Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

To: Tony Walker, Regional Director, Region 4 **Date:** January 28, 2011

From: Carla Kinslow, Ph.D

Subject: Health Effects Review of Ambient Air Monitoring Data Collected by Titan Engineering, Inc. for Barnett Shale Energy Education Council.

SUMMARY

- The highest valid, 1-hour benzene concentration was below Texas Commission on Environmental Quality's (TCEQ's) short-term air monitoring comparison value (AMCV; 180 ppb_v). One 1-hour sample collected downwind from the Encana Mercer Ranch facility (3.15 ppb_v) and one 24-hour canister of 1.96 ppb_v, is considered elevated above typical background benzene concentrations and the Toxicology Division (TD) recommends additional investigation in this area to determine if this concentration is representative of normal and prolonged ambient conditions.

- Several 1-hour monitored concentrations of formaldehyde collected upwind (100.3 ppb_v and 126.9 ppb_v) and downwind (68.8 ppb_v, 114.4 ppb_v, 81.20 ppb_v) of the Quicksilver Lake Arlington facility exceeds the TCEQ's short-term AMCV for formaldehyde (41 ppb_v). A residential area is located approximately 0.15 miles downwind of the facility, thus the TD recommends a reduction in these levels as well as additional investigation in this area to evaluate if these concentrations are representative of normal and prolonged ambient conditions.

- H_2S samples collected at the Devon Hyde-Hickman (5 ppb_v, 8.3 ppb_v, and 8.6 ppb_v) and the Encana Mercer Ranch (12 ppb_v, 13, ppb_v, and 29 ppb_v) facilities did not exceed the Texas state standard for H_2S of 80 ppb_v but did exceed the H_2S odor threshold of 0.5 ppb_v. Persistent or recurrent exposure to levels which significantly exceed the odor threshold may cause odor-related effects such as headache and nausea.

BACKGROUND

Ambient air monitoring analysis was conducted during the June 1- 15, 2010 sampling

event by TITAN Engineering, Inc. for the Barnett Shale Energy Education Council (referred to in this document as "the TITAN report" (See Appendix 1)). The report describes the site selection process, air monitoring data, and interpretation of the results. The sampling event was conducted to characterize the ambient air quality adjacent to several natural gas sites in the cities of Arlington and Fort Worth, Texas.

According to the TITAN report, samples were collected at 10 natural gas sites in the cities of Arlington and Fort Worth, which included two compressor stations and eight completed well sites. However, no active drilling sites were tested as part of this study. The sites listed in this study were Quicksilver Alliance Saratoga B, Encana Mercer Ranch, Chesapeake Arc Park, Quicksilver (Gas Services) Lake Arlington, Quicksilver Exelon North, Devon Lumberman B, Devon Hyde-Hickman, Chesapeake Indus, Chesapeake Leggett & Platt, and XTO Rose.

In total, the following samples were collected:

- 48 (1-hour) volatile organic compound (VOC) and 45 (24-hour) VOC samples. At least one set of upwind and downwind 1- and 24-hour VOC samples were collected at each site.

- seven (1-hour) formaldehyde samples. Formaldehyde samples were only collected at the compressor stations at Chesapeake Arch Park, and Quicksilver (Gas Services) Lake Arlington sites. and

- 21 (1-hour) sulfur compound samples were collected for this project. One-hour samples were also collected up-and downwind of each site for sulfur compounds.

Sampling locations were based on the results of on-site meteorological data. Most samples were collected outside the property lines, but several samples (CAP4DC1, CLP9UW, XRA4UW and QLA5DC) were collected within the facility property. These on-site samples did not exceed the short-term AMCVs.

TITAN collected both 1-hour and 24-hour VOC samples. They compared the samples collected over a 24-hour period to TCEQ long-term AMCVs. The TD considers results from 24-hour sampling periods in order to recommend further investigation, but did not compare 24-hour samples to our short- or long-term AMCVs in this health effects review. Long-term AMCVs are designed to be compared to samples that are collected at a minimum of every sixth day for an entire year; thus, the TD does not consider the 24-hour sampling results to be comparable to the long-term AMCVs. Short-term AMCVs are derived for evaluating short-term (1-hour) exposure. Therefore, the TD did evaluate the reported 1-hour concentrations for each target analyte for potential short-term odor, health, and vegetative concerns by comparing the measured chemical concentrations to their respective short-term AMCVs. H_2S samples were compared to the Texas regulatory

standard of 80 ppb_v as well as to its odor threshold of 0.5 ppb_v.

Health effects evaluation

Sulfur Compounds

None of the reported concentrations for H_2S samples were above the Texas state standard. However, H_2S was monitored at concentrations that could have caused odorous conditions at Encana Mercer (Sample Nos. EMR3DE, 12 ppb_v; EMR3DW, 13 ppb_v; and EMR3U, 29 ppb_v) and Devon Hyde Hickman (Sample Nos. DHH7U, 8.6 ppb_v and DHH7DE, 8.3 ppb_v). Elevated levels of H_2S were reported at both upwind and downwind monitoring sites. This exceeds the H_2S odor threshold of 0.5 ppb_v. Persistent or recurrent exposure to levels which significantly exceed the odor threshold may cause odor-related effects such as headache and nausea. Other target sulfur compounds (see Titan Report) were not reported above their respective AMCVs.

VOC Compounds

Of the target VOCs shown in the report, none of the reported concentrations for 1-hour samples were above their respective short-term AMCVs. Additional analyses were conducted for benzene, as discussed below.

Benzene

None of the monitored 1-hour concentrations of benzene exceeded the short-term, health-based AMCV of 180 ppb_v. A reported 1-hour benzene concentration (3.15 ppb_v) at the Encana Mercer facility was above typical background levels measured throughout the state. Additional information from the 24-hour canister shows a 24-hour concentration of 1.96 ppb_v, which suggests additional monitoring is needed in the area to help provide a better understanding of long-term exposure levels in the area.

Formaldehyde

One-hour samples collected upwind (QLA5UCm, 100.3 ppb_v; QLA5UW, 126.9 ppb_v) and downwind (QLA5DR, 68.8 ppb_v; QLA5CD, 114.4 ppb_v) of the Quicksilver Lake Arlington facility exceeded the short-term AMCV of 41 ppb_v. The nearest residential area was located approximately 0.15 miles downwind from the facility. Studies of humans under controlled conditions clearly indicate that acute (short-term) exposures to air concentrations ranging from 400 to 3000 ppb_v induce reversible mild to moderate eye, nose, and throat irritation, produce changes in nasal lavage fluid contents indicative of irritation of the nasal epithelium. However, these levels do not consistently or markedly affect pulmonary function variables in most individuals (ATSDR 1999). The highest monitored 1-hour concentration of 126 ppb_v is well below 400 ppb_v. It was not possible

to determine if residents were actually exposed to this concentration of formaldehyde based on the information provided in the report. However, the TD is concerned that the monitored concentrations of this chemical at several of the sampling locations could pose a long-term health risk to residents if this monitored concentration is indeed representative of normal and prolonged ambient conditions. Thus, further investigation is needed.

CONCLUSIONS

Formaldehyde levels measured around the Quicksilver Lake Arlington site exceeded the short-term AMCV by as much as three-fold. The TD recommends a reduction in these levels and TCEQ has initiated investigation in the areas near the Quicksilver Lake Arlington site. Furthermore the TCEQ has begun our own long-term monitoring to better assess long-term ambient air conditions in the areas near natural gas facilities in the Barnett Shale area. Levels of H_2S were reported below the state standard of 80 ppb_v, but above the odor threshold of 0.5 ppb_v at two locations (Encana Mercer Ranch and Devon Hyde-Hickman facilities). Persistent exposure to odorous conditions at concentrations of H_2S such as these, may lead to various indirect health effects, including headaches and nausea.

Benzene concentrations were measured below our short-term AMCV for all samples reported. However, one 1-hour sample collected downwind from the Encana Mercer Ranch facility (3.15 ppb_v) and one 24-hour canister of 1.96 ppb_v, is considered elevated above typical background concentrations and the TD recommends additional investigation in this area to determine if this concentration is representative of normal and prolonged ambient conditions.

If you have any questions about this evaluation, please call me at (512) 239-1075 or email me at ckinslow@tceq.state.tx.us.

SUPPORTIVE DOCUMENTATION

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological profile for benzene. U.S. Department of Health and Human Services.

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological Profile for Formaldehyde.

International Agency for Research on Cancer (IARC). 2006. IARC monographs on the evaluation of carcinogenic risk of chemicals to humans. Vol. 88: Formaldehyde, 2-butoxyethanol, and 1-tert-butoxypropan-2-ol. World Health Organization, Lyon, France.

Texas Commission on Environmental Quality (TCEQ). 2007. Development support document for benzene.

APPENDIX 1

AMBIENT AIR QUALITY STUDY

NATURAL GAS SITES
CITIES OF FORT WORTH & ARLINGTON, TEXAS

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Barnett Shale
Energy Education Council

Project No. 427-01

July 2010

TITAN ENGINEERING, INC.

Distribution (via email)