



<p>Construction Technical Specification</p> <h1 style="text-align: center;">Biomethane Quality Verification and Monitoring</h1>	
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Approved: Dan Kizer	Reviewed: Steiner/DeLucia

1. Scope

This Specification establishes the technical requirements for ongoing Biomethane quality verification and monitoring.

2. General Requirements

2.1 Abbreviations

- AD – Anaerobic Digestate
- ELAP – Washington State Department of Ecology Laboratory Accreditation Program
- LAM – Live Animal Manure
- MTS – Material Technical Specification
- ORELAP – Oregon Environmental Laboratory Accreditation Program
- WWT – Wastewater Treatment

2.2 Definitions

- Biomethane – pipeline-quality gas produced from various biomass sources through a biochemical process, such as anaerobic digestion.
- Force Majeure – war, terrorism, revolution, civil commotion, acts of public enemies, blockade, embargo, national strikes, or any other act whatsoever, that is beyond the reasonable control of the Party affected, that could not have been prevented by the exercise of due diligence, or that could not otherwise reasonably be foreseen and guarded against. Force Majeure does not include changes in pricing or other economic conditions.
- LDC System – pipelines and facilities within NW Natural’s natural gas local distribution system.
- Producer – Group, entity, or persons generating Biomethane
- Producer-Owned Facilities – any upstream facilities, piping, and equipment, necessary to connect the Producer site to the Receipt Point Facilities.
- Receipt Point Facilities – NW Natural-owned facilities at the Producer site including pipe connecting Producer’s outlet flange to NW Natural’s distribution system, metering, pressure control equipment, quality monitoring equipment, odorization facilities, valving, automation control, communication equipment, and associated appurtenances and site work.

2.3 Reference Documents

MTS-006 – Biomethane Quality Specification

3. Testing Prerequisites

3.1 Biomethane Quality

In addition to the constituents in the Biomethane Quality Specification(MTS-006), Producer will ensure that the Biomethane injected into the Receipt Point Facilities has the following qualitative conditions:

- 3.1.1 The Biomethane will be free from foreign odors, solid matter, dust, gums, and gum forming constituents, or any other substance that interferes with the intended merchantability of the Biomethane or NW Natural's ability to properly odorize or causes interference with the proper and safe operation of the lines, meters, regulators, or other facilities or equipment through which it may flow.
- 3.1.2 The Biomethane will not contain any toxic or hazardous substance in concentrations that, in the normal use of the Biomethane, may be hazardous to health, injurious to pipeline facilities, limit merchantability, or be inconsistent with applicable legal requirements or government standards.
- 3.1.3 The Biomethane will not contain substances, including microbiological organisms, active bacteria, or bacterial agents, at levels that may damage NW Natural's pipelines, meters, regulators, or other facilities and equipment through which such Biomethane flows, or interfere with the operation of NW Natural's facilities.

3.2 Producer-Owned Facilities Start-Up

Prior to injection of the Biomethane into the LDC System, Producer will prepare and deliver to NW Natural a document ("Plant Operations Document") that details procedures and protocols for the Producer-Owned Facilities that may impact NW Natural operations or assets or the safety of NW Natural customers. The Plant Operations Document should include the following, at a minimum:

- 3.2.1 A detailed list of anticipated maintenance procedures that necessitate a shut-down of the Producer-Owned Facilities.
- 3.2.2 A detailed description of contingency plans for disruptions to the Producer-Owned Facilities, including key contact personnel, phone numbers, and chains of command.
- 3.2.3 A listing of all gas analysis equipment and analysis cycles (time between analyses) used at the Producer-Owned Facilities, including details for inspections, calibration, and adjustments to equipment.
- 3.2.4 Details of the remote transmittal of Biomethane quality and flow data from the Producer-Owned Facilities to the Receipt Point Facilities.
- 3.2.5 A detailed emergency plan, in case of system failure, fire, and other emergencies related to the Producer-Owned Facilities.

- 3.2.6 Details of the remote gas shut-in system for the Producer-Owned Facilities, including process plan and schematics.
- 3.2.7 Details of the gas metering equipment at the Producer-Owned Facilities.
- 3.2.8 Details of recycling/flaring of Biomethane that does not comply with the MTS-006.
- 3.2.9 Other details related to the Producer-Owned Facilities, as requested by NW Natural.

4. Testing Requirements

4.1 Continuous Monitoring

Following completion of Pre-Injection Testing, the following monitoring will be performed by NW Natural at Producer's expense:

- 4.1.1 Gas monitoring equipment (including a gas chromatograph, related equipment, and applicable communications facilities and software) will be installed, operated, and maintained at the Receipt Point Facilities to monitor Biomethane compliance with the MTS-006.
- 4.1.2 For each parameter in the MTS-006, the value of the Biomethane for that parameter will be measured, calculated, and evaluated either (at NW Natural's sole discretion) on a continuous basis or at a frequency consistent with the normal cycling time of the applicable instrument(s)
- 4.1.3 If there are multiple gas quality monitoring devices providing information for the same parameters, Producer will accept the measurements provided by NW Natural's gas monitoring equipment for the purpose of distinguishing between Biomethane that does and does not meet the MTS-006.
- 4.1.4 If data is not available through NW Natural's equipment, NW Natural may use data generated from Producer's on-line gas quality monitoring equipment to decide whether to accept delivery of Biomethane, under the following conditions:
 - 4.1.4.1. Producer's monitoring data is shared with NW Natural and transmitted in real time to NW Natural continuously, and
 - 4.1.4.2. NW Natural verifies that data from Producer's equipment has accuracy and measurement frequency equivalent to NW Natural's equipment.
- 4.1.5 NW Natural may request a deviation from the gas quality monitoring equipment and interval requirements established in this specification where additional measures are necessary to provide reliable service in a safe environment.
- 4.1.6 Calibrations will be completed on all NW Natural-owned equipment by NW Natural or its designated contractor based on manufacturer recommendations.

4.2 Testing and Sampling

At Producer's sole cost and expense, Producer will procure and furnish all materials, equipment, supplies, services, and labor required to test the Biomethane for the constituents identified in the Biomethane Quality Specification for the feedstock used to produce the Biomethane. Samples will be extracted, sealed, and transported by Producer, using established and customary sampling procedures, and sent for analysis to an independent certified third-party laboratory. All sampling and testing methods must comply with the requirements outlined in Exhibit A.

- 4.2.1 The Producer will hire an independent certified third-party laboratory (Oregon Environmental Laboratory Accreditation Program [ORELAP] certified, Washington State Department of Ecology [ELAP] certified, or equivalent in another state, as applicable to the location of the Plant) to perform tests for the Biomethane constituents. The laboratory must be capable of detecting constituents at levels specified in the MTS-006. NW Natural reserves the right to specify the laboratory that Producer uses for testing required under in this specification.
- 4.2.2 Producer will provide NW Natural a minimum of five (5) business days' advance notice of the Biomethane sampling and NW Natural will have the option to have a representative present to observe the samples being taken.
- 4.2.3 Sample collection, handling, preservation, packaging, and delivery must be performed in accordance with industry standards, by qualified and properly trained individuals. NW Natural reserves the right to specify the personnel that Producer uses for sampling required under this specification
- 4.2.4 NW Natural and Producer agree to share information related to any testing of the Biomethane quality with each other no more than five (5) business days from the date of receipt from the laboratory, including the constituent(s) measured, the date of the sample, the date of the analysis, the sampling methodology, the sampling equipment, detection and reportable limits, the sample test results, and quality control test results.
- 4.2.5 Any testing results that identify a constituent outside the allowed levels in the MTS-006 must be shared with NW Natural by Producer immediately upon receipt of results by calling the NW Natural Gas Control phone number (1-800-422-4012 x4613, as may be updated from time to time by NW Natural).
- 4.2.6 Producer will ensure that field sampling of Biomethane constituents complies with the following requirements: (i) all field samples will be collected in triplicate (i.e., for each sampling event, three samples of each constituent will be retrieved, concurrently or in sequence, with the results of the three samples averaged); (ii) unless approved by NW Natural in writing, the sampling will not exclude a data point that differs from other sampling data; (iii) samples collected using the same analytical method may be collected in triplicate, but tested together.
- 4.2.7 NW Natural may at its sole discretion provide Producer with requirements for sampling method, analytical method in laboratory, and any required laboratory

instruments.

4.3 Pre-Injection Testing

Prior to injection of Biomethane from the Producer-Owned Facilities to the Receipt Point Facilities, Producer will at its expense ensure that Biomethane is tested weekly for 2 or 4 consecutive weeks (depending on the source of the Biomethane) for compliance with the MTS-006 (“**Pre-Injection Testing**”). Pre-Injection Testing will be performed in accordance with the following:

- 4.3.1 Biomethane from live animal manure (LAM), agricultural waste, or municipal organics/industrial grade food waste/mixed organics systems will be tested weekly for 2 weeks. Biomethane from landfill/wastewater treatment (WWT) systems will be tested weekly for 4 weeks.
- 4.3.2 Parameters listed in the MTS-006 for “Continuous Monitoring” will be monitored in real-time, using on-line instrumentation that records and reports continuously at the Receipt Point Facilities. Constituents that are listed in the MTS-006 as “Constituents for Laboratory Testing” will be sampled post-conditioning and laboratory-tested in accordance with Section 4.1.
- 4.3.3 Biomethane will not be injected into the Receipt Point Facilities until Pre-Injection Testing has been completed and the testing results verified by NW Natural as compliant with the MTS-006.
- 4.3.4 If at any time prior to completion of Pre-Injection Testing the Biomethane does not comply with the MTS-006, testing will continue on a weekly basis until the required consecutive test results comply with the MTS-006.
- 4.3.5 If halogens, heavy metals or siloxanes are present in the municipal organic/industrial grade food waste/mixed waste used to produce the Biomethane, Pre-Injection Testing and following monitoring periods will include the testing requirements for landfill/WWT systems.
- 4.3.6 If LAM or agricultural waste will be used to produce the Biomethane, NW Natural may at its sole discretion require the testing for the complete list of constituents listed in the Biomethane Quality Specification as “Constituents for Laboratory Testing”. If it is found that halogens, heavy metals or siloxanes are present in any LAM/agricultural waste systems, the sampling schedule will immediately revert to the program associated with landfill/WWT sludge systems for Pre-Injection Testing and the following monitoring periods.

4.4 Monitoring Period 1

After the successful completion of Pre-Injection Testing, Producer will comply with the requirements of this Section 4.3 (“**Monitoring Period 1**”) at Producer’s expense. During Monitoring Period 1, on-line, continuous sampling will record all major components data in real-time, and sampling for all trace constituents will occur, in accordance with the following requirements:

- 4.4.1 For Biomethane sources of LAM or agricultural waste AD, samples for total sulfur, ammonia and hydrogen will be collected monthly for 6 months.
- 4.4.2 For Biomethane sources of landfill or WWT sludge AD, samples for all constituents in the Biomethane Quality Specification will be collected bi-weekly, for 5 months.
- 4.4.3 For Biomethane produced from municipal organics/industrial grade food waste/mixed organics AD, testing will be as follows: monthly sampling of total sulfur, ammonia and hydrogen and bi-monthly sampling of all other constituents in the MTS-006, for 6 months. If halogens, heavy metals or siloxanes are present in any municipal organic/industrial grade food waste/mixed waste AD are used as the source for the Biomethane, Monitoring Period 1, and the following monitoring periods, will include compliance with the testing requirements for landfill/WWT systems.
- 4.4.4 NW Natural may at its sole discretion perform a full trace constituent profile on LAM/agricultural waste AD used as the source of the Biomethane, without notice to Producer. If halogens, heavy metals, or siloxanes are present in any LAM/agricultural waste AD system, the sampling schedule Monitoring Period 1, and the following monitoring periods, will include compliance with the testing requirements for landfill/WWT systems.
- 4.4.5 If during Monitoring Period 1 any constituent is noncompliant with the MTS-006, the Producer will immediately resample in accordance with Section 4.2. If that constituent is again noncompliant with the MTS-006, the out-of-specification constituent will return to a more stringent level of testing (previous Monitoring Period) for that trace constituent only. For example, if Producer is in Monitoring Period 1, this constituent testing would return Pre-Injection Testing. If Producer is in Monitoring Period 2, this constituent would return to Monitoring Period 1.

4.5 Monitoring Period 2

Upon successful completion of Monitoring Period 1, the Producer will comply with the requirements of this Section 4.5 ("**Monitoring Period 2**"). During Monitoring Period 2, on-line, continuous sampling will record all major components data in real-time, and sampling for all trace constituents will occur, in accordance with the following requirements:

- 4.5.1 For Biomethane sources of LAM or agricultural waste AD, samples will be collected quarterly for total sulfur, ammonia and hydrogen, from the seventh month after completion of Pre-Injection Testing ("Month 7") until the Producer-Owned Facilities are no longer in operation.
- 4.5.2 For Biomethane sources of landfill or WWT sludge AD, samples will be collected monthly for all constituents in the MTS-006 from Month 7 to the eighteenth month after completion of Pre-Injection Testing ("Month 18").
- 4.5.3 For Biomethane produced from municipal organics or industrial-grade food waste or mixed organics AD, all constituents in the MTS-006 will be tested quarterly, from Month 7 until the Plant is no longer in operation. If halogens, heavy metals or

siloxanes are present in any municipal organic or industrial grade food waste or mixed waste AD system used to produce the Biomethane, the sampling schedule Monitoring Period 2 will include compliance with the testing requirements for landfill/WWT systems.

- 4.5.4 NWN may at its discretion perform a full trace constituent profile on LAM or agricultural waste AD Biomethane, without notice to Producer, at the Producer's expense. If it is found that halogens, heavy metals, or siloxanes are present in any LAM or agricultural waste AD system, Monitoring Period 1 will include compliance with the testing requirements for landfill/WWT systems.
- 4.5.5 If during Monitoring Period 2 any constituent is noncompliant with the MTS-006, the Producer will immediately resample in accordance with Section 4.2. If that constituent is again noncompliant with the Biomethane Quality Specification, the out-of-specification constituent will return to a more stringent level of testing (previous Monitoring Period) for that trace constituent only.

4.6 Monitoring Period 3

Upon successful completion of Monitoring Period 2, the Biomethane from landfills and WWT sludge AD will be monitored through on-line, continuous sampling of all constituents listed in the MTS-006 for "Continuous Monitoring" in perpetuity, and sampling for constituents that are listed in the MTS-006 as "Constituents for Laboratory Testing" will occur quarterly.

If during Monitoring Period 3 any constituent is noncompliant with the MTS-006, the Producer will immediately resample in accordance with Section 4.2. If that constituent is again noncompliant with the MTS-006, the out-of-specification constituent will return to a more stringent level of testing (previous Monitoring Period) for that trace constituent only.

4.7 Changes to Producer-Owned Facilities

Producer will provide sixty (60) days' notice to NW Natural if there will be (i) feedstock used in the Producer-Owned Facilities other than the types described in items (1) and (2) of the definition of "renewable biomass" in 40 CFR 80.1401, (ii) a change in feedstock from what has been used in the Producer's Biomethane production process, or (iii) a change in the Producer-Owned Facilities (including the conditioning or cleanup equipment) that could cause the Biomethane injected into the Receipt Point Facilities to be out of compliance with the MTS-006. For purposes of item (iii) of this Section 4.7, replacing a component with a functionally-equivalent component does not constitute a "change". As a result of any of the changes identified in this Section 4.7, NW Natural may direct Producer to complete one round of Pre-Injection Testing pursuant to Section 4.3 for the constituents identified in the MTS-006 before resuming Biomethane injections.

5. Interruption of Biomethane Injection and Restart Procedure

- 5.1 At its sole discretion, NW Natural may interrupt Biomethane injection to the Receipt Point Facilities under any of the following circumstances:
- 5.1.1 Any on-line gas quality monitoring instrument is not providing current and accurate measurements or power is not available to critical components;
 - 5.1.2 The Biomethane contains constituents at concentrations that prevent or restrict the normal marketing of Biomethane, are at levels that are injurious to pipeline facilities, or are at levels that present a health or safety hazard to people;
 - 5.1.3 There is an imminent safety risk; or
 - 5.1.4 Force Majeure.
- 5.2 NW Natural will interrupt Biomethane injections to the Receipt Point Facilities under any of the following circumstances:
- 5.2.1 Two consecutive samples of a constituent in the Biomethane do not comply with the MTS-006 for Continuous Monitoring as stated in Section 4.1;
 - 5.2.2 If the value of a constituent exceeds the applicable Immediate Shut-In Limit stated in Table A (below).
 - 5.2.3 If the value for any constituent exceeds the applicable Specification Limit stated in Table A, but is less than the applicable Immediate Shut-in Limit in Table A, and after Producer resamples and tests for that constituent, the constituent continues to exceed the Specification Limit.

Table A: Specification Limits and Immediate Shut-In Limits

Constituent	Specification Limit*	Immediate Shut-In Limit	Unit
Ammonia	0.001	0.003	% vol.
Hydrogen	5.0	8.0	% vol.
Siloxanes	0.1	0.5	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

* Biomethane required to be consistently at or below these limits.

5.3 Restart Procedure

Prior to restart of Biomethane injection into the Receipt Point Facilities following a shut-off pursuant to Section 5.1 or 5.2, Producer will demonstrate to NW Natural (in accordance with NW Natural's operation procedure for the Receipt Point Facilities) that the Biomethane meets the MTS-006.

NW Natural, at its sole discretion, may require Pre-Injection Testing (described in Section 4.3), at the Producer's expense, as part of demonstrating compliance with the MTS-006.

6. Certifications and Submittals

Producer will summarize the results of all laboratory testing using a cover sheet approved by NW Natural. Producer will attach the cover sheet to a compiled PDF of laboratory results and submit the compiled PDF to NWNRNGQuality@nwnatural.com.



Exhibit A – Biomethane Sampling and Testing Requirements

Gas Quality Constituent	Field or Lab Instrument	Analytical Lab Method	Sampling Method, Material, or Devise*	Comments
Arsenic (As)	Atomic Adsorption Spectroscopy	EPA Method 29 Modified	EPA Method 29 Impingers	
Copper (Cu)	Atomic Adsorption Spectroscopy/ICAP	EPA Method 29 Modified	EPA Method 29 Impingers	
Ammonia (NH ₃)	AAS, Ion Chromatography	OSHA ID-188 NIOSH 6015/6016 EPA Method 26 Modified	Glass Tubes Glass Tubes EPA Method 26 Modified	Analytical Method pairs with the Sampling Method; EPA Method is an impinger method
Hydrogen (H ₂)	Online Gas Chromatograph	ASTM D1945/D1946	Steel Cylinder	Standard Procedure
Mercury (Hg)	Atomic Adsorption Spectroscopy/ICAP	ASTM D5954	Gold Plated Silica Beads	
Siloxanes (Si)	Gas Chromatography/Mass Spectrometry	ASTM D8230 -19	Tedlar bag - Analysis within 72 hours; Sample cylinder - check with your laboratory for preference, holding times	
Chlorine, Total (Cl)	Gas Chromatography/Mass Spectrometry	EPA TO-15**	5-L Tedlar Bag; Summa Canisters: TO-15; Impinger method in the field: EPA Modified 26/26A	Impinger method available for Cl and F quantification only: EPA 26/26A
Fluorine, Total (F)				
Sulfur, Total (S)		ASTM D6228/D5504	Sulfinert Steel Cylinder	

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

**TO-15 with calculation for total chlorine and fluorine, considering molecular weight and % of total compound