

Letter Health Consultation

ALOHA Air Modeling of Pigging Operations Near the

CARTER IMPOUNDMENT

MT PLEASANT TOWNSHIP, WASHINGTON COUNTY, PENNSYLVANIA

JUNE 6, 2017

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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U.S. Department of Health and Human Services
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and Disease Registry
Atlanta GA 30333

May 11, 2017

Douglas Snyder
Assistant Regional Counsel
U.S. Environmental Protection Agency, Region 3
1650 Arch Street
Philadelphia, PA 19103

Dear Mr. Snyder:

ATSDR appreciates the opportunity to work with the U.S. Environmental Protection Agency (EPA) in conducting an exploratory environmental health review of the data collected from various natural gas pipeline-associated pig launching and venting operations at a location in Mt. Pleasant Township, Washington County, PA.¹ As discussed in our November 5, 2015 letter to you, ATSDR has been actively assessing environmental public health concerns in this area and we committed to sharing our interim conclusions with you.

On July 27, 2015, ATSDR released a public health consultation identifying the need to further assess exposure to contaminants in ambient air in this community. Based on the findings from this health consultation, ATSDR consulted with EPA to obtain additional air sampling information for this location. On September 10, 2015, ATSDR received an initial air sampling data set from EPA related to natural gas pipeline-associated pig launching and venting activities at this site. The information provided by EPA characterizes near-field occupational-type exposures. On November 10, 2015, ATSDR wrote a letter to you stating our intention to evaluate this information using modeling to explore if it could further add to our understanding of community-based exposures near these types of operations. Since that time, we have discussed our preliminary efforts with EPA and possible options for incorporating different sources of modeling inputs. Using the information available to ATSDR at this time, this letter summarizes the results of our preliminary evaluation of the 2015 data using air modeling to assess potential community exposures at this site. This letter is provided as technical assistance to EPA and the Pennsylvania Department of Environmental Protection (PADEP) to support further consideration of this exposure pathway for community members living near natural gas pipeline-associated pig launching/receiving and venting locations.

¹Pig launching/receiving operations or "pigging" refers to the practice of using devices known as "pigs" to perform various maintenance operations on a pipeline. "Pigs" are put into a "pig launcher" and the pressure-driven flow of the product in the pipeline is used to push it along down the pipe until it reaches the receiving "pig catcher." Remaining pressure in the pig catcher must be released before the "pig" can be removed from the "barrel" of the pig catcher.

Background on Modeling Parameters

In order to estimate potential residential exposures to contaminants in air, ATSDR used EPA's ALOHA (Areal Locations of Hazardous Atmospheres) computer program. ALOHA is a hazard modeling program that is widely used to plan for and respond to chemical emergencies. ALOHA allows you to enter details about a real or potential chemical release, and then it will generate threat zone estimates for various types of hazards. ATSDR selected ALOHA for this preliminary evaluation because the releases during pigging operations are discrete events (like an accidental release) and we were interested in considering potential immediate short term exposures. ATSDR used ALOHA to model chemical exposures at two residential locations situated within 300 yards southeast (SE) and northeast (NE) from pig launching and receiving emission sources at this discrete location in Mount Pleasant Township, Washington County, PA. These two locations were chosen because they are the two closest residences to the release point at this site.

Per the ALOHA model's approach, ATSDR set concentrations of interest or ALOHA "protective action criteria" (PAC) for all model runs to generate the model's estimated "threat zones."² ATSDR used the model's default PACs³ for methane and benzene, and also set a user-defined PAC for benzene using the estimated methane to benzene ratio of the source gas that corresponds to ATSDR's acute Minimal Risk Level for benzene (9 ppb).⁴

Due to concerns about emissions related to pigging operations at this location, in July 2015 the company implemented mitigation actions. These site-specific mitigation actions included installation of a high-to-low pressure jumper line which routes gases in the pig barrel to a nearby low pressure pipeline instead of venting directly to the atmosphere. This jumper line reduces pressure in the pig barrel to approximately 100 psi. The remaining gases in the barrel are then routed to a flare until the pressure in the pig barrel is close to atmospheric pressure.

ATSDR conducted modeling runs using parameters for conditions with higher and lower tank (i.e., pig barrel) pressure prior to venting, to simulate conditions before and after mitigation actions were implemented at this location. Based on discussions with EPA and the available sampling data, ATSDR used an estimated benzene to methane ratio in the source gas of 0.01%. Table 1 provides a summary of the comparison values ATSDR used in this ALOHA modeling effort.

²A threat zone is an area where a hazard has exceeded a user-specified level of concern.

³PACs are set by the Department of Energy using a hierarchical approach of Acute Exposure Guideline Levels (AEGL), Emergency Response Planning Guidelines (ERPG), and Temporary Emergency Exposure Limits (TEEL). ATSDR used PACs for this project from the February 2012 (Revision 27) PAC list available at https://sp.eota.energy.gov/pac/teel/teel_archives.html. PACs may also be user-defined by the modeler.

⁴ATSDR's MRLs are an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure, and are available at <https://www.atsdr.cdc.gov/mrls/index.asp>.

Table 1. Comparison Values Used in ALOHA Modeling of Releases from Pig Launching and Receiving

	Methane	Benzene
ATSDR Acute MRL	NA	9 ppb*
PAC-1 [†] (discomfort, irritation, or reversible health effects)	2,900 ppm	52ppm
PAC-2 [†] (irreversible health effects or impaired ability to escape)	2,900 ppm	800 ppm
PAC-3 [†] (life threatening health effects or death)	17,000 ppm	4,000 ppm

Bold text indicates a comparison value that was used as one of the threat zone values in the ALOHA modeling.

*9 ppb benzene corresponds to 90 ppm methane using the estimated benzene to methane ratio for the source gas. Modeling was conducted based on methane concentrations, so modeling results showing areas with concentrations greater than 90 ppm methane are assumed to have more than 9 ppb benzene based on the estimated composition of the gas.

[†]protective Action Criteria (PAC) are set by the Department of Energy. PACs are set with a hierarchical approach of Acute Exposure Guideline Levels (AEGL), Emergency Response Planning Guidelines (ERPG), and Temporary Emergency Exposure Limits (TEEL). PACs used for this project were from the February 2012 (Revision 27) PAC list available at https://sp.eota.energy.gov/pac/teel/teel_archives.html.

Summary of Modeling Results

1,000 psi Source Pressure Results (representative of past operating conditions at this location)

Initially when pigging was performed at this location, gas in the pig barrel was vented directly to the atmosphere at an initial pressure of approximately 1,000 psi. For our first set of modeling runs, ATSDR used this input of 1,000 psi to represent past operating conditions at this location. Higher source pressure conditions produce higher air emissions. Using 1,000 psi, there were no meteorological conditions that would result in exceeding the PAC-3 level at either of the nearby residences. Extremely stable nighttime conditions with or without an inversion would exceed the PAC-2 level at the house to the SE of the pig launcher. No meteorological conditions would result in exceeding the PAC-2 level at the house to the NE of the pig launcher. At both locations, all nighttime or overcast conditions with certain wind directions (placing pigging location upwind of nearest receptor) would exceed the lowest threshold (ATSDR acute MRL for benzene). During daylight hours in both summer and winter the lowest threshold could be exceeded for all meteorological conditions with certain wind conditions (i.e., receptors downwind of the source) at the house to the SE of the pig launcher. This threshold could also be exceeded for inversion conditions (summer or winter) or low wind speed winter conditions at the house to the NE of the pig launcher.

Stable nighttime conditions with winds from 340 degrees or 250 degrees could have resulted in concentrations of methane in excess of PAC-2 (potential irreversible health effects) at the nearby houses when releases were occurring from a 1,000 psi tank.

All meteorological conditions modeled could have resulted in concentrations of benzene in excess of ATSDR's acute MRL at the house SE of the pig launcher. Some meteorological conditions (nighttime, overcast, inversion present, low wind speed) could have resulted in

concentrations of benzene in excess of ATSDR's acute MRL at the house NE of the pig launcher.

100 psi Source Pressure Results (possible current operating conditions at this location)

As described previously, to address concerns about emissions at this location, pressure controls and a "candlestick" flare were incorporated into the pigging operations at this site after late July 2015.⁵ For our second set of modeling runs, ATSDR used an input of 100 psi to represent a possible current operating scenario at this location. This process change was predicted to result in reduced emissions and lower air concentrations of contaminants of interest.

Using 100 psi, there were no meteorological conditions that would result in exceeding the PAC-3 or PAC-2 level at either of the nearby residences. At the house NE of the pig launcher, only extremely stable nighttime conditions with a shallow inversion and certain wind conditions are predicted to exceed the lowest threshold. At the house SE of the pig launcher ALOHA predicts concentrations in excess of the lowest threshold under the following conditions:

- Winter daylight hours with a shallow inversion and 1 m/s winds
- Overcast conditions with 1 m/s winds
- Nighttime conditions with winds less than 5 m/s
- Nighttime conditions with a shallow inversion

No meteorological conditions would result in concentrations of methane in excess of PAC-2 at the nearby houses with releases occurring from a 100 psi tank. The frequency of meteorological conditions discussed here is based on data from the Pittsburgh airport meteorological station data set. Meteorological conditions (e.g., wind speed and direction) at the release point may be different.

At the house to the NE of the pig launcher, meteorological conditions that would result in concentrations of benzene greater than 9 ppb are very rare; mixing heights less than 30 meters with a certain range of wind direction (230 to 270 degrees) occur less than 0.3% of the time (and only at night).

At the house to the SE of the pig launcher exceedances of the acute MRL for benzene are predicted to occur more often. The majority of nighttime conditions (combinations of wind speed, stability, cloud cover, and the presence/absence of an inversion) with certain wind directions could result in exceeding the acute MRL for benzene. Approximately 10% of the time, wind directions are such that materials from the pig launcher can impact the house to the SE. Evaluation of five years of data from the Pittsburgh airport shows daytime meteorological conditions that would be expected to result in concentrations of benzene greater than the ATSDR acute MRL occur less than 1% of the time. This is an upper limit for the percent of daytime conditions that could exceed the threshold as some of these hours could occur at night.

⁵Since late July 2015, the pig barrel at this site was vented first by using the high-to-low pressure jumper line to reduce pressure to about 100 psi, and then the remainder of the barrel contents was sent to a candlestick flare until barrel pressure reached near-atmospheric pressure. However, there are other pigging sites where the pig barrel is vented directly to the atmosphere from approximately 100 psi (EPA Region 3, personal communications to ATSDR Region 3, 2017).

In summary, ATSDR found that reducing the tank pressure from 1,000 psi to 100 psi prior to venting resulted in a substantial decrease in the size of the threat zones for all conditions. Using the lower tank pressure, no concentrations of methane greater than PAC-2 are predicted for any meteorological conditions. Nighttime releases could potentially result in concentrations of benzene greater than the 9 ppb acute MRL for benzene at both nearby houses.

At this site, modeling results indicate that limiting venting to daylight hours could further reduce or eliminate these potential exposures. If releases were limited to daylight hours, no concentrations in excess of the acute MRL would be expected at the house NE of the pig launcher. Daytime concentrations in excess of the acute MRL could still occur at the house to the SE of the pig launcher, but only with light winds and certain wind directions (320 to 360 degrees and less than 2 m/s) and either a shallow inversion or overcast skies. These conditions are expected to occur less than 1% of the time at this location.

Limitations

There are some important limitations to ATSDR's modeling:

- ALOHA "is designed to produce reasonable results quickly enough to be of use to emergency responders. ALOHA's calculations represent a compromise between accuracy and speed, and are designed to provide information about how a toxic cloud might disperse after a chemical release in an acute exposure scenario."⁶ Therefore, this modeling does not provide estimates about chronic/longer duration exposures that may be of public health concern.
- Meteorological inputs (e.g., wind speed and direction) used for estimating pigging operation emissions impacts at nearby homes are from the Pittsburgh International Airport. The Pittsburgh airport is located approximately 12 miles northeast of the site and over considerably different terrain than at the site. Actual meteorological conditions at the site may not be the same as those observed at the airport.
- Although the model provides predictions of concentrations that may occur under specific release conditions, we cannot determine whether exposure to these modeled concentrations has actually occurred. Monitoring data would be required to determine the concentrations of air contaminants at nearby residences while pigging activities are being conducted.
- The ALOHA outputs summarized in this letter represent an approximation of the worst case circumstances that could occur during pigging operations. The majority of meteorological conditions would result in lower modeled concentrations at the nearby houses than those reported here. Using these worst case conditions results in substantial conservatism in this modeling but the model may over- or underestimate actual exposure.
- The estimated methane to benzene source gas ratio input ATSDR used in the ALOHA model was based on a limited data set collected under specific conditions. There is uncertainty regarding the range of values that might occur for this value. For example, in the data ATSDR reviewed, the maximum benzene to methane ratio observed was

⁶ALOHA Factsheet, NOAA's National Ocean Service, Office of Response and Restoration, <http://response.restoration.noaa.gov/sites/default/files/aloha.pdf>. July 2015.

0.035%. Increasing the benzene to methane ratio of the source gas results in a proportional increase in the concentrations of benzene predicted by the model (e.g., doubling the benzene to methane ratio results in a doubling of the modeled benzene concentrations).

- - It is important to note that ATSDR's evaluation at this time focused only on two chemicals (benzene and methane) and only considered the source of these chemicals as being from the pig launching and receiving operations at this site. Based on our understanding of the variety of natural gas related operations in the vicinity, there are likely other air contaminants of concern at this site, as well as other less concentrated sources (e.g., venting at tanks, well head emissions, flaring at pigging locations) of these two chemicals nearby. Without sampling at the exposure point (with sufficient temporal resolution to capture acute releases), cumulative ambient air concentrations in residential areas at this site remains a data gap.
- - Calm conditions (wind speeds less than 1 m/s) cannot be modeled using ALOHA. When modeling an inversion, the inversion height must be greater than the reference wind height. To put the model results in context, estimates of how frequently different meteorological conditions occur were required. The parameters used to model dispersion assume that the gas released is pure methane. While methane is the primary component of the gas, there are other hydrocarbons present that may behave differently in the atmosphere than a plume of pure methane would.

Conclusions

ATSDR concludes that, using conservative modeling assumptions, the potential for community exposures to emissions from pig launching and venting activities can exist under certain meteorological conditions (particularly at higher tank pressure conditions, such as were the case in the past at this location prior to mitigation actions being implemented). Note, although higher tank pressure conditions are no longer used at this location, these conditions are currently still in use at other pipeline pigging operations in different communities. Based on these modeling results at this location, reducing tank pressures and avoiding unfavorable meteorological conditions (e.g., nighttime conditions) results in substantial decreases in the potential for residential exposure to contaminants released during pigging operations. We cannot determine whether exposure to these modeled concentrations has actually occurred. Monitoring data would be required to determine the concentrations of air contaminants at nearby residences while pigging activities are being conducted.

ATSDR concludes that a data gap still exists for assessing acute and chronic exposures to air toxics (such as benzene) at residential locations nearby these operations.

Recommendations

Consistent with our 2015 Health Consultation document, ATSDR recommends further air sampling to better understand community environmental exposures from natural gas operations at this location.

ATSDR recommends environmental regulatory agencies consider the development of best management practices that reduce emissions from natural gas pipeline-associated pig launching and venting operations for nearby community members.

Thank you again for allowing ATSDR this opportunity to evaluate this data set in the context of our ongoing environmental public health activities at this location. We would welcome opportunities to further discuss community-based monitoring at this location. Please contact Lora Werner, ATSDR Regional Director and Region 3 at 215-814-3141 or via email at lkw9@cdc.gov if you would like to discuss this further.

Sincerely,



,, Tina Forester, PhD
Associate Director for Science (Acting)
Division of Community Health Investigations (DCHI)
Agency for Toxic Substances and Disease Registry

Cc:

Kenya Ford, CDC OGC

Sharon Williams-Fleetwood, PhD, Eastern Branch Chief, DCHI, ATSDR

Brad Goodwin, PhD, Science Support Branch, DCHI, ATSDR

Lora Werner, Regional Director, ATSDR Region 3, Eastern Branch, DCHI

Farhad Ahmed, MBBS, MPH, PI & Health Assessment Section Chief, Bureau of Epidemiology
Pennsylvania Department of Health

John Krueger, Assistant Bureau Director, Air Quality, Pennsylvania Department of
Environmental Protection