Dickson, Laura

From: Juarez, Allie M. <AJuarez@marathonpetroleum.com>
Sent: Wednesday, October 19, 2022 9:42 AM
To: Dickson, Laura
Subject: RE: [External] MPLX Harmon Creek Follow Up
Attachments: P22-0902-01.pdf

Laura,

Please find the updated proposal from Tulsa Heaters attached including the existing heater NOx guarantee at 23 ppmv.

Allie

From: Dickson, Laura <ldickson@pa.gov>
Sent: Tuesday, October 18, 2022 11:00 AM
To: Juarez, Allie M. <AJuarez@marathonpetroleum.com>
Subject: RE: [External] MPLX Harmon Creek Follow Up

Allie,

Thank you for sending this information. I look forward to our meeting.

Best Regards,

Laura S. Dickson, P.E. | Environmental Engineer *She/her/hers*
Pennsylvania Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive | Pittsburgh, PA 15222
Phone: 412.442.4155
www.depweb.state.pa.us

DEP is now accepting permit and authorization applications, as well as other documents and correspondence, electronically through the OnBase Electronic Forms Upload tool. Please use the link below to view the webpage, get instructions, and submit documents:
https://www.dep.pa.gov/DataandTools/Pages/Application-Form-Upload.aspx

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From: Juarez, Allie M. <AJuarez@marathonpetroleum.com>
Sent: Monday, October 17, 2022 10:54 AM
To: Dickson, Laura <ldickson@pa.gov>
Subject: [External] MPLX Harmon Creek Follow Up

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Laura,

Please find the Harmon Creek 2 regulatory review, Best Available Technology analysis, and revised PTE. The PTE was updated to reflect:

- The PM emission rate in the spec sheet and the 23 ppmv NOx guarantee for H-2711. Tulsa Heaters will provide the NOx guarantee this week. I will forward it once received.
- Updated rod packing emission rates based on monitoring data, where available.
- Revised number of measurement devices. I had a calculation error in the original set of emissions.

I look forward to our discussion on Thursday.

Thanks,
Allie

MPLX

Allie Juarez
G&P Engineer I
4600 J Barry Court, Suite 500
Canonsburg, PA 15317
Mobile: 412-815-8886
ajuarez@marathonpetroleum.com

Allie Juarez
Marathon Petroleum
G&P Engineer I

4600 J Barry Court, Suite 500
Canonsburg, PA 15317
Phone: (412)815-8886
Email: ajuarez@marathonpetroleum.com

Quote Number: P22-0902-01
Date: October 18th, 2022
RE: NOx Reduction

Allie,

Please see the following proposal for NOx reduction options for existing heater, per your request:

OPTION 1 – Use Existing Burner

Notes: No equipment change required for this option. This is using the burner that was originally sold with the heater. One thing to note is that this burner is long out of warranty, so if this option is chosen there could be some small cost associated with including a new warranty. NOx guarantee is 0.03 lb./MMBtu or 23 ppm.

OPTION 2 – Fiber Matrix Burner

DELIVERABLES
Fiber Matrix burner package with BMS
Relevant Datasheets/Drawings

THM SCOPE
Provide equipment. Installation by others.

ADDITIONAL OPERATING COSTS (basis = $0.12/kWh, $3/MMBtu)
- Added fuel duty: $47,304/yr.
- Added blower hp: $9,797/yr.

Notes: This burner operates with 60% excess air which causes efficiency to drop from 84.7% to 78%. The blower motor increases from 7.5 hp to 20 hp. Turndown limit is 4:1. Firing rate increases From 16.21 to 17.55 MMBtu/hr. NOx guarantee 9ppm.

Price: $184,600

Lead Time: 18 weeks ARO

Brandon Rutter
Tulsa Heaters Midstream, LLC1215 South Boulder, Ste 1040 Tulsa OK 74119
Cell:918-671-3985 www.tulsaheatersmidstream.com

OPTION 3 – FGR

DELIVERABLES
FGR Blower
Ducting
Burner
FGR control damper
BMS re-programming to include FGR logic
New burner mounting adapter plate
Relevant Datasheets/Drawings

THM SCOPE
Equipment listed above, and re-programming for added control loop. Installation by others.

ADDITIONAL OPERATING COSTS (basis = $0.12/kWh, $3/MMBtu)

- FGR blower hp: $3,919/yr.

Notes: The change in efficiency is negligible with this option. The burner end wall will need to be modified to accommodate the new burner. This option will take a slip stream of flue gases from the stack and run through a blower back into the burner. The flow will be controlled with an automated butterfly valve downstream of the blower. This will require the addition of another control loop in the BMS logic. This programming has been included in the pricing. NOx guarantee 9ppm.

Price: $220,000

Lead Time: 30 weeks

Quote is valid for 30 days

Freight by others or prepay and add

If you have any questions or comments, please feel free to contact me directly.

Best Regards,

Brandon Rutter
Mechanical Engineer
Tulsa Heaters Midstream, LLC

Dickson, Laura

From: Juarez, Allie M. <AJuarez@marathonpetroleum.com>
Sent: Monday, October 17, 2022 10:54 AM
To: Dickson, Laura
Subject: [External] MPLX Harmon Creek Follow Up
Attachments: 2022-1017 HC2 BAT.pdf; 2022-1017 REVISED HC2 PTE.pdf

ATTENTION: *This email message is from an external sender. Do not open links or attachments from unknown senders. To report suspicious email, use the [Report Phishing button in Outlook.]*

Laura,

Please find the Harmon Creek 2 regulatory review, Best Available Technology analysis, and revised PTE. The PTE was updated to reflect:

- The PM emission rate in the spec sheet and the 23 ppmv NOx guarantee for H-2711. Tulsa Heaters will provide the NOx guarantee this week. I will forward it once received.
- Updated rod packing emission rates based on monitoring data, where available.
- Revised number of measurement devices. I had a calculation error in the original set of emissions.

I look forward to our discussion on Thursday.

Thanks,
Allie

MPLX

Allie Juarez
G&P Engineer I
4600 J Barry Court, Suite 500
Canonsburg, PA 15317
Mobile: 412-815-8886
ajuarez@marathonpetroleum.com

MarkWest Liberty Midstream and Resources, L.L.C.
1515 Arapahoe Street
Tower 1, Suite 1600
Denver, CO 80202-2137
(800) 730-8388
(303) 290-8700
(303) 825-0920 Fax

October 17, 2022

Laura S. Dickson, EIT
Environmental Engineering Specialist
PA DEP SW Regional Office
400 Waterfront Drive
Pittsburgh, PA 15222

Re: MarkWest Liberty Midstream and Resources, L.L.C.
Harmon Creek Gas Plant (Facility ID 819388)
Best Available Technology Analysis

Dear Mrs. Dickson:

MarkWest Liberty Midstream and Resources, L.L.C., a fully owned subsidy of MPLX and hereinafter referred to as MPLX, submitted a Plan Approval application for the Harmon Creek 2 Cryo (HC2) on June 29, 2022. As requested by the Pennsylvania Department of Environmental Protection, MPLX is providing a Best Available Technology (BAT) analysis for sources under the HC2 project. In addition to the BAT analysis, MPLX is also providing the requested regulatory review for affected sources.

Should you have any questions or comments, please call me (412) 815-8886 or e-mail ajuarez@marathonpetroleum.com.

Sincerely,

Alexandra M. Juarez
G&P Engineer I
MPLX

Regulatory Review

Federal New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) require new, modified, or reconstructed sources to control emissions to the level that is achievable by the best system for emission reduction as specified in the provisions of the applicable rule. The following section provides applicability determinations for each of the NSPS and NESHAP regulation to which the Harmon Creek 2 (HC2) project is potentially subject.

40 Code of Federal Regulations (CFR) Part 60 Subpart Dc – Standards of Performance for Small (10 to 100 MMBtu/hr) Industrial, Commercial, Institutional Steam Generating Units for Which Construction, Reconstruction, or Modification Commenced After June 9, 1989.

Process heater (H-2711) is rated at maximum design heat release of 17.84 MMBtu/hr on a LHV basis and will be constructed after June 9, 1989. However, process heaters are excluded from the definition of a steam generating unit. Therefore, no emission processes associated with the project will have requirements under NSPS Subpart Dc [40 CFR 60.41c].

40 CFR Part 60 Subpart OOOOa - Standards of Performance for Crude Oil and Natural Gas Facilities:

NSPS Subpart OOOOa applies to facilities constructed, modified, or reconstructed after September 18, 2015. The Harmon Creek 2 plant will be constructed after September 18, 2015 and is therefore subject to the requirements of NSPS OOOOa. The following sections outline the applicability of the various components outlined under NSPS Subpart OOOOa:

> **Reciprocating Compressors –** The three (3) residue gas compressors associated with this project will require the replacement of rod packing every 26,000 hours or every 36 months of operation for each subject compressor.
>
> **Equipment within a Process Unit –** MPLX will comply with the NSPS Subpart OOOOa Equipment Leak VOC standards at the Harmon Creek Gas Plant for subject equipment within a process unit.

Best Available Technology Review

Existing Process Flare and Enclosed Combustor

MarkWest Liberty Midstream and Resources, L.L.C., a fully owned subsidy of MPLX, hereinafter referred to as MPLX, is seeking authorization to construct and operate the Harmon Creek 2 Cryo (HC2). During maintenance and emergency situations, MPLX will require the blowdown of equipment associated with HC2. MPLX plans to route such vapors to the existing process flare. Because the most recent version of the GP5 excludes the use of open flares, MPLX submitted a plan approval application seeking authorization to control HC2 with the existing process flare. Per request of the Department, a BAT analysis for the installation and operation of an enclosed combustion device (ECD) in addition to the existing process flare was included in the application. MPLX would like to note that the Harmon Creek Gas Plant will remain a minor source after the implementation of HC2.

<u>One Enclosed Combustion Device</u>

As described in the plan approval application, MPLX obtained a quote for an ECD adequately sized for the HC2 process. The ECD was guaranteed the same destruction and removal efficiency (DRE) as the existing plant flare; thus, no emission reductions would be achieved. Based on the required purge and pilot gas rates to safely operate the ECD, an emissions increase would result from the operation of the unit, as shown in Table 1. Therefore, the existing flare meets BAT for this project.

Further, the Department has requested that MPLX consider installing multiple smaller ECDs or installing one with a DRE of 99%. In response, MPLX has evaluated the technical, environmental, and economic feasibility of the Department's request. The change in emissions associated with the addition of an ECD with 99% DRE is shown in Table 1.

Table 1. Summary of facility-wide emissions and change in emissions using the existing process flare and adding an ECD with 98% or an ECD with 99% DRE.

	Existing Process Flare	*Existing Process Flare and One (1) ECD with 98% DRE*		*Existing Process Flare and One (1) ECD with 99% DRE*	
Pollutant	Facility-wide PTE	Facility-wide PTE	Change in Emissions	Facility-wide PTE	Change in Emissions
VOC	38.63	38.64	+0.01	36.62	-2.01
NOx	31.42	31.87	+0.45	31.87	+0.45
CO	50.38	52.42	+2.04	52.42	+2.04

As shown in Table 1, routing HC2 to an ECD with a VOC DRE of 99% would result in a reduction of 2.01 tpy of VOC for a capital cost of $25M or greater. However, CO and NOx emissions would increase at the facility by 2.04 and 0.45 tpy, respectively.

A well-known flare manufacturer, Cimarron, has cautioned against using 99% DRE for permits, despite test data demonstrating that their ECDs performed above 99.9% under controlled test conditions. NSPS OOOOa testing conducted by the manufacturer does not use natural gas as fuel and is conducted under controlled conditions. However, typical operations at an oil and gas facility vary from the control conditions. Thus, the recommended guarantee by most enclosed combustor manufacturers is 98% DRE for permitting purposes. MPLX prefers to use a DRE of 98% for conservatism because the Department may establish permit limits based on potential emissions provided in the application.

Further, Zeeco guaranteed the quoted enclosed combustor DRE at 98%. Even with a DRE of 99%, solely considering the estimated minimum capital cost of the project at $25M, the cost per ton savings over a ten-year period would equate to approximately $1.24M/ton VOC. However, there would be an increase in NOx and CO emissions, resulting in an increase of 0.48 tpy of criteria pollutants facility-wide.

<u>Multiple Smaller Enclosed Combustion Devices</u>

MPLX has evaluated the feasibility of installing multiple smaller ECDs at the facility as requested by the Department. Each ECD requires a significant footprint for equipment and piping and, per API standards, must be constructed at a specific height and distance from the process. To accommodate multiple ECDs at the facility, MPLX would be required to acquire more land, create new disturbed acreage, and undergo timely permitting processes related to such projects.

To comply with API Standard 537 on Flare Details for Natural Gas Industries, each ECD at a facility would require a separate flare header to maintain an open path from process vents to the flares. Each new flare header would require the construction of foundation, steel racks, and piping resulting in an estimated minimum cost of $5M. The estimated cost for a flare header does not include the cost of an ECD or installation. Also, new flare header piping would result in an increase in fugitive component counts and associated emissions.

With each additional ECD, additional emissions from the combustion of pilot and purge gas would be generated. The facility-wide emissions using the existing process flare and an enclosed combustor are summarized in Table 1. The emission increases associated with the ECD providing a DRE of 98% show the pilot and purge combustion emissions. Thus, if multiple enclosed combustors were operated, there would be more emissions than those presented in the table above.

<u>Summary</u>

Due to the considerable footprint of each ECD requiring more land, increased emissions from the combustion of pilot and purge gas and fugitive components associated with new flare header piping, and the significant cost associated with even one ECD, MPLX has determined that installing ECD(s) at the facility is not technically, environmentally, or economically feasible. Thus, the existing flare at the facility is determined to meet BAT for this project.

Reciprocating Compressor Rod Packing and Measurement Device Vents

Emissions associated with the three (3) reciprocating compressor rod packing vents needed to compress residue gas for Harmon Creek 2 results in a facility-wide increase of 0.20 tpy of VOC. The measurement device venting for HC2 results in a facility-wide increase of 0.26 tpy of VOC. Per #31 of 25 Pa Code §127.14(a)(8), rod packing and measurement device venting from this project are exempt from the Plan Approval requirements of §127.11 and §127.12 because the uncontrolled VOC emissions from the project are less than 2.7 tons on a 12-month rolling basis. In addition to exemption #8, the measurement devices are exempt from permitting under 25 Pa Code §127.14(a)(7) because the gas chromatographs (GCs) and moisture analyzers are considered laboratory equipment used exclusively for chemical or physical analyses.

At the request of the Department, MPLX is providing a BAT analysis on rod packing emissions associated with the three (3) reciprocating compressors. A search for “rod packing” was conducted in the RBLC Database from 1/2017 through 9/2022 for all pollutants and no results were returned. Therefore, MPLX relied on technical expertise from the compressor manufacturer and facility personnel.

MPLX contacted Ariel Corporation in May 2022 to explore options to reduce rod packing emissions associated with the compressors. Based on reference material provided and discussions with Ariel representatives, the standard Ariel packings meet or exceed today's industry-standard requirements, and ongoing research and development efforts ensure the best possible seal. The new reciprocating compressors will be equipped with what Ariel identifies as low-emission packing.

Finally, the Department has suggested that MPLX consider using carbon adsorption canisters to control rod packing and measurement vents. In discussions with technical experts, risks were identified in association with the use of carbon adsorption canisters. The downstream design pressure from rod packing vents is 1440 psi, and with the obstruction of a vent line, back pressure could result in a dangerous overpressure of a carbon canister.

One option considered is routing low-pressure measurement device vents to the closed drain where vapors are controlled by the process flare. One known risk is the possible contamination of the sensitive GC equipment due to potential flowback. However, this method is not practiced at MPLX facilities, and other potential challenges and risks are unknown. The estimated cost is approximately $200,000 per vent to route vent streams to the closed drain. Eight (8) measurement device vents are proposed for HC2, and the total installation cost would be approximately $1.6M to control 0.26 tpy VOC.

Routing rod packing vents to the closed drain is not an option due to the low pressure of the closed drain system, which is approximately 1 psi. As mentioned earlier, the downstream design pressure from the rod packing vents is 1440 psi.

Another option to reduce emissions from low-pressure vents is by routing vents to a vapor recovery unit (VRU). The estimated range to acquire and install a VRU is approximately $1-2M. Because these vents are located throughout the facility, multiple VRUs and significant amounts of piping would be required to recover these vapors. The cost per ton reduction from just one (1) VRU, without considering the operation and maintenance, over a ten-year period would range from approximately $218,000/ton to $436,000/ton.

The high cost to install an emissions control for an insignificant emission reduction of 0.46 tpy is not economically reasonable. As referenced in 25 Pa Code §127.14(a), a plan approval is not required for the rod packing or measurement device vents. MPLX meets BAT by complying with the OOOOa standard requiring rod packing replacement every 26,000 hours or every 36 months.

Regenerative Heater Burner

As requested by the Department, a review of NOx control technologies for burners has been conducted. The proposed heater is equipped with a burner guaranteed at 23 ppmv NOx resulting in emissions of 2.58 tpy.

A reduction from 23 ppmv to 9 ppmv NOx on the regenerative heater burner would reduce NOx emissions by 1.63 tpy. Options to achieve this reduction include:

<u>Selective Catalytic Reduction</u>

Selective Catalytic Reduction (SCR) uses ammonia or urea in the presence of a reducing catalyst on the flue gas to reduce NOx back to free nitrogen and oxygen. Equipment costs for this system are in the $400k range and the installation costs for SCR are estimated at approximately $800k. Storage tanks and loading facilities for the ammonia or urea will be required, resulting in new emission sources. SCR has high capital and operational cost and requires handling ammonia or urea. Because other technologies are available to achieve the same level of emission reduction, and those options are lower in cost and do not require new emission sources, MPLX is not further evaluating SCR as an option for BAT.

Flue Gas Recirculation

The Flue Gas Recirculation (FGR) technology requires a slipstream of flue gas to be taken off the stack and recirculated back into the burner. This process requires a special burner, some new flue gas ducting, and a new blower that can push the FGR into the burner. For outdoor environments, precautions like insulating and heat tracing the FGR ducting are recommended to prevent icing in cold winter conditions.

The equipment cost for the system is $220,000, not including insulating and heat trace, installation is estimated to cost at least $220,000, and annual operating costs are estimated at $3,919. The cost per ton NOx over a ten-year period for FGR is $33,940.

The cost per ton reduction is significant, and FGR is not technically feasible due to the 30-week lead time. MPLX is contractually obligated to begin processing prior to the date that the FGR system would be available and delaying the project could interfere with MPLX's contractual obligations.

Fiber Matrix Burners

These special burners use a flame zone media to sustain the combustion at stoichiometry, which produces very low NOx. Outdoor installations require air inlet filtering and maintenance to keep those filters clean. A new blower would be required as these burners run at higher excess air levels, making the furnace operate less efficiently.

The equipment costs for this option are $184,600, installation costs are estimated to be at least equivalent to the equipment costs, and annual operating costs are estimated at $57,101. The cost per ton NOx over a ten-year period for the Fiber Matrix Burners is $91,396. The lead time for this option is 18 weeks.

Summary

The cost per ton reduction for the Fiber Matrix Burner and Flue Gas Recirculation equipment is provided in Table 2. The proposed heater is equipped with a low NOx burner and would not require additional cost to operate at 23 ppmv NOx. The equipment costs in the table below consider the new equipment needed and the retrofit of the existing burner.

Table 2. Cost Summary of Fiber Matirx Burner versus Flue Gas Recirculation

	Fiber Matrix Burner	Flue Gas Recirculation
Equipment Cost	$184,600	$220,000
Estimated Installation	$184,600	$220,000
Annual Operating Cost	$57,101	$3,919
Ten-Year Cost	$1,492,491	$554,248
Tons NOx Reduced per Year	1.63	1.63
Cost/Ton NOx Reduction	$91,396	$33,940

Based on the high cost of these technologies and the relatively low NOx reduction for the minor source facility, MPLX believes the low NOx burner that the proposed heater is already equipped with meets BAT. The additional cost and the potential delay in the project due to long lead times are not justified.

Best Available Technology Supporting Information

Cost Analysis for Regenerative Heater (H-2711)

Table 1. Fiber Matrix Burner Cost Analysis

Year	MPLX Cost of Capital	Capital	Annual Operating	Annual Total	Annual Total with Cost of Capital
2023	8.96%	$ 369,200	$ 57,101	$ 426,301	$ 464,498
2024	8.96%	$ -	$ 57,101	$ 57,101	$ 67,792
2025	8.96%	$ -	$ 57,101	$ 57,101	$ 73,866
2026	8.96%	$ -	$ 57,101	$ 57,101	$ 80,484
2027	8.96%	$ -	$ 57,101	$ 57,101	$ 87,696
2028	8.96%	$ -	$ 57,101	$ 57,101	$ 95,553
2029	8.96%	$ -	$ 57,101	$ 57,101	$ 104,115
2030	8.96%	$ -	$ 57,101	$ 57,101	$ 113,444
2031	8.96%	$ -	$ 57,101	$ 57,101	$ 123,608
2032	8.96%	$ -	$ 57,101	$ 57,101	$ 134,684
2033	8.96%	$ -	$ 57,101	$ 57,101	$ 146,751
				Ten-Year Total	$ 1,492,491
				Tons Reduced Over Ten Years	16.33
				Ten-Year Cost/Ton Reduction	$ 91,396

Table 2. Flue Gas Recirculation Cost Analysis

Year	MPLX Cost of Capital	Capital	Annual Operating	Annual Total	Annual Total with Cost of Capital
2023	8.96%	$ 440,000	$ 3,919	$ 443,919	$ 483,694
2024	8.96%	$ -	$ 3,919	$ 3,919	$ 4,653
2025	8.96%	$ -	$ 3,919	$ 3,919	$ 5,070
2026	8.96%	$ -	$ 3,919	$ 3,919	$ 5,524
2027	8.96%	$ -	$ 3,919	$ 3,919	$ 6,019
2028	8.96%	$ -	$ 3,919	$ 3,919	$ 6,558
2029	8.96%	$ -	$ 3,919	$ 3,919	$ 7,146
2030	8.96%	$ -	$ 3,919	$ 3,919	$ 7,786
2031	8.96%	$ -	$ 3,919	$ 3,919	$ 8,484
2032	8.96%	$ -	$ 3,919	$ 3,919	$ 9,244
2033	8.96%	$ -	$ 3,919	$ 3,919	$ 10,072
				Ten-Year Total	$ 554,248
				Tons Reduced Over Ten Years	16.33
				Ten-Year Cost/Ton Reduction	$ 33,940

Allie Juarez
Marathon Petroleum
G&P Engineer I

4600 J Barry Court, Suite 500
Canonsburg, PA 15317
Phone: (412)815-8886
Email: ajuarez@marathonpetroleum.com

Quote Number: P22-0902-0
Date: October 6th, 2022
RE: NOx Reduction

Allie,

Please see the following proposal for two NOx reduction options for existing heater, per your request:

OPTION 1 – Fiber Matrix Burner

DELIVERABLES
Fiber Matrix burner package with BMS
Relevant Datasheets/Drawings

THM SCOPE
Provide equipment. Installation by others.

ADDITIONAL OPERATING COSTS (basis = $0.12/kWh, $3/MMBtu)

- Added fuel duty: $47,304/yr.
- Added blower hp: $9,797/yr.

Notes: This burner operates with 60% excess air which causes efficiency to drop from 84.7% to 78%. The blower motor increases from 7.5 hp to 20 hp. Turndown limit is 4:1. Firing rate increases From 16.21 to 17.55 MMBtu/hr. NOx guarantee 9ppm.

Price: $184,600

Lead Time: 18 weeks ARO

Brandon Rutter
Tulsa Heaters Midstream, LLC1215 South Boulder, Ste 1040 Tulsa OK 74119
Cell:918-671-3985 www.tulsaheatersmidstream.com

OPTION 2 – FGR

DELIVERABLES
FGR Blower
Ducting
Burner
FGR control damper
BMS re-programming to include FGR logic
New burner mounting adapter plate
Relevant Datasheets/Drawings

THM SCOPE
Equipment listed above, and re-programming for added control loop. Installation by others.

ADDITIONAL OPERATING COSTS (basis = $0.12/kWh, $3/MMBtu)

- FGR blower hp: $3,919/yr.

Notes: The change in efficiency is negligible with this option. The burner end wall will need to be modified to accommodate the new burner. This option will take a slip stream of flue gases from the stack and run through a blower back into the burner. The flow will be controlled with an automated butterfly valve downstream of the blower. This will require the addition of another control loop in the BMS logic. This programming has been included in the pricing. NOx guarantee 9ppm.

Price: $220,000

Lead Time: 30 weeks

Both options valid for 30 days

Freight by others or prepay and add

If you have any questions or comments, please feel free to contact me directly.

Best Regards,

Brandon Rutter
Mechanical Engineer
Tulsa Heaters Midstream, LLC

MarkWest Liberty Midstream & Resources, L.L.C.
Harmon Creek Gas Plant

Summary of Potential Emissions

Criteria Pollutant Potential Emissions

Process/Facility	Source ID	Potential Emissions (lb/hr)					
		NOx	CO	VOC	SO_2	PM[1]	HAPs
Cryo Plant 1 Regen Heater (H-1711)	031	0.47	0.47	0.22	0.01	0.09	0.02
Cryo Plant 2 Regen Heater (H-2711)	032	0.59	0.78	0.37	0.01	0.26	0.04
De-Ethanizer HMO Heater 1 (H-1767)	033	1.93	1.93	0.91	0.03	0.36	0.09
De-Ethanizer HMO Heater 2 (H-1768)	034	1.93	1.93	0.91	0.03	0.36	0.09
Stabilization HMO Heater (H-1769)	036	0.48	0.48	0.23	0.01	0.09	0.02
De-Ethanizer Regen Heater (H-1775)	035	0.26	0.26	0.13	0.00	0.05	0.01
Process Flare	C601	1.23	5.61	3.07	0.01	0.11	0.22
Generac SD015	102	0.26	0.14	0.08	0.10	0.02	0.00
Generac SD150	102	1.31	0.55	0.41	0.10	0.04	0.01
Fugitives Emissions	701	--	--	--	--	--	--
Pigging*	801	--	--	--	--	--	--
Rod Packing	601	--	--	0.21	--	--	0.00
Drain Tank Loadout*	--	--	--	--	--	--	--
Methanol Tanks	--	--	--	0.08	--	--	0.08
Measurement Devices	--	--	--	0.24	--	--	0.02
Future Site-Wide Emissions (lb/hr)		**8.46**	**12.16**	**6.88**	**0.30**	**1.37**	**0.60**

[1] PM = PM_{10} = $PM_{2.5}$

Process/Facility	Source ID	Potential Emissions (tpy)					
		NOx	CO	VOC	SO_2	PM[1]	HAPs
Cryo Plant 1 Regen Heater (H-1711)	031	2.07	2.07	0.98	0.03	0.39	0.10
Cryo Plant 2 Regen Heater (H-2711)	032	2.58	3.44	1.63	0.05	1.12	0.16
De-Ethanizer HMO Heater 1 (H-1767)	033	8.44	8.44	4.01	0.12	1.57	0.39
De-Ethanizer HMO Heater 2 (H-1768)	034	8.44	8.44	4.01	0.12	1.57	0.39
Stabilization HMO Heater (H-1769)	036	2.10	2.10	1.00	0.03	0.39	0.10
De-Ethanizer Regen Heater (H-1775)	035	1.16	1.16	0.55	0.02	0.22	0.05
Process Flare	C601	5.39	24.56	13.46	0.04	0.50	0.98
Generac SD015	102	0.07	0.04	0.02	0.03	0.01	0.00
Generac SD150	102	0.33	0.14	0.10	0.03	0.01	0.00
Fugitives Emissions	701	--	--	10.72	--	--	0.50
Pigging*	801	--	--	--	--	--	--
Rod Packing	601	--	--	0.94	--	--	0.01
Drain Tank Loadout*	--	--	--	--	--	--	--
Methanol Tanks	--	--	--	0.35	--	--	0.35
Measurement Devices	--	--	--	1.04	--	--	0.08
Future Site-Wide Emissions (tpy)		**30.56**	**50.38**	**38.82**	**0.47**	**5.77**	**3.11**

[1] PM = PM_{10} = $PM_{2.5}$

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

Hazardous Air Pollutant Potential Emissions

Process/Facility	Source ID	HAPs - Potential Emissions (lb/hr)								
		Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methanol	n-Hexane	Toluene	Xylenes
Cryo Plant 1 Regen Heater (H-1711)	031	--	--	2.44E-05	--	8.70E-04	--	0.02	3.95E-05	--
Cryo Plant 2 Regen Heater (H-2711)	032	--	--	4.04E-05	--	1.44E-03	--	0.03	6.54E-05	--
De-Ethanizer HMO Heater 1 (H-1767)	033	--	--	9.91E-05	--	3.54E-03	--	0.08	1.60E-04	--
De-Ethanizer HMO Heater 2 (H-1768)	034	--	--	9.91E-05	--	3.54E-03	--	0.08	1.60E-04	--
Stabilization HMO Heater (H-1769)	036	--	--	2.47E-05	--	8.82E-04	--	0.02	4.00E-05	--
De-Ethanizer Regen Heater (H-1775)	035	--	--	1.36E-05	--	4.85E-04	--	0.01	2.20E-05	--
Process Flare	C601	--	--	--	--	--	--	--	--	--
Generac SD015	102	2.89E-04	3.48E-05	3.51E-04	--	4.44E-04	--	--	1.54E-04	1.07E-04
Generac SD150	102	1.42E-03	1.72E-04	1.73E-03	--	2.19E-03	--	--	7.59E-04	5.29E-04
Fugitives Emissions	701	--	--	--	--	--	--	--	--	--
Pigging*	801	--	--	--	--	--	--	--	--	--
Rod Packing	601	--	--	--	--	--	--	0.00	--	--
Drain Tank Loadout*	--	--	--	--	--	--	--	--	--	--
Methanol Tanks	--	--	--	--	--	--	8.04E-02	--	--	--
Measurement Devices	--	--	--	--	--	--	--	0.02	--	--
Future Site-Wide Emissions (lb/hr)		**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.08**	**0.28**	**0.00**	**0.00**

Process/Facility	Source ID	HAPs - Potential Emissions (tpy)								
		Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methanol	n-Hexane	Toluene	Xylenes
Cryo Plant 1 Regen Heater (H-1711)	031	--	--	1.07E-04	--	3.81E-03	--	0.09	1.73E-04	--
Cryo Plant 2 Regen Heater (H-2711)	032	--	--	1.77E-04	--	6.32E-03	--	0.15	2.87E-04	--
De-Ethanizer HMO Heater 1 (H-1767)	033	--	--	4.34E-04	--	1.55E-02	--	0.37	7.03E-04	--
De-Ethanizer HMO Heater 2 (H-1768)	034	--	--	4.34E-04	--	1.55E-02	--	0.37	7.03E-04	--
Stabilization HMO Heater (H-1769)	036	--	--	1.08E-04	--	3.86E-03	--	0.09	1.75E-04	--
De-Ethanizer Regen Heater (H-1775)	035	--	--	5.95E-05	--	2.13E-03	--	0.05	9.64E-05	--
Process Flare	C601	--	--	--	--	--	--	--	--	--
Generac SD015	102	7.22E-05	8.70E-06	8.78E-05	--	1.11E-04	--	--	3.85E-05	2.68E-05
Generac SD150	102	3.56E-04	4.29E-05	4.33E-04	--	5.47E-04	--	--	1.90E-04	1.32E-04
Fugitives Emissions	701	--	--	--	--	--	--	--	--	--
Pigging*	801	--	--	--	--	--	--	--	--	--
Rod Packing	601	--	--	--	--	--	--	0.01	--	--
Drain Tank Loadout*	--	--	--	--	--	--	--	--	--	--
Methanol Tanks	--	--	--	--	--	--	3.52E-01	--	--	--
Measurement Devices	--	--	--	--	--	--	--	0.08	--	--
Future Site-Wide Emissions (tpy)		**0.00**	**0.00**	**0.00**	**0.00**	**0.05**	**0.35**	**1.22**	**0.00**	**0.00**

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

Greenhouse Gas Potential Emissions

Process/Facility	Source ID	GHG
		CO_{2}(e) (tpy)
Cryo Plant 1 Regen Heater (H-1711)	031	6857
Cryo Plant 2 Regen Heater (H-2711)	032	11369
De-Ethanizer HMO Heater 1 (H-1767)	033	27893
De-Ethanizer HMO Heater 2 (H-1768)	034	27893
Stabilization HMO Heater (H-1769)	036	6946
De-Ethanizer Regen Heater (H-1775)	035	3824
Process Flare	C601	10622
Generac SD015	102	15
Generac SD150	102	76
Fugitives Emissions	701	306
Pigging*	801	--
Rod Packing	601	2687
Methanol Tanks	--	--
Measurement Devices	--	83
Future Site-Wide Emissions (tpy)		**98,569.58**

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

MarkWest Liberty Midstream & Resources, L.L.C.
Harmon Creek Gas Plant

Potential Emissions Increases from Project

Criteria Pollutant Potential Emissions Increase

Process/Facility	Source ID	Potential Emissions (lb/hr)					
		NOx	CO	VOC	SO2	PM1	HAPs
Cryo Plant 2 Regen Heater (H-2711)	032	0.59	0.78	0.37	0.01	0.26	0.04
Process Flare	C601	0.00	0.00	0.00	0.00	0.00	0.00
Fugitives Emissions	701	--	--	--	--	--	--
Pigging (De Minimis)*	801	--	--	--	--	--	--
Rod Packing (De Minimis)	601	--	--	0.04	--	--	0.00
Drain Tank Loadout (De Minimis)*	--	--	--	--	--	--	--
Methanol Tanks (De Minimis)	--	--	--	0.04	--	--	0.04
Measurement Devices (Exempt)	--	--	--	0.06	--	--	0.00
Future Site-Wide Emissions (lb/hr)		**0.59**	**0.78**	**0.52**	**0.01**	**0.26**	**0.08**

1 PM = PM10 = PM2.5

Process/Facility	Source ID	Potential Emissions (tpy)					
		NOx	CO	VOC	SO2	PM1	HAPs
Cryo Plant 2 Regen Heater (H-2711)	032	2.58	3.44	1.63	0.05	1.12	0.16
Process Flare	C601	0.00	0.00	0.00	0.00	0.00	0.00
Fugitives Emissions	701	--	--	3.95	--	--	0.19
Pigging (De Minimis)*	801	--	--	--	--	--	--
Rod Packing (De Minimis)	601	--	--	0.20	--	--	0.00
Drain Tank Loadout (De Minimis)*	--	--	--	--	--	--	--
Methanol Tanks (De Minimis)	--	--	--	0.18	--	--	0.18
Measurement Devices (Exempt)	--	--	--	0.26	--	--	0.02
Future Site-Wide Emissions (tpy)		**2.58**	**3.44**	**6.22**	**0.05**	**1.12**	**0.54**

1 PM = PM10 = PM2.5

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

Hazardous Air Pollutant Potential Emissions

Process/Facility	Source ID	HAPs - Potential Emissions (lb/hr)								
		Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methanol	n-Hexane	Toluene	Xylenes
Cryo Plant 2 Regen Heater (H-2711)	032	--	--	4.04E-05	--	1.44E-03	--	3.46E-02	6.54E-05	--
Process Flare	C601	--	--	--	--	--	--	--	--	--
Fugitives Emissions	701	--	--	--	--	--	--	--	--	--
Pigging (De Minimis)*	801	--	--	--	--	--	--	--	--	--
Rod Packing (De Minimis)	601	--	--	--	--	--	--	2.80E-05	--	--
Drain Tank Loadout (De Minimis)*	--	--	--	--	--	--	--	--	--	--
Methanol Tanks (De Minimis)	--	--	--	--	--	--	4.02E-02	--	--	--
Measurement Devices (Exempt)	--	--	--	--	--	--	--	4.35E-03	--	--
Future Site-Wide Emissions (lb/hr)		**0.00E+00**	**0.00E+00**	**4.04E-05**	**0.00E+00**	**1.44E-03**	**4.02E-02**	**3.90E-02**	**6.54E-05**	**0.00E+00**

Process/Facility	Source ID	HAPs - Potential Emissions (tpy)								
		Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	Methanol	n-Hexane	Toluene	Xylenes
Cryo Plant 2 Regen Heater (H-2711)	032	--	--	1.77E-04	--	6.32E-03	--	1.52E-01	2.87E-04	--
Process Flare	C601	--	--	--	--	--	--	--	--	--
Fugitives Emissions	701	--	--	--	--	--	--	--	--	--
Pigging (De Minimis)*	801	--	--	--	--	--	--	--	--	--
Rod Packing (De Minimis)	601	--	--	--	--	--	--	1.23E-04	--	--
Drain Tank Loadout (De Minimis)*	--	--	--	--	--	--	--	--	--	--
Methanol Tanks (De Minimis)	--	--	--	--	--	--	1.76E-01	--	--	--
Measurement Devices (Exempt)	--	--	--	--	--	--	--	1.90E-02	--	--
Future Site-Wide Emissions (tpy)		**0.00E+00**	**0.00E+00**	**1.77E-04**	**0.00E+00**	**6.32E-03**	**1.76E-01**	**1.71E-01**	**2.87E-04**	**0.00E+00**

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

Greenhouse Gas Potential Emissions

Process/Facility	Source ID	GHG
		CO2(e) (tpy)
Cryo Plant 2 Regen Heater (H-2711)	032	1.14E+04
Process Flare	C601	0.00E+00
Fugitives Emissions	701	1.01E+02
Pigging (De Minimis)*	801	--
Rod Packing (De Minimis)	601	2.66E+03
Drain Tank Loadout (De Minimis)*	--	--
Methanol Tanks (De Minimis)	--	2.08E+01
Future Site-Wide Emissions (tpy)		**14,147.12**

* Emissions are controlled by the flare and thus, are accounted for in the process flare emissions.

MarkWest Liberty Midstream & Resources, L.L.C.
Harmon Creek Gas Plant

Cryo Plant II Regen Heaters
H-2711

Source Designation:	
Manufacturer:	Tulsa Heaters
Year Installed	*Planned 2023*
Fuel Used:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,153
Max Design Heat Release (mmbtu/hr)	17.84
Heat Release (HHV) (mmbtu/hr)	19.62
Fuel Consumption (mmscf/hr):	0.0170
Potential Annual Hours of Operation (hr/yr):	8,760

Criteria and Manufacturer Specific Pollutant Emission Rates

Pollutant	**Emission Factor (lb/mmbtu) (lb/MMscf)[a,b]**	**Potential Emissions (lb/hr)[c]**	**(tons/yr)[d]**
NOx	0.03	0.589	2.579
CO	0.04	0.785	3.438
VOC	0.019	0.373	1.633
SO_2	0.68	0.0115	0.0506
PM Total	0.013	0.255	1.117
PM Condensable	0.013	0.255	1.117
PM_{10} (Filterable)	0.013	0.255	1.117
$PM_{2.5}$ (Filterable)	0.013	0.255	1.117
CO_2	59.9 kg/mmbtu	2,593	11,357
CH_4	0.001 kg/mmbtu	0.04890	0.214
N_2O	0.0001 kg/mmbtu	0.00489	0.021

Hazardous Air Pollutant (HAP) Potential Emissions

Pollutant	Emission Factor (lb/MMscf)[a]	Potential Emissions (lb/hr)[c]	Potential Emissions (tons/yr)[d]
HAPs:			
3-Methylchloranthrene	2.03E-06	3.46E-08	1.52E-07
7,12-Dimethylbenz(a)anthracene	1.81E-05	3.08E-07	1.35E-06
Acenaphthene	2.03E-06	3.46E-08	1.52E-07
Acenaphthylene	2.03E-06	3.46E-08	1.52E-07
Anthracene	2.71E-06	4.62E-08	2.02E-07
Benz(a)anthracene	2.03E-06	3.46E-08	1.52E-07
Benzene	2.37E-03	4.04E-05	1.77E-04
Benzo(a)pyrene	1.36E-06	2.31E-08	1.01E-07
Benzo(b)fluoranthene	2.03E-06	3.46E-08	1.52E-07
Benzo(g,h,i)perylene	1.36E-06	2.31E-08	1.01E-07
Benzo(k)fluoranthene	2.03E-06	3.46E-08	1.52E-07
Chrysene	2.03E-06	3.46E-08	1.52E-07
Dibenzo(a,h) anthracene	1.36E-06	2.31E-08	1.01E-07
Dichlorobenzene	1.36E-03	2.31E-05	1.01E-04
Fluoranthene	3.39E-06	5.77E-08	2.53E-07
Fluorene	3.17E-06	5.39E-08	2.36E-07
Formaldehyde	8.48E-02	1.44E-03	6.32E-03
Hexane	2.03E+00	3.46E-02	1.52E-01
Indo(1,2,3-cd)pyrene	2.03E-06	3.46E-08	1.52E-07
Phenanthrene	1.92E-05	3.27E-07	1.43E-06
Pyrene	5.65E-06	9.62E-08	4.21E-07
Toluene	3.84E-03	6.54E-05	2.87E-04
Arsenic	2.26E-04	3.85E-06	1.69E-05
Beryllium	1.36E-05	2.31E-07	1.01E-06
Cadmium	1.24E-03	2.12E-05	9.27E-05
Chromium	1.58E-03	2.69E-05	1.18E-04
Cobalt	9.50E-05	1.62E-06	7.08E-06
Lead	5.65E-04	9.62E-06	4.21E-05
Manganese	4.30E-04	7.31E-06	3.20E-05
Mercury	2.94E-04	5.00E-06	2.19E-05
Nickel	2.37E-03	4.04E-05	1.77E-04
Selenium	2.71E-05	4.62E-07	2.02E-06
Polycyclic Organic Matter:			
Methylnaphthalene (2-)	2.71E-05	4.62E-07	2.02E-06
Naphthalene	6.90E-04	1.17E-05	5.14E-05
Total HAP	**2.135**	**0.036**	**0.159**

[a] Emission factors from manufacturers guarantees on VOC, NOx, CO, PM in lb/mmbtu. The remainder from AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-1, 1.4-2, & 1.4-3 (07/98) for all criteria and HAP pollutants, corrected to site-specific gas heat content.

[b] Emission factors for GHG pollutants from 40 CFR Part 98, Subpart C and corrected to site-specific gas heat content.

[c] Emission Rate (lb/hr) = Rated Capacity (MMscf/hr) × Emission Factor (lb/MMscf).

[d] Annual Emissions $(tons/yr)_{Potential} = (lb/hr)_{Emissions}$ × (Maximum Allowable Operating Hours, 8760 hr/yr) × (1 ton/2000 lb).

MarkWest Liberty Midstream & Resources, L.L.C.
Harmon Creek Gas Plant
Rod Packing Emissions

Rod Packing

Total Rod Packing Emissions

Pollutant	Emissions	
	lb/hr	tpy
VOC	0.27	1.18
Total HAPs	0.00	0.01
Methane	24.54	107.48
Carbon Dioxide	24.23	106.15
n-Hexane	0.00	0.01
Total HAPs	0.00	0.01

Proposed Residue Compressors

Emission Rate[a]	215.0	(scf/hr)
Density	0.043	(lb/scf)
Number of Compressors	3	
Total Emissions	27.923	(lb/hr)

[a]Based on residue compressor monitoring data.

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	0.15%	0.041	0.180
Total HAPs	0.00%	0.000	0.000
Methane	87.54%	24.444	107.066
Carbon Dioxide	0.31%	0.087	0.382
n-Hexane	0.00%	0.000	0.000
Total HAPs	0.00%	0.000	0.000

Existing Residue Compressors

Emission Rate[a]	215.0	(scf/hr)
Density	0.043	(lb/scf)
Number of Compressors	4	
Total Emissions	37.230	(lb/hr)

[a]Based on residue compressor monitoring data.

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	0.15%	0.055	0.240
Total HAPs	0.00%	0.000	0.000
Methane	87.54%	32.593	142.755
Carbon Dioxide	0.31%	0.116	0.509
n-Hexane	0.00%	0.000	0.000
Total HAPs	0.00%	0.000	0.000

Stabilization Compressors

Emission Factor[a]	0.018	(scf CH_4/min)
Mole fraction Methane	0.440	
Total Emission Factor	0.041	(scf/min)
MW	29.162	(lb/lbmole)
Number of Compressors	2	
Total Emissions	0.378	(lb/hr)

[a]Based on 40 CFR Part 98 Subpart W Section 233 Emissions Factors

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	44.89%	0.170	0.743
Total HAPs	0.60%	0.002	0.010
Methane	24.26%	0.092	0.402
Carbon Dioxide	0.24%	0.001	0.004
n-Hexane	0.60%	0.002	0.010
Total HAPs	0.60%	0.002	0.010

CO2 Compressor

Emission Rate[a]	215.0	(scf/hr)
MW	0.115	(lb/scf)
Number of Compressors	1	
Total Emissions	24.684	(lb/hr)

[a]Based on residue compressor monitoring data.

Pollutant	Mass %	Emissions	
		lb/hr	tpy
VOC	0.02%	0.004	0.018
Total HAPs	0.00%	0.000	0.000
Methane	0.01%	0.002	0.010
Carbon Dioxide	97.82%	24.146	105.760
n-Hexane	0.00%	0.000	0.000
Total HAPs	0.00%	0.000	0.000

MarkWest Liberty Midstream & Resources, L.L.C.
Harmon Creek Gas Plant

Measurement Devices

Exempt under Section 127.14(a) #7

Source Information:	
Analyzer Vent Rate (scf/hr)	2.12
Spectra Analyzers	8.00
GC Vent Rate (scf/hr)	0.04
GC Streams	21.00
Total Number of Measurement Vents to Atm	29.0
Potential Annual Hours of Operation (hr/yr)	8,760
Potential Volume Emitted (scf/yr)	18,561

Pollutant	Per Analyzer		Per GC Stream		Total	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Carbon Dioxide	0.000	0.001	0.000	0.000	0.00	0.011
Methane	0.09	0.397	0.00	0.007	0.76	3.311
VOC	0.03	0.125	0.00	0.002	0.24	1.042
n-Hexane	2.07E-03	0.009	3.45E-05	0.000	0.02	0.076
Total HAPs	2.07E-03	0.009	3.45E-05	0.000	0.02	0.076