**From:** Stacy Dieffenbach <S.Dieffenbach@bre.com>
**Sent:** Friday, October 29, 2021 1:11 PM
**To:** GHGInventory <ghginventory@epa.gov>
**Subject:** Feedback for Anomalous Leak Events in GHG Inventory

To whom it may concern,

The following feedback is for some of the requests from section 6 of the document titled "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2020: Updates Under Consideration for Anomalous Events including Well Blowout and Well Release Emissions":

Feedback for: "1.a. EPA seeks stakeholder feedback on the data currently available, including on measurement methods and quantification approaches used in the two highlighted studies."

It seems to me the data was filtered well as to what days were usable and not from what was collected. However, it seems that the usable data was minimal, especially for the 2018 blowout event study. It seems many assumptions and inferences were made in attempting to quantify the results. I believe using an engineering software to estimate emissions could lead to significant improvements in the quality and quantity of data that could be used, which is detailed in feedback for #3 below.

Feedback for: "1.b. EPA seeks stakeholder feedback on the number of observations used to develop an estimate for an anomalous leak event. The 2018 blowout event study had one day of emissions data (from a TROPOMI concentration observation) the 2019 event had data for around 13 days from a variety of instruments and approaches."

As mentioned above, it seems that the usable data was minimal, especially for the 2018 blowout event study. A minimum of three data points is required to determine trends or anomalies in the data that should not be considered. With only one data point in the 2018 study, the results may not be reliable. The 2019 study does have more data points, which is certainly better, however it seems many assumptions and inferences were made in attempting to quantify the results.

Feedback for: "1.c. EPA seeks stakeholder feedback on assumptions applied to calculate emissions rate when data are unavailable. Pandey et al. assumed that the emission rate quantified for the observed day was applicable for the duration of the event. Other events such as the blowout quantified in Cusworth et al. and the Aliso Canyon event as incorporated into the GHGI had data over several days of the event which were used to quantify a changing emission rate over time.

For both blowouts and well releases, the highest emission rate will typically be at the beginning of the event, when the pressure (and by extension the flowrate) are highest. The most conservative (highest) estimate of emissions could be determined assuming the pressure of the system does not decrease as fluid leaves throughout the event. The longer the duration of the event, the more likely the pressure of the system will decrease, which will subsequently decrease the flowrate of the escaping fluid. As such, assuming that the emission rate quantified for a single day is the same over the entire duration of the event is likely unrealistic. Furthermore, assuming that the emission rate quantified for day 13 of 20 was the same over the entire course of the event could be underestimating the total emissions, as the flowrate was likely higher at the beginning of the event. Especially for longer events, a changing emission rate over time is probably more accurate.

Feedback for: "3. EPA seeks stakeholder feedback on approaches for estimating emissions from anomalous events where measurement data are unavailable but other records exist."

Engineering simulation software such as ProMax could be extremely useful in quantifying emissions from anomalous events.
This software is often used to size safety equipment like valves for emergency pressure relieving scenarios in the design phases of facilities, so calculating the maximum amount of flow through a given relief valve going off in an emergency situation is also fairly straightforward in the software. The basic information required to be input to the model should be already known values or relatively easy for operators to estimate. The basic pieces of information that would be required to determine emissions from a pressure relieving valve in ProMax are:

1. Composition of the facility or a representative sample from a nearby facility. This is typically sampled prior to emergency situations in order to size both the regular and emergency equipment, estimate emissions for permitting the site, estimate production numbers, and ensure product specifications can be met.
2. Relief Temperature. This is required to be determined when designing safety systems prior to installation.
3. Relief Pressure. This is also required to be determined when designing safety systems prior to installation.
    a. Note: a conservative (highest emissions) estimate would be that the relief pressure stays constant and the system pressure does not decrease over time. If the system pressure decreases after relief begins, there could be significantly lower emissions from such an event than if the relief pressure is assumed to be constant. If operators could provide an estimated pressure profile over the duration of the event, this could also be modelled and would likely contribute to more accurate accounting of emissions from the event. The longer the event duration, the more likely it is that the upstream system pressure would decrease. This also touches on request 1c from the same document, which is summarized in an above section.
4. Valve size. This is also required to be determined when designing safety systems prior to installation, and can also typically be read off the valve in the field.
5. Duration of relieving event. This could be conservatively estimated by the operators based on when the site was last visited prior to the emergency pressure relief.

Well blowouts can be a bit more complex scenarios, but engineering software could still help with estimating emissions from surface or subsea blowouts. If the assumption is made that the well blowout is emitting from an open wellbore, the wellbore could be modelled in ProMax to determine the maximum flow through it for a given reservoir pressure and bore diameter. To model such a scenario in ProMax, the following information would be needed:

1. Composition of the wellstream fluid either from this facility or a representative sample from a nearby facility.
2. Approximate Reservoir Temperature
3. Estimated Reservoir Pressure
    a. Note: similar to the note about relief pressure above, a conservative (highest emissions) estimate would be that the reservoir pressure stays constant. If the reservoir pressure decreases after the blowout has been occurring for some amount of time, there could be significantly lower emissions from such an event than if the reservoir pressure is assumed to be constant. If operators could provide an estimated pressure profile over the duration of the event, this could also be modelled and would likely contribute to more accurate accounting of emissions from the event. The longer the event duration, the more likely it is

that the reservoir pressure would decrease, especially for wells that are horizontally drilled. This also touches on request 1c from the same document, which is summarized in an above section.

4. Wellbore diameter
5. Wellbore length and depth. Depth below ground level (and additional length for a horizontal well) would be needed if a surface blowout, and both seafloor depth and wellbore depth below the seafloor would be needed for a subsea blowout.
6. Duration of relieving event

Many operating and engineering companies already have access to ProMax or other engineering software, and many already have models of their facilities. Adding an extra calculation for quantification of emissions from an emergency pressure relieving scenario to one of these existing models would be quite simple. Modelling a well blowout does require some additional information or assumptions, but this would provide an additional option for estimating emissions that have historically been difficult to quantify. An advantage to this calculation method for both emergency pressure relieving equipment and blowouts is that the full composition would be determined for the relieving fluid (gas, liquid, or a mix of both) at the site, so it would be easy to quantify both individual components (methane, ethane, propane, etc.) and component groups (GHGs, VOCs, etc.) for the event. Additionally, adverse weather conditions would not impede quantifying emissions from these events, which was an issue in much of the referenced literature. If flaring begins partway through an event, this could also be modelled in the software.

Feedback for: "4.a. EPA requests stakeholder feedback on the use of the same emissions value (i.e., 2.5 MMScf CH4/event) for well blowouts and well releases and whether there are additional/updated data that should be considered for adjusting these emissions values.

I don't believe using the same emission value for both blowouts and well releases is realistic. They are vastly different events, and likely have nowhere close to the same emissions. Even for the same type of event (e.g. a well release), the actual emissions can vary significantly on a case-by-case basis. If obtaining specific data about the release is not possible, I think it would be much better to have two emissions values, one for well blowouts and one for well releases. Unfortunately, I don't have additional data to provide to improve this value, and understand that the lack of data poses a problem.

However, I do think it would improve accuracy to break down the emissions value(s) into a time-basis instead of an event-basis. For example, a blowout that lasts for 20 days will have significantly different emissions than one that lasts for 10 days. If the emissions value(s) were provided on a time scale basis (e.g. 1 MMScf CH4/day), this could lead to a much closer approximation per event. It might be helpful to incorporate a potential change in flowrate over the duration of the event into this emission value, either through tabular amounts for given days (e.g. days 1-5 have one value, days 5-10 have another value, etc.) or integrating this behavior into the selected time-basis emission value.

Thank you for your time, and thank you for everything that you all do!

Best regards,

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