Letter Health Consultation

Vapor Intrusion Event

HARTFORD RESIDENTIAL COMMUNITY

HARTFORD, ILLINOIS

Prepared by the
Illinois Department of Public Health

FEBRUARY 24, 2010

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

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Illinois Department of PUBLIC HEALTH

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February 9, 2010
#409088901H; Hartford Hydrocarbon Plume Site
Hartford Residential Vapor Intrusion Event at 119 W. Date St., October 2009

Michelle Kaysen-Majack
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Dear Ms. Kaysen-Majack:

The Agency for Toxic Substances and Disease Registry (ATSDR) and the Illinois Department of Public Health (IDPH) prepared this letter health consultation to summarize our review of environmental sampling data and our recommendations to the U.S. Environmental Protection Agency (USEPA) involving the vapor intrusion event that occurred at the Hartford, Illinois Hydrocarbon Plume site beginning on October 24, 2009. The primary home of concern is 119 West Date St. in Hartford.

Site Background

The site is primarily a residential community in the Village of Hartford, Madison County, Illinois. It is bounded by Hawthorne Street to the south, Old St. Louis Road to the west, Rand Avenue to the north, and Olive Street to the east. The primary home of concern, 119 W. Date St., is located in the northwest quadrant of this site. Three petroleum refineries and associated facilities, the oldest dating back a century, surround the village. Years of leaking product lines and storage containers in and near the Village of Hartford have resulted in the release of millions of gallons of gasoline and other refined products into the subsurface soil and groundwater beneath the site.

Complaints by residents regarding petroleum odors related to vapor intrusion have been recorded since the 1960s. In the twenty year period from 1970 to 1990, more than a dozen odor complaints to the fire or police department were registered from 119 West Date St. Since the 1970s, twenty-two fires related to petroleum vapors have been documented in the basements of several homes at the site, with the last reported fires occurring in May 1990. A fire associated with vapor intrusion was reported at 119 West Date St. on March 13, 1973.

Five fires within three days in May 1990 prompted the installation of a soil vapor extraction (SVE) system in a portion of the site. This SVE system was completed by the end of 1992, but was not adequately maintained and the wells became clogged over time. In 2002, a vapor intrusion event occurred in homes on East Watkins St. prompting the temporary relocation of two families. In the 2002 ATSDR health consultation prepared for this incident, IDPH concluded that there was a public health hazard in affected homes.

The Illinois Environmental Protection Agency (Illinois EPA) requested USEPA Emergency Response involvement. In August 2003, USEPA became the lead agency at the site. The SVE system was replaced in areas covered by the 1992 SVE system and was greatly expanded between 2003 and 2008. The original SVE consisted of 12 wells; the new system contains 102 wells. Some of these wells may not be functional at all times due to short circuiting and occlusion by groundwater. One function of the new SVE system is to protect residents from sub-surface vapor intrusion into their homes.

In addition to the SVE system, approximately 50% of the homes at the site have had interim measures performed. These interim mitigation measures include pouring concrete on dirt floors in basements and crawlspaces, sealing cracks and utility penetrations in basement floors and walls, and installing explosimeters and ventilation fans. A residential monitoring plan for quarterly sampling of indoor air and sub-slab monitoring ports, event based sampling, and operations and maintenance were put in place to ensure the effectiveness of the residential interim measures. At 119 West Date St., an interim measures needs assessment was performed in July 2004, and mitigation measures were put in place by January 2005 with sub-slab port sampling beginning in June 2006.

Vapor intrusion events in Hartford have been correlated with rise in the Mississippi River and, to a lesser extent, rainfall. An "event" is currently defined as river rise of two feet in a 24-hour period when the river level at the Alton Lock and Dam tail water gauge is at or above 410 mean sea level. During an event, 12 homes are to be screened and sampled within two or three days after the event begins. This involves field screening the indoor air with a flame ionization detector (FID) and lower explosive limit (LEL) meter (combustible gas meter) and collecting sub-slab soil gas in Tedlar bags, which are later analyzed in a field laboratory, for FID, percent of the LEL, methane, oxygen and carbon dioxide. Sampling consists of collecting a 24-hour summa can sample from the 1st floor and basement, and from each sub-slab port in the home. There are usually three sub-slab ports in each home.

The LEL is defined as the minimum concentration of a gas or vapor in air that is needed to have the gas ignite n the presence of an ignition source. Reaching 10% LEL in indoor air is considered immediately dangerous to life and health (IDLH).

After a vapor intrusion incident occurred at 119 West Date St. in May 2007, this home was added to the list of those sampled for a defined event. This 2007 incident coincided with the rising river stage. On May 14, 2007, FID readings in the basement were 195 parts per million (ppmv). A field FID reading near a basement drain read 276 ppmv. Sub-slab FID readings were reported greater than 800,000 ppmv, and sub-slab LEL readings were over range. On recommendation from USEPA, Illinois EPA, and IDPH, the resident opted for temporary relocation while the oil companies worked to resolve the issue and prevent future vapor intrusion occurrences. It was concluded in an assessment of the vapor intrusion issue prepared by the Hartford Working Group in December 2007 that "the local significant variation in geology combined with the rising water table and other factors lead to rise in sub-slab vapor concentrations". To mitigate this event, an additional soil vapor extraction well was placed in closer proximity to the home, the Drainjer floor

drain was removed, the drain was sealed, and a condensate pump was installed in the basement. The home was cleared by USEPA, Illinois EPA, and IDPH for re-occupancy on June 4, 2007.

October 24, 2009 Event -- 119 West Date St.

At approximately 8:00 PM on Saturday, October 24, 2009, the Mississippi River rose to 16.52 feet, a two foot increase within 24 hours, which triggered an event. Samples collected during the October 24, 2009 event included screening and sampling of indoor air and sub-slab soil gas and monitoring of soil vapor monitoring points. Initially, eight homes, the post office, and the Hartford Community Center were screened and sampled between October 27 and October 29, 2009. Soil gas screening of 23 monitoring points took place in the residential areas of the Hartford site on October 26, 2009. All screening and air/soil gas samples for this event were collected by a contractor for Apex Oil Company.

Reports of elevated FID sub-slab readings on October 27, 2009 at 119 West Date St. (FID range 6,600 to 10,770 ppmv for three sub-slab ports) and 504 North Delmar St. (FID range 0.22 to 468.9 ppmv for three sub-slab ports) prompted an October 28, 2009 request by USEPA to conduct daily screening of the indoor air and sub-slab ports at these homes. Daily screening of the indoor air and sub-slab ports at 119 West Date St. was performed from October 27 to November 20, 2009. Four sets of summa cans were collected from 119 West Date St. between October 27 and November 17, 2009. A summa can sample from a single sub-slab port was collected on December 3, 2009.

Percent LEL field screening values in the three sub-slab ports on October 28, 2009, were 17%, 38%, and 72%, and the FID readings generally continued to increase with those readings between 5,800 and 44,280 ppmv. The greatest FID reading within the home was 1.67 ppmv. On October 29, 2009, one sub-slab port was greater than 100% (over range) on the LEL meter. After consulting with the USEPA, Illinois EPA, IDPH and ATSDR, on the following day Apex Oil offered the residents of 119 West Date St. alternative lodging, but they declined.

By October 31, 2009, all three sub-slab ports were greater than the LEL, and at least one or more of the sub-slab ports remained over range for the LEL until November 13, 2009. By November 1, 2009, FID readings for all three sub-slabs ports were greater than 100,000 ppmv. The highest FID reading occurred on November 5, 2009 and was 1,062,000 ppmv at sub-slab port 3 (SS3). FID readings for SS3 remained greater than 100,000 ppmv through November 14, 2009. It was not until November 19, 2009 that all three sub-slab ports had LEL readings of zero and FID readings less than 100 ppmv.

The highest FID reading measured within the living space of the home was 18.75 ppmv on November 2, 2009. The residents did not have their combustible gas meter or their ventilation fan running. Subsequent FID readings performed when the ventilation fan was on were more consistently below 5 ppmv. FID measurements taken directly over the basement drain reached a maximum of 202 ppmv on November 4, 2009. The drain plug was replaced and later readings were all less than 5 ppmv.

During the 16-day period when the LEL was over range, the two adult residents of 119 West Date St. were offered alternative lodging by Apex Oil on multiple occasions. A USEPA contractor also discussed temporary relocation with the residents. The offer of alternative lodging was repeated and the situation was discussed by IDPH and Illinois EPA with the residents during a visit to 119 West Date St. on November 3, 2009. The residents repeatedly declined the offer, but agreed to keep ventilation fans running continuously in the basement.

Summa can samples from 119 West Date St. were collected on October 28, 31, November 6 and 17, 2009. Eight petroleum hydrocarbons (benzene, hexane, isopentane, butane, trimethylbenzene, xylene, toluene, and methylcyclohexane) for this site have indoor air and sub-slab comparison values and these compounds are analyzed in each summa can sample. A single sub-slab summa can sample was collected on December 3, 2009.

All ten summa can sub-slab samples analyzed for the first three collection dates had isopentane, butane, and hexane concentrations several orders of magnitude greater than their comparison values. Isopentane concentrations ranged from 790,000 micrograms per cubic meter ($\mu g/m^3$) to 38,000,000 $\mu g/m^3$, butane ranged from 110,000 $\mu g/m^3$ to 19,000,000 $\mu g/m^3$, and hexane ranged from 23,000 $\mu g/m^3$ to 3,100,000 $\mu g/m^3$. Methylcyclohexane exceeded its sub-slab comparison value in six of ten samples with two of the samples having a detection limit that exceeded the comparison value. The high concentrations of isopentane and butane did not allow for the dilution of the samples and subsequent accurate detection of benzene, toluene, xylene or trimethylbenzene. For example, benzene was reported as a non-detect in all of these ten sub-slab samples, however the detection limit in all ten samples was one to three orders of magnitude greater (110,000 $\mu g/m^3$ on November 6, 2009) than its comparison value (100 $\mu g/m^3$ acute 290 $\mu g/m^3$ chronic). On November 17, 2009, only the sub-slab summa can sample for SS3 continued to have isopentane (970,000 $\mu g/m^3$), butane (100,000 $\mu g/m^3$) and hexane (23,000 $\mu g/m^3$) reported greater than their comparison values. The sub-slab summa can for SS3 collected on December 3, 2009 reported all eight hydrocarbons below their respective comparison values.

The indoor air comparison value for isopentane (115 $\mu g/m^3$) was exceeded in four of eight samples (maximum 970 $\mu g/m^3$ on October 31, 2009) and the comparison value for butane (115 $\mu g/m^3$) was exceeded in two of the eight samples (maximum 360 $\mu g/m^3$on October 31, 2009). The other chemical that slightly exceeded its indoor air comparison value was trimethylbenzene in one of eight samples. None of the remaining five compounds exceeded their health-based comparison values indoors; however, hexane and methylcyclohexane were detected indoors at elevated concentrations that were indicative of vapor intrusion. Summa can samples for November 6 and 17 were collected when the ventilation fan was in continuous operation.

October 24, 2009 Event -- Other Homes

Four other homes in the vicinity of 119 W. Date St. had elevated sub-slab FID readings. These homes were 504 North Delmar St., 500 N. Old St. Louis Road, and 117 and 122 West Date St. The home at 504 North Delmar St. was one of the original eight homes sampled for the event. The latter three homes were part of the group of homes sampled in response to the elevated sub-slab readings at 119 W. Date St. and 504 N. Delmar St.

At 504 North Delmar St., elevated sub-slab readings prompted a USEPA request on October 28, 2009 to conduct daily screening of the indoor air and sub-slab ports at that home. Petroleum vapors have historically been detected below the slab at this home. The highest sub-slab concentrations were detected at sub-slab 2 (SS2) on July 30, 2007, with benzene, hexane, and isopentane concentrations of 18,000 $\mu g/m^3$, 100,000 $\mu g/m^3$, and 640,000 $\mu g/m^3$, respectively.

Screening for the October 24, 2009 event was performed at 504 North Delmar St. from October 28 through November 6, 2009. One set of summa cans also was collected as part of the original event response. Sub-slab FID readings were highest in SS2, which were 468.9 ppmv on October 27, 2009, with a peak level of 8,880 ppmv on October 31, 2009, and dropping below 100 ppmv on November 4, 2009. The percent LEL was similar to the FID readings at SS2 with an initial reading on October 28, 2009 of 9% and the highest reading of 16% on October 29, 2009. The LEL at SS2 dropped to zero on November 3, 2009.

The results of the summa cans collected at 504 North Delmar St. on October 27, 2009 detected hexane in SS2 greater than the comparison value at a concentration of 4,700 $\mu g/m^3$; isopentane and butane were also above sub-slab comparison values in SS2 and SS3. The highest sub-slab concentrations for isopentane and butane were in SS2 with concentrations of 190,000 $\mu g/m^3$ and 88,000 $\mu g/m^3$, respectively. Indoor petroleum hydrocarbons detected at 504 N. Delmar St. were benzene, hexane, toluene, isopentane, and butane; however, none were above their respective comparison values for indoor air during this event.

The continued elevated FID and LEL screening values at 119 West Date St. led to a November 3, 2009 request by USEPA to screen neighboring homes, several of which have sub-slab ports. Five additional homes were screened in the vicinity of 119 West Date St. (500 North Old St. Louis Road, 117, 122 and 124 West Date St., and 100 West Cherry St.). All of these homes had been part of the quarterly sampling program and had interim residential measures such as basement cracks and floor drains sealed and ventilation fans installed. Access was not provided to some of the neighboring homes, a few of which have never had interim residential measures placed (for example, the immediate neighboring home to the west, 123 West Date St.).

The residence at 500 North Old St. Louis Road was screened for this event on November 5 and November 10, 2009. Summa can sampling was requested on November 6, 2009 by USEPA for this home; however, Apex Oil did not collect summa can samples from this home during the event. Historical data of four quarterly samples collected between March 2007 and March 2008 detected the presence of sub-slab petroleum hydrocarbons with the highest sub-slab FID reading of 9.69 ppmv. The highest sub-slab FID reading taken during this event was 465.7 ppmv from SS2 on November 5, 2009. The FID at SS2 was 37 ppmv on November 10, 2009. Indoor FID readings at all locations were higher, in some instances more than double, on November 5, 2009 when compared to November 10, 2009. These FID readings are indicative of vapor intrusion.

A field screening FID sub-slab reading of 73.9 ppmv was reported at 117 West Date St. on November 4, 2009. All of the indoor FID readings recorded were less than 3 ppmv. Upon review of four years of historical data for the site, with the exception of May 2007, sub-slab FID readings

ranged from 0 to 9 ppmv. During the May 2007 event, which resulted in the temporary relocation of the resident at 119 West Date St., the home at 117 West Date St. had sub-slab readings up to 1,200 ppmv and a first floor FID reading of 3.18 ppmv. This suggests that the river rise that resulted in this event was impacting the sub-slab of the home and that the interim residential measures were effective.

The home at 122 W. Date St. was screened for this event between November 4 and November 6, 2009. A request was made to Apex Oil on November 5, 2009 by USEPA to collect summa cans at 122 W. Date St.; however, no summa can samples were collected from this home during the event. Historical data from eight quarterly samples collected between January 2007 and October 2008 detected the presence of sub-slab petroleum hydrocarbons, with the highest sub-slab FID reading of 10,000 ppmv and a methane concentration in that sub-slab port of 7,950 ppmv. The highest sub-slab FID reading taken during the event was 90.64 ppmv with no methane in SS1 on November 4, 2009. Indoor FID readings on November 4, 2009 in the basement were 18.01 ppmv, 95.03 ppmv, and 102 ppmv. Apex Oil attributed these readings to an air freshener used indoors prior to the November 4, 2009 screening. On November 5, 2009, the single sub-slab reading taken was 18.22 ppmv and the indoor FID readings in the basement were all less than 8.0 ppmv. Without summa can sampling it is not possible to determine the sub-slab contribution to the indoor FID readings.

Both sub-slab and indoor air field screening at 124 West Date St. and 100 West Cherry St. did not indicate vapor intrusion.

Discussion

The chemicals of interest at the site are petroleum products, primarily automotive gasoline. During this event the immediate concern was house fires because of the flammability of petroleum hydrocarbons. Exposure to the constituents of gasoline, including benzene, hexane, toluene, xylene, methylcyclohexane and trimethylbenzene, also was a concern because of the potential to cause adverse health effects. This letter health consultation focuses primarily on 119 West Date St.; however, sub-slab gasoline vapors were detected in at least three other homes.

Field screening with an FID and an LEL meter was used to evaluate the immediate hazard to the residents. The LEL for isopentane is 1.4% (14,000 ppm) and for butane is 1.6% (16,000 ppm). While the field instruments are calibrated to methane, they still provide a reasonable estimate of the presence and concentrations of other hydrocarbons.

In this event, the indoor FID and LEL readings within the rooms of the home were less than levels that would be considered IDLH; however, given the field readings of over range (greater than) LEL and FID readings in the 100s of ppmv in the sub-slab ports at 119 West Date St., the concern was that vapors coming through cracks in the sub-slab would be ignited by a spark from the various appliances or static electricity. This situation had been the cause of some previous fires in Hartford. Thus, this safety concern was the reason for notifying the residents of 119 West Date St. of the need to temporarily relocate to alternate lodging.

Comparison of the field screening FID and LEL readings for sub-slab ports and indoor air provided a rough assessment of the effectiveness of the residential interim measures. The seven homes discussed in this letter all had interim measures in place, so ideally, no sub-surface hydrocarbons would enter the homes and an attenuation factor for sub-soil to indoor air would be infinite. In this event, the indoor FID readings at 119 West Date St. indicated that the residential interim measures were not completely effective.

In this event, field screening was used in the decision for resident relocation as well as for requesting summa can sampling. Since FID readings are reported in ppmv and indoor air health-based comparison values are in parts per billion (ppb), summa can data are required to provide information about the constituents of the hydrocarbons totals detected by the FID and LEL meters. These ppb concentrations are necessary to assess the potential for acute and chronic health effects. Conducting field instrument screening and summa can sampling at the same time provides further information for evaluating a vapor intrusion event. For this event, only 119 West Date St. had follow-up summa can sampling performed. Apex Oil denied the USEPA requests to collect summa can samples at 500 North Old St. Louis Road and 122 West Date St., which limited the interpretation of the field screening data at those homes.

Summa can data is used to evaluate the effectiveness of the interim in-home measures in preventing acute and chronic health effects. Since there is a lag in receiving the results from these samples of 48 hours to several days or weeks, the results are not as immediately useful in making decisions for urgent safety situations. Comparison of summa can results between indoor air and sub-slab ports allows for assessing the contribution of sub-slab vapor sources in the indoor air.

The data from 119 W. Date St. indicated that vapor intrusion occurred in the home. With the exception of total trimethylbenzene, which exceeded the comparison value by 0.9 $\mu g/m^3$ on November 6, 2009, the levels of gasoline components in indoor air were less than acute and chronic health-based comparison values. The comparison values for isopentane and butane, which were exceeded, while not health based, are used to assess the presence of hydrocarbons that were not part of the analysis or cannot be determined because of the presence of very high concentrations of these two chemicals. In this case, the results confirmed that vapor intrusion was occurring.

The indoor summa can results and the field screening results with the ventilation fan on compared with results with the ventilation fan off confirm the importance of this interim measure. Operating the ventilation fan during the event decreased the concentration of hydrocarbons in the home, even when sub-slab air measurements had over range detections on the LEL meter.

Conclusions

IDPH and ATSDR conclude that the Hartford vapor intrusion event that began on October 24, 2009 could harm people's health and represented an urgent public health hazard. Exceedance of the LEL in the sub-slab and the evidence of vapor intrusion in indoor air at 119 West Date St. presented a threat to the safety of the residents. As a result, the residents were offered alternative lodging until these conditions were resolved.

Exposure to petroleum hydrocarbons in indoor air at the homes sampled are not expected to result in short term adverse health impacts that would harm people's health. The indoor hydrocarbon levels in nearby homes without mitigation measures were not screened and thus the presence or absence of hydrocarbons in those structures is not known.

Currently, the SVE system as a stand alone interim measure does not provide adequate protection against vapor intrusion for all homes located above the hydrocarbon plume. Field screening and sampling, performed during this defined event related to river rise, was useful in identifying an unsafe condition at the home and in evaluating the effectiveness of the in-home interim measures.

Recommendations

In-home interim measures should be installed in all on-site homes and maintained in homes that already have them.

The event-based sampling plan, as part of the interim measures effectiveness monitoring plan, should continue in order to evaluate the effectiveness of the in-home interim measures, identify unsafe conditions at homes, and determine the effectiveness of the regional SVE system. The plan should be revised to include more definitive steps based on field screening for prompt notification of appropriate agencies, local officials, homeowners and residents; relocation of residents; collection of summa can samples; and evaluation and mitigation of contributing factors to the vapor intrusion event. The plan should include extending sampling of the indoor air and sub-slab soil gas, if available, of all homes adjacent to the home with elevated sub-slab readings.

Sincerely,

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Certification

This Hartford Hydrocarbon Plume Site letter health consultation was prepared by the Illinois Department of Public Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Charisse J. Walcott
Technical Project Officer, CAT, CAPEB, DHAC

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

Alan Yarbrough
Team Lead, CAT, CAPEB, DHAC, ATSDR