Assessment of Potential Benzene Contamination of the Ogallala Aquifer at the Pantex Plant, Texas

Submitted by

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Background and Objectives:

In 1999 the Pantex Plant changed its groundwater sampling procedure from use of traditional methods where three well volumes were purged at relatively high flow rate before sampling to use of low-flow sampling with minimal removal of purged water. During May 1999 sampling of Ogallala monitoring well PTX01-1003 located northeast of Playa 3 near the Burning Grounds, groundwater samples detected the presence of trichloroethylene (TCE) at a location that had not shown contamination during previous sampling. Because chlorinated solvents (including TCE) where known to have been disposed of at the Burning Grounds, this raised concerns of potential dense nonaqueous phase liquid (DNAPL) contamination of the Ogallala Aquifer at a location southwest of the Amarillo Well Field. In an attempt to investigate these concerns, a series of on-site and off-site monitoring wells were established along the northern boundary of the Plant. Since DNAPL contamination can appear at discrete intervals within an aquifer, these monitoring wells were equipped with sampling equipment that allowed samples to be taken from multiple depths from a single well. These Ogallala monitoring wells marked the greatest depths to which such sampling equipment have been utilized.

In 2001, when these new wells were first sampled, groundwater from these multilevel sampling wells showed low (near detection limits) concentrations of volatile organic compounds including benzene, toluene and acetone. While concentrations of toluene and acetone were significantly below maximum contaminant levels (MCL), measured concentrations of benzene were near or exceeded MCL values. Based on concerns raised by these sampling results, Pantex Plant personnel initiated an internal investigative program to determine the source of Ogallala contaminants, and they requested off-site assistance through the DOE Subsurface Contaminant Focus Area (SCFA). In addition, through the Agreement in Principle (AIP) between the Pantex Plant and the State of Texas, an off-site assessment was requested from researchers at the University of Texas, Austin.

A number of parallel investigations were initiated at the Pantex Plant, the Savannah River Technology Center, and the Pacific Northwest National Laboratory. The objective of this Independent Review is to assess the scope of these investigations and to draw conclusions from the separate investigation findings.

Findings from Investigative Studies

The finding of widespread benzene contamination at all depths (through nearly 500 feet of saturated thickness) along a nearly four-mile length boundary at a very uniform and low concentration suggests that the benzene cannot be associated with either single or multiple independent source areas. This conclusion appears to have been reached by Plant and off-site investigators. Given the known groundwater flow, some of the wells showing contamination do not have potential source areas located upgradient on Pantex Plant property. Unless benzene is ubiquitous in the Ogallala Aquifer, the likely sources appear to be either the sampling equipment or well construction material. The following findings have been developed.

- The Pantex Plant, Savannah River Technology Center, and Pacific Northwest National Laboratory have carried out independent laboratory leaching studies of sampling equipment material. In all cases they have found that benzene is released from the tubing material while toluene is released from the liner and spacer materials.

- Historical sampling records show that contaminant concentrations measured using multilevel sampling systems are decreasing through time. Furthermore, purge tests show that benzene concentrations decrease significantly with purge volume.

- Monitoring well PXT06-1066, located northeast of Playa 3 along the Plant boundary, has been sampled using multilevel sampling equipment, and independently with a separate pump system. Both benzene and toluene were measured during multiple sampling events with the multilevel sampling equipment in place, while benzene was not detected during the single sampling event after the equipment was removed. Toluene was detected, however.

Conclusions and Recommendations

Pantex has actively responded to the recommendations of the various independent and on-plant technical committees. The critical field and lab studies that were requested studies have been implemented. The results are consistent and provide the basis for a strong technical conclusion. The observed data from both laboratory and field investigations indicates that the detected benzene concentrations are associated with the sampling equipment, particularly the tubing material (nylon-11). The liner material is the likely source of toluene, though the presence of toluene in monitoring well PXT06-1066 deserves further investigation. The following recommendations are made.

- Continue to use monitoring well PXT06-1066 without the multilevel sampling equipment (FLUTe) in place. Over time, this would serve as a confirmation, or control, measurement to document that the benzene and toluene detected in the multilevel samplers is not associated with an Ogallala contaminant plume.

- For monitoring wells utilizing the multilevel sampling equipment, purge at least two tubing volumes before sampling.

- Monitor the well data over time to confirm that constituent concentrations behave as expected. In particular, low concentrations of benzene in multilevel sampling wells should not be a concern, at least over the short-term. The advantages of using this sampling equipment for detecting potential Pantex plumes likely exceeds the present concerns.

- The multilevel sampling equipment liner (FLUTe) contains water that is not purged. This water presses the sampler into the inside of the well – forming a seal and holding it in place. We recommend sampling the water contained within the liner to determine if it contains leached toluene. If this water contains significant levels of toluene, flushing with fresh water would be prudent.

- Vertical borehole flow profiles should be measured in monitoring well PXT06-1066. This measurement in a well that is not equipped with the multilevel sampler will help establish background information on three-dimensional flow potential within the Ogallala Aquifer. The resulting data could be used to support future decisions related to multilevel sampling equipment in deep Ogallala Aquifer monitoring wells.

- Importantly, the general use of multilevel sampling equipment provides a sensitive and technically superior monitoring approach for discrete groundwater plumes. As a technical review panel we strongly encourage continued use of the current devices and the use of such equipment in the future. Based on the data, we recommend that future systems minimize, to the extent practicable, the use of materials that leach trace levels of organic compounds into the sampled water.