ABL

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MEMORANDUM

TO: Ms. Ann Lin, PE
Site Cleanup Program IV
California Regional Water Quality Control Board Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

FROM: Hristo Hristov, M.D., Ph.D., M.Env.Sc.
Integrated Risk Assessment Branch
Office of Environmental Health Hazard Assessment

DATE: January 21, 2011

SUBJECT: Review of "Updated Soil Vapor Intrusion Evaluation for Southern Boundary, Former Chemoil Refinery, Signal Hill, California"

SWRCB # R4-10-34 **OEHHA # 880247-01**

Document Reviewed

Per your request, I reviewed the *"Updated Soil Vapor Intrusion Evaluation for Southern Boundary, Former Chemoil Refinery, Signal Hill, California"*, prepared by Exponent, and dated May 5, 2010.

(Italicized text is quoted from the request or from the documents provided for review.)

Scope of the Review

I reviewed the document for scientific and regulatory issues related to the assessment of human health risk due to indoor inhalation of vapors migrating from subsurface into residences located south of the former Chemoil Refinery site.

Limitations

OEHHA was not involved in the Former Chemoil Refinery on- and off-site characterization. I assumed that the provided soil gas data accurately represent the contamination under the houses located beyond the southern site boundary.

This health risk assessment is limited to the indoor inhalation of vapors pathway.

My review was limited to the content of the report. The report (p.1) states *"however, health risks associated with potential vapor intrusion into indoor air will be re-evaluated following completion of additional soil vapor and groundwater sampling scheduled for the first half of 2010."* No such additional data were provided to me at the time of preparing this memorandum.

General Comments

1. *Background Section* provides information of the site use history and the land use of its surroundings. No other information is provided on the off-site area of interest at this study, except that it is located south of the site. Section *Data Included in Evaluation* states that *"six sampling locations are located closer to the offsite residents than the previous locations south of the property."* More detailed information about the houses being potentially impacted, and about the presence of natural or man-made preferential migration pathways would help determine the representativeness of the selected sampling locations, and decrease the potential for underestimation of the calculated risk and hazard results. Please note that according to section 5.4 of the "Report on Off Site Soil Gas Survey...April 15, 2010", *"higher soil vapor concentrations at 5 ft bgs are indicative of a localized shallow soil source coincident with an unlined culvert that paralleled the southern boundary."* I assumed that the collected samples were representative of the contamination under the impacted houses for the purpose of completing this review in a timely manner. The Los Angeles Regional Water Quality Control Board (LA RWQCB) should clarify the issue with the parties involved in this off-site contamination delineation.

2. This health risk assessment is based on:

1. Soil gas data collected from 5 and 10 ft bgs at five locations, and from 5 ft bgs at one additional location.
2. Groundwater data collected at five monitoring wells during the last four monitoring events.

   The data are presented in a table format. No original laboratory reports were found in the documents available for review. I assumed that the data are consistent with the laboratory reports and representative of the groundwater contamination under the residences of interest. LA RWQCB may want to verify the presented data to the laboratory reports for consistency.

3. Chemicals of Potential Concern. Exponent screened out C_4-C_{12} range total petroleum hydrocarbons (TPHs), 4-isopropyltoluene, and tert-butanol due to limited toxicity

information. In my modeling I used isopropylbenzene as a surrogate for 4-isopropyltoluene.

Subsurface to Indoor Air Migration, Cancer Risk and Non-cancer Hazard Modeling

4. Exponent modified the advanced US EPA soil gas and groundwater spreadsheets based on the Johnson and Ettinger (J&E) model. I updated the two original US EPA, 2004 spreadsheets with California EPA-specific toxicity information before performing modeling for the contaminants of interest.

5. According to p. 4, Exponent performed the modeling using default input assumptions, except for the soil gas and groundwater sampling depth, and the soil type. No information on the soil type and layer thickness (*"based on the recommendation from Stephen Testa, P. A-1"*) was presented in the reviewed reports. Please note that the soil type model parameters are among the most sensitive ones in the model. Exponent should have provided a table and discussion of the selected soil parameters supported by boring logs and/or laboratory reports as a minimum. In their absence, I assumed that the soil parameters' values used as model inputs were representative of the soil under the buildings of interest. I used the same input parameter values as Exponent. LA RWQCB should verify the soil type and layer thickness and may require site-specific soil data to eliminate potential underestimation of the indoor air concentrations, risk and hazard results.

OEHHA's Modeling Results

Estimated Health Impact Due to Indoor Air Inhalation Resulting from Migration of Soil-Gas and Groundwater Contaminants

Exposure Medium Health Impact	Maximum Soil-Gas Concentrations at 5 ft bgs	Maximum Soil-Gas Concentrations at 10 ft bgs	Maximum Groundwater Concentrations
Excess Cancer Risk	4E-06 (1E-06)	2E-06 (5E-07)	5E-06
Non-cancer Hazard Index	9E-02 (1E-02)	7E-02* (1E-02)	2E-01*

Notes:

( ) Based on minimum detection limit.
* Modeling results differing from the reported ones.

Exponent modeled chemicals present in groundwater but not detected in soil gas at half of their maximum and minimum soil gas detection limits. The recommended risk assessment approach under residential scenario considers the maximum detected concentration as exposure point concentration (EPC) to protect the most exposed individual(s). Therefore, half of the maximum detection limit should be considered as

primary EPCs when estimating the risk and hazard. Half of the minimum detection limit may be used in the analysis of the uncertainty of the estimated risk and hazard.

My risk and hazard results replicated Exponent's results except for the soil gas hazard index at 10 ft bgs (7E-02 vs. Exponent's 6E-02 based on incorrect half of detection limits for 1,2,4-trimethylbenzene and m,p-xylenes), and the hazard index estimated from maximum groundwater concentrations (2E-01 vs. Exponent 's 8E-01 based on cumene). These small differences do not change the significance of the estimated hazard index which is less than unity, above which would raise a concern. Using isopropylbenzene (cumene) as a surrogate for 4-isopropyltoluene resulted in insignificant hazard quotient when estimated from soil-gas at 5 ft bgs and 10 ft bgs, and from groundwater. The C_4-C_{12} range total petroleum hydrocarbons (TPHs), and tert-butanol excluded from the risk assessment due to lack of toxicity criteria are expected to result in some non-cancer hazard underestimation. This underestimation may be considered in a qualitative way while discussing your risk management decision(s).

The analysis of the estimated cancer risk should be performed recognizing that the acceptability of any risk level above 1E-06 (under residential scenario) is a risk management decision. I agree with the points made by Exponent regarding the level of risk estimated from soil gas versus the risk estimated from groundwater at the sampled locations. However, I have to point out that some contaminants were identified in the groundwater and soil gas (and may be assumed to originate from the groundwater coming from the site), while others were only identified in soil gas or groundwater. While the chemicals identified in groundwater only may not be migrating to the sampling depths, the chemicals in soil-gas only may be migrating through preferential pathway(s) or may be due to a different source(s). To elaborate on this, I compared the contaminants identified in soil gas and groundwater near the residences beyond the southern site boundary shown in Table 3 of the report to the contaminants identified at the southern site boundary shown in Table 7-2a of the "Report on Off Site Soil Gas Survey, Former Chemoil Refinery..., dated April 15, 2010". Acetone, 2-butanone, chlorobenzene, 4-methyl-2-pentanone, and 1,1,1-trichloroethane were not detected in groundwater or in the soil gas at the southern site boundary but were detected in the soil gas at the residences. Additional sampling may be needed to determine the source(s) of contamination and all impacted residences located beyond the southern site boundary.

Conclusions

I concur with Exponent that the indoor air contaminant concentrations estimated from soil gas and groundwater are not likely to be of concern. However, this conclusion is based on the assumptions regarding the groundwater data, soil properties, and layer thickness described above. Also, the conclusion is limited to the data set used in the risk and hazard estimation. That dataset may not be representative of all impacted

houses, and /or may not account for preferential pathway(s) and different on- or off-site sources of contamination.

Additional sampling may be needed to identify the source(s) of contamination, and all impacted residences located beyond the southern site boundary.

Please do not hesitate to contact me at (916) 322-8364 or by e-mail at hhristov@oehha.ca.gov, if you have any questions related to this review.

Reviewed by:

David Siegel, Ph.D., DABT
Section Chief
Integrated Risk Assessment Branch

References

US EPA, 2004 Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings v.3.1, Waste and Cleanup Risk Assessment, US Environmental Protection Agency, February 2004
http://www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm