RNG Interconnect Guideline

A Process for "Getting to Yes"

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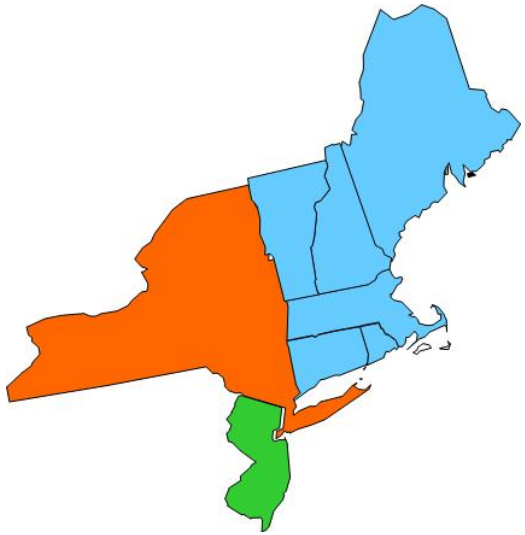
Northeast Gas Association
New England Pipeline Safety Seminar 2018

About NGA

- Non-profit trade association
- Local gas utilities (LDCs) serving New England, New York, New Jersey and Pennsylvania
- Several interstate pipeline companies
- LNG importers and LNG trucking companies
- Over 380 “associate member” companies, from industry suppliers and contractors to electric grid operators
- www.northeastgas.org



NGA Function Areas

Education & Training

RD&D

Advocacy

Guide Sponsors and Participants

- Sponsors
  - Central Hudson
  - Con Edison
  - National Grid
  - NYSEG/RGE
  - Orange and Rockland
- Project Manager
  - NGA
- Consultant
  - GTI

Can We *Reasonably & Rationally* Meet The Challenges of The Second "Great Conversion"

A purge burner igniting manufactured gas being replaced in a main by natural gas during the 'great conversion' in 1952

- **Supply Mix Is Changing……..**
- **Renewable Gas is a *reality and an important part of the nations supply future***
- **Clean-up Technology has evolved**

Guideline Development Process

- Kickoff Discussion – 09/29/2016
- Interim Report Review – NYS Utilities 11/29/2016
- Draft Guide Review – NYS Utilities 04/10/2017
- Final Guide Review & Revision– 09/22/2017
- Discussion with NYSDPS, NYSERDA – 01/24/ 2018
- Review with RNC & ABC – 06/2018

Policy Collides with Science .....

- RNG is already accepted and used in New York and in the US.
- For example, introduction of RNG directly into a gas distribution system has been successfully practiced for over 30 years from the Staten Island, NY landfill 4-7 MMSCF/Day recovered and processed followed by direct injection into the local distribution system.
- Project developers are in discussion with gas distributors throughout NE and the northeast but the processes, requirements, and agreements are not uniform, resulting in commercial and technical uncertainty for both parties.
- A consistent approach will bring certainty for all parties involved in negotiations with regard to safety, reliability, continuity, and interchangeability.

What, Why How Approach

- What are LDC concerns ?
- Why are LDC's concerned ?
- How can we address these concerns ?

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The What ?

- HHV/SG
- Total Inerts
- Moisture
- Oxygen
- Sulfur Compounds / Total Sulfur
- Trace Constituents
- Supply Reliability

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The Why ?

- HHV/SG – Interchangeability, Therm Billing
- Total Inerts – Interchangeability, Integrity
- Moisture – System Integrity
- Oxygen – System Integrity, Interchangeability
- Sulfur Compounds – System Integrity, Safety
- Trace Constituents – End Use, Safety
- Supply Reliability – gas system supply balancing

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Constituents of Concern Summary

- Potential COCs that may be found in raw gas from specific feedstocks for RNG production – focus analysis on reasonable COC's

Parameter	Landfill	Dairy, Swine	WWTP	Food Waste	Gasifier, Syngas
Water Content					
Sulfur, including Hydrogen Sulfide					
Hydrogen					
Carbon dioxide					
Nitrogen					
Oxygen					
Ammonia					
Biologicals					
Mercury					
Volatile metals					
Siloxanes					
Volatile Organic Compounds					
Semi-volatile Organic Compounds					
Halocarbons					
Aldehydes and Ketones					
Polychlorinated biphenyls (PCBs)					
Pesticides					

Making Gas "*Constituent Equivalent*"

- Observed Ranges Found in Fully Upgraded RNG from Landfills, Dairy Farms, and WWTPs

Parameter	AGA 4A Reported Range	Range Found in Upgraded Landfill-Derived RNG	Range Found in Upgraded Dairy-Derived RNG	Range Found in Upgraded WWTP-Derived RNG	Range Found in Natural Gas Samples
Total Sulfur	maximum 0.5 to 20 grains per 100 SCF	BDL (0.003) to 0.32 grains per 100 SCF	BDL (0.003) to 0.31 grains per 100 SCF	BDL (0.003) to 0.01 grains per 100 SCF	BDL (0.003) to 1.1 grains per 100 SCF
Hydrogen Sulfide	maximum 0.25 to 1.0 grains per 100 SCF	BDL (0.003) to 0.03 grains per 100 SCF	BDL (0.003 ppmv)	BDL (0.003) to 0.01 grains per 100 SCF	BDL (0.003) to 0.36 grains per 100 SCF
Hydrogen	max. 0.04 to 0.1 vol%	BDL (0.1) to 1.0 vol%	BDL (0.1 vol%)	BDL (0.1 vol%)	BDL (0.1) to 0.3 vol%
Carbon dioxide	maximum 1 to 3 vol%	BDL (0.03) to 2.2 vol%	0.06 to 0.95 vol%	0.49 to 0.66 vol%	BDL (0.03) to 2.6 vol%
Nitrogen	maximum 1 to 4 vol%	0.5 to 9.5 vol%	0.20 to 7.81 vol%	BDL (0.03 vol%)	BDL (0.03) to 12.7 vol%
Oxygen	max. 0.001 to 1 vol% majority: 0.1 to 0.2 vol%	BDL (0.03) to 1.3 vol%	BDL (0.03) to 1.99 vol%	BDL (0.03 vol%)	BDL (0.03) to 1.2 vol%
Diluents + Inerts	maximum 3 to 6 vol%	0.6 to 10.0 vol%	0.37 to 10.65 vol%	0.49 to 0.66 vol%	0.3 to 12.7 vol %
Ammonia	none	BDL (10 ppmv)	BDL (10 ppmv)	BDL (10 ppmv)	BDL (10 ppmv)
Total Bacteria	none	$2.46x10^4$ to $3.29x10^8$ # per 100 SCF	$3.28x10^3$ to $1.02x10^7$ # per 100 SCF	$9.85x10^5$ to $2.14x10^6$ # per 100 SCF	$3.47x10^4$ to $6.39x10^7$ # per 100 SCF
Mercury	none	BDL (0.01) to 0.3 µg/m^3	BDL (0.01 µg/m^3)	BDL (0.01 µg/m^3)	BDL (0.01) to 0.06 µg/m^3
Other Volatile Metals3	none	BDL (30) to 250 µg/m^3 (Cr, Cu, Mn, Pb, Sb, Zn)	BDL (20 µg/m^3)	BDL to 229 µg/m^3 (Zn)	BDL (30) to 213 µg/m^3 (As, Cu, Pb, Zn)
Siloxanes (D4)	none	BDL[1] to 6.0 mg Si/m^3	BDL[1]	BDL (0.1 mg/m^3)	BDL[1]
Non-Halogenated Semi-Volatile and Volatile Compounds	none	BDL[2] to 1.4 ppmv (BTEX, phthalates)	BDL[2] to 0.1 ppmv (BTEX, N-nitroso-di-n-propylamine, benzyl alcohol)	BDL[2] to 6 ppbv (phthalate)	BDL[2] to 471 ppmv (1,3-butadiene, acrylonitrile, BTEX)
Halocarbons	none	BDL (0.1) to 3.6 ppmv (Freons, chloroethane, vinyl chloride)	BDL (0.1 ppmv)	BDL (0.1 ppmv)	BDL (0.1 ppmv)
Aldehyde/Ketones3	none	BDL (10) to 522 ppbv	not tested	BDL (10 ppbv)	BDL (10) to 103 ppbv
Polychlorinated biphenyls (PCBs)	none	BDL (0.01 ppbv)	BDL (0.01 ppbv)	BDL (0.01 ppbv)	BDL (0.01 ppbv)
Pesticides	none	BDL (0.0006) to 0.003 ppbv (4,4'-DDT)	BDL (0.0004) to 0.5 ppbv (gamma-chlordane)	BDL (0.0006) to 0.006 ppbv (4,4'-DDT)	BDL (0.0006 ppbv)

The How……

- ✓ Establish trace constituent product equivalency
- ✓ Explore opportunities & common ground
- ✓ Willingness to understand each others concerns & work towards solutions
- ✓ Finding ways to say “yes” rather than imposing overly restrictive requirements based on operational uncertainty

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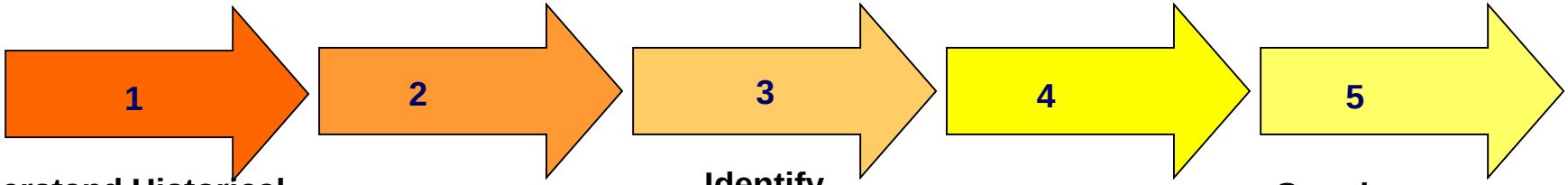
RNG Interchangeability Implementation Process



1 — Understand Historical Supply

- Work with Pipelines to establish system adjustment gas

2 — Understand "Zone of Influence"

- Work with pipeline to determine optimum injection point
- Establish reasonable supply compositions
- Pipeline to model influence on system including therm zones

3 — Identify "Potential Sensitive Receptors"

- LDC's catalog potential sensitive customer equipment

4 — Assessment

- Assess sensitive equipment
- Establish extent of retrofits
- Negotiate fixes

5 — Supply Agreement

- Establish interchangeability GSA parameters
- Establish most economical & balanced retrofit strategy if necessary

How to Achieve Success……..

- ✓ Don't rely on published tariff values alone, gas within distribution systems may be historically different than broad ranges in pipeline tariffs
- ✓ Work with Utilities to understand chemical properties of gas in the area of anticipated injection (adjustment gas).
- ✓ Work with Utilities to balance processing requirements and potential opportunities for contractual blending to meet HHV requirements.
- ✓ Share as much information as possible to provide operational certainty that the processed gas stream is similar to pipeline gas flowing in the area of injection.

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How to Achieve Success……..

- ✓ Optimize start-up and operational monitoring protocols.
- ✓ Develop “surrogate” monitoring parameters as process indicators that drive the need for more exotic testing if necessary.
- ✓ Leverage application of similar processes in similar situations – don’t reinvent the wheel!
- ✓ Establish mutually agreeable testing and monitoring parameters, limits, test methods and procedures to deal with anomalies.

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The Guideline Combines
Good Science & Common Sense……

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