Letter Health Consultation

AIR QUALITY IN LAYTON HOMES

DAVIS COUNTY, UTAH

Prepared by the
Utah Department of Health

MAY 15, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

LETTER HEALTH CONSULTATION

AIR QUALITY IN LAYTON HOMES

DAVIS COUNTY, UTAH

Prepared By:

Utah Department of Health
Environmental Epidemiology Program
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

State of Utah
JON M. HUNTSMAN, JR.
Governor

Utah Department of Health
David N. Sundwall, M.D.
Executive Director
Epidemiology and Laboratory Services
Teresa Garrett, R.N., M.S.
Acting Director
Robert T. Rolfs, M.D., M.P.H.
State Epidemiologist

May 13, 2009

Mr. Kyle Gorder
75 CEG/CEVR
7274 Wardleigh Road
Hill Air Force Base, Utah 84056-5137

Dear Mr. Gorder:

At the request of Hill Air Force Base, the Utah Department of Health, Environmental Epidemiology Program (EEP) evaluated the current data collected on 1,2-dichloroethane (1,2-DCA) from a number of homes in Layton, Utah to determine if the concentrations detected in indoor air posed a public health hazard and required further action.

Contaminant/Site History

Hill Air Force Base (Hill AFB), in Davis and Weber Counties, was the subject of a Public Health Assessment (PHA) in 2003 for contamination. Part of the recommendations from the original PHA was the continued monitoring of Operable Unit 8 (OU-8), which extended from Hill AFB south into the cities of Layton and Clearfield. OU-8 was established in 1993 as part of a plan to consolidate all groundwater contamination under the base's industrial complex. Although the Agency for Toxic Substances and Disease Registry (ATSDR) stated in the original Public Health Assessment (PHA) that no public health hazard existed as a result of OU-8 due to the inaccessibility of groundwater and soil, indoor air in homes residing above the plume was found to contain low levels of volatile organic contaminants (VOCs) that had volatilized from the groundwater plumes. Although the VOC concentrations detected at the time were below levels that would pose a public health hazard, continued indoor air sampling was recommended for homes residing above the plume, both in Layton and Clearfield (ATSDR 1989; UDOH 2003).

The indoor air monitoring for homes surrounding the base began in 2003 and currently continues. Both homes residing directly over the plume as well as homes outside of the plume boundaries were sampled. During the routine sampling, indoor air samples were collected and analyzed for VOCs. One of the contaminants routinely detected in indoor air samples is 1,2-DCA; it has been detected in approximately 90 homes in Layton. Measured concentrations in the homes ranged from 6×10^{-5} to 0.127 milligrams per cubic

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • www.health.utah.gov
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

meter (mg/m^3) with an average of 3.2×10^{-3} mg/m^3 (personal communication with Kyle Gorder, Hill AFB, February 5, 2009). Although vapor intrusion into homes is possible, indoor sources of 1,2-DCA have been suspected because:

- 1,2-DCA has been detected in many homes that do not reside above groundwater contaminated with 1,2-DCA; and,
- Vapor removal systems have been ineffective at successfully removing 1,2-DCA from homes.

At the time, Hill AFB was not aware of any specific products that were known to contain concentrations of 1,2-DCA high enough to warrant the increase in detected measurements. In an effort to identify a source, an indoor source study was conducted in 2007 and 2008 in an attempt to identify items in homes that contained 1,2-DCA. The results of the study confirmed that 1,2-DCA was detected in several home decorations made of molded plastics. Upon further examination, many of these items were Christmas decorations. Since the initial study, both items found in residences and new items purchased from local stores have been shown to contain 1,2-DCA (Hall 2008).

To date, molded plastics emitting 1,2-DCA have been found in six homes that have had previous 1,2-DCA detections as part of the Basewide Indoor Air Sampling Program. The concentration of 1,2-DCA in the initial item, a molded plastic gingerbread man Christmas ornament/decoration (see Appendix, Figure 2), was measured by Utah State University (USU) using Gas Chromatography/Mass Spectroscopy (GC/MS) according to EPA standard testing method TO17 (Hall 2008); subsequent sampling in the additional five homes has used a portable HAPSITE GC/MS. The portable device has been run using the Selected Ion Monitoring (SIM) mode and results have been confirmed to the initial sample using both a retention time and three ion match. In addition to the items found in the home, several molded plastic items similar to those found in residences were purchased from local retailers and also found to emit 1,2-DCA with both the portable and lab-based GC/MS at USU.

In addition to the current study, two additional independent studies were conducted that corroborate the current findings in this study. The first was performed by a graduate student at USU. The focus of the thesis was developing a test strategy for quantifying sources of trichloroethylene (TCE), 1,2-DCA, and perchloroethylene (PCE) in the indoor air of eight residences near Hill Air Force Base. In cases where elevated levels of chlorinated solvents were detected, the suspected source material(s) were removed and the indoor air re-sampled. If removal of the materials resulted in a reduction or elimination of air contamination, the items were placed into an emission chamber to accurately quantify emission rates from the materials. Source items were identified in three of the sampled residences and consisted of molded plastic decorative items that emitted 1,2-DCA and a wedding dress that emitted detectable levels of PCE. Although the concentration of PCE emitted from the wedding dress was below the method detection limit of the analytical equipment (GC/MS), 1,2-DCA is a natural breakdown product of PCE; therefore, contributions of 1,2-DCA would be made to overall indoor air quality concentrations over time from the storage of the wedding dress (Hall 2008).

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

In another study conducted on the Redfield site in Denver, Colorado, over 9,300 indoor air samples have been collected since 1998 as part of a routine air quality study. The contaminants detected in the plume include 1,1-Dichloroethene (1,1-DCE), trichloroethene (TCE), 1,1,1-Trichloroethane (1,1,1-TCA), 1,2-Dichloroethane (1,2-DCA), Percholorethylene (PCE), Methylene chloride and Benzene. Although all of the contaminants were detected in the plume, concentrations ranged from below detection levels to approximately 1 ppm. Being that the concentrations of contaminants measured were extremely low, it was hypothesized that the concentrations of 1,2-DCA being detected in indoor air in homes overlaying the plume was greater than that which would be a product of the vapor intrusion of the plume contaminants over time. Therefore, another source of 1,2-DCA must be contributing to the concentrations measured. Of the 9,374 samples collected, 31% (2,904) have measured detectable concentrations of 1,2-DCA. The mean concentrations of 1,2-DCA range from a low of 7.2×10^{-4} mg/m^3 in 1999 to a high of 0.027 mg/m^3 in 2008. The data collected from this 11 year study show that measured concentrations of 1,2-DCA continue to increase in indoor air.

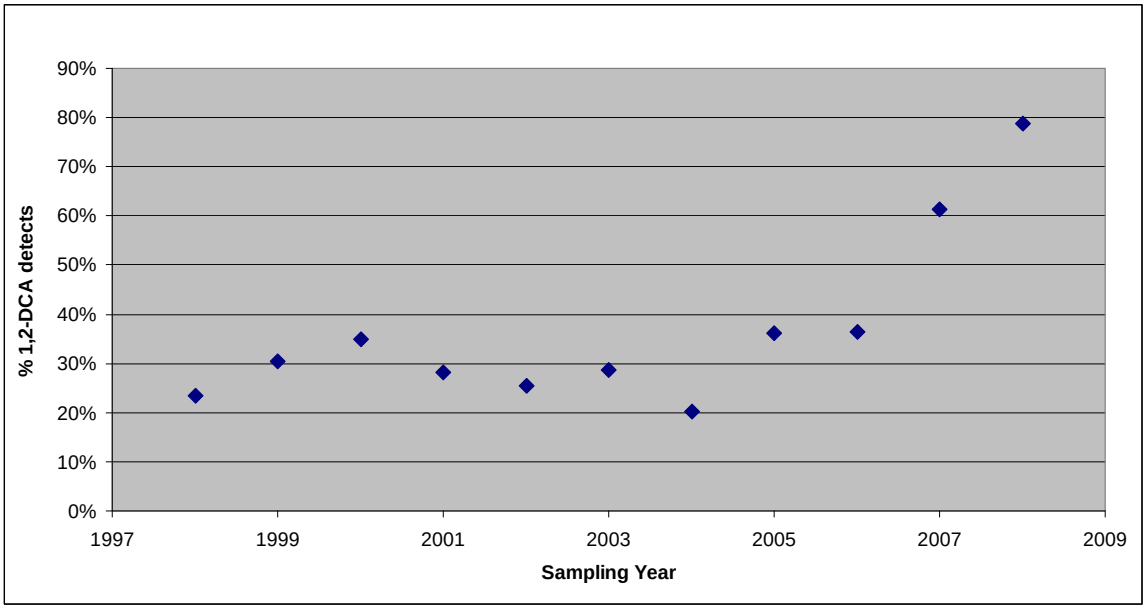

Figure 1. Percent detection of 1,2-DCA in indoor air vs. time for the Redfield, Colorado site (RL = 8×10^{-5} mg/m^3) (data obtained through personal communication with J. Kurtz, EnviroGroup Limited).

1,2-DCA Emission Calculations

Results based on mass release rate measurements conducted by USU show that the amount of 1,2-DCA being emitted from these items is sufficient to account for 1,2-DCA levels greater than Hill AFB management action levels (9.4×10^{-4} mg/m^3), which is based on a 10^{-5} health based risk level. The plastic material used in the design of the gingerbread man decoration was analyzed by USU and found to contain 1,2-DCA at 2.3 milligrams per gram (mg/g). The calculated indoor 1,2-DCA concentrations from this

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

decoration range from 1 x 10-4 mg/m3 to 1.7 x 10-3 mg/m3 (Personal communication with Kyle Gorder, Hill AFB, February 5, 2009).

Three smaller items purchased from a local retailer were found to emit 1,2-DCA by the USU researchers, albeit at lower rates than the gingerbread man. Emission rates are correlated to the surface area of an item. Thus larger items would be expected to have higher emission rates.

In addition, if a large number of molded plastic decorations containing 1,2-DCA are displayed in homes, the combined contribution to indoor air from 1,2-DCA concentrations could be sufficient to exceed both the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) Preliminary Remediation Goal Standards. Even with the degradation of the compound over time, this could result in adverse health effects from prolonged, chronic exposure to 1,2-DCA in indoor air.

Health Concerns

1,2-DCA, also called ethylene dichloride, is a manufactured chemical that is not found naturally in the environment. It is a clear liquid and has a pleasant smell and sweet taste. Commonly, 1,2-DCA is used in the production of vinyl chloride which is used to make a variety of plastics and vinyl products including polyvinyl chloride (PVC) pipes, furniture and automobile upholstery, wall coverings, house wares and automobile parts (ATSDR 2001).

When 1,2-DCA is released to the environment, it generally evaporates into the air. In the air, it can be broken down through photolysis; however, it can remain in the atmosphere up to five months before being broken down and converted to other chemicals (Nobre and Nobre 2004). In water, 1,2-DCA breaks down slowly allowing the majority to be evaporated into the air. In soil, it will either evaporate into the air or travel through the soil and enter groundwater (ATSDR 2001).

Human studies examining whether 1,2-DCA can cause cancer have been considered inadequate. In animals, increases in stomach, mammary gland, liver, lung and endometrium cancers have been observed following exposure through inhalation, oral and dermal absorption routes. The Department of Health and Human Services (DHHS) has determined that 1,2-DCA may reasonably be expected to cause cancer. The EPA has determined that 1,2-DCA is a probable human carcinogen and the International Agency for Cancer Research (IARC) also considers it to be a human carcinogen (ATSDR 2001).

A variety of adverse health conditions have been reported following ingestion or inhalation exposure to 1,2-DCA in humans; these include, nervous system disorders, liver and kidney diseases and decreased lung function. These observations have caused the EPA to set a limit of 0.005 milligram per liter (mg/L) for 1,2-DCA in drinking water. OSHA has also set a limit of 50 parts per million (ppm) (202.37 mg/m^3) of 1,2-DCA in workplace air for 8-hour shifts and 40-hour work weeks (ATSDR 2001). EPA Region 9

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

has set a Preliminary Remediation Goal (PRG) for 1,2-DCA in ambient air of 7.4×10^{-5} mg/m^3 (EPA 2002). In addition, ATSDR has set a Minimum Risk Level (MRL) for inhalation of 1,2-DCA and a Cancer Risk Evaluation Guide (CREG) of 600 ppb (2.43 mg/m^3) and 0.01 ppb (4.05×10^{-5} mg/m^3), respectively. The MRL value is a non-cancer value, whereas the CREG value takes into account a 10^{-6} excess cancer risk (ATSDR 2001). Although numerous items would need to be displayed and off-gassing at the same time for the concentrations of 1,2-DCA to reach or exceed the MRL for inhalation, the concentration range estimated from calculations of indoor air (1×10^{-4} mg/m^3 to 1.7×10^{-3} mg/m^3) as well as the actual concentration ranges measured in homes (6×10^{-5} to 0.127 mg/m^3) both exceed the CREG level for exposure. Therefore, exposure to concentrations of 1,2-DCA in this range could increase the development of cancer from exposure over the lifetime of an individual. A CREG assumes a lifetime exposure of 70 years being exposed to a constant concentration of the contaminant 24 hours a day; although this is not likely to occur in this situation, the concentrations that could result in a home with various decorations left on display could increase indoor air concentrations enough to exceed this cancer risk. Additionally, if molded plastic items other than Christmas decorations are found to off-gas similar concentrations of 1,2-DCA, then the duration of the exposure would be much greater.

A comparison of the concentrations of 1,2-DCA found to off-gas from specific molded plastic items with the CREG value could result in a theoretical cancer risk that exceeds the ATSDR value, especially if other inputs of 1,2-DCA are present in the home (such as volatilization into the sub-slab from a groundwater contamination plume). Although each case would need to be examined on an individual basis, exposure to these decorations could result in a moderately increased risk to 1,2-DCA from exposure to indoor air. Currently, it is homes already being monitored for indoor air quality that have the potential to exceed this standard. Additional homes may be at risk as well, depending on the number and amount of decorations identified to emit 1,2-DCA. Additional research to identify the types of items shown to emit 1,2-DCA, coupled with the average number of items found in a typical home, would help to better quantify the risk associated with exposure to these items.

One of the most challenging aspects to determining the types of items containing 1,2-DCA is that the chemical can only be quantified using chemical analysis. However, USU has tested a variety of items and have found similar characteristics among many of the items. These include:

- The items are lightweight (as compared to ceramics);
- The items have a plastic sound when tapped (rather than a glass or ceramic-type sound);
- All items have a country of manufacture label present on the underside; and,
- All the items identified to date have been manufactured in China.

Although all items tested thus far have these general characteristics in common, it is important to note that other household items may be identified in the future as off-gassing 1,2-DCA.

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

Exposure Evaluation

Although indoor air quality is routinely monitored in the area directly above the plume boundaries, the problem may be much larger than the homes tested in this study. The emission rate of 1,2-DCA from these ceramic-type decorations may raise the risk for cancer from inhaling air with 1,2-DCA if exposure occurs over a long period of time in numerous homes across the country. The more items found to be made from 1,2-DCA, the higher the emission rate of these items collectively, which could negatively impact any person residing in the home. Also, concentrations would have the tendency to be higher in homes that are not well ventilated or are closed up in winter months due to outside weather conditions. In these types of homes, 1,2-DCA concentrations will have the ability to increase over time.

Although the number of items found to off-gas 1,2-DCA may contribute to the increased concentrations of the compound detected in indoor air, it is important to note that these concentrations will degrade over time; therefore, a resident in the home would not experience the same level of exposure over time. As the product ages, the level of 1,2-DCA will decrease. The degradation of 1,2-DCA in indoor air is a slow process; the estimated half-life of 1,2-DCA in indoor air is approximately 29 days (WHO 2000) and would need to be taken into consideration in the calculation of exposure levels for individuals residing in the homes. Numerous factors can contribute to the indoor air exposure to 1,2-DCA for residents in homes displaying such items; however, it is difficult to accurately assess each person's exposure due to a variety of changing factors (i.e., air flow through the home, average time spent in the home, ventilation, etc.).

Conclusions and Recommendations

The levels of 1,2-DCA found in some homes in Layton could cause a theoretical increased cancer risk if residents were exposed to certain off-gassing products for a long period of time. It is unknown if the levels of 1,2-DCA that are currently in homes will remain at that level. It is more likely that they will decrease with time if the same products are retained in the homes. However, adding more off-gassing products could keep the level more steady or increase the level of 1,2-DCA. Many factors will influence the concentration of 1,2-DCA from off-gassing products in the home:

- Age of off-gassing product,
- Size/surface area of off-gassing product,
- Number of off-gassing products,
- Ventilation of indoor space,
- Area where off-gassing product is displayed in the home, and
- Atmospheric conditions at the time.

Due to the uncertainties and varying exposure concentrations of 1,2-DCA, it is difficult to determine possible health effects. None of the levels currently measured are high enough to cause any non-cancer adverse health effects. However, UDOH is concerned that some

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

high levels of 1,2-DCA found in homes contributes to an increased cancer risk if residents would breathe that level of 1,2-DCA for a long period of time.

Because of the uncertainty, and the potential for increased cancer risks, UDOH recommends that any concerned residents remove the off-gassing products from their homes. As part of best public health practice for healthy indoor air quality, homes should always be well ventilated (e.g., periodically open windows or run an HVAC system with an outdoor air intake).

UDOH recommends continued air monitoring of the homes identified with detections of 1,2-DCA to ensure that vapor intrusion does not become an additional source of 1,2-DCA in the homes. The unique code for this article is 480859

UDOH also recommends that this information be provided to the Consumer Products Safety Commission for follow-up on these off-gassing consumer products because these products are not isolated to this community or the state of Utah.

If you have additional questions or need further clarification, please contact me at (801) 538-6191.

Sincerely,

Christina McNaughton, Ph.D.
Environmental Toxicologist/Health Program Manager
Utah Department of Health
Environmental Epidemiology Program

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1989. "Preliminary Health Assessment for Hill Air Force Base, Utah". Atlanta. U.S. Department of Health and Human Services. Available January 27, 1989.

Agency for Toxic Substances and Disease Registry (ATSDR). 2001. Toxicological Profile for 1,2-Dichloroethane. Update. Atlanta, Georgia: U.S. Department of Health and Human Services. Public Health Service.

Hall, Andrew Jensen. 2008. "Identification of Chlorinated Solvent Sources in the Indoor Air of Private Residence around Hill Air Force Base, Utah". Thesis. Utah State University, Logan, Utah.

Nobre, R.C.M. and M.M.M. Nobre. 2004. "Natural Attenuation of Chlorinated Organics in a Shallow Sand Aquifer." Journal of Hazardous Materials **110**(1-3): 129-137.

U.S. Environmental Protection Agency (EPA). 2002. Region 9: Superfund Preliminary Remediation Goals. Washington, DC: U.S. Environmental Protection Agency. http://www.epa.gov/region09/waste/sfund/prg/index.htm. Accessed 12/03/2008.

Utah Department of Health (UDOH). 2003. Public Health Assessment. Hill Air Force Base, Hill Air Force Base, Davis and Weber Counties, Utah. May 2003. Prepared by the Utah Department of health, Office of Epidemiology, Environmental Epidemiology Program.

World Health Organization (WHO). 2000. "Air Quality Guidelines on 1,2-Dichloroethane". WHO Regional Office for Europe, Copenhagen, Denmark.

Utah Department of Health
Promote Prevent Protect

Office of Epidemiology
288 North 1460 West, Salt Lake City, UT
Mailing Address: P.O. Box 142104, Salt Lake City, UT 84114-2104
Telephone (801) 538-6191 • Facsimile (801) 538-9923 • *www.health.utah.gov*
To Report Disease or Outbreak 1-888-EPI-UTAH (374-8824)

CERTIFICATION

This Letter Health Consultation, **Air Quality in Layton Homes, Davis County, Utah**, was prepared by the Utah Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement partner.

Jennifer Freed
Technical Project Officer, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

Alan Yarbrough
Cooperative Agreement Team Leader, DHAC, ATSDR

APPENDIX

Figure 2. Gingerbread man Christmas decoration; first item identified by Utah State University to off-gas 1,2-DCA. Currently, more products are being tested for 1,2-DCA off gassing; identification of these items will occur at a later date.