AIR MANAGEMENT
PROGRAM GUIDANCE

DRAFT FOR PUBLIC REVIEW

Wisconsin Department of Natural Resources
101 S. Webster Street, P.O. Box 7921
Madison, WI 53707-7921

PERMIT GUIDANCE FOR RNG PROCESSORS

March 21, 2024

AM-641 2024

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

Air Management Guidance

February 2024

PERMIT GUIDANCE FOR RNG PROCESSORS

Renewable natural gas process

Renewable natural gas (RNG) is generated using the biogas exhaust from anaerobic digesters and can be pumped to, and injected into, a natural gas pipeline. Farms may install anaerobic digesters to process dairy manure, reducing odors and the volume of liquid waste that would otherwise need to be spread on fields. Wastewater treatment plants (WWTP), food production facilities and organic waste management facilities are other examples of facilities that may install digesters to reduce odors and manage waste volume. RNG systems can be installed and operated by the same facility generating the organic materials (i.e., farms, WWTP) or by a separate facility that collects either the organic materials to be stored in anaerobic digesters or the raw biogas directly.

The conversion of raw biogas to RNG typically includes the following three treatment stages:

- Primary: basic moisture and particulate removal
- Secondary: additional moisture removal, contaminant removal (e.g., sulfur and siloxanes) and compression
- Advanced: carbon dioxide (CO_2), oxygen (O_2), nitrogen (N_2) and volatile organic compounds (VOC) removal and further compression

The primary treatment stage removes moisture by passing the gas through a knockout pot, filter and blower. This primary treatment is all that is required if the biogas is to be burned off in a flare. The secondary stage condenses and removes additional moisture, then removes contaminants such as siloxanes and sulfur compounds and, if needed, can include additional compression. This secondary treatment results in medium-Btu gas that can be used in boilers or for electricity generation applications such as engines and turbines. The advanced treatment stage is used to transform biogas into RNG by removing CO_2, O_2, N_2, VOCs and siloxanes (as needed).

Pollutants emitted from a RNG process

The primary air pollutants from a digester and RNG conversion process are organic compounds and sulfur compounds, with hydrogen sulfide (H_2S) being the most common sulfur compound emitted. When combusted, H_2S, a hazardous air contaminant, is converted to sulfur dioxide (SO_2), a criteria air pollutant. Digesters also can require the combustion of natural gas or other fuels as part of the operations. For example, materials in the digester may be heated by steam from boilers that burn natural gas or other fuels. Fuel combustion produces additional criteria pollutants, such as nitrogen oxides (NOx), carbon monoxide (CO), particulate matter (PM), and hazardous air pollutants (HAPs).

Other sources of air pollution from RNG processing result from burning biogas that does not meet natural gas pipeline specifications. Such gas is typically sent through a flare resulting in emissions of CO, NOx, PM, and SO_2. RNG processing may also generate tail gases which are produced during the secondary processing step that removes contaminants, mostly sulfur compounds, including H_2S. The sulfur-rich tail gas is usually controlled through the use of a thermal oxidizer, which combusts the H_2S and other hazardous air contaminants, converting most of the H_2S into SO_2 that is then emitted to the atmosphere. In some cases, tail gas may be vented uncontrolled if emissions of hazardous air pollutants are below regulatory thresholds.

Does adding a RNG process require an air pollution permit?

Any new construction or modification at a facility should be evaluated for the need to obtain an air pollution permit. Most RNG facilities require a permit before construction can be started. Some RNG facilities may qualify for the DNR's streamlined registration permit while others will need a source specific construction and operation permit. For more information on permit options visit the Air Permit Options webpage.

The first step to evaluate the type of permitting needed is determining the scope of the facility. When the RNG facility and the organic materials generator (e.g., farm or WWTP) are co-located or located near each other, a determination by the Wisconsin Department of Natural Resources (DNR) must be made on whether the sources are separate or considered a single facility. If the RNG facility is determined to be a separate source from the organic materials generator, only the emissions associated with the RNG processes (i.e., flaring, tail gas venting and heating) need to be evaluated. Otherwise, if the RNG process is under ownership and control of the organic materials generator, all air emissions units at the facility must be included and total emissions compared against the registration permit thresholds.

If the anaerobic digester providing biogas to the RNG plant is owned and operated by the organic materials generator instead of by the RNG plant, the digester and supporting equipment will be covered by a separate air permit. If the anaerobic digester is owned and operated by the RNG plant, the digester and supporting equipment will be included in the RNG plant permit. The DNR may request information about the contracts in place between the RNG plant and the owner of the digester to ensure the facilities are permitted correctly.

Emissions calculations needed for a RNG process

SO_2 emissions are usually the determining factor in deciding whether a source specific permit or registration permit is the best fit for a facility. Both maximum theoretical and actual emissions of SO_2 need to be calculated to make this determination.

Calculating actual emissions of SO_2 should be based on an average using multiple samples of measured hydrogen sulfide (H_2S) concentrations and the expected normal gas flow from the existing digester. This information can be obtained by installing a continuous H_2S monitoring device. Facilities should use Equation 1 to calculate SO_2 emissions. Lacking H_2S concentration samples, the worst-case concentration described below must be used.

Equation 1:

$$SO_2\left(\frac{lb}{hr}\right) = \frac{C_{H_2S}\,(ppmv)}{10^6} \times Q_{gas}\left(\frac{ft^3}{min}\right) \times 10.13$$

Where:
$\boldsymbol{SO_2}$ = Sulfur dioxide emission rate from digester gas combustion, in units of pounds per hour
$\boldsymbol{C_{H_2S}}$ = Concentration of hydrogen sulfide in digester gas, in units of parts per million by volume (ppmv)
$\boldsymbol{Q_{gas}}$ = Flowrate of digester gas, in units of standard cubic feet per minute (scfm)
10.13 = Conversion factor assuming standard conditions (*1 atm, 60°F*) and 100% conversion of H_2S to SO_2.

To calculate maximum theoretical emissions of SO_2 from biogas combustion assume at least 6,000 ppmv for digester gas at dairy farms or 2,500 ppmv for digester gas at WWTP. These default values represent the worst-case scenarios and should be used for the air dispersion modeling analysis if required by the permit. Alternatively, existing facilities can use the peak H_2S concentration in raw biogas measured during the last 12 consecutive months consisting of at least one sample per month and incorporate a 25% safety factor in the calculation of maximum theoretical emissions.

Next steps

After calculating the actual and maximum theoretical emission rates, review the eligibility thresholds for the registration permits. If the company decides to pursue a registration permit, complete the appropriate application form and application checklist. Application guides for the respective registration permits are found on the Registration Permit Options webpage. If all registration permit eligibility criteria cannot be met, including a demonstration that the facility protects ambient air quality through air dispersion modeling if required, the facility should submit a source specific permit application. Helpful information on the source specific air permit process can be found by selecting the Construction tab on the Air Permit Options webpage.

Permit applicants also should note the following:

- A plot plan with locations and heights of buildings and stacks will be requested for the permit review.
- Any existing biogas engines subject to Standards of Performance for spark ignition internal combustion engines, NSPS Subpart JJJJ, must be decommissioned prior to applying for a registration permit. If a facility plans to continue operation of an existing biogas engine,the facility should apply for a source specific permit.

Application forms and checklists are available on the Air Permit and Compliance Forms webpage. Review the application steps on the How to Apply webpage to ensure a smooth application process.

For more information:

- Industry specific webpages: Agribusiness and Wastewater Treatment Plants
- For questions on registration permits, contact the Registration Permit Coordinator at DNRAMROPSAIRPERMIT@wisconsin.gov.
- For questions on environmental requirements, contact the Small Business Environmental Assistance Program at DNRSmallBusiness@wisconsin.gov or 855-889-3021.

DISCLAIMER *— The Wisconsin Department of Natural Resources (DNR) is committed to promoting diversity, fairness, equity and the principles of environmental justice. We ensure that we do not discriminate in employment, programs, decisions, actions or delivery of services. If you have questions or to request information in an alternative format (large print, Braille, audio tape, etc.), please contact us at 888-936-7463 or https://dnr.wi.gov/About/Nondiscrimination.*

Wisconsin Department of Natural Resources
Air Management Program
Box 7921- AM/7
Madison, WI 53707
PHONE 608-266-7718 • FAX 608-267-0560
AM-641 2024