06/12/2025

No	TOXIC REVIEW
No	SYNTHETIC MINOR TO AVOID MAJOR NSR
No	CEMS
No	MACT/GACT
No	NSPS
No	NESHAPS
No	NETTING
No	MODELING SUBMITTED
No	SYNTHETIC MINOR TO AVOID TITLE V
No	FEDERALLY ENFORCABLE PTIO (FEPTIO)
No	SYNTHETIC MINOR TO AVOID MAJOR GHG

Mr. Tim Fuller
Massillon NG2H, LLC
1200 E Market Street
Suite 650
Akron, OH 44305

RE: **FINAL AIR POLLUTION PERMIT-TO-INSTALL AND OPERATE**

Facility ID: 1576135042
Permit Number: P0137644
Permit Type: Initial Installation
County: Stark

Dear Permit Holder:

Enclosed please find a final Ohio Environmental Protection Agency (EPA) Air Pollution Permit-to-Install and Operate (PTIO) which will allow you to install, modify, and/or operate the described emissions unit(s) in the manner indicated in the permit. Because this permit contains conditions and restrictions, please read it very carefully. In this letter, you will find the information on the following topics:

- **Pay any applicable permit fee**
- **How to appeal this permit**
- **How to save money, reduce pollution and reduce energy consumption**
- **How to give us feedback on your permitting experience**
- **How to get an electronic copy of your permit**
- **What should you do if you notice a spill or environmental emergency?**

Pay any applicable permit fee

If there is an enclosed invoice that is associated with this permit action, you must pay the invoice in 30 days. This permit fee supports Ohio EPA's activities to review and issue the necessary approvals for construction or modification of the affected sources. Failure to provide the applicable permit fee within 30 days may result in the accrual of substantial interest penalties. This permit is also conditioned on the payment of any applicable permit fee.

How to appeal this permit

The issuance of this PTIO is a final action of the Director and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of $70.00,

made payable to "Ohio Treasurer Robert Sprague," which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
30 East Broad Street, 4th Floor
Columbus, OH 43215

How to save money, reduce pollution and reduce energy consumption

The Ohio EPA is encouraging companies to investigate pollution prevention and energy conservation. Not only will this reduce pollution and energy consumption, but it can also save you money. If you would like to learn ways you can save money while protecting the environment, please contact our Office of Compliance Assistance and Pollution Prevention at (614) 644-3469. Additionally, all or a portion of the capital expenditures related to installing air pollution control equipment under this permit may be eligible for financing and State tax exemptions through the Ohio Air Quality Development Authority (OAQDA) under Ohio Revised Code Section 3706. For more information, see the OAQDA website: ***Ohio Air Quality Development Authority***.

How to give us feedback on your permitting experience

Please complete a survey at ***DAPC - Survey | Ohio Environmental Protection Agency*** and give us feedback on your permitting experience. We value your opinion.

How to get an electronic copy of your permit

This permit can be accessed electronically via the eBusiness Center: Air Services in Microsoft Word format or in Adobe PDF on the Ohio EPA document search website here: ***eDocument Search | Ohio Environmental Protection Agency***.

What should you do if you notice a spill or environmental emergency?

Any spill or environmental emergency which may endanger human health or the environment should be reported to the Emergency Response 24-HOUR EMERGENCY SPILL HOTLINE toll-free at (800) 282-9378. Report non-emergency complaints to the appropriate district office or local air agency.

If you have any questions regarding your permit, please contact Canton City Public Health Air Pollution Control at (330)489-3385

Sincerely,

Robert Hodanbosi
Chief, Division of Air Pollution Control

cc: Canton

Ohio Environmental Protection Agency

FINAL

Division of Air Pollution Control

Permit-to-Install and Operate

for

Massillon NG2H, LLC

Facility ID:	1576135042
Permit Number:	P0137644
Permit Type:	Initial Installation
Issued:	06/12/2025
Effective:	06/12/2025
Expiration:	06/12/2035

Ohio Environmental Protection Agency

Division of Air Pollution Control

Permit-to-Install and Operate

for

Massillon NG2H, LLC

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Authorization

Facility ID:	1576135042
Application Number(s):	A0076940
Permit Number:	P0137644
Permit Description:	Initial installation PTIO for a chemical looping process which converts natural gas to produce nearly pure hydrogen while isolating carbon dioxide for beneficial use.
Permit Type:	Initial Installation
Permit Fee	$1,000.00
Issue Date:	06/12/2025
Effective Date:	06/12/2025
Expiration Date:	06/12/2035
Permit Evaluation Report (PER) Annual Date:	Jan 1 - Dec 31, Due Feb 15

This document constitutes issuance of a Permit-to-Install and Operate for the emissions unit(s) identified on the following page to:

Massillon NG2H, LLC
1810 Ninth St SW
Massillon, OH 44647

Ohio Environmental Protection Agency (EPA) District Office or local air agency responsible for processing and administering your permit:

Canton City Public Health Air Pollution Control
420 Market Ave.
Canton, OH 44702-1544
(330)489-3385

The above-named entity is hereby granted this Permit-to-Install and Operate for the air contaminant source(s) (emissions unit(s)) listed in this section pursuant to Chapter 3745-31 of the Ohio Administrative Code. Issuance of this permit does not constitute expressed or implied approval or agreement that, if constructed or modified in accordance with the plans included in the application, the described emissions unit(s) will operate in compliance with applicable State and federal laws and regulations.

This permit is granted subject to the conditions attached hereto.

Ohio Environmental Protection Agency

Entered into the Journal of the Director on:

John Logue
Director

Date: 06/12/2025

Authorization (continued)

Permit Number:P0137644

Permit Description:Initial installation PTIO for a chemical looping process which converts natural gas to produce nearly pure hydrogen while isolating carbon dioxide for beneficial use.

Permits for the following Emissions Unit(s) or groups of Emissions Units are in this document as indicated below:

Emissions Unit ID:	**P001**
Company Equipment ID:	Hydrogen Production via Chemical Looping Process
Superseded Permit Number:	
General Permit Category and Type:	Not Applicable

List of Commonly Used Abbreviations

AP-42 = U.S. EPA's Compilation of Air Pollution Emissions Factors	HVLP = high volume, low pressure	PER = Permit Evaluation Report
ASTM = American Society for Testing and Materials	LAER = lowest achievable emission rate	PM = particulate matter
BACT = Best Available Control Technology	lb(s)/hr = pound(s) per hour	PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns
BAT = Best Available Technology	LDAR = leak detection and repair	$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
CAA = Clean Air Act	LPG = liquefied petroleum gas/propane	ppb = parts per billion
CAM = compliance assurance monitoring	MACT = maximum achievable control technology	ppm = parts per million
CEMS = continuous emissions monitoring system	MAGLC = maximum acceptable ground level concentration	PSD = Prevention of Significant Deterioration
CFC = chlorofluorocarbon	mg/m3 = milligrams per cubic meter	psi = pounds per square inch
CFR = Code of Federal Regulations	MM = million	psia = pounds per square inch absolute
CH_4 = methane	MMBtu = million British Thermal Units	PTE = potential-to-emit
CI = compression ignition	MSDS = material safety data sheet	PTI = Permit-to-Install
CO = carbon monoxide	MSW = municipal solid waste	PTIO = Permit-to-Install and Operate
CO_2 = carbon dioxide	NAAQS = National Ambient Air Quality Standard	PTO = Permit-to-Operate
COM = continuous opacity monitor	NESHAP = National Emission Standard for Hazardous Air Pollutants	PWR = process weight rate
DAPC = Division of Air Pollution Control	NG = natural gas	RACM = reasonably available control measures
DO/LAA = District Office/Local Air Agency	ng/m3 = nanograms per cubic meter	RACT = reasonably available control technology
dscf = dry standard cubic foot	NH_3 = ammonia	RATA = relative accuracy test audit
EAC = emissions activity category	NMHC = non-methane hydrocarbons	RTO = regenerative thermal oxidizer
eDocs = electronic documents database	NMOC = non-methane organic compound	SB265 = Senate Bill 265
ERAC = Environmental Review Appeals Commission	NO = nitrogen oxide	scfm = standard cubic feet per minute
ESP = electrostatic precipitator	NO_2 = nitrogen dioxide	SI = spark ignition
EU = emissions unit	NO_x = nitrogen oxides	SIP = State Implementation Plan
FEPTIO = Federally Enforceable Permit-to-Install and Operate	NSPS = New Source Performance Standard	SO_2 = sulfur dioxide
FER = Fee Emissions Report	NSR = New Source Review	SSMP = startup, shutdown, and malfunction plan
FR = Federal Register	NTV = Non-Title V	TDS = total dissolved solids
GACT = generally achievable control technology	O&M = operation and maintenance	TLV = threshold limit value
GHG = greenhouse gases	OAC = Ohio Administrative Code	TO = thermal oxidizer
gr/dscf = grains per dry standard cubic foot	OC = organic compound	TPH = ton(s) per hour
H_2S = hydrogen sulfide	Ohio EPA = Ohio Environmental Protection Agency	TPY = ton(s) per year
H_2SO_4 = sulfuric acid	ORC = Ohio Revised Code	TSP = total suspended particulates
HAP = hazardous air pollutant	Pb = lead	VE = visible emissions
HCl = hydrogen chloride	PBR = Permit-By-Rule	VMT = vehicle miles traveled
HF = hydrogen fluoride	PCB = polychlorinated biphenyl	VOC = volatile organic compound
Hg = mercury	PE = particulate emissions	WPP = work practice plan
hp = horsepower	PEMS = predictive emissions monitoring system	µg/m3 = micrograms per cubic meter

A. Standard Terms and Conditions

1. What does this permit-to-install and operate (PTIO) allow me to do?

This permit allows you to install and operate the emissions unit(s) identified in this PTIO. You must install and operate the unit(s) in accordance with the application you submitted and all the terms and conditions contained in this PTIO, including emission limits and those terms that ensure compliance with the emission limits (for example, operating, recordkeeping and monitoring requirements).

2. Who is responsible for complying with this permit?

The person identified on the "Authorization" page, above, is responsible for complying with this permit until the permit is revoked, terminated, or transferred. "Person" means a person, firm, corporation, association, or partnership. The words "you," "your," or "permittee" refer to the "person" identified on the "Authorization" page above.

The permit applies only to the emissions unit(s) identified in the permit. If you install or modify any other equipment that requires an air permit, you must apply for an additional PTIO(s) for these sources.

3. What records must I keep under this permit?

You must keep all records required by this permit, including monitoring data, test results, strip-chart recordings, calibration data, maintenance records, and any other record required by this permit for five years from the date the record was created. You can keep these records electronically, provided they can be made available to Ohio EPA during an inspection at the facility. Failure to make requested records available to Ohio EPA upon request is a violation of this permit requirement.

4. What are my permit fees and when do I pay them?

There are two fees associated with permitted air contaminant sources in Ohio:

a) PTIO fee. This one-time fee is based on a fee schedule in accordance with Ohio Revised Code (ORC) section 3745.11 or based on a time and materials charge for permit application review and permit processing if required by the Director.

You will be sent an invoice for this fee after you receive this PTIO and payment is due within 30 days of the invoice date. You are required to pay the fee for this PTIO even if you do not install or modify your operations as authorized by this permit.

b) Annual emissions fee. Ohio EPA will assess a separate fee based on the total annual emissions from your facility. You self-report your emissions in accordance with Ohio Administrative Code (OAC) Chapter 3745-78. This fee assessed is based on a fee schedule in ORC section 3745.11 and funds Ohio EPA's permit compliance oversight activities. For facilities that are permitted as synthetic minor sources, the fee schedule is adjusted annually for inflation. Ohio EPA will notify you when it is time to report your emissions and to pay your annual emission fees.

5. When does my PTIO expire, and when do I need to submit my renewal application?

This permit expires on the date identified at the beginning of this permit document (see "Authorization" page above) and you must submit a renewal application to renew the permit. Ohio EPA will send a renewal notice to you approximately six months prior to the expiration date of this permit. However, it is very important that you submit a complete renewal permit application (either electronically through Ohio EPA's eBusiness Center: Air Services web service or postmarked prior to expiration of this permit) even if you do not receive the renewal notice.

If a complete renewal application is submitted before the expiration date, Ohio EPA considers this a timely application for purposes of ORC section 119.06, and you are authorized to continue operating the emissions unit(s) covered by this permit beyond the expiration date of this permit until final action is taken by Ohio EPA on the renewal application.

6. What happens to this permit if my project is delayed or I do not install or modify my source?

This PTIO expires 18 months after the issue date identified on the "Authorization" page above unless otherwise specified if you have not (1) started constructing the new or modified emission sources identified in this permit, or (2) entered into a binding contract to undertake such construction. This deadline can be extended once by 12 months, provided you apply to Ohio EPA for this extension within a reasonable time before the 18-month period has ended and you can show good cause for any such extension.

7. What reports must I submit under this permit?

An annual permit evaluation report (PER) is required in addition to any malfunction reporting required by OAC rule 3745-15-06 or other specific rule-based reporting requirement identified in this permit. Your PER due date is identified in the Authorization section of this permit.

8. If I am required to obtain a Title V operating permit in the future, what happens to the operating provisions and permit evaluation report (PER) obligations under this permit?

If you are required to obtain a Title V permit under OAC Chapter 3745-77 in the future, the permit-to-operate portion of this permit will be superseded by the issued Title V permit. From the effective date of the Title V permit forward, this PTIO will effectively become a PTI (permit-to-install) in accordance with OAC rule 3745-31-02(B). The following terms and conditions of this permit will no longer be applicable after issuance of the Title V permit: Section B, Term 1.b) and Section C, for each emissions unit, Term a)(2).

The PER requirements in this permit remain effective until the date the Title V permit is issued and is effective and cease to apply after the effective date of the Title V permit. The final PER obligation will cover operations up to the effective date of the Title V permit and must be submitted on or before the submission deadline identified in this permit on the last day prior to the effective date of the Title V permit.

9. What are my obligations when I perform scheduled maintenance on air pollution control equipment?

You must perform scheduled maintenance of air pollution control equipment in accordance with OAC rule 3745-15-06(A). If scheduled maintenance requires shutting down or bypassing any air pollution control equipment, you must also shut down the emissions unit(s) served by the air pollution control equipment during maintenance, unless the conditions of OAC rule 3745-15-06(A)(3) are met. Any emissions that exceed permitted amount(s) under this permit (unless specifically exempted by rule) must be reported as deviations in the annual permit evaluation report (PER), including nonexempt excess emissions that occur during approved scheduled maintenance.

10. Do I have to report malfunctions of emissions units or air pollution control equipment? If so, how must I report?

If you have a reportable malfunction of any emissions unit(s) or any associated air pollution control system, you must report this to the Canton City Public Health Air Pollution Control in accordance with OAC rule 3745-15-06(B). Malfunctions that must be reported are those that result in emissions that exceed permitted emission levels. It is your responsibility to evaluate control equipment breakdowns and operational upsets to determine if a reportable malfunction has occurred.

If you have a malfunction but determine that it is not a reportable malfunction under OAC rule 3745-15-06(B), it is recommended that you maintain records associated with control equipment breakdown or process upsets. Although it is not a requirement of this permit, Ohio EPA recommends that you maintain records for non-reportable malfunctions.

11. Can Ohio EPA or my local air agency inspect the facility where the emission unit(s) is/are located?

Yes. Under Ohio law, the Director or his/her authorized representative may inspect the facility, conduct tests, examine records or reports to determine compliance with air pollution laws and regulations and the terms and conditions of this permit. You must provide, within a reasonable time, any information Ohio EPA requests either verbally or in writing.

12. What happens if one or more emissions units operated under this permit is/are shut down permanently?

Ohio EPA can terminate the permit terms associated with any permanently shut down emissions unit. "Shut down" means the emissions unit has been physically removed from service or has been altered in such a way that it can no longer operate without a subsequent "modification" or "installation" as defined in OAC Chapter 3745-31.

You should notify Ohio EPA of any emissions unit that is permanently shut down by submitting a certification that identifies the date on which the emissions unit was permanently shut down. The certification must be submitted by an authorized official from the facility. You cannot continue to operate an emission unit once the certification has been submitted to Ohio EPA by the authorized official.

You must comply with all recordkeeping and reporting for any permanently shut down emissions unit in accordance with the provisions of the permit, regulations or laws that were enforceable during the period of operation, such as the requirement to submit a PER, air fee emission report, or malfunction report. You must also keep all records relating to any permanently shut down emissions unit, generated while the emissions unit was in operation, for at least five years from the date the record was generated.

Again, you cannot resume operation of any emissions unit certified by the authorized official as being permanently shut down without first applying for and obtaining a permit pursuant to OAC Chapter 3745-31.

13. Can I transfer this permit to a new owner or operator?

You can transfer this permit to a new owner or operator. If you transfer the permit, the new owner or operator must follow the procedures in OAC Chapter 3745-31-07, including notifying Ohio EPA or the local air agency of the change in ownership or operator within thirty days of the transfer date. Any transferee of this permit shall assume the responsibilities of the transferor permit holder.

14. Does compliance with this permit constitute compliance with OAC rule 3745-15-07, "air pollution nuisance"?

This permit and OAC rule 3745-15-07 prohibit operation of the air contaminant source(s) regulated under this permit in a manner that causes a nuisance. Ohio EPA can require additional controls or modification of the requirements of this permit through enforcement orders or judicial enforcement action if, upon investigation, Ohio EPA determines existing operations are causing a nuisance.

15. What happens if a portion of this permit is determined to be invalid?

If a portion of this permit is determined to be invalid, the remainder of the terms and conditions remain valid and enforceable. The exception is where the enforceability of terms and conditions are dependent on the term or condition that was declared invalid.

B. Facility-Wide Terms and Conditions

1. This permit document constitutes a PTI issued in accordance with ORC 3704.03(F) and a PTO issued in accordance with ORC 3704.03(G).

   a) For the purpose of a PTI document, the facility-wide T&C identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

      (1) None.

   b) For the purpose of a PTO document, the facility-wide T&C identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

      (1) None.

C. Emissions Unit Terms and Conditions

1. P001, Hydrogen Production via Chemical Looping Process

Operations, Property and/or Equipment Description:

Hydrogen production via chemical looping process. One overall process with two separate exhaust streams. The first is the Combined CO_2/Depleted Air Stream where particulate emissions from the breakdown of the oxygen carrier particles are controlled by a baghouse. The second is the Hydrogen Product Stream, where potential particulate emissions are controlled by an in-line cyclone, a direct contact cooler, and a wet ESP in series, all of which which are inherent to the process rather than being add-on control equipment. There is also a flare used to combust the Hydrogen Product Stream during commissioning and tuning operations or during upset conditions. The flare has a continuously lit pilot (0.07 MMBtu/hr). Not located in an Appendix A area.

a) This permit document constitutes a PTI issued in accordance with ORC 3704.03(F) and a PTO issued in accordance with ORC 3704.03(G).

(1) For the purpose of a PTI document, the emissions unit terms & conditions identified below are federally enforceable with the exception of those listed below which are enforceable under state law only.

a. None.

(2) For the purposes of a PTO document, the emissions unit terms & conditions identified below are enforceable under state law only with the exception of those listed below which are federally enforceable.

a. None.

b) Applicable Emissions Limitations and/or Control Requirements

(1) The specific operation(s), property, and/or equipment that constitute each emissions unit along with the applicable rules and/or requirements and with the applicable emissions limitations and/or control measures are identified below. Emissions from each unit shall not exceed the listed limitations, and the listed control measures shall be specified in narrative form following the table.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
a.	ORC 3704.03(T) OAC Rule 3745-31-05(A)(3) [Best Available Technology (BAT) for pollutants with potential to emit greater than 10 TPY]	The permittee shall install and operate a baghouse designed to meet a control efficiency of at least 98% for PE/PM_{10} emissions from the Combined CO_2 /Depleted Air Stream whenever this emissions unit is in operation. See c)(1)-(2) below.

	Applicable Rules/Requirements	Applicable Emissions Limitations/Control Measures
		Emissions of nitrogen oxide (NO_x) shall not exceed 1.07 tons/month averaged over a 12-month rolling period. See b)(2)a. below.
b.	OAC Rule 3745-31-05(A)(3)(a)(ii) [Less than 10 ton/yr BAT exemption]	The Best Available Technology (BAT) requirements under OAC rule 3745-31-05(A)(3) do not apply to the CO, SO_2, or VOC emissions from this emission unit since the uncontrolled potential to emit is less than 10 tons per year for each of these air contaminants. See g)(1) – g)(3) below.
c.	OAC rule 3745-17-07(A)(1) [Visible particulate emission limitations for stack emissions]	Visible particulate emissions from the baghouse stack and flare serving this emissions unit shall not exceed 20% opacity as a six-minute average, except as provided by rule.
d.	OAC rule 3745-17-11(B) [Restrictions on particulate emissions from industrial processes (stack emissions)]	Particulate emissions from the baghouse stack serving the Combined CO_2 /Depleted Air Stream shall not exceed 6.75 pounds per hour.

(2) Additional Terms and Conditions

a. The emissions limit for NOx was established to reflect the potential to emit. Therefore, it is not necessary to develop monitoring, recordkeeping and/or reporting requirements to ensure compliance with this emissions limitation.

c) Operational Restrictions

(1) The permittee shall install and operate a dry particulate filter system (hereafter "baghouse") for the control of particulate emissions from the Combined CO_2 /Depleted Air Stream whenever this emissions unit is in operation, and shall maintain the baghouse in accordance with the manufacturer's recommendations, instructions, and/or operating manual(s), with any modifications or additional instructions or operating procedures deemed necessary by the permittee.

(2) In the event the baghouse is not operating in accordance with the manufacturer's recommendations, instructions, or operating manual, with any modifications or additional instructions or operating procedures deemed necessary by the permittee, the baghouse shall be expeditiously repaired or otherwise returned to these documented operating conditions.

d) Monitoring and/or Recordkeeping Requirements

(1) The permittee shall properly install, operate, and maintain equipment to monitor the pressure drop across the baghouse while the emissions unit is in operation. The monitoring equipment shall be installed, calibrated, operated, and maintained in accordance with the manufacturer's recommendations, instructions, and/or operating manual(s), with any modifications or additional instructions or operating procedures deemed necessary by the permittee.

a. The pressure drop across the baghouse shall be maintained within the range recommended by the manufacturer, with any modifications deemed necessary by the permittee, while the emissions unit is in operation.

b. The permittee shall record the pressure drop across the baghouse on a weekly basis on all days when the emissions unit is in operation.

c. If the pressure drop across the baghouse is outside the acceptable range, the permittee shall take prompt corrective action to bring the pressure drop within the acceptable range. The permittee shall document the corrective actions taken, including the start time and date, and end time and date when the pressure drop was outside of the acceptable range.

(2) The permittee shall maintain records that document any time periods when the baghouse was not in service when the emissions unit was in operation, as well as a record of all operations during which the baghouse was not operated according to the manufacturer's recommendations, instructions, or operating manuals, with any documented modifications deemed necessary by the permittee.

e) Reporting Requirements

(1) An annual Permit Evaluation Report (PER) form will be mailed or e-mailed to the permittee at the end of the reporting period specified in the Authorization section of this permit. The permittee shall submit the annual PER to Canton City Public Health, Air Pollution Control Division (Canton APC) by the due date identified in the Authorization section of this permit. The PER shall cover a reporting period of no more than twelve months for each air contaminant source identified in this permit.

(2) The annual PER may be submitted electronically through the Ohio EPA's eBusiness Center: Air Services online web portal, or mailed/delivered in hard copy form to Canton APC, or sent to Canton APC as a scanned email attachment.

(3) The permittee shall identify the following information in the annual permit evaluation report, in accordance with the monitoring requirements for the baghouse in d)(1) above:

a. Each period of time (start time and date, and end time and date) when the pressure drop across the baghouse was outside of the acceptable range.

b. A description of the corrective actions taken to bring the pressure drop into compliance with the acceptable range.

f) Testing Requirements

(1) Compliance with the Emissions Limitations and/or Control Requirements specified in section b) of these terms and conditions shall be determined in accordance with the following methods:

a. Control Requirement

The permittee shall install and operate a baghouse designed to meet a control efficiency of at least 98% for PE/PM_{10} emissions from the Combined CO_2 /Depleted Air Stream whenever this emissions unit is in operation.

Applicable Compliance Method

If required, the permittee shall demonstrate compliance with the control requirement above by emissions testing performed in accordance with U.S. EPA Method 5 as set forth in 40 CFR part 60, Appendix A. For the purpose of this compliance demonstration, all particulate emissions (PE) are assumed to be less than or equal to 10 microns in diameter (PM_{10}) and are assumed to be filterable. Accordingly, Method 5 for filterable PE shall be considered the appropriate test method.

b. Emissions Limitation

Emissions of nitrogen oxide (NO_x) shall not exceed 1.07 tons/month averaged over a 12-month rolling period.

Applicable Compliance Method

The emissions limitation was established based on the maximum potential to emit from this air contaminant source. It is the total potential to emit from the Combined CO_2/Depleted Air Stream plus the Hydrogen Product Stream (at the flare exhaust when combusting hydrogen). First, the maximum hourly emission rate for each of the two exhaust streams was calculated as shown below based on information provided in the permit application received 1/30/2025.

Combined CO_2/Depleted Air Stream

As explained in the permit application, natural gas used in this process is oxidized at a lower temperature than conventional combustion, so the permittee did not use the standard AP-42 emission factor for natural gas combustion, but rather made their own conservative estimate that worst-case NOx emissions would be 2.05 lb/hr for this exhaust stream.

Hydrogen Product Stream (flare exhaust)

First, the hourly natural gas usage rate for the 0.07 MMBtu/hr continuously lit flare pilot was calculated as follows, using information provided in the permit application (including the permittee's assumed value of 1070 Btu/scf for natural gas):

$(0.07 \times 10^6 \text{ Btu/hr}) \div 1070 \text{ Btu/scf}_{\text{NATURAL GAS}} = 0.000065 \times 10^6 \text{ scf gas/hr}_{\text{PILOT}}$

The following emission factor was then applied: 100 lb_{NOx} per million scf natural gas burned (AP-42, Table 1.4-1, small boilers, uncontrolled):

$(100 \text{ lb}_{NOx}/10^6 \text{ scf gas}) \times (0.000065 \times 10^6 \text{ scf gas/hr}) = 0.0065 \text{ lb}_{NOx}/\text{hr}_{\text{PILOT}}$

Next, the NOx emission rate when hydrogen is being fed to the flare at the maximum production rate of 270 lb_{H2}/hr was calculated as follows:

$270 \text{ lb}_{H2}/\text{hr} \div (0.00575 \text{ lb}_{H2}/\text{scf})_{\text{DENSITY}} = 46{,}957 \text{ scf}_{H2}/\text{hr}$

$46{,}957 \text{ scf}_{H2}/\text{hr} \times (274 \text{ Btu/scf})_{\text{H2 HHV}} = 12.87 \times 10^6 \text{ Btu/hr} = 12.87 \text{ MMBtu/hr}$

$(0.068 \text{ lb}_{NOx}/\text{MMBtu})_{EF} \times (12.87 \text{ MMBtu/hr})_{\text{FROM H2 COMBUSTION}} = 0.875 \text{ lb}_{NOx}/\text{hr}$

Where 0.068 lb_{NOx}/MMBtu is the emission factor from AP-42, Table 13.5-1, elevated flares.

Flare pilot + hydrogen combustion hourly emissions:

$(0.0065 \text{ lb}_{NOx}/\text{hr})_{\text{PILOT}} + (0.875 \text{ lb}_{NOx}/\text{hr})_{\text{H2 COMBUSTION}} = 0.88 \text{ lb}_{NOx}/\text{hr}_{\text{FLARE}}$

Total from both exhaust streams

$(2.05 \text{ lb}_{NOx}/\text{hr})_{\text{CO2/DEPLETED AIR}} + (0.88 \text{ lb}_{NOx}/\text{hr})_{\text{FLARE}} = 2.93 \text{ lb}_{NOx}/\text{hr}_{\text{TOTAL}}$

The potential annual emissions were calculated by multiplying the hourly emissions rate by 8,760 hr/yr, then dividing by 2,000 lb/ton:

$2.93 \text{ lb}_{NOx}/\text{hr} \times 8{,}760 \text{ hr/yr} \div 2{,}000 \text{ lb/ton} = 12.83 \text{ ton}_{NOx}/\text{yr}$

Expressed as a monthly average: $12.83 \text{ ton}_{NOx}/\text{yr} \div 12 = 1.07 \text{ ton}_{NOx}/\text{mo}$

c. Emissions Limitation

Visible particulate emissions from the baghouse stack and flare serving this emissions unit shall not exceed 20% opacity, as a six-minute average, except as provided by rule.

In the paragraph above, "except as provided by rule" means the following, pursuant to paragraphs (A)(1)(b) and (A)(2) of OAC rule 3745-17-07:

i. visible particulate emissions may exceed 20 percent opacity, as a six-minute average, for not more than six consecutive minutes in any 60 minutes, but shall not exceed 60 percent opacity, as a six-minute average, at any time; and

ii. it shall be deemed not to be a violation where the presence of uncombined water is the only reason for failure of a stack emission to meet the above opacity limitation.

Applicable Compliance Method

If required, the permittee shall demonstrate compliance through visible particulate emission observations performed in accordance with U.S. EPA Method 9 as set forth in 40 CFR part 60, Appendix A.

d. Emissions Limitation

Particulate emissions from the baghouse stack serving the Combined CO_2/Depleted Air Stream shall not exceed 6.75 pounds per hour.

The above emissions limitation was established by applying the applicable portions of OAC rule 3745-17-11 to the operations in this emissions unit.

According to OAC rule 3745-17-11(B)(1), particulate emissions for sources located in Stark county shall not exceed the allowable emission rate specified by Curve P-1 of Figure II, or by Table I in the Appendix to OAC rule 3745-17-11, whichever is applicable under paragraph (A)(2) of the rule. Paragraph (A)(2) states that the allowable mass emissions rate shall be selected as the more stringent of two results determined by using both Figure II and Table I.

Figure II

Based on information provided in the permit application received 1/30/2025, the uncontrolled mass rate of emission is 45.02 lb_{PE}/hr for the Combined CO_2/Depleted Air Stream and 2.37 lb_{PE}/hr for the Hydrogen Product Stream.

However, the Hydrogen Product Stream emissions are controlled by an in-line cyclone, a direct contact cooler, and a wet electrostatic precipitator in series, all of which which are inherent to the process of producing nearly pure hydrogen, and are therefore *not* considered to be add-on control equipment.

Accordingly, for the purpose of this permit, the effective uncontrolled mass rate of emissions for the Hydrogen Product Stream is not 2.37 lb_{PE}/hr, but rather a *negligible* rate of 2.56 x 10^{-4} lb_{PE}/hr based on the in-line, inherent control devices described above and calculated according to information provided in the permit application.

Therefore, for the purpose of OAC rule 3745-17-11, the applicable uncontrolled mass rate of emission is 45.02 lb_{PE}/hr, all of which is from the Combined CO_2/Depleted Air Stream. This value was applied to the appropriate portion ("b") of Curve P-1, for which the applicable formula is as follows:

$A = 0.5782 \times U^{0.6456}$, where A = the max. allowable rate of particulate matter emissions and U = the uncontrolled mass rate of emission.

$A = 0.5782 \times 45.02\ lb_{PE}/hr^{0.6456} = 6.75\ lb_{PE}/hr$

Table I

Pursuant to paragraph (A)(4) of OAC rule 3745-17-11, the applicable process weight rate is "the total weight of all materials introduced into any single, specific process (at its maximum capacity) that may cause any emission of particulate matter." From information provided in the permit application, the permittee determined that the applicable process weight rate was the weight of all reactants used in the chemical looping process: air, steam, natural gas, and makeup oxygen carrier particles, since each component contributes to the formation of particulate emissions. [Comment: for this process, natural gas is not used solely as fuel and air is not used for the purpose of combustion. Therefore, these components are not exempted from inclusion in the process weight as they would otherwise be, referring to the definition of "process weight" in OAC rule 3745-17-01.]

The maximum combined usage rate for the reactants mentioned in the above paragraph is 16,233 lbs/hr = 8.12 ton/hr = PWR

Using equation $E = 4.10 \times (P)^{0.67}$ from Table I, where E = the allowable emissions rate in lb/hr, and P = PWR in tons:

$E = 4.10 \times (8.12)^{0.67} = 16.68\ lb_{PE}/hr$

Conclusion

The allowable emissions rate from Figure II (6.75 lb_{PE}/hr) is more stringent than the allowable emissions rate from Table I (16.68 lb_{PE}/hr). Therefore, the applicable value pursuant to OAC rule 3745-17-11(B) was determined to be 6.75 lb_{PE}/hr.

Applicable Compliance Method

Compliance shall be demonstrated by comparing the allowable emissions rate of 6.75 lb_{PE}/hr from Figure II with the following one-time, conservative calculation of the maximum hourly emissions rate.

As described above under "Figure II," the emission rate for the Hydrogen Product Stream is a negligible 2.56×10^{-4} lb_{PE}/hr, based on the in-line cyclone, direct contact cooler, and wet electrostatic precipitator which are inherent to the process and therefore not considered to be add-on control equipment.

45.02 lb_{PE}/hr is the uncontrolled rate for the Combined CO_2/Depleted Air Stream, which is then controlled by a baghouse with a control efficiency of 98%, as provided in the permit application, resulting in a controlled rate of 0.90 lb_{PE}/hr:

$45.02\ lb_{PE}/hr \times (1 - 0.98_{CTRL\ EFF}) = 0.90\ lb_{PE}/hr_{\ CO2/DEPLETED\ AIR\ STREAM\ AFTER\ CONTROLS}$

$0.90\ lb_{PE}/hr_{\ AFTER\ CONTROLS} < 6.75\ lb_{PE}/hr_{\ FIGURE\ II\ ALLOWABLE}$

if required, the permittee shall demonstrate compliance with the hourly emissions limitation above by emissions testing performed at the baghouse exhaust stack in accordance with U.S. EPA Method 5 as set forth in 40 CFR part 60, Appendix A (and in accordance with OAC rule 3745-17-03(B)(10) for the purpose of determining compliance with OAC rule 3745-17-11).

Since the in-line control devices for the Hydrogen Product Stream are inherent to the process and the resulting controlled emissions are assumed to be negligible, no testing for this part of the overall process shall be required to demonstrate compliance.

g) Miscellaneous Requirements

For informational purposes, the maximum uncontrolled potential to emit for CO, SO_2, and VOC emissions from this air contaminant source were calculated as shown below:

(1) CO emissions:

CO emissions primarily come from the Combined CO_2/Depleted Air Exhaust Stream, with a small amount contributed from the Hydrogen Product Stream (specifically from the continuously lit flare pilot).

The potential uncontrolled hourly emissions rate for CO was conservatively estimated by the permittee as 1.70 lb/hr for the Combined CO_2/Depleted Air Exhaust Stream portion of the novel chemical looping process. In addition, the permit application included CO emissions from the continuously lit flare pilot, calculated as follows based on the AP-42 emission factor of 84 $lb_{CO}/10^6$ scf gas:

$(84\ lb_{CO}/10^6\ scf\ gas) \times (0.000065 \times 10^6\ scf\ gas/hr) = 0.0055\ lb_{CO}/hr$

$1.70\ lb_{CO}/hr + 0.0055\ lb_{CO}/hr = 1.7055\ lb_{CO}/hr_{\ TOTAL}$

The potential annual emissions were calculated by multiplying the total hourly emissions rate by 8,760 hr/yr, then dividing by 2,000 lb/ton:

$1.7055\ lb_{CO}/hr \times 8{,}760\ hr/yr \div 2{,}000\ lb/ton = 7.47\ ton_{CO}/yr$, which is <10 tpy

(2) SO_2 emissions:

SO_2 emissions primarily come from the Combined CO_2/Depleted Air Exhaust Stream, with negligible emissions contributed from the Hydrogen Product Stream.

The potential uncontrolled hourly emissions rate for SO_2 was conservatively estimated by the permittee as 0.08 lb/hr for the novel chemical looping process. The potential annual emissions were calculated by multiplying the hourly emissions rate by 8,760 hr/yr, then dividing by 2,000 lb/ton:

$0.08\ lb_{SO2}/hr \times 8{,}760\ hr/yr \div 2{,}000\ lb/ton = 0.34\ ton_{SO2}/yr$, which is <10 tpy

(3) VOC emissions:

VOC emissions primarily come from the Combined CO_2/Depleted Air Exhaust Stream, with negligible emissions contributed from the Hydrogen Product Stream.

The potential uncontrolled hourly emissions rate for VOC was conservatively estimated by the permittee as 0.02 lb/hr for the novel chemical looping process. The potential annual emissions were calculated by multiplying the hourly emissions rate by 8,760 hr/yr, then dividing by 2,000 lb/ton:

$0.02\ lb_{VOC}/hr \times 8{,}760\ hr/yr \div 2{,}000\ lb/ton = 0.09\ ton_{VOC}/yr$, which is <10 tpy