Appendix E

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To: Rosalie Winn, EDF

From: Dana Lowell, MJB&A

Date: December 11, 2018

Re: **Analysis of OOOOa Annual Air Emission Reports**

MJB&A conducted an analysis of Air Emission Reports (AERs) submitted to EPA by oil and gas production companies in compliance with the reporting requirements of the Code of Federal regulations, Part 60, Subpart OOOOa (40 CFR 60, OOOa; New Source Performance Standards, Standards of Performance for Crude Oil and Natural Gas Facilities). Some of these reports were accessed via EPA's WebFIRE website[1], and others – which are not included on the WebFIRE site – were released by EPA in response to Freedom of Information Act (FOIA) requests[2]. The reports analyzed, which are summarized here, are annual reports of fugitive emission sources detected at company-owned natural gas well sites during mandated Leak Detection and Repair (LDAR) surveys. The data includes reports from reporting year 2017 and reporting year 2018.

The data included in these reports indicated that:

- The average time to conduct an LDAR survey is approximately 1.25 – 1.6 hours per well, including travel time between sites. Based on this, EPA's estimate of the cost of semi-annual LDAR at oil and gas sites is likely overstated by 15% - 32%.
- At least one fugitive emission source was detected during 54% of LDAR surveys at well sites. The average number of fugitive emission sources detected was 1.7 per well site, including surveys where none were detected.
- Open thief hatches or other open vents were the most common fugitive emission sources detected during LDAR surveys, comprising 37% of all detected sources. Other major sources of fugitive emissions were leaking flanges/connectors, and leaking valves/regulators.
- All detected fugitive emission sources had been repaired by the end of the reporting period at approximately 90% of sites, with approximately one third of detected fugitive sources corrected on the same day they were detected.

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[1] https://cfpub.epa.gov/webfire/reports/eSearchResults.cfm; Accessed on July 31, 2018.

[2] EPA-HQ-2018-001886 https://www.foiaonline.gov/foiaonline/action/public/submissionDetails?trackingNumber=EPA-HQ-2018-001886&type=request: Last accessed on October 9, 2018.

Summary of Reports Analyzed

WebFIRE Reports

As of July 31, 2018 there were162 unique OOOOa AERs included on the WebFIRE site (not including a handful of reports repeated more than once). Of these reports, 70 are related to "Gas Plants", 23 are related to "Compressor Stations", 17 are related to "Processing Facilities", 5 were submitted by "pipeline companies", and 5 document fugitive emission sources from individual process units at a well site or other facility (i.e. a tank battery or dryer). These reports were not included in the analysis summarized here.

The remaining 42 reports (26% of total reports) each address one or more natural gas well site(s) owned by the reporting companies. The analysis summarized here is based on data in these 42 reports. All 42 reports analyzed were submitted on Excel™ spreadsheet templates provided by EPA; however, some required data elements (per the EPA template) were missing or incomplete on some reports. In addition, the different companies did not use a consistent data format when completing other required data elements.

The site information sections of these 42 reports list 1,496 unique "well sites". These well sites are located in 15 different states[3], but the vast majority (~80%) are in North Dakota and belong to only one company – Oasis Petroleum North America, LLC. Based on the descriptions provided, the majority of the reported well sites appear to be single well pads, but some "sites" identified by various companies do include more than one adjacent well pad[4].

Not all of the "sites" listed in the site information section of a given report have corresponding data on "fugitive emission sources" at that site; of the 1,496 unique well sites included in the 42 reports analyzed, only 953 sites (64%) have any fugitives data. Of these 953 sites with fugitive data, 56% have data on one LDAR survey, and the rest have data on more than one LDAR survey (i.e. there is data on 2 – 6 separate surveys of the same site conducted on different days).

Altogether there is at least partial data describing the results of 1,597 unique LDAR surveys (unique survey date at unique site). However, the data is not complete for all of these 1,597 unique surveys. Of these, only 988 have leak data (number of leaks detected, by component) and only 358 have data on start and end time of the LDAR survey (to calculate LDAR survey time). In particular, the Oasis Petroleum report does not include LDAR survey start-end time for any of the listed sites.

Of 1,449 unique LDAR surveys for which the survey method was reported, 96.5% used Optical Gas Imaging to detect fugitive emission sources, and 3.5% used a toxic vapor analyzer in conjunction with Method 21.

Of 580 unique LDAR surveys for which repair data was reported, 96.7% reported that all detected fugitive emission sources were repaired, 0.4% reported that less than 60% of detected sources were repaired, and 2.1% reported that less than 10% of detected sources were repaired.

FOIA Reports

As of October 5, 2018, EPA has released eighty-one unique files containing OOOOa AERs in response to FOIA requests. Releases occurred on seven different dates between May 2018 and October 2018. Of the AERs included in the FOIA releases, data for four of the companies can also be found on the WebFIRE site. The remaining unique reports which are included in the FOIA releases, but which are not on the WebFIRE site, were submitted by seventy-one different companies, and cover wells in fifteen different states.

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[3] The states include: CA, CO, IL, KS, KY, LA, MI, ND, NE, NY, OH, PA, TX, UT, and WY

[4] Many operators reported the "US Well ID" number(s) associated with each listed "site". For the most part only one well ID was listed per site.

These reports summarize the results of LDAR surveys at 1,620 unique "sites" identified by the reporting company. At 530 of these sites it is not clear from the site descriptions provided how many wells the site includes, and/or survey start-end times were not noted. The remaining 1,090 "sites" (for which definitive information was provided on the number of wells surveyed, survey start - end time, and leak data) covered a total of 2,844 individual well pads.

Of the fugitive emission sources detected at these 2,844 well pads, the companies reported that 36% were corrected on the same day they were detected, and repairs were "delayed" for 15% of them.

Total Data Set

Including data from the WebFIRE and FOIA reports, the below analysis of LDAR survey times is based on LDAR surveys conducted at 3,202 unique well pads, and the analysis of detected fugitive sources is based on LDAR surveys conducted at 3,832 unique well pads.

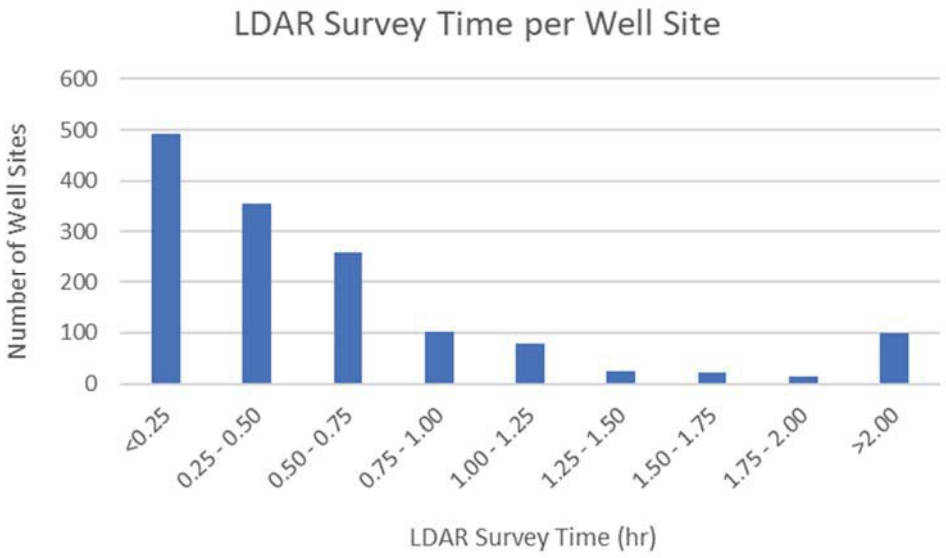
Summary of LDAR Survey Data

LDAR Survey Time per Well Site

See Figure 1 for a distribution of reported LDAR survey times at well sites. For the 1,449 well site LDAR surveys with reported start- and end-time data, 58% took less than 30 minutes to complete the LDAR survey, and 83% took less than one hour. Only seven percent of LDAR surveys took more than 2 hours per well site. The average reported time to conduct the LDAR surveys was 0.72 hours per well site across the entire data set.

Review of survey start and end times for multiple surveys conducted on the same day by the same surveyor indicates that the time between ending a survey at one site and starting a survey at the next site ranged from less than five minutes to more than 2 hours, with an average of 30 minutes. Therefore, for the LDAR surveys included in this data set the average time to conduct them, including travel time between sites, was approximately 1.25 hours per site.

Figure 1 Distribution of LDAR Survey Times at Well sites



While Oasis Petroleum did not report LDAR survey start and end time for their sites, they did report survey date and "Name of Surveyor". Analysis of this data indicates that two different surveyors together conducted a total of

1,125 LDAR surveys for this company. On average these two surveyors were each able to conduct LDAR surveys at five different sites per day, with a high of 15 sites surveyed in one day. This implies that the average LDAR survey time for this company, including travel time between sites, was 1.3 – 1.6 hours per site, assuming a 6.5- to 8-hour work day (net of breaks). This implied LDAR survey time is consistent with the survey time data reported directly by other companies, as discussed above.

Implied LDAR Costs

In the supporting documentation for their background Technical Support Document for the proposed reconsideration of OOOOa[5], EPA estimates that:

- the cost of semi-annual LDAR at natural gas well sites, using optical gas imaging (OGI), is $2,333 (2016$) per site,
- there will be an average of two wells per well site,
- OGI camera surveys will take an average of 6.1 hours per site – or an average of 3.05 hours per well per LDAR survey
- OGI camera surveys using an outside contractor will cost $635 per survey, implying a contract cost for OGI services of $104/hour based on a 6.1 hour/site survey
- Average labor costs for in-house personnel are $61.21/hr

As noted above, the data submitted by oil and gas companies on their annual emission reports indicates that the average LDAR survey time was approximately 1.25 – 1.60 hours/well/survey[6], including travel time. The AER data therefore indicates that EPA's estimate of LDAR costs may overstate the labor effort for LDAR surveys by 2.9 – 3.6 hours per well, and 5.8 – 7.2 hours per site, per year, for semi-annual LDAR. Utilizing an average in-house labor cost of $61.21/hr (EPA assumption), EPA's estimate of LDAR costs for oil and gas wells may be overstated by 15% - 19% ($355 - $440/site/year). Utilizing an average outside contractor labor cost of $104/hr EPA's estimate of LDAR costs for oil and gas wells may be overstated by 26% - 32% ($603 - $749/site/year)

Number of Detected Fugitive Emission Sources per Well Site

See Figure 2 for a distribution of the number of fugitive emission sources detected at well sites during the LDAR surveys. Of the 2,179 unique LDAR surveys with reported fugitive data, there were no fugitive sources detected during 46% of the surveys, and 54% of the surveys detected at least one fugitive emissions source at the surveyed well site.

Of the unique surveys with detected fugitive sources, 34% detected one source, 52% detected 2 – 4 different sources, and 14% detected 5 or more different sources at the well site. There were three well sites with more than 50 fugitive emission sources detected during a single LDAR survey. The average number of fugitive sources detected during LDAR surveys was 1.7 fugitive sources per site, including those sites with no detected sources.

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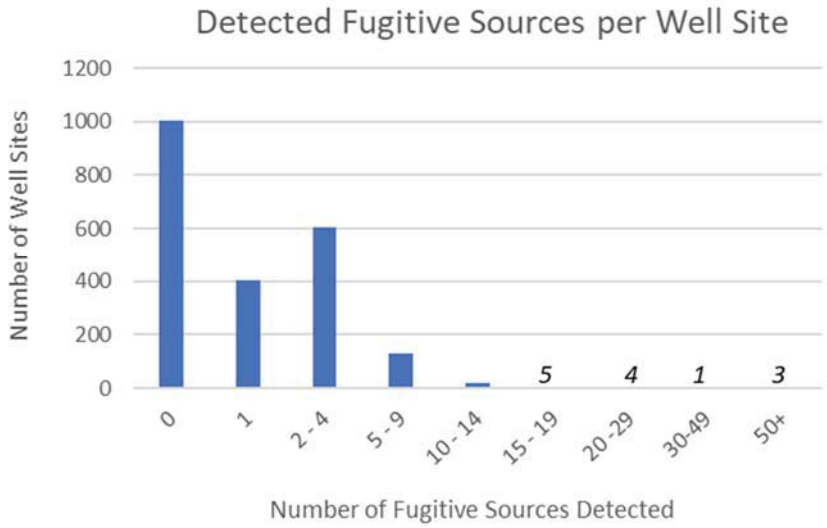
[5] https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-0040

[6] Note that EPA assumes 2 wells per site, but the AERs submitted by oil and gas companies generally define a "site" as a single well, based on reported US Well IDs, with most companies reporting a single ID per identified site.

Figure 2 Distribution of Fugitive Emission Sources Detected at Well Sites During LDAR Surveys



Types of Fugitive Emission Sources Detected

See figure 3 for a summary of the types of fugitive emission sources detected during the LDAR surveys. Out of 5,271 fugitive emission sources identified by type in the reports, 37% were open thief hatches or other vents, 20% were leaking flanges or connectors, and 14% were leaking valves or regulators. The remaining 29% of fugitive emission sources were various component types for which no single type accounted for more than 1% of detected fugitive sources.

Figure 3 Types of Fugitive Emission Sources Detected During LDAR Surveys