2018 AGA-EPA Renewable Natural Gas Workshop

Overview: "CGA Guideline for the Introduction of Biomethane into Existing Natural Gas Distribution & Transmission Systems"

CANADIAN GAS ASSOCIATION
ASSOCIATION CANADIENNE DU GAZ

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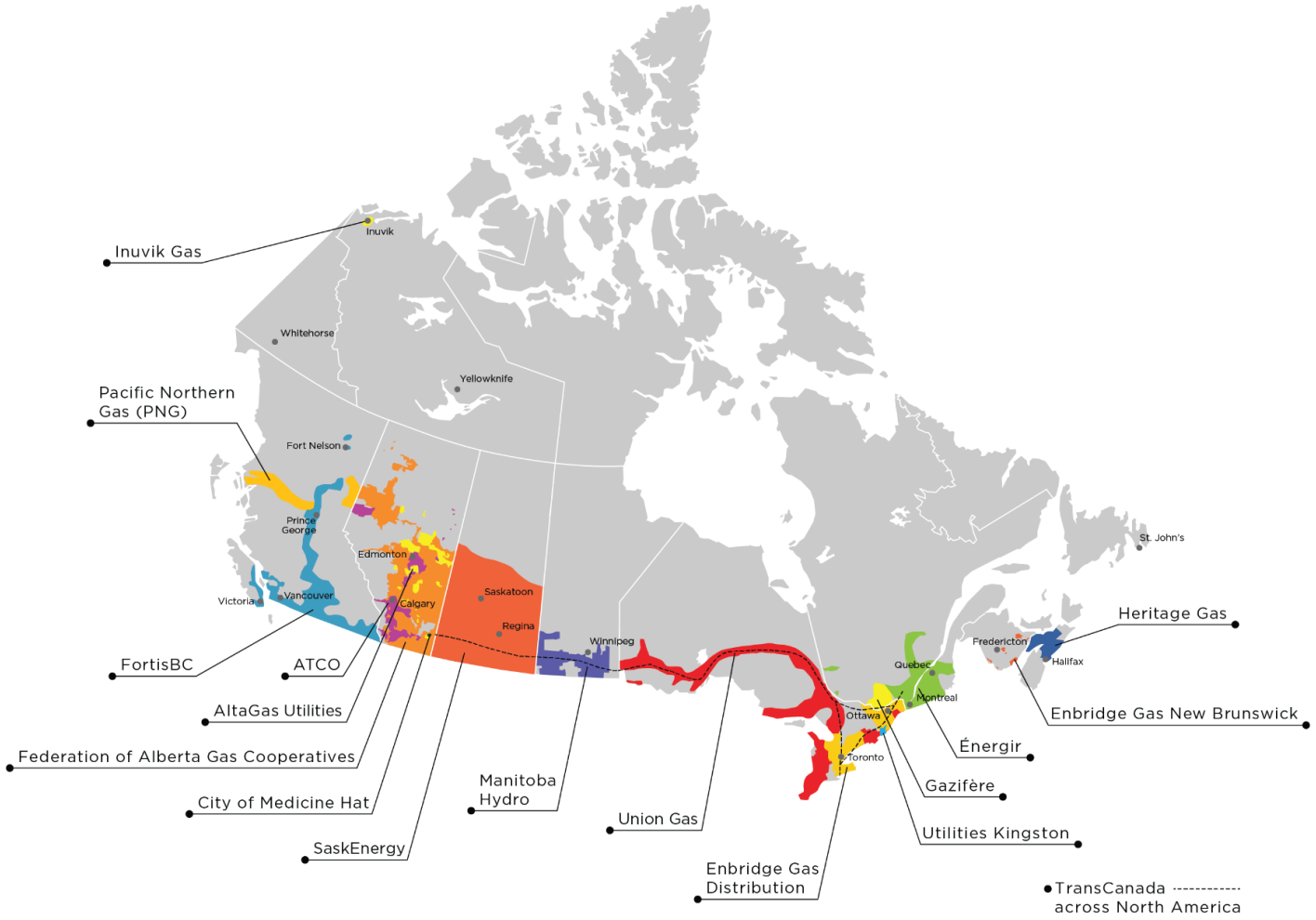
CANADIAN GAS ASSOCIATION MEMBERSHIP



Number of NG Customers	**7.05 million**
Employees	**13,259**
Distribution Plant	**483,234 Kms**
Transmission Plant	**67,207 Kms**

Non-Utility/Transmission CGA Members:
Suppliers of goods & services to the NG delivery industry; manufacturers, suppliers, contractors & consultants

DEVELOPMENT OF INDUSTRY GUIDANCE

- The growing significance of RNG/Biomethane was recognized but there was concern that gas quality specifications only existed for geologically formed natural gas.

- These specifications were typically contained in gas transportation tariffs agreed upon by the supplier & the local distribution or transportation organization contracting for the gas & specifications could vary by region &/or by individual tariff.

- **Biomethane was not sufficiently characterized by these existing tariff provisions.**

- Understanding raw biogas must be cleaned sufficiently before introduction as biomethane into natural gas pipeline networks, the **CGA's Standing Committee on Operations & Safety** formed a Task Group to create a guidance document that could be used as a reference for producers, suppliers & receivers of this product.

2012 GUIDELINE FOR THE INTRODUCTION OF BIOMETHANE INTO NATURAL GAS SYSTEMS

Purpose:

- A common framework for the introduction of biomethane into existing natural gas distribution & transmission systems in Canada

Content Overview:

- Biomethane Quality Guidelines,
- A project approach model for the introduction of biomethane to the natural gas pipeline grid, including explanations of actions associated with each phase of the project,
- A biomethane verification program, for examining & testing biomethane, &
- General definitions/information concerning biomethane interchangeability, downstream equipment performance & delivery system equipment performance & integrity

GUIDELINE TABLE OF CONTENTS

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- Wobbe Index
- Carbon Dioxide, Oxygen and other Inert/Diluent Gases
- Carbon Dioxide (CO_2)
- Oxygen (O_2)
- Nitrogen (N_2)
- Hydrogen Sulphide (H_2S), Total Sulphur and Mercaptans /Methyl Mercaptan
- Water Content
- Hydrocarbon Dew Point
- Gas Interchangeability
- Temperature – Metallic and Non-Metallic Pipelines
- Particulates (Dust, Gums and Biologicals)
- Dust and Gums
- Biologicals
- Other Trace Constituents

VERIFYING BIOMETHANE QUALITY

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CGA BIOMETHANE QUALITY GUIDELINES

- Created from a compilation of existing Canadian natural gas quality specifications, recommended component limits cited in European standards & in the United States & practices recommended by members of the CGA Biomethane Task Force
- The Guidelines are supported by references, however it is important to consider the particular situation in which the biomethane will be injected, as specifics between systems may vary & other considerations may dominate in a decision for biomethane introduction to the pipeline network
- *These Guidelines are not prescriptive & the final decision for biomethane introduction should be carefully considered by the gas utility

Physical Properties	Reference	Symbol	Upper Content Limit	Units	Comments	Example Test Methods
Heating Value	Published Canadian Tariffs	-	*36 to 41.3*	*MJ/M3*		ASTM D1945 or GPA 2261
Wobbe Index	Published Canadian Tariffs	-	*47.23 to 51.16*	-		
Carbon Dioxide	Published Canadian Tariffs	CO_2	*2*	*mol%*		*ASTM D1945/1946*
Oxygen	Published Canadian Tariffs	O_2	*0.4*	*mol%*		ASTM D1945/1946
Inerts	Published Canadian Tariffs	-	*4*	*mol%*	N, O_2, CO_2 + others	ASTM D1945/1946
Hydrogen Sulphide	Published Canadian Tariffs & CSA Z662	H_2S	*6 or 7 to 23*	*mg/m3*	7 is Distribution (Z662), 23 is Transmission (Tariffs)	ASTM D4084
Sulphur (in total)	Published Canadian Tariffs	S	*115*	*mg/m3*		ASTM D3246, ASTM D5504M
Mercaptans or Methyl Mercaptan	Published Canadian Tariffs	-	*6 to 8*	*mg/m3*		
Water Content	Published Canadian Tariffs	H_2O	*35 to 65*	*mg/m3*		ASTM D1142 or ASTM D5454
Hydrocarbon Dew Point	Published Canadian Tariffs	HCDP	*-10*	°C		
Gas Interchangeability	Published Canadian Tariffs & CGA NGI Report (2009)	-	*IC & YT Indexes*		Weaver Incomplete Combustion & AGA Yellow Tipping indices	
Temperature Steel	Published Canadian Tariffs	-	*Max 49 to 50*	°C	(Temperature of the injection gas)	
Temperature Plastic	CSA Z662	-	*Max 30*	°C	(Temperature of the injection gas)	
Particulates	Published Canadian Tariffs	-	*Free of...*		0.3 micron filter separator recommended	Similar to EPA Method 5
Biologicals/Bacteria	Published Canadian Tariffs	-	*Free of...*		0.3 micron filter separator recommended	
Hydrogen	TBD	H_2	*TBD*		TBD relative to individual pipe material considerations concerning Hydrogen embrittlement and stress cracking. Hydrogen permiability regarding threaded and gasketed joints and non-metalic pipe systems needs to be well understood.	ASTM D1945/1946
Ammonia	MarcoGaz compilation of European specifications (TBC)	NH_3	*3*	*mg/m3*		*ASTM D1945/1946, NIOSH 6015*
Halocarbons and Organochlorinated Compounds	MarcoGaz (France) compilation of European specifications & AFSSET Reports. Vinyl Chloride based on NIOSH & OSHA	-	*10*	*mg/m3*	Limit of 1 mg/m3 for vinyl chlorides within the 10 mg/m3 total	EPA Compendium Method TO-15
Heavy Metals	Laboratory Detection limits for mercury & arsenic	-	*Mercury 0.05 Arsenic 30*	*micro-grams /m3*	For copper, zinc & other metals; comparison to existing metals in current Natural Gas stream, i.e. metals from biomethane do not substantialy contribute to background levels.	NIOSH 6009 (Hg), NIOSH 7300
Siloxanes	Based on end use requirements. Twice the lab detection limit of 0.5.	-	*1*	*ppm*		
Volatile and Semi-Volatile Compounds	-	-			Monitor & establish presence in NG stream; must know what's in both Natural Gas & Biomethane streams	EPA Method 8270
Other Considerations: This is not a complete listing of potential trace constituents. Refer to published reports concerning trace constituents that may be present in various biogas sources. (see GTI Reports: Pipeline Quality Biogas: Guidance Document for Dairy Waste, Wastewater Treatment Sludge and Landfill Conversion, Pipeline Quality Biomethane: North American Guidance Document for Introduction of Dairy Waste Derived Biomethane into Existing Natural Gas Networks).						
Footnotes: There may be circumstances, based on the judgement of the gas system operator, where specific component limits may differ from the information above.						

Project Model Approach

Feasibility

- Assess Biogas Source
- Assess Biomethane Quantity/Location/Quality
- Assess Impact to System Design Operations and Components
- Examine Potential Impact to End Users and Their Requirements
- Review Options and Requirements for Blending
- Identify Other Potential Issues Associated With the Biogas Source

Preliminary Discussions

- Perform Baseline Natural Gas Analysis and Determine Gas Specifications
- Determine Supply Quantity and Variation
- Identify Contractual Language

Design

- Establish Online Instrumentation Package and Controls
- Identify Operational Upset Considerations
- Define Requirements for Location, and Blending
- Assess Environmental Issues
- Discussion with Project Proponents about Approach and Concerns
- Establish Parameters for Start-up and Verification
- Establish Contingency Plan

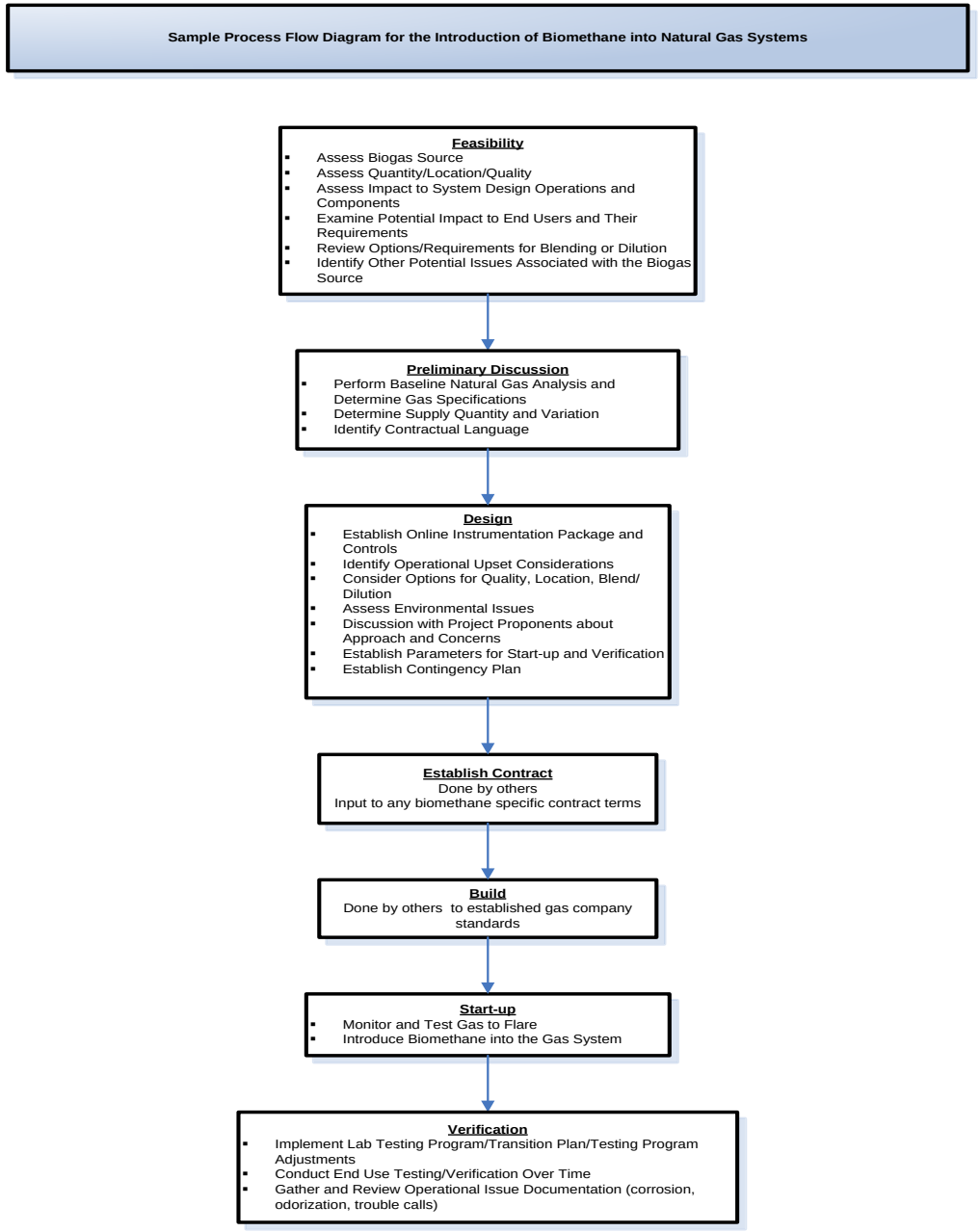
Establish Contract

Build

Start-up

Verification

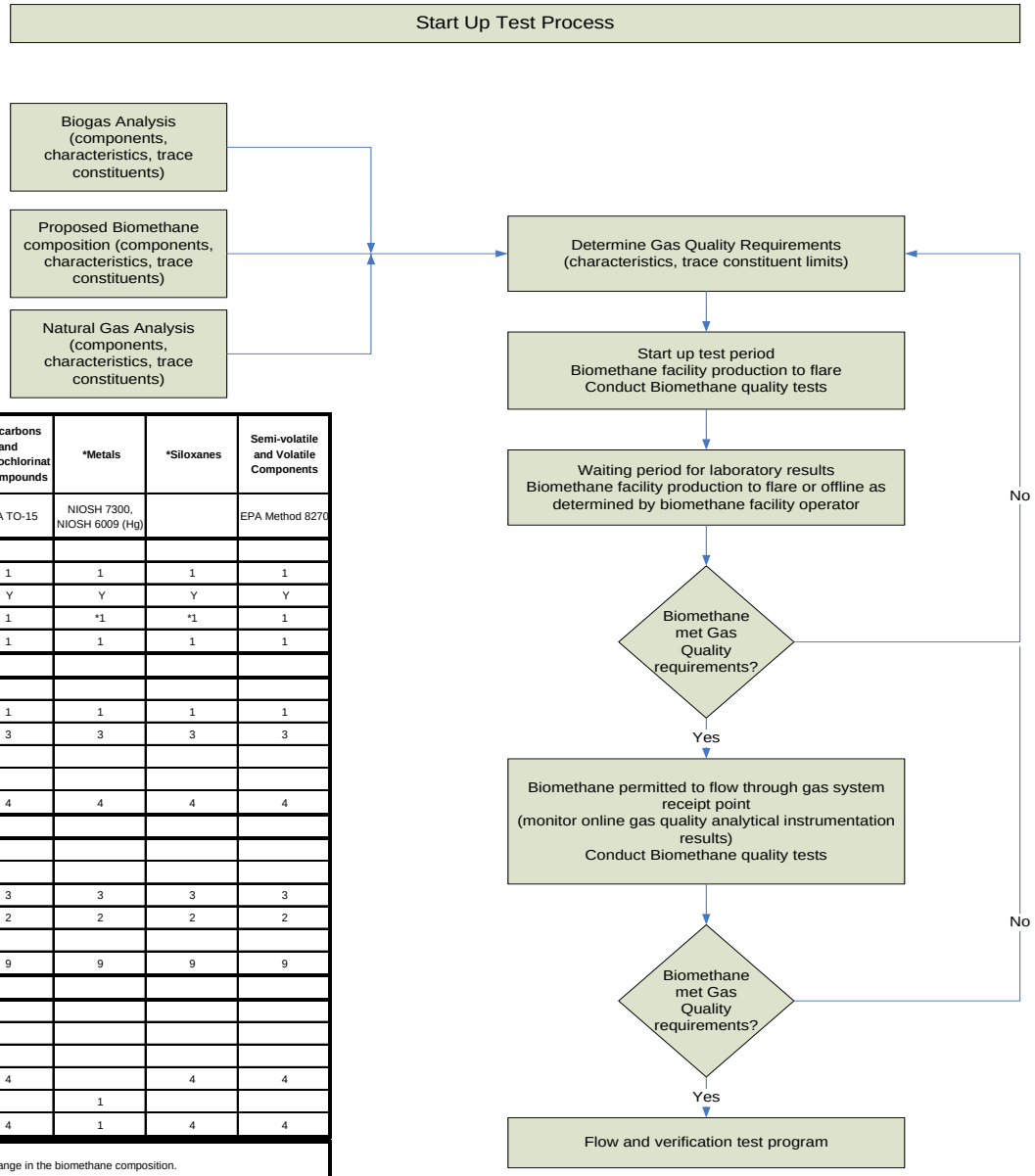
- Implement Laboratory Testing Program/Transition Plan/Testing Program Adjustments
- Conduct End Use Testing/Verification Over Time
- Gather and Review Operational Issue Documentation (corrosion, odourization, trouble calls)



START UP TEST PROGRAM & SAMPLE VERIFICATION TESTING PROGRAM SCHEDULE

	Constituent(s) / Property(ies)	On-site	Major Components (C6/C9)	Heating Value	Oxygen	H2S/Total Sulphur	Water Content	Hydrocarbon Dew Point	Biologicals	*Hydrogen	*Ammonia	Halocarbons and Organochlorinated Compounds	*Metals	*Siloxanes	Semi-volatile and Volatile Components
		Laboratory Sample and Test	GPA 2261	GPA 2261		ASTM D4084, ASTM D5504M	Chilled Mirror/ ASTM D1142	Chilled Mirror		ASTM D1945/1946	ASTM D1945/1946, NIOSH 6015	EPA TO-15	NIOSH 7300, NIOSH 6009 (Hg)		EPA Method 8270
One Month	**PreStartup\2**														
	Historical or Anticipated Biogas Analysis		1	1	1	1	N/R	N/R	1	1	1	1	1	1	1
	Proposed Biomethane Composition		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Actual Biogas Analysis		1	1	1	1	1	1	1	*1	*1	1	*1	*1	1
	Natural Gas Stream Analysis		1	1	1	1	1	1	1	1	1	1	1	1	1
	Startup														
	Start up Testing		1	1	1	1	1	1	1	1	1	1	1	1	1
	Weekly (3 tests consistently meeting specification)		3	3	3	3	3	3	3	3	3	3	3	3	3
	PreStartUp & StartUp Count	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Remainder of Calendar Year 1	**Verification Year 1**														
	Continuous		Y	Y	Y	Y	Y								
	Monthly						12	12	3	3	3	3	3	3	3
	Quarterly								2	2	2	2	2	2	2
	Annually														
	Total Year 1	9	4	4	4	4	12	12	9	9	9	9	9	9	9
Calendar Year 2	**Verification Year 2**														
	Continuous		Y	Y	Y	Y	Y	Y							
	Monthly						12	12							
	Quarterly								4		4	4		4	4
	Annually									1			1		
	Total Year 2	4	0	0	0	0	12	12	4	1	4	4	1	4	4

Notes: Events or conditions that would trigger a Lab analysis include: a significant off spec as indicated by the continuous analyser(s), a expansion of the biogas generation process; an indication of a a significat change in the biomethane composition.
*Continue testing for component if present in biogas analysis or may be reasonably anticipated to be present in biogas.



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