EASTERN RESEARCH GROUP, INC.

MEMORANDUM

To: Gerri Garwood, U.S. Environmental Protection Agency (EPA)/Measurement Policy Group (MPG)

From: Eastern Research Group (ERG)

Date: February 1, 2018

Subject: Summary of EPA Responses to Public Comments Received on the Proposed Emissions Factors for Enclosed Ground Flares at Natural Gas Production Sites and Chemical Manufacturing Processes

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1.0 Introduction

On June 5, 2017, the EPA proposed revisions to AP-42 Section 13.5 that included new total hydrocarbon (THC) emissions factors for enclosed ground flares at natural gas production sites and certain chemical manufacturing plants in response to a consent decree (see https://www.epa.gov/air-emissions-factors-and-quantification/new-emissions-factors-enclosed-ground-flares). A suit was brought against the EPA for having allegedly failed to perform a nondiscretionary duty under Clean Air Act (CAA) section 130 to review, and, if necessary, revise the emissions factor for volatile organic compounds (VOC) for flares at natural gas production sites at least once every three years. *Alliance Houston. v. McCarthy*, No. 1:16-cv-01998-RC (D. D.C.)). A consent decree was entered in the case. Under the terms of the consent decree, by June 5, 2017, EPA would review and either propose revisions to the VOC emissions factors for elevated and enclosed ground flares at natural gas production sites under CAA section 130, or propose a determination under CAA section 130 that revision of the emissions factor is not necessary, and EPA is to take final action by February 5, 2018.

On June 5, 2017, based on a review of available data, the EPA proposed to determine that revision of the existing VOC emissions factor for flares at natural gas production sites is not necessary; however, the EPA proposed a new THC emissions factor for enclosed ground flares at natural gas production sites and two new THC emissions factors for enclosed ground flares at certain chemical manufacturing processes. The comment period for the proposal ended on August 18, 2017. Based on its review of the comments, the EPA is finalizing its determination that revision of the existing VOC emissions factor is not necessary; in addition, the EPA is finalizing six new THC emissions factors for enclosed ground flares.

2.0 Summary of Public Comments and EPA Responses

The following entities provided public comments in response to EPA's proposed emissions factors:

- Wyoming Department of Environmental Quality (WDEQ),
- Colorado Department of Public Health and Environment (CDPHE), and
- Environmental Integrity Project (EIP).

This section summarizes the public comments and EPA's responses.

2.1 Limited Data Are Not Adequate to Develop Emissions Factors

Comment: One commenter (WDEQ) asserted that the small sample size (9 field test reports) used by EPA to develop the proposed emissions factor for THC from enclosed ground flares at natural gas production sites does not adequately categorize emissions from the various types of enclosed ground flares being represented by the proposed emissions factor. The commenter recommended that EPA reevaluate the proposed THC emissions factor from enclosed ground flares at natural gas production sites by conducting or considering more extensive emissions testing on various types of flare designs and fuel heat contents.

Response: In developing the proposed factors, the EPA considered all the data specific to enclosed ground flares at natural gas production sites that were available to the agency. Based on EPA's analysis of the data, there was not a sufficient amount of data to fully evaluate different classifications of flares as the commenter suggests, because the data provided in the test reports generally provided generic descriptions and did not fully characterize the flare design or fuel types. Additionally, there was not enough data available to draw clear conclusions about how the data should be grouped, e.g., there was no clear line between low and high heating value of the fuel. While it would be ideal to evaluate different flare designs or fuel heat contents to determine the degree to which such factors influence a flare's emissions and whether different categories of emissions factors are warranted, in this case where there is not a sufficient amount of data to perform such an analysis, we recommend using the emissions factors finalized today for estimating emissions from the source categories noted in Tables 13.5-1 and 13.5-3 of AP-42.

Comment: One commenter (WDEQ) stated that the manufacturer test reports shown in Table 6 of EPA's *Review and Analysis of Emissions Test Reports for Purposes of Reviewing the Natural Gas Production Flares Emissions Factor Under Clean Air Act Section 130* should be considered representative of enclosed ground flares at natural gas production sites because the test data is required for an enclosed ground flare to be certified as meeting requirements under 40 CFR §60.5413 or §60.54 l 3a.

Response: EPA disagrees with the commenter. As explained in Section 4.2 of EPA's review document, although EPA developed emissions factors using units tested by manufacturers for compliance with the Oil and Gas sector rules, the emissions profiles for these manufacturer-tested units are not likely to be representative of the THC emissions of an enclosed combustor burning field gas because the units are burning a different fuel during the manufacturer tests. During the manufacturer tests, the enclosed combustors burn propylene. In the field, the enclosed combustors burn a variety of waste gases from natural gas production, including tank vapors, waste gas from glycol dehydrators, etc.; this fuel is expected to be high in methane and other light-end alkanes, not propylene. The difference in emissions profiles is confirmed by the statistical analysis (Student's t-test) between the field-tested and manufacturer-tested datasets,

which showed that the manufacturer-tested units do not belong in the same group as the field-tested units at natural gas production sites. See Section 4.2 of EPA's review document.[1]

In the Oil and Gas sector rules,[2] propylene is the fuel manufacturers must use for performance testing even though it is not often seen in natural gas production because propylene is harder to burn than methane and other compounds expected to be sent to the enclosed combustor in the field. Therefore, while burning propylene, it is expected to be more challenging for the units to meet the rules' required destruction efficiency (95%) than if the unit were burning the fuel that would be sent to the it in the field. The manufacturer-tested units have demonstrated high destruction efficiencies in a controlled setting, well over 99%, which is much higher than the 95% control efficiency required by the Oil and Gas sector rules. However, the fact that the unit can meet a destruction efficiency of 99%, while useful in proving compliance with the rule, provides no information on the type or quantity of compounds that would be expected to be emitted from a unit burning field gas, as propylene is not generally a component of field gas. As such, the emissions data from the manufacturer-tested units do not provide data that are appropriate for developing emissions factors for enclosed ground flares operating on natural gas production sites.

The EPA applied the emissions factors developed using the manufacturer test reports to chemical manufacturing Source Classification Codes (SCCs) instead of natural gas SCCs. These SCCs are the same SCCs that are assigned to the original flare factors. The original flare factors are based on an 80% propylene-20% propane fuel, which is similar to the 100% propylene fuel used in the manufacturer tests. The SCCs mostly represent processes related to olefins production, namely ethylene and propylene production. Propylene is expected to be a major component of streams sent to flares in propylene production. Additionally, because ethylene and propylene are close related and have similar molecular stabilities, it is likely that the emissions profiles of a flare burning ethylene would be similar to that of a flare burning propylene.

2.2 Low-Capacity Emissions Factors for Flares at Natural Gas Production Facilities

Comment: One commenter (EIP) supported EPA's proposal to develop low- and high-capacity emissions factors for flares at chemical plants and questioned whether a low-capacity factor should be developed for enclosed ground flares at natural gas production facilities. The commenter noted that a low-capacity emissions factor may be supported by the test data (i.e., the field test data from the Cimarron Parshall facility yields a low-capacity factor of 646 pounds THC per million standard cubic feet (lb/mmscf) and a high-capacity factor of 4.4 lb THC/mmscf).

Response: Most of the field test reports for enclosed ground flares at natural gas production facilities do not contain sufficient data characterizing the percent load for use in developing low- and high-capacity factors. Additionally, when looking at the dataset as a whole, there is not enough data available to draw clear conclusions about where a clear demarcation between low and high heat input values exists in order to perform statistical analysis to determine if subcategorization is warranted. Therefore, EPA has not developed separate subcategories of emissions factors for enclosed ground flares at natural gas production facilities.

[1] https://www3.epa.gov/ttn/chief/consentdecree/ONGflare/report_ef_ONG_2018.pdf

[2] In this document, EPA refers to its regulations at 40 C.F.R. part 60, subparts OOOO and OOOOa, and part 63, subparts HH and HHH, collectively as the "Oil and Gas sector rules."

While the EPA acknowledges that the Cimarron Parshall facility tested at three different pressure settings (effectively three different fuel feed rates) and there does appear to be variance in the emissions between the tests at the lowest pressure setting and the two higher pressure settings, similar data is not available for other field-tested units, nor is data available to indicate at what percent of capacity other field-tested units were tested. Therefore, even if we were to divide the Cimarron Parshall data into two sets of data, it is not possible to determine to which of the datasets each of the other field test data would belong. Additionally, looking at the inlet fuel rate vs. the THC emissions, the lowest emissions belong to the fuel rates on either end of the spectrum, e.g., the lowest and highest fuel rates. Therefore, the dataset as a whole does not support separate emissions factors at this time.

2.3 Implications of Emissions Factor Development

Comment: One commenter (WDEQ) stated that the EPA's proposed THC emissions factors may cause far-reaching implications to emissions inventories and Prevention of Significant Deterioration and New Source Review permitting (especially where VOC emissions are determined as a percentage of THC).

Response: EPA notes that AP-42 emissions factors are intended for the purpose of developing national emissions inventories and that the factors represent an average range of emissions rates. While air pollution control agencies could potentially choose to use the emissions factors in permit applications, AP-42 expressly states that: "Use of these factors as source-specific permit limits and/or as emission regulation compliance determinations is not recommended by EPA." (see AP-42 Introduction). EPA acknowledges that development of new emissions factors can impact emissions inventories; however, because the process is data-driven, these changes are expected to lead to more accurate emissions inventories.

2.4 Emissions Factor Units

Comment: One commenter (EIP) requested an explanation for why the units of EPA's proposed emissions factors are expressed in terms of gas volume (lb THC/mmscf) rather than on a heat rate basis (lb THC/million British thermal units, lb THC/mmBtu). The commenter stated that, based on a review of the field test data, heat rate value appears to be closely related to the destruction and removal efficiency (DRE) of the flare. The commenter noted that the two facilities with the lowest recorded heat rate values (ETC Debeque and ETC Rifle Bolton) correspond to two of the three highest average emissions factors based on facility field test data. The commenter added that the units of the VOC and THC emissions factors in Section 13.5 of AP-42 (EPA's *Compilation of Air Pollutant Emission Factors*) are expressed in terms of lb/mmBtu.

The commenter noted that it may also be important for the EPA to consider heat input values in developing emissions factors because of how closely THC emissions mirror VOC emissions. Gas streams that are predominantly natural gas and have relatively high methane content will have relatively low heat values. High methane and ethane content streams will also have a higher gap between THC and VOC concentrations, as VOC is typically calculated by subtracting methane and ethane emissions from the THC measurement.

Response: EPA agrees with the commenter that heat input is an appropriate basis for flare emissions factors. At proposal, EPA specified a fuel feed rate basis because there are more

test reports with information on fuel rate than heating value of the fuel; therefore, the dataset is more robust for developing a factor expressed on a fuel feed rate basis. Additionally, based on the available data, it was our understanding that fuel feed rate may be a more accessible piece of information for those interested in using the emissions factor. That said, in response to the comment asking that EPA consider heat input value in developing flare emissions factors, EPA is expressing the final emissions factors both in terms of gas volume fed (lb THC/mmscf) and heat rate input (lb THC/mmBtu).

However, with regard to the comment that there appears to be a correlation between heat rate and DRE, the EPA does not believe that there are sufficient data in the field test reports to support that assertion. EPA also disagrees that the two facilities with the lowest recorded heat rate values have the highest emissions. While ETC Debeque and ETC Rifle Bolton were burning the fuel streams with the lowest heating value, based on the fuel feed rate, the heat input rates for these two facilities fall in the middle of the dataset.

Comment: One commenter (EIP) stated that in order to estimate the heat value and gas composition from multiple sources, heat value data from the field testing can be supplemented with additional data sources on gas composition and heat value information, such as permit applications for similar sources, like storage tank or glycol dehydrator emissions sent to ground flares at natural gas production facilities.

Response: For emissions factor development, EPA disagrees that heat value data could be supplemented using generic heat input data information from additional data sources. To correlate the emissions to heat input rate, the actual heat input rate of the tested source during the performance test must be available. That is the only way available to determine the accuracy of the resulting emissions factor.

2.5 Volatile Organic Compound Data

Comment: One commenter (EIP) contended that the EPA has not adequately explained why the test data it reviewed cannot be used to determine an appropriate emission factor for VOCs rather than THC. The commenter argued that field tests from multiple facilities included in the EPA's analysis used Method 18 to determine methane and ethane concentrations to calculate non-methane, non-ethane hydrocarbon (NMEHC) as a reasonable proxy for VOC emissions, indicating that there are available VOC data from the field tests. However, the commenter also questioned whether measuring VOC emissions by determining the THC emissions and subtracting the ethane and methane emissions is an effective method for approximating VOC concentrations, because, as the commenter pointed out, the data for some facilities result in negative values for NMEHC concentrations when using this approach. The commenter noted that some facilities use EPA Method 25A with a methane separator to measure non-methane hydrocarbons (NMHC). This approach alleviates the potential for negative values and results in positive VOC concentration approximations. In addition to providing an explanation on whether the field tests present valid VOC data, the commenter also requested feedback on the more effective and accurate measurement methods for future field tests and VOC calculations.

Response: For the reasons provided below, the EPA has insufficient data to develop a VOC emissions factor for flares at natural gas production sites. No methane or ethane data are provided for the manufacturer-tested units and, therefore, VOC emissions cannot be determined

for those units. EPA has also determined that the VOC emissions data reported in the facility field-tested flare reports are not useable for developing a VOC emissions factor. For each test where both methane and ethane are available, the VOC concentration is a negative value when the methane and ethane are subtracted from the THC measurement. Clearly, it is not possible for a flare to have negative emissions, and therefore, it is inappropriate for EPA to use the data to develop an emissions factor for VOC.

The commenter notes that there are NMHC data available for some facilities. However, NHMC is not the same as NMEHC, which we consider to be a surrogate for VOC (i.e., VOC = THC – methane – ethane). Furthermore, the size of the NMHC dataset is much smaller than the THC dataset; because emissions factors are meant to represent the average emissions from an entire category of sources, more data yields more representative emissions factors. Finally, while the use of a methane separator did alleviate negative NMHC values in the available field tests, this is not always the case for this methodology.

Although not recommended for combustion sources due to the complex nature of combustion byproducts, some sources may be able to approximate VOC emissions by measuring individual VOC compounds and summing the emissions. Additionally, while subtracting methane and ethane from THC resulted in negative numbers for the test reports in this dataset, that is not always the case nor should generalizations be made regarding the validity of this measurement method based on such a small subset of the data. In the field test reports included in this project, where methane and ethane data were available, the THC emissions were small, less than 10 ppmv. Every test method contains some uncertainty in the measurement, and the uncertainty becomes more pronounced as the emissions decrease. Therefore, it is possible to have a negative result when one subtracts two small numbers measured with one method from one small number measured with a different method. While this is the case for the field test reports in this project, it is not always the case, and this is still a reasonable approach for approximating VOC in general, especially where the THC emissions are larger.

2.6 Representativeness of the Existing VOC Emissions Factor for Elevated Flares at Natural Gas Production Facilities

Comment: One commenter (EIP) requested that the EPA provide additional explanation for how the existing VOC emissions factor for elevated flares at natural gas production facilities in EPA's WebFIRE database is representative or useful for modern gas production sites. The commenter stated that the apparent age (1985) of the emissions factors indicates that they may have been derived from conventional oil wells, and therefore may not be applicable to modern facilities that utilize hydraulic fracturing for shale gas production.

Response: EPA clarifies that it makes no representation of the representativeness of the current VOC emissions factor for flares at natural gas production sites that exists in WebFIRE. This factor was obtained from the 1990 *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants* (EPA, 1990). There is no background information in that document to indicate the source of the data or the methods used to derive the emissions factor. As such, the emissions factor has a "U" rating. A "U" designation indicates an unrated factor, meaning that the factor is developed from source tests that have not been thoroughly evaluated, research papers, modeling data, or other sources that may lack supporting documentation. The data used to develop an unrated emission factor are not necessarily poor, but

there is not enough information to rate the factor. As discussed in EPA's review document,[3] based on available data on enclosed ground flares, the EPA has developed THC emissions factors for enclosed ground flares at natural gas production sites and recommends that they be used instead of the existing VOC flare emissions factor. Unfortunately, the EPA could not do the same for elevated flares due to the lack of available data on elevated flares. The existing VOC flare emissions factor is the only emissions factor applicable to elevated flares at natural gas production sites, and there is no information indicating that it is not representative of VOC emissions at natural gas production sites. In light of the above, the EPA thinks it is reasonable for one to use the existing VOC emissions factor to estimate emissions from elevated flares at natural gas production sites.

2.7 Rationale for Assigning "Moderately Representative" to SCCs for Proposed THC Emissions Factors at Chemical Plants

Comment: One commenter (EIP) noted that the original emissions factors in AP-42 Section 13.5 (Table 13.5-1) for flares at chemical manufacturing facilities (represented by 5 SCCs) were based on units firing a mix of propylene and propane (80/20 mix). The commenter requested that the EPA provide additional explanation for the agency's conclusion that the performance of a flare firing pure propylene is moderately representative of the 5 SCCs cited for chemical manufacturing facilities.

Response: As discussed in Section 4.2 of EPA's review document, we consider the 80% propylene-20% propane fuel as almost entirely propylene and therefore similar to the fuel burned by the enclosed ground flares, 100% propylene, during the manufacturer performance tests EPA reviewed in developing the proposed THC emissions factors. Because these fuels are considered similar, it is expected that flares combusting these fuels will have a similar emissions profile. Therefore, EPA concluded that the same SCCs that apply to the original flare factors should be applied to the new flare emissions factors. The representativeness of "moderately" was determined using EPA's emissions factor development procedures and is based on the quality and quantity of test reports used to develop the emissions factors. See Recommended Procedures for Development of Emissions Factors and Use of the WebFIRE Database, August 2013, at https://www3.epa.gov/ttn/chief/efpac/procedures/procedures81213.pdf for further explanation on how representativeness of individual factors is determined.

2.8 Clarification Needed for Control Status of Emissions Factors in AP-42 Tables

Comment: One commenter (CDPHE) stated that Tables 13.5-1, 13.5-2, and 13.5-3 in AP-42 are not clear as to whether the emissions factors represent uncontrolled emissions (i.e., the emissions entering the flare from the associated process unit) or controlled emissions (i.e., the emissions from the outlet of the flare). The commenter provided draft language to use in either a paragraph in the body of AP-42 Section 13.5 or a footnote to each table. In addition, the commenter recommended changing the format of AP-42 Tables 13.5-1, 13.5-2, and 13.5-3 by incorporating new columns and adjustments to column headings to clarify the uncontrolled/controlled basis of the emissions factors.

Response: EPA agrees that the tables in the draft version of AP-42 Section 13.5 are unclear regarding whether the emissions factors represent uncontrolled or controlled emissions.

[3] https://www3.epa.gov/ttn/chief/consentdecree/ONGflare/report_ef_ONG_2018.pdf

Therefore, EPA is adding clarifying language to the tables to indicate whether the emissions factors represent controlled or uncontrolled emissions. However, EPA is not adding new columns to the tables, as the factors all represent the emissions at the exit of the flare, either through control or through a byproduct of the combustion process.