

Northern Natural Gas Operating Guidelines
Biomethane Receipts
UPDATE 11/24

GENERAL

Pursuant to Section 44 of the General Terms and Conditions of Northern Natural Gas' ("Northern") Federal Energy Regulatory Commission Gas Tariff, all gas to be received into the Northern pipeline system shall conform to the Specifications listed in the Tariff. Specification 44(a) states the "gas shall be commercially free from objectionable odors, solid matter, dust, gums and gum forming constituents, or any other substance, which might interfere with the merchantability of the gas, or cause injury to or interference with proper operation of the lines, meters, regulators, or other appliances through which it flows." Accordingly, the following operational procedure provides actions required for the acceptance of biomethane gas into Northern's system and the actions required when biomethane gas receipts ("Receipt Gas") exceed certain levels of constituents, listed in the Tables 1 and 2 below, that would render the gas unmerchantable. The constituents are dependent upon the source of the biogas. The two distinct sources are: (1) landfills, wastewater treatment (WWT) sludge anaerobic digestion (AD), municipal organic waste AD, industrial-grade food waste (IGFW) AD, and all mixed organic waste AD projects (many trace constituents), and (2) dairy/feedlot manure (live animal manure, LAM) only (few trace constituents.) All sources will be considered for appropriateness to the programs. Receipt of biomethane from an unknown source is prohibited.

REQUIREMENTS

For the purposes of this Operating Guidelines Document, Renewable Natural Gas (RNG) is defined as biomethane only. Biomethane is extracted from raw biogas. Biogas is produced through the microbial degradation of organic compounds and consists of methane, inert gases, sulfur compounds and a wide variety of trace constituents. Biogas must be "cleaned" or "upgraded" through processing or "conditioning" to produce a gas which may be safely introduced to the pipeline network. The Operator of the biogas upgrading facility ("Receipt Point Operator" or "Operator") shall demonstrate, before gas flow starts or resumes into Northern's pipeline system, that the Receipt Gas is merchantable and meets the gas quality specifications required by Northern's Specification and the applicable constituent levels shown in Attachments 1 and 2 (*Northern Natural Gas Renewable Natural Gas (Biomethane): Pipeline Quality Specification*, and, *Northern Natural Gas RNG Quality Parameters (Biomethane) with Testing Methodology*) by providing test results from 1) on-site, real-time, appropriate analytical instrumentation (for major components), and, 2) test results ("Acceptable Test") from a third-party analytical laboratory approved by Northern ("Approved Laboratory") for trace constituents, following the schedules in Attachments 3 and 4 (*Northern Natural Gas RNG (Biomethane) Plant Start-Up, Verification and Monitoring Program Guidelines for Injection to the Natural Gas Pipeline*). The Receipt Point Operator shall be responsible for costs associated with all required Receipt Point Operator installed on-site analytical instrumentation, and field sampling/laboratory testing for the program as set forth herein.

The Receipt Point Operator will install gas monitoring equipment after the gas conditioning unit to continuously monitor gas quality. The Receipt Point Operator will not use Northern's real-time analytical instrumentation for gas quality confirmation. The Receipt Point Operator will release data from on-site, real-time analysis upon request and throughout the Verification Period. The Receipt Point Operator will provide Northern with at least forty-eight (48) hours' notice of planned field sampling



events and allow Northern the option of witnessing any Receipt Gas sample collection. All gas sampling must be performed by a qualified, experienced sampling team, and all samples must be sent to Approved Laboratories unless otherwise approved by Northern in writing.

All test results will be shared with Northern within five (5) calendar days of the laboratory test results being received by the Receipt Point Operator.

Northern will install gas monitoring equipment at the receipt meter station to *continuously monitor* the gas quality of the Receipt Gas. Receipt Gas will also be tested through field sampling and laboratory analysis. A schedule of sampling events has been included in these Operating Guidelines. If results of field sampling for trace constituents indicates that the Receipt Gas is not merchantable, Northern may require the Receipt Point Operator, at the Receipt Point Operator's sole cost and expense, to perform additional testing of the Receipt Gas. Events or conditions that trigger additional laboratory analysis include: (1) a significant reading of off-spec biomethane as indicated by the continuous analyzer(s); (2) an expansion of the RNG generation process; (3) an indication of a significant change in the Receipt Gas composition; or (4) addition of a new biomass source.

Sampling methods and analytical test methods may be modified or changed over time, based upon updates in test methods and instrumentation. Proposed alternative test methods, especially for trace constituents, must be approved by Northern. Northern reserves the right to modify the program based upon results of sampling. Northern reserves the right to modify/waiver requirements of the program based upon specific conditions of the project.

Allowable concentration limits for each of the biomethane gas constituents to be tested are shown in Attachment 1, Table 1 and Table 2. Blending of Receipt Gas (Attachment 1) with natural gas supplies prior to analytical testing is strictly prohibited. Test methods for all on-site and laboratory testing are included in Attachment 2.

The Receipt Point Operator will immediately notify Northern prior to changing or augmenting the Receipt Gas source, or the type of equipment used to make the Receipt Gas merchantable. At Northern's sole discretion, a change in biomass source or type of upgrading equipment could result in the testing protocol restarting for that type of biogas source.

Northern prohibits Receipt Gas from a landfill containing hazardous waste, as defined in 40 CFR, part 261.3, from being delivered into its pipeline system. Development of landfills shall be limited to fully and currently permitted RCRA Subtitle D landfills only.

The Operator of a receipt point shall not knowingly supply or cause to supply biomethane from a landfill containing hazardous waste. The Operator of a landfill receipt point has the responsibility to disclose whether the landfill is a site of hazardous waste, has ever been a site of hazardous waste, contains hazardous waste, or has ever accepted hazardous waste. The Operator of the landfill receipt point shall demonstrate verification from an approved third-party environmental company that the biomethane does not originate from hazardous waste before gas flows into Northern's pipeline system.



The Operator of a landfill receipt point with any source of merchantable biomethane will be required to provide documentation in the form of an environmental due diligence assessment (Phase I Environmental Site Assessment/ESA) *prior* to the execution of an interconnect agreement. The cost of the Assessment/ESA is to be paid by the Receipt Point Operator.

A. Biomethane Testing Protocol for Landfills, Wastewater Treatment Sludge AD, Municipal Waste AD, and Industrial-Grade Food Waste AD, and Mixed Organic Waste AD Biogas Sources

The Receipt Point Operator shall demonstrate, before gas flow starts or resumes into Northern's pipeline system, that the Receipt Gas is merchantable and meets the Northern gas quality specifications by providing results from on-site analytical instrumentation and test results from a qualified analytical laboratory approved by Northern (Approved Laboratory).

1. *Verification Period – Gas is Not Delivered to the Pipeline*

Prior to the initial delivery of Receipt Gas into Northern's pipeline, the Receipt Point Operator shall operate their installed on-site analyzers (real-time instrumentation owned and operated by the Operator, set at 5-minute analysis periods), **over a continuous four (4)-week period**, and provide Northern with results of analyses. In addition, the Operator will provide Northern with **weekly test results for the four (4) week period**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 1 below. All on-line, real-time on-site analyzer results and field sample results must be verified by Northern and must demonstrate an acceptable level for each of the constituents listed in Attachment 1/Table 1 before Receipt Gas will be allowed into Northern's system. The Receipt Point Operator must provide four (4) consecutive Acceptable Test results, **over the period of 4 weeks**, to proceed to the next testing Period. During this Period of testing, the Receipt Point Operator shall make reasonable efforts to produce Receipt Gas continuously, with at least 70% uptime, in order to be compliant. Northern requires 100% uptime for the final week of this Period of testing.

2. *Monitoring Period One – Gas Enters the Pipeline*

After successfully completing the Verification Period, the Receipt Point Operator will enter into Monitoring Period One, during which Northern will verify continuous recordings from their installed on-site analyzers to verify that the Receipt Gas meets Northern's gas quality Specifications. In addition, the Operator will provide Northern with **bi-weekly test results (twice per month) for a period of five (5) months**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 1 below, for each of the months of Monitoring Period One. The initial Monitoring Period One test shall occur within the first week of entering the Monitoring Period One. Individual Acceptable Tests during the Monitoring Period One cannot be collected longer than eighteen (18) days from the preceding Acceptable Test.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

3. *Monitoring Period Two*

After successfully completing the Verification Period and Monitoring Period One, the Operator will enter into Monitoring Period Two, during which Northern will continue to take continuous recordings from its installed on-line analyzers to verify the Receipt Gas meets Northern's gas quality Specifications. In addition, the Operator will provide Northern with **monthly test results for a period of twelve (12) months**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 1 below, for each of the months of Monitoring Period Two. The initial Monitoring Period Two test shall occur within the first week of entering the Monitoring Period Two. Individual Acceptable Tests during the Monitoring Period Two cannot be collected longer than forty-five (45) days from the preceding Acceptable Test.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

4. *Monitoring Period Three*

After successfully completing the Verification Period, Monitoring Period One, and Monitoring Period Two, the Receipt Point Operator will enter into Monitoring Period Three. Northern will continue to take continuous recordings from its installed on-line analyzers to verify the Receipt Gas meets the gas quality specifications in Northern's Specifications. In addition, the Operator will provide Northern with **quarterly (every 3 months) test results**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the constituents listed in Table 1 below, **for as long as the plant is in operation** (Monitoring Period Three). The initial Monitoring Period Three test shall occur within the first month of entering the Monitoring Period Three. Individual Acceptable Tests during the Monitoring Period Three cannot be collected longer than one hundred ten (110) days from the preceding Acceptable Test.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

Northern reserves the right to test for any and all constituents at any time, without notice to the Receipt Point Operator.

Table 1 – Monitored Constituents for Landfill, Wastewater Treatment Sludge AD, Municipal Organics AD, Industrial Grade Food Waste AD and Mixed Organics AD Biomethane

Northern Natural Gas Renewable Natural Gas Pipeline Quality Specification (Biomethane)			
Parameter	Abbreviation	Tariff Limit (min./max.) or Assigned Value	Unit
Major Components			
Heating Value	HV	950 min.	BTU/scf
Carbon Dioxide	CO2	2.0 max.	% vol.
Oxygen	O2	0.2 max.	% vol.
Total O2+N2+CO2		4.0 max.	% vol.
Hydrogen Sulfide	H2S	0.25 max.	grains/100scf
Total Sulfur	S	20.0 max.	grains/100scf
Water Content	H2O	6.0 max.	lbs./MMscf
Temperature		<120° and >40°	Fahrenheit
Particulate Matter/Objectionable Material		Commercially free of any substance that interferes with the merchantability of the gas	
Trace Constituents			
Ammonia ^{2,3,4}	NH3	0.001 ⁵	% vol.
Hydrogen ^{2,3}	H2	0.1	% vol.
Siloxanes ^{1,4}	Si	0.5	mg Si/m3
Chlorine Total ⁴	Cl	10	mg/m3
Fluorine Total ⁴	F	10	mg/m3
Mercury ^{2,3,4}	Hg	0.08	mg/m3
Arsenic ^{2,3,4}	As	0.19 ⁶	mg/m3
Copper ^{2,3,4}	CU	0.6 ⁷	mg/m3

Footnote References/Conversions

¹CCST Report, June 2018

² Rules 21 + 29 (update), PG&E

³ Rules 30 + 45 (update), SoCal

⁴ CAN-BNQ 3672-100/2023

⁵10 ppmv

⁶0.06 ppmv

⁷0.23 ppmv

B. Biomethane Testing Protocols for Live Animal Manure (LAM) AD Biogas Source

The Receipt Point Operator shall demonstrate, before gas flow starts or resumes into Northern's pipeline system, that the Receipt Gas is merchantable and meets the gas quality specifications required by Northern's Specifications/Tariff by providing results from on-site analytical instrumentation and test results from a reputable analytical laboratory approved by Northern (Approved Laboratory).

1. *Verification Period – Gas is Not Delivered to the Pipeline*

Prior to the initial delivery of Receipt Gas into Northern's pipeline, the Receipt Point Operator shall operate their continuous on-site analyzers (real-time instrumentation owned and operated by the Operator, set at 5-minute analysis periods), **over a continuous two (2)-week period**, and provide Northern with results of analyses. In addition, the Operator will provide Northern with **weekly test results for the two (2) week period**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 2 below. All on-line, real-time, on-site analyzer results and field sample results must be verified by Northern and must demonstrate an acceptable level for each of the constituents listed in Table 2 before Receipt Gas will be allowed into Northern's system. The Receipt Point Operator must provide two (2) consecutive acceptable sets of test results to proceed to the next testing Period.

2. *Monitoring Period One – Gas is Delivered to the Pipeline*

After successfully completing the Verification Period, the Operator will enter into Monitoring Period One, during which Northern will take continuous recordings from its installed online analyzers, to verify that the Receipt Gas meets Northern's gas quality Specifications. In addition, the Operator will provide Northern with **monthly (once a month)**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 2 below, for **each of the months of the 6-month period** (Monitoring Period One). The initial Monitoring Period One test shall occur within the first week of entering Monitoring Period One. Individual Acceptable Tests during the Monitoring Period One cannot be collected longer than forty-five (45) days from the preceding Acceptable Test. The Receipt Point Operator must provide six (6) consecutive monthly Acceptable Test results to proceed to Monitoring Period Two.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

3. *Monitoring Period Two*

After successfully completing Monitoring Period One, the Operator will enter into Monitoring Period Two, during which Northern will take continuous recordings from its installed online analyzers, to verify that the Receipt Gas meets Northern's gas quality Specifications. In addition, the Operator will provide Northern with **quarterly (every three months)**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 2 below, for **the 12-month period following Monitoring Period One** (Monitoring Period Two). The initial Monitoring Period Two test shall occur within the first month of entering Monitoring Period Two. Individual Acceptable Tests during the Monitoring Period Two cannot be older than one hundred ten (110) days from the preceding Acceptable Test. The Receipt Point Operator must provide four (4)



consecutive quarterly Acceptable Test results to proceed to Monitoring Period Three.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

4. *Monitoring Period Three*

After successfully completing the Verification Period, Monitoring Period One, and Monitoring Period Two, the Operator will enter into Monitoring Period Three, during which Northern will continue to take continuous recordings from its installed online analyzers to verify the Receipt Gas meets Northern’s gas quality Specifications. In addition, the Operator will provide Northern with **semi-annual (twice yearly) test results**, from an Approved Laboratory, of triplicate sample analyses (Attachment 2) of the Receipt Gas for the trace constituents listed in Table 2 below, **for as long as the plant is in operation** (Monitoring Period Three). The initial Monitoring Period Three test shall occur within the first quarter of entering the Monitoring Period Three. Individual Acceptable Tests during the Monitoring Period Three cannot be older than two hundred ten (210) days from the preceding Acceptable Test.

See Section C.2. for shut-in conditions; review Table 3 for trace constituent shut-in tolerances.

Table 2 – Constituents for Dairy/Agricultural Waste AD ONLY

Northern Natural Gas Renewable Natural Gas Pipeline Quality Specification (Biomethane)			
Parameter	Abbreviation	Tariff Limit (min./max.) or Assigned Value	Unit
Major Components			
Heating Value	HV	950 min.	BTU/scf
Carbon Dioxide	CO2	2.0 max.	% vol.
Oxygen	O2	0.2 max.	% vol.
Total O2+N2+CO2		4.0 max.	% vol.
Hydrogen Sulfide	H2S	0.25 max.	grains/100scf
Total Sulfur	S	20.0 max.	grains/100scf
Water Content	H2O	6.0 max.	lbs./MMscf
Temperature		<120° and >40°	Fahrenheit
Particulate Matter/Objectionable Material		Commercially free of any substance that interferes with the merchantability of the gas	
Trace Constituents			
Ammonia ^{1,2,3}	NH3	0.001 ⁴	% vol.
Hydrogen ^{1,2}	H2	0.1	% vol.

Footnote References/Conversions
¹ Rules 21 + 29 (update), PG&E
² Rules 30 + 45 (update), SoCal
³ CAN-BNQ 3672-100/2023
⁴10 ppmv

C. Biomethane Receipt Gas Parameters- All Biogas Sources

1. Flow Interruption Testing

If the Receipt Gas flow is idled or stopped for more than sixty (60) consecutive days, the Receipt Point Operator will be required to perform one Acceptable Test of all major components, measured through on-line analytical testing, and the required trace constituents, through laboratory testing, prior to resuming flow. With respect to landfill, wastewater treatment sludge AD, municipal organics AD, industrial-grade food waste AD and mixed organics AD biogas sources, Northern must receive, review, and approve the results for one Acceptable Test prior to allowing the Receipt Gas to flow to the pipeline. Once Receipt Gas is flowing, the testing protocol may resume as normal. For LAM sources of biogas, the Receipt Gas may flow to the pipeline prior to return of laboratory analyses, if continuous readings from the on-line analyzers are approved by Northern. If the flow is idled or stopped for more than one (1) year, the testing protocol will be required to *start over* at the Verification Period set forth above for the biogas source. Acceptable Test results following a short flow interruption shall count toward the regular testing protocol.

If the receipt point flow is idled or stopped due to Receipt Point Operator's equipment, processing, or gas quality issues, Northern may require the Receipt Point Operator, at the Receipt Point Operator's sole cost and expense, to perform additional testing of the Receipt Gas.

2. Out-of-Tolerance Laboratory Results

All Receipt Gas entering the Northern pipeline shall be: 1) continuously monitored for major components through on-line, real-time analysis, and 2) tested for the presence of a set of trace constituents through scheduled, periodic field sampling and off-site laboratory testing. NOTE: If, at a time when reliable on-line instrumentation for accurate measurement of specific trace compounds is available, Northern may elect to install a suitable on-line analyzer. However, *all parameters must always be within the designated analytical boundaries (Attachment 1) despite testing regime*. The shut-in procedures will be discussed in turn:

- On-line, Real-time Monitoring of Receipt Gas – **MAJOR COMPONENTS**

With respect to on-line monitoring and analyses, Receipt Gas will be excluded from entering Northern's system ("shut-in" conditions) if any parameter, recorded in real-time, is measured outside of the Specification limits (Attachment 1) for a period of testing which includes **three consecutive test periods**, as recorded by Northern's instrumentation. For the purposes of determining shut-in, all on-line parameters will be recorded at the same (or as close to the same) interval as the GC reading. For example, using a GC which records measurements at five (5) minute intervals, off-specification Receipt Gas would potentially be shut-in after a total of three (3) consecutive readings or ten (10) minutes (time zero, 5 minutes and 10 minutes). Readings from Northern's on-line instrumentation will be used to determine shut-in requirements of Receipt Gas. The Receipt Point Operator shall be proactive in preventing off-specification Receipt Gas from entering the pipe which connects to the Northern system, in order to prevent shut-ins. The Receipt Point Operator is required to maintain their own automatic shut off/ diversion protocols, including use of flares, etc. Design of shut-in recirculation loops and pipeline evacuation schemes should be considered.

The Receipt Point Operator shall operate and maintain analytical equipment in accordance with good industry practice.

If parameters within the major components profile do not comply with Receipt Gas Specifications, where on-line, real-time monitoring is occurring on a continuous basis, then Receipt Gas will be shut-in (see language above) until Receipt Gas production plant issues have been rectified. When the problem has been mitigated, the Receipt Gas will again be monitored continuously. The Receipt Point Operator must have a plan for management of gas which does not meet the Receipt Gas Specifications. Receipt Gas outside the Receipt Gas Specifications cannot be blended or otherwise delivered to Northern's system. After a shut-in, and once the gas quality issue is resolved, Northern personnel will use commercially reasonable efforts to respond, at Receipt Point Operator's expense, during normal business hours to manually intervene to allow gas receipts to resume. Northern shall have no obligation to allow a resumption of the gas flow until the Receipt Point Operator has implemented corrective measures to bring Receipt Gas in line with the Receipt Gas Specifications.

- Field Sampling and Laboratory Testing – **TRACE CONSTITUENTS**

With respect to testing for trace constituents, field sampling and laboratory testing of Receipt Gas is necessary (on-line, real-time monitoring is not possible); the following protocol shall be executed. The stated analytical sampling methods and laboratory testing methods shall be used (see Attachment 2).

If the testing laboratory has returned results with analytical values outside the required Specification limits, the Receipt Point Operator will immediately assess the Receipt Gas production facility. Refer to Table 3, below, for Specification Limits and Immediate Shut-in Limit Values:

- a. If the value for any trace constituent is above the Specification Limit (Attachment 1) but **below** the Immediate Shut-in Limit, the Receipt Gas will be immediately resampled/tested for that parameter (in triplicate) and Receipt Gas will not be shut in. Laboratory testing of samples will be expedited. The Receipt Point Operator will make adjustments so that Receipt Gas quality is in line with the required Specification Limit. If, upon receipt of the second round of testing, the Receipt Gas does not meet the Specification limit, shut-in will occur until the production process has been corrected and the Receipt Gas quality is verified. Receipt Gas will be allowed to flow to the Northern pipeline *once the resulting value from the laboratory testing for the trace constituent meets the Specification Limit*.
- b. If a value for any trace constituent is **above** the Immediate Shut-In Limit, the Receipt Gas will be immediately shut in. The Receipt Point Operator shall make adjustments to meet the Specification Limit; Receipt Gas will be resampled (in triplicate) and results of testing will be expedited. Receipt Gas will be allowed to flow to the Northern pipeline *once the resulting value from laboratory testing for the trace constituent meets the Specification Limit*.
- c. **However, under either scenario listed above (#1 or #2), the out-of-specification parameter will return to a more stringent level of testing (previous Monitoring Period) for that trace constituent only.**

Table 3 – Northern Natural Biomethane Trace Constituent Limits

PARAMETER	SPECIFICATION LIMIT*	IMMEDIATE SHUT-IN LIMIT	UNIT
Ammonia	0.001	0.003	% vol.
Hydrogen	0.1	0.1	% vol.
Siloxanes	0.5	1.0	mg Si/m ³
Chlorine Total	10	25	mg/m ³
Fluorine Total	10	25	mg/m ³
Mercury	0.08	0.2	mg/m ³
Arsenic	0.19	0.48	mg/m ³
Copper	0.6	3.0	mg/m ³

* This is the limit which biomethane Receipt Gas is required to meet consistently. Design of the conditioning unit is based on this value and consistent performance is expected at this level.

For all instances (on-line testing and laboratory testing), when Receipt Gas is shut-in from the Northern pipeline, the Receipt Point Operator shall promptly deliver to Northern a detailed report describing the cause of the out-of-specification parameter, steps which rectified the situation, and an upgraded process/operation/maintenance plan to ensure that the situation does not occur again. Modifications to the Verification and Monitoring requirements are at the discretion of Northern.

Attachments 3 and 4 show the constituents, test method, and test frequency for each Monitoring Period, for each biogas source.

3. Plant Start-Up Requirements – All Receipt Gas

Prior to actual delivery of the Receipt Gas and prior to the Verification Period testing, a Plant Start-Up document shall be produced. This Period applies to all biogas sources. The Receipt Point Operator shall prepare and deliver to Northern a *Biomethane RNG Plant Operation Document*, comprised of the following, at a minimum:

1. A detailed list of anticipated maintenance procedures which necessitate planned Plant shutdown, even for a very short period of time.
2. A detailed description of contingency plans for Plant disruptions, including key contact personnel, phone numbers and chains of command.
3. A listing of all gas analysis equipment and analysis cycles (time between analyses). Specifics pertaining to inspections, calibration, and adjustments to the equipment on a regular basis shall be included.
4. Details of the remote transmittal of biomethane quality data/flow data to Northern.
5. A detailed emergency plan, in case of system failure, fire, etc.
6. Details of the remote gas shut-in system (including process plan, schematics).
7. Details of the gas metering equipment.
8. Details of Maximum Allowable Operating Pressure – Over Pressure Protection equipment.
9. Process/plan for purging of off-specification gas from line upstream of the receipt point into Northern’s pipeline.
10. Other details as requested by Northern specific to the site.

Receipt Gas produced during this Period *does not enter the pipeline*. This Period allows the Receipt Point Operator the flexibility to fully assess the Plant and modify engineering, equipment, etc. to meet the demands of the overall project. The length of time for this Period is variable and depends upon the ability of the Operator to yield Receipt Gas which reliably meets the requirements for gas quality and provide the comprehensive above-mentioned documentation to Northern.

D. Miscellaneous

- Northern reserves the right to test for any and all constituents at any time, without notice to the Receipt Point Operator.
- Northern shall have the right to share test results provided by the Receipt Point Operator with appropriate interested parties downstream of the Receipt Point and potential shippers.
- These guidelines will be included by reference in any Interconnect and Operating Agreement for a biomethane Receipt Point. These guidelines may be revised from time-to-time at Northern's sole discretion.
- At no time and at no point in the gas cleanup process is natural gas to be co-mingled with the biomethane Receipt Gas in order to dilute or enhance the quality of the final product to be added to the pipeline.
- If the biomass source changes or other sources of biomass are added to the AD system, the gas must be thoroughly tested for the presence of additional trace constituents. The Verification and Monitoring Program designed for LAM biogas is never to be used for other sources of biogas which may possess compromised biomass.
- Bacteria is categorized as a "particulate matter." Therefore, it falls under the category of "Objectionable Material". An industrial-grade, in-line filter is required to be installed by the Receipt Point Operator for filtration (0.3-micron pore size or less preferred), as is typical in natural gas operations. To monitor total corrosion, an Extended Analysis/Electron Microscope Corrosion Coupon may be installed by Northern. Testing for bacterial counts is not required.
- Northern reserves the right to alter the monitoring program, depending upon the success in maintaining a constant and high-quality gas profile over time. This applies to additional projects executed by the same Receipt Point Operator, using the same biogas source.
- Northern reserves the right to test the Receipt Gas at any time for any or all constituents in the Specification, without notice to the Operator. If, at any time, the results from LAM AD testing indicate that there are constituents cited in the landfill, wastewater treatment sludge, municipal organics, industrial-grade food waste and/or mixed organic waste AD requirements, the LAM AD Only program will revert to the more stringent program, with increased testing for all constituents shown in the associated Table 1.



NNG Biomethane Specification

PIPELINE QUALITY SPECIFICATION

Attachment 1

Parameter	Abbreviation	Tariff Limit (min./max.) or Assigned Value	Unit
Major Components			
Heating Value	HV	950 min.	BTU/scf
Carbon Dioxide	CO2	2.0 max.	% vol.
Oxygen	O2	0.2 max.	% vol.
Total O2+N2+CO2		4.0 max.	% vol.
Hydrogen Sulfide	H2S	0.25 max.	grains/100scf
Total Sulfur	S	20.0 max.	grains/100scf
Water Content	H2O	6.0 max.	lbs./MMscf
Temperature		<120° and >40°	Fahrenheit
Particulate Matter/Objectionable Material		Commercially free of any substance that interferes with the merchantability of the gas	
Trace Constituents			
Ammonia ^{2,3,4}	NH3	0.001 ⁵	% vol.
Hydrogen ^{2,3}	H2	0.1	% vol.
Siloxanes ^{1,4}	Si	0.5	mg Si/m3
Chlorine Total ⁴	Cl	10	mg/m3
Fluorine Total ⁴	F	10	mg/m3
Mercury ^{2,3,4}	Hg	0.08	mg/m3
Arsenic ^{2,3,4}	As	0.19 ⁶	mg/m3
Copper ^{2,3,4}	CU	0.6 ⁷	mg/m3

Footnote References/Conversions

¹CCST Report, June 2018

² Rules 21 + 29 (update), PG&E

³ Rules 30 + 45 (update), SoCal

⁴ CAN-BNQ 3672-100/2023

⁵10 ppmv

⁶0.06 ppmv

⁷0.23 ppmv



NNG RNG Quality Parameters

TESTING METHODOLOGY

Attachment 2

NORTHERN NATURAL GAS RNG QUALITY PARAMETERS (BIOMETHANE) WITH TESTING METHODOLOGY*							Testing Required: Biogas Source	
Gas Quality Constituent	Reference	Tariff Limit (max.) or Assigned Value	Field Instrument or Laboratory Instrument*	Analytical Method in the Laboratory*	Sampling Material, Material or Devise for Laboratory Analysis*	Comments	LF, WWT Sludge AD, MOW AD, IGFW AD, Mixed Waste AD***	Live Animal Manure****
MAJOR COMPONENTS- TESTED ONLINE, IN FIELD UNLESS APPROVED OTHERWISE								
High Heating Value (HHV)	Published Tariff	950 BTU/scf	Online Gas Chromatograph - NNat Approved; Calculation	ASTM D3588	N/A	See CCST Report for HHS tolerance - 970 BTU/scf recommended	X	X
Carbon Dioxide (CO2)	Published Tariff	2.0 vol% MAX	Online Gas Chromatograph	ASTM D1945/D1946	Steel Cylinder	Standard Procedure	X	X
Oxygen (O2)	Published Tariff	0.2 vol% MAX	Online Oxygen Analyzer	ASTM D1945/D1946	Steel Cylinder	Standard Procedure	X	X
Total Inerts (CO2+N2+O2)	Published Tariff	4.0 vol% MAX	Online Gas Chromatograph	ASTM D1945/D1946	Steel Cylinder	Standard Procedure, add all inerts	X	X
Hydrogen Sulfide	Published Tariff	.25 grains/100scf MAX	Online H2S Analyzer or Sulfur Analyzer	ASTM D6228/D5504	Sulfinert Steel Cylinder	Standard Procedure	X	X
Total Sulfur Compounds, as sulfur	Published Tariff	20 grains/100scf MAX	Online Sulfur Analyzer	ASTM D6228/D5504	Sulfinert Steel Cylinder	Standard Procedure; Field sampling and laboratory analysis is an option	X	X
Water Content	Published Tariff	6.0 lbs/MMscf	Online Analyzer	ASTM D1142 or ASTM D5454	Continuous Online	Standard Procedure	X	X
Delivery Temperature	Published Tariff	<120° and >40° F.	Online Analyzer	RTD in meter tube thermo well or similar/company preference	Continuous Online	Temperature of the injection gas	X	X
Particulates/Biologicals	Published Tariff	Commerically Free Of...	Filter as per gas company protocol		Filter prior to gas injection	Operator required to install in-line filter (0.3 micron or less) prior to gas introduction; Total corrosion can be monitored by EA/EM in-line coupon	X	X
TRACE CONSTITUENTS - SAMPLES RETRIEVED FROM FIELD, TAKEN TO LAB FOR ANALYSIS								
Ammonia	Ref. 2, 3, 4	0.001 vol% 10 ppmV	AAS/Ion Chromatography	OSHA ID-188 NIOSH 6015 EPA M26	Glass Tubes Glass Tubes Mod. EPA Method 26 (Impingers)	Analytical Method pairs with Sampling Method; EPA Method is impinger method	X	X
Hydrogen	Ref. 2, 3	0.1 Vol %	Gas Chromatography/Thermal Conductivity Detector	ASTM D1945/D1946	Tedlar Bag/Cylinder/Check with your Laboratory	Specific to pipeline integrity	X	X
Siloxanes	Ref. 1, 4	0.5 mg Si/m3	Gas Chromatography/Mass Spectrometry	ASTM D8230-19	Tedlar bag - Analysis within 72 hours; Sample cylinder - check with your laboratory for holding times, options	ASTM recently approved method	X	
Halocarbons - Halogens	Ref. 4	Chlorine: 10 mg/m3 TOTAL Fluorine: 10 mg/m3 TOTAL	Gas Chromatography/Mass Spectrometry	EPA TO-15**	5-L Tedlar Bag; Summa Canisters. Check with laboratory. Impinger method in field: EPA Method 26/26A	Total Cl and F can also be quantified from TO-15 results.	X	
Mercury	Ref. 2, 3, 4	0.08 mg/m3	Atomic Adsorption Spectroscopy	ASTM D5954	Gold Plated Silica Beads		X	
Arsenic	Ref. 2, 3, 4	0.19 mg/m3 or 0.06 ppmv	Atomic Adsorption Spectroscopy/ICAP	EPA Method 29 Modified	EPA Method 29 Impingers		X	
Copper	Ref. 2, 3, 4	0.60 mg/m3 or 0.23 ppmv	Atomic Adsorption Spectroscopy/ICAP	EPA Method 29 Modified	EPA Method 29 Impingers		X	

Specification References

Reference 1 CCST, 2018
 Reference 2 Rules 30 and 45 (updated), SoCal
 Reference 3 Rules 21 and 29 (updated), PG&E
 Reference 4 CAN-BNQ 3672-100/2023

*Sampling methods and analytical testing methods for trace constituents may be updated over time. Alternative methods must be approved by NNat.

**TO-15 with calculation for total chlorine and fluorine, considering molecular weight and % of total compound, unless impinger method is used.

***Landfill, Wastewater Treatment Sludge AD, Mixed Organic Wastes (MOW) ("Green Bin" wastes), Industrial-Grade Food Waste (IGFW), Mixed organics from various sources

****Agricultural waste may be considered for this program, if qualified as "clean"



NNG RNG Plant Start-Up, Verification and Monitoring Program Guidelines for Injection to the Natural Gas Pipeline

LANDFILL, WASTEWATER TREATMENT SLUDGE AD, MUNICIPAL ORGANICS WASTE AD, INDUSTRIAL GRADE FOOD WASTE AD, MIXED ORGANICS AD

Attachment 3

**NORTHERN NATURAL RNG (BIOMETHANE) PLANT START-UP, VERIFICATION and MONITORING PROGRAM GUIDELINES FOR INJECTION TO THE NATURAL GAS PIPELINE GRID:
LANDFILL, WASTEWATER TREATMENT SLUDGE AD, MUNICIPAL ORGANICS WASTE AD, INDUSTRIAL-GRADE FOOD WASTE AD, MIXED ORGANICS AD**

TARIFF - MAJOR COMPONENTS									
PARAMETER and COMPANY APPROVED ON-LINE, CONTINUOUS METHODOLOGY/EQUIPMENT									
	HHV	CARBON DIOXIDE	OXYGEN	TOTAL INERTS (CO ₂ + N ₂ + O ₂)	HYDROGEN SULFIDE	TOTAL SULFUR	MOISTURE CONTENT	DELIVERY TEMP	PARTICULATE/BIOLOGICALS
Tariff Limit or Assigned Value	950 BTU/scf min.	2.0 vol% max.	0.2 vol% max.	4.0 vol% max.	0.25 grains/100scf max	20.0 grains/100scf max	6.0 lb/MMscf max.	40 - 120° F	Commercially Free Of...
Referenced Laboratory Method*	ASTM D3588	ASTM D1945/D1946	ASTM D1945/D1946	ASTM D1945/D1946	ASTM D6228/D5504	ASTM D6228/D5504	ASTM D1142/ASTM D5454	RTD in meter tube thermo well	
Sampling Method*	Online GC*	Online GC*	Online Oxygen Analyzer	Online GC*	Online Analyzer*	Online Analyzer* or Field Sample	Online Analyzer*	Online Analysis*	In-line, industrial filter; 0.3 micron or less, installed by Receipt Point Operator
PLANT START-UP PERIOD RNG Plant Operation Document	Producer Creates								
RNG VERIFICATION PERIOD GAS DOES NOT FLOW TO THE PIPELINE Week 1 - 4 Testing On-Line, Continuous**	Y	Y	Y	Y	Y	Y	Y	Y	Check Filter at Completion
RNG MONITORING PERIODS GAS FLOWS TO PIPE									
MONITORING PERIOD 1 (Month 2 - 6) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Check/Change Filter at Completion
MONITORING PERIOD 2 (Month 7 - 18) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Check/Change Filter at Completion
MONITORING PERIOD 3 (Month 19 - Length of Project) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Change Filter Annually/As Necessary

* Approved Northern Natural instrumentation and methodology only

**Gas does not flow to the pipeline until all testing results have been returned and verified/approved by Northern Natural

Y = Yes

NOTE: All on-line instruments are continuous, always.

NOTES: Events or conditions that trigger addition laboratory analysis include: a significant reading of off-spec RNG as indicated by the continuous analyser(s), an expansion of the RNG generation process, an indication of a significant change in the RNG composition. NOTE THE FOLLOWING IMPORTANT INFORMATION: If any parameter measured through Continuous Testing exceeds the tariff limits or assigned values, for three consecutive readings with on-line instrumentation, immediate shut-in of the RNG will occur. Gas must be flared/diverted until the situation has been rectified and the producer can verify gas quality standards. Sampling methods and analytical test methods may be modified or changed over time, based upon updates in test methods and instrumentation. Proposed alternative test methods, especially for trace constituents, must be approved by Northern Natural. Northern Natural reserves the right to modify this program based upon testing results.

**NORTHERN NATURAL RNG (BIOMETHANE) PLANT START-UP, VERIFICATION and MONITORING PROGRAM GUIDELINES FOR INJECTION TO THE NATURAL GAS PIPELINE GRID:
LANDFILL, WWT TREATMENT SLUDGE AD, MUNICIPAL ORGANIC WASTE AD, INDUSTRIAL-GRADE FOOD WASTE AD, MIXED ORGANICS AD**

TRACE CONSTITUENTS								
PARAMETER and TESTING BY THIRD PARTY LABORATORIES								
	HYDROGEN	AMMONIA	SILOXANES	CHLORINE: TOTAL	FLUORINE: TOTAL	MERCURY	ARSENIC	COPPER
Assigned Value	0.10%	0.001% - 10 ppm	0.5 mg Si/m3	10 mg/m3	10 mg/m3	0.08 mg/m3	0.19 mg/m3 or 0.06 ppmv	0.60 mg/m3 or 0.23 ppmv
Referenced Laboratory Method*	ASTM D1945/D1946	OSHA ID-188; NIOSH 6015/6016; EPA Method 26 (Mod)	ASTM D8230-19	EPA TO-15	EPA TO-15	ASTM D5954	EPA Method 29	EPA Method 29
Sampling Method*	Steel Cylinder	Glass Tubes or EPA Method 26 (Mod)	ASTM D8230	Check with Lab	Check with Lab	Gold Pated Silica Beads	EPA Method 29 Mod.	EPA Method 29 Mod.
PLANT START-UP PERIOD RNG Plant Operation Document	PRODUCER CREATES							
RNG VERIFICATION PERIOD GAS DOES NOT FLOW TO THE PIPELINE								
WEEK 1-4 Testing: Sample ONCE A WEEK, same day of the week, over 4 weeks ** (4 Test Sets Consistently Meeting Specification)***	4	4	4	4	4	4	4	4
RNG MONITORING PERIODS GAS FLOWS TO PIPE								
MONITORING PERIOD 1 (Month 2 - 6) Bi-Weekly (Total Count for 5 months) - Same week during each Month (first, second, third, etc.)**	10	10	10	10	10	10	10	10
MONITORING PERIOD 2 (Month 7 - 18) Monthly (Every Month, for 12 Months)****	12	12	12	12	12	12	12	12
MONITORING PERIOD 3 (Month 19 - Length of Project) Quarterly (Every 3 Months, for Length of Project)****	4 per year	4 per year	4 per year	4 per year	4 per year	4 per year	4 per year	4 per year

* Approved Northern Natural methodology only
 ** Samples to be taken on MONDAY, TUESDAY or WEDNESDAY for overnight shipment to the laboratory.
 *** Gas does not flow to the pipeline until all testing results have been returned and verified/approved by Northern Natural.
 **** Sample events shall be regular, separated equally through the test period; see Operating Guidelines.

NOTES: Events or conditions that trigger additional laboratory analysis include: a significant reading of off-spec RNG as indicated by the continuous analyser(s), an expansion of the RNG generation process, an indication of a significant change in the RNG composition, addition of a new biomass source, others. Sampling methods and analytical test methods may be modified or changed over time, based upon updates in test methods and instrumentation. Proposed alternative test methods, especially for trace constituents, must be approved by Northern Natural. Northern Natural reserves the right to modify this program, based on results of testing over time. Northern Natural reserves the right to update laboratory methodologies, as newer, more accurate, less expensive approved approaches become available.



NNG RNG Plant Start-Up, Verification and Monitoring Program Guidelines for Injection to the Natural Gas Pipeline

LAM ONLY
Attachment 4

NORTHERN NATURAL RNG (BIOMETHANE) PLANT START-UP, VERIFICATION and MONITORING PROGRAM GUIDELINES FOR INJECTION TO THE NATURAL GAS PIPELINE GRID:
LAM ONLY

TARIFF - MAJOR COMPONENTS									
PARAMETER and COMPANY APPROVED ON-LINE, CONTINUOUS METHODOLOGY/EQUIPMENT									
	HHV	CARBON DIOXIDE	OXYGEN	TOTAL INERTS (CO ₂ + N ₂ + O ₂)	HYDROGEN SULFIDE	TOTAL SULFUR	MOISTURE CONTENT	DELIVERY TEMP	PARTICULATE/BIOLOGICALS
Tariff Limit or Assigned Value	950 BTU/scf min.	2.0 vol% max.	0.2 vol% max.	4.0 vol% max.	0.25 grains/100scf max.	20.0 grains/100scf max.	6.0 lb/MMscf max.	40 - 120° F	Commercially Free Of...
Referenced Laboratory Method*	ASTM D3588	ASTM D1945/D1946	ASTM D1945/D1946	ASTM D1945/D1946	ASTM D6228/D5504	ASTM D6228/D5504	ASTM D1142/ASTM D5454	RTD in meter tube thermo well	
Sampling Method*	Online GC*	Online GC*	Online Oxygen Analyzer*	Online GC*	Online Analyzer*	Online Analyzer* or Field Sample	Online Analyzer*	Online Analysis*	In-line, industrial filter, 0.3 micron or less, installed by Receipt Point Operator
PLANT START-UP PERIOD RNG Plant Operation Document	Producer Creates								
RNG VERIFICATION PERIOD GAS DOES NOT FLOW TO THE PIPELINE Week 1 - 2 Testing On-Line, Continuous**	Y	Y	Y	Y	Y	Y	Y	Y	Check Filter at Completion
RNG MONITORING PERIODS GAS FLOWS TO PIPE									
MONITORING PERIOD 1 (Month 1 - 6) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Check/Change Filter at Completion
MONITORING PERIOD 2 (Month 7 - 18) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Check/Change Filter at Completion
MONITORING PERIOD 3 (Month 19 - Length of Project) Continuous	Y	Y	Y	Y	Y	Y	Y	Y	Change Filter Annually/As Necessary

* Approved Northern Natural instrumentation and methodology only
 **Gas does not flow to the pipeline until all testing results have been returned and verified/approved by Northern Natural
 Y = Yes
 NOTE: All on-line instruments are continuous, always.

NOTES: Events or conditions that trigger addition laboratory analysis include: a significant reading of off-spec RNG as indicated by the continuous analyser(s), an expansion of the RNG generation process, an indication of a significant change in the RNG composition.
 NOTE THE FOLLOWING IMPORTANT INFORMATION: If any parameter measured through Continuous Testing exceeds the tariff limits or assigned values, for three consecutive readings with on-line instrumentation, immediate shut-in of the RNG will occur. Gas must be flared/diverted until the situation has been rectified and the producer can verify gas quality standards. Sampling methods and analytical test methods may be modified or changed over time, based upon updates in test methods and instrumentation. Proposed alternative test methods, especially for trace constituents, must be approved by Northern Natural. Northern Natural reserves the right to modify this program based upon testing results.



NORTHERN NATURAL RNG (BIOMETHANE) PLANT START-UP, VERIFICATION and MONITORING PROGRAM GUIDELINES
FOR INJECTION TO THE NATURAL GAS PIPELINE GRID:

LAM ONLY

TRACE CONSTITUENTS		
PARAMETER and TESTING BY THIRD PARTY LABORATORIES		
	HYDROGEN	AMMONIA
Assigned Value	0.10%	0.001% - 10 ppm
Referenced Laboratory Method*	ASTM D1945/D1946	OSHA ID-188; NIOSH 6015/6016; EPA Method 26 (Mod)
Sampling Method*	Steel Cylinder	Glass Tubes or EPA Method 26 (Mod)
PLANT START-UP PERIOD		
RNG Plant Operation Document	PRODUCER CREATES	
RNG VERIFICATION PERIOD		
GAS DOES NOT FLOW TO THE PIPELINE		
WEEK 1-2 Testing: Sample ONCE A WEEK, same day of the week, over 2 weeks ** (2 Test Sets Consistently Meeting Specification)***	2	2
RNG MONITORING PERIODS		
GAS FLOWS TO PIPE		
MONITORING PERIOD 1 (Month 1 - 6)		
Monthly (Total Count for 6 months) - Same week during each Month (first, second, third, etc.)**	6	6
MONITORING PERIOD 2 (Month 7 - 18)		
Quarterly (Every 3 Months, for 12 Months)****	4	4
MONITORING PERIOD 3 (Month 19 - Length of Project)		
Twice a Year (Every 6 Months, for Length of Project)****	2 per year	2 per year

* Approved Northern Natural methodology only

** Samples to be taken on MONDAY, TUESDAY or WEDNESDAY for overnight shipment to the laboratory.

***Gas does not flow to the pipeline until all testing results have been returned and verified/approved by Northern Natural.

**** Sample events shall be regular, separated equally through the test period, see Operating Guidelines.

NOTES: Events or conditions that trigger additional laboratory analysis include: a significant reading of off-spec RNG as indicated by the continuous analyser(s), an expansion of the RNG generation process, an indication of a significant change in the RNG composition, addition of a new biomass source, others. Sampling methods and analytical test methods may be modified or changed over time, based upon updates in test methods and instrumentation. Proposed alternative test methods, especially for trace constituents, must be approved by Northern Natural. Northern Natural reserves the right to modify this program, based on results of testing over time.