic	PTFE & TFE	2,9

Function Categories
1 = gasket
2 = o-ring
3 = diaphragm
4 = diaphragm seat
5 = flange seal
6 = quad seal
7 = square ring
8 = gasket body
9 = valve seat

- 1-9 are elastomers/rubbers
- 10-11 are thermoplastics

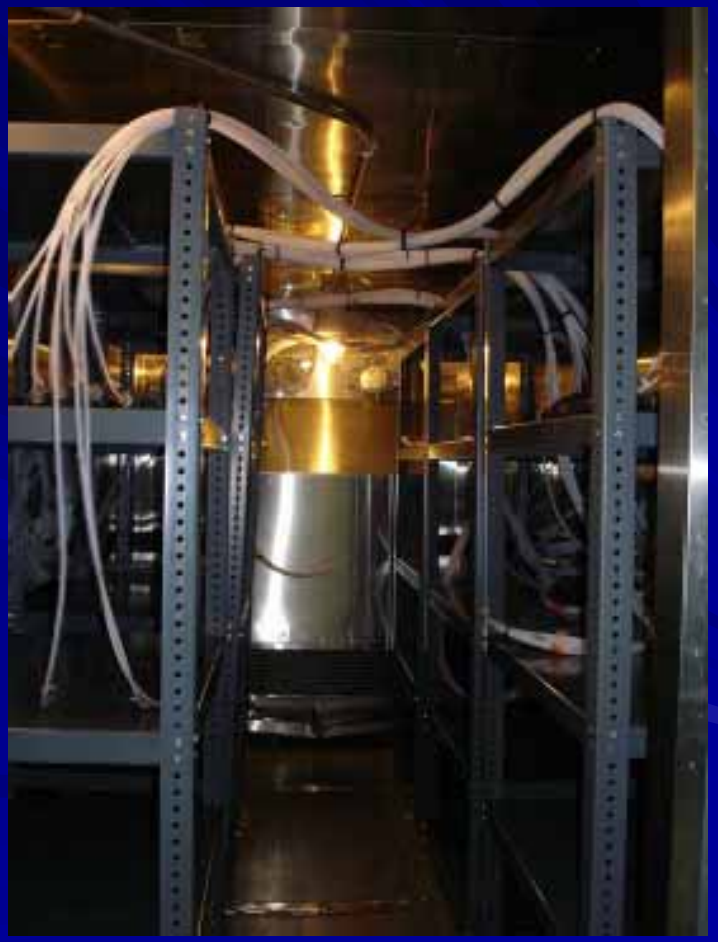
Materials Testing Protocol

- Developed detailed and systematic protocol for determining the effect of various gas components on the integrity of the materials selected
- Laboratory testing of materials extracted from components in the field
  - Mostly based on ASTM standards
  - In the absence of standards, protocols developed using closest existing standards and solid engineering analysis

Phase II – Fast Track

- Initiated in July 2006
- Four deliverables:
  1. Extraction protocols for most common infrastructure components - completed
  2. Testing protocols – completed
  3. Testing facilities – completed
  4. Test results for
     i. small infrastructure components – in-progress
     ii. large infrastructure components – not yet available

Testing Facility for Small Sizes



Testing of Couplings

- Two tasks
  - Conditioning tests – in progress
  - Leak tests – initiation and duration depends on results of conditioning tests

Future Phases

- Phase II
  - Systematic study of respond of elastomers to varying gas compositions under varying operating conditions
- Phase III
  - Systematic study of respond of all infrastructure components to varying gas compositions under varying operating conditions

Conclusions

- *Results should allow all stakeholders make sound decisions regarding new supplies and their impact on the infrastructure*
- Project results are of high interest to funders, overall gas industry and outside agencies