RTD REMEDIATION TESTING AND DESIGN, INC.

Environmental Investigation Remediation Natural Attenuation Closure

A California Corporation P.O. Box 1356, Santa Cruz, California 95061-1356 E-mail:
Ph: (831) 458-1612 Fax: (831) 458-1509

March 19, 2012

State Water Resources Control Board
c/o Jeanine Townsend
Clerk to the Board
1001 I Street, 24th Floor
Sacramento, CA 95814

SUBJECT Comment re: Low-Threat UST Closure

Dear Chair and Board Members:

Remediation Testing and Design, Inc. (RTD) is pleased to submit comments on the January 31, 2012 Draft Low-Threat Underground Storage Tank Case Closure Policy prepared by the State Water Resources Control Board (SWRCB) Underground Storage Tank (UST) Program. This policy has been over 17-years in the making starting with the Lawrence Livermore National Laboratory (LLNL) Report in 1995. RTD has actively participated in this long, slow process for the SWRCB to formally adopt a risk-based case closure policy.

We appreciate all of the hard work and thoughtfulness that staff, stakeholders and consultants put into preparing this draft Closure Policy. RTD has carefully examined the Draft Policy and we are in agreement with the *General Criteria*.

RTD's primary comment is that the Closure Policy should include total petroleum hydrocarbons (TPH) in the development of screening levels and determining if a site meets technically justified criteria of "Low-Threat". Based on our recommendation for inclusion of TPH, RTD has specific recommendations for the *Media-Specific Criteria* as detailed in the Draft Policy. With relatively minor revision to the current draft, we support the SWRCB in adopting a Low-Threat Underground Storage Tank Case Closure Policy.

COMMENTS ON TOTAL PETROLEUM HYDROCARBONS (TPH)

This comment will focus on TPH as gasoline (TPHg), however, the technical approach is readily applicable to TPH-diesel and other hydrocarbon fuels. The draft Closure Policy generally focuses on free-product and benzene as the primary chemicals of concern for groundwater, soil vapor and soil. The draft Closure Policy also uses (methyl-tert-butyl ether) MTBE to assess groundwater risks and soil direct contact risks are additionally assessed with naphthalene, ethylbenzene and polynuclear aromatic hydrocarbons (PAH's).

For determining groundwater risks, free-product, benzene and MTBE are reasonable and appropriate indicator chemicals. We are in complete agreement with the draft Closure Policy for groundwater. Specific fractions of TPH are superior indicator chemicals to evaluate exposure pathways and determining risks for soil vapor and soil impacts.

By ignoring TPHg fractions in soil vapor and soil, contaminant transport pathways and exposure risks can be grossly underestimated.

<u>TPH Fractions of Gasoline</u>

Gasoline consists of thousands of individual compounds and has significant differences in composition depending on region, time of year, date of manufacture and from individual refineries. Once released into the subsurface, gasoline begins a weathering process that changes the composition based on the physical and chemical properties of gasoline, site-specific conditions and weathering time. The composition of gasoline can be greatly simplified using the method established by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) series of reports and other resources.

Gasoline can be broken down into two major categories: 1) Aromatics (includes BTEX Aromatic and Heavy Aromatic fractions); and 2) Aliphatics (Includes Light Aliphatic and Heavy Aliphatic fractions). Aromatics are further broken down

The general properties of Aromatic TPHg include:

- Benzene Ring Structure
- High Toxicity
- Some Carcinogenic/Mutagenic
- High Water Leaching
- Low to Very Low Evaporation
- Low to Moderate Soil Adsorption

The general properties of Aliphatic TPHg include:

- Simple Chain Structure
- Low to Moderate Toxicity
- Not Carcinogenic/Mutagenic
- Low to Moderate Water Leaching
- Very High Evaporation
- Moderate to Very High Soil Adsorption

Based on these physical and chemical properties, subsurface weathering separates the four major TPHg fractions into groundwater, soil vapor and soil.

- <u>BTEX Aromatics</u> ***Leach to Groundwater*** (with minor Heavy Aromatics)
- <u>Light Aliphatics</u> ***Evaporate into Soil Vapor*** (with minor Heavy Aliphatics)

- Heavy Aromatics and Heavy Aliphatics ***Adsorb to Soil***

Based on the characteristic weathering of TPHg and the toxicological factors, the following TPHg fractions are the Primary Indicator Chemicals for the following Impact Media:

- **Groundwater = Benzene**
- **Soil Vapor = Light Aliphatics**
- **Soil = Heavy Aromatics**

In our comments on Media-Specific Criteria, RTD proposes TPHg fraction Screening Levels for Soil Vapor and Soil.

COMMENTS ON MEDIA-SPECIFIC CRITERIA

Groundwater

Groundwater impacts have driven corrective action and site closure for the entire history of petroleum UST cases in California. However, decades of data and analysis have conclusively shown that, except in extremely rare cases, impacted groundwater is not a complete exposure pathway. Given decades of monolithic regulatory emphasis on the lowest exposure risk, it is not surprising that the Tank Fund ended up having severe cash-flow shortage.

Given the long history of poorly allocated cleanup funds to extraordinary groundwater remediation without scientific, technological or economic justification, this is the single most important addition to the Closure Policy.

RTD concludes that the draft Closure Policy for groundwater is conservative, reasonable and appropriate; therefore, RTD does not have any recommended changes to this section of the draft Closure Policy.

Petroleum Vapor Intrusion to Indoor Air

The regulatory concern for the vapor intrusion exposure pathway has increased greatly in California over the last six years. The department of Toxic Substances Control (DTSC) has developed several guidelines and updates covering the sampling program design, vapor probe installation, soil vapor and air sampling and analysis of data to make reasonable and technically defensible estimates of vapor intrusion risk. Most of the focus and concern is with chlorinated solvents because of their high carcinogenic and toxicity potential and their lack of biodegradation potential.

Petroleum volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene and xylenes (BTEX) and total petroleum hydrocarbons as gasoline (TPHg) are thought to be a significantly lower vapor intrusion threat due to oxygen-enhanced biodegradation in the vapor phase. The draft Closure Order cites several studies to reach a conclusion that aerobic biodegradation of petroleum VOCs in soil vapor can result in 1,000-fold reduction between the source and the building.

This conclusion may be partially appropriate for BTEX Aromatics and Heavy Aromatics, but is not justified for the ubiquitous Light Aliphatic TPHg fraction impact to soil vapor. There are two major reasons that the 1,000-fold biodegradation factor is not technically justified: 1) Soil Vapor Field Data is Unreliable: and 2) Biodegradation of TPHg in Soil Vapor is Reduced by High Soil Moisture and Low Water Solubility.

DTSC (with help from the Los Angeles Regional Water Board) have developed a very stringent and exacting soil vapor sampling protocol that is not universally used outside California. In addition, the DTSC protocol is not perfect as it still allows for sampling from driven probes. In addition, there is no standard, consistent or technically justified vapor diffusion equilibration time between probe installation and vapor sampling. The quality of the soil vapor field data collected from all over the United States and in foreign countries used to justify the 1,000-fold biodegradation factor is of uncertain quality and is very likely biased low by up to several orders of magnitude. In addition, some studies have shown that biodegradation may not be a significant factor at up to 25-percent of the sites (Roggemans, S., C.L. Bruce, and P.C. Johnson, 2001, Vadose zone natural attenuation of hydrocarbon vapors: An empirical assessment of soil gas vertical profile data. API Technical Bulletin No. 15., Washington, D.C., American Petroleum Institute). This was one of many reasons given by DTSC in their rejection of much of the same set of arguments to justify a very high biodegradation factor for hydrocarbon vapor intrusion (Department of Toxic Substances Control, Response to Public Comments, Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air - Interim Final, December 15, 2004 and Revised February 7, 2005).

Aerobic biodegradation of soil vapor impacts does not occur in the soil vapor phase. Soil gas must be dissolved into soil moisture before biodegradation can occur. These conditions are simulated in a modeling study (J.R., P.A. Holden, and M.K. Firestone, Coupling Transport and Biodegradation of VOCs in Surface and Subsurface Soils, Environmental Health Perspectives Volume 103, Supplement 5, June 1995). In that study, they conclude that:

> In order for petroleum hydrocarbons to be degraded by bacteria, the individual components must diffuse from the bulk gas phase to the interface of the water film, then partition into the water, diffuse through the water, partition into the cell membranes, and be transported into the cell.
>
> …Consideration of aromatic and aliphatic hydrocarbons revealed that **aromatics are rapidly removed**, while **aliphatics have very slow removal rates due to mass transfer through the water film**. Additional consideration of simultaneous oxygen transfer revealed that degradation of aromatic hydrocarbons

> can be significantly depressed even if oxygen is present in the gas phase at 10 times the amount needed for complete oxidation. **(emphasis added)**

Based on the relative short time that soil vapor intrusion has been emphasized and due to the difficulty in obtaining reliable soil vapor samples representative of in situ equilibrium conditions, use of an across-the-board 1,000-fold biodegradation factor is not protective of human health.

RTD proposes using Light Aliphatic TPHg fraction as the Primary Indicator Chemical of concern with no biodegradation factor. Using data from TPHCWG and others, RTD has calculated soil vapor screening levels of:

Light Aliphatics (C5-C8)	Residential	140,000-ug/m^3
Light Aliphatics (C5-C8)	Commercial	410,000-ug/m^3

RTD has submitted these results to the SWRCB team working on the risk assessment for the draft Closure Policy.

Soil Direct Contact and Outdoor Air Exposure

RTD used all of the equations and input data provided in the draft Closure Order and created a spreadsheet to calculate the soil direct contact and outdoor air exposures. Upon completing this task, we discovered a mistake in the draft Closure Order screening levels for commercial/industrial (C/I) and utility worker (Util) exposure scenarios. The error was the inclusion of an extra body weight factor in both the cancer and non-cancer for the C/I and Util direct contact and outdoor air exposure equations. RTD contacted the SWRCB team working on the risk assessment for the draft Closure Policy and we confirmed these errors. Below are the corrected screening levels.

Table 8. Soil Screening Levels (for the Policy)

Depth (feet)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Naphthalene (mg/kg)	PAH* (mg/kg)
0 to 5	1.9	21	9.8	0.063
5 to 10	2.8	32	9.8	4.5

Table 9. Summary of Soil Screening Levels for Each Receptor

Chemical	Residential		Commercial/ Industrial		Utility Worker
	0 to 5 feet bgs mg/kg	Volatilization to outdoor air (5 to 10 feet bgs) mg/kg	0 to 5 feet bgs mg/kg	Volatilization to outdoor air (5 to 10 feet bgs) mg/kg	0 to 10 feet bgs mg/kg
Benzene	1.9	2.8	8.2	12	14
Ethylbenzene	21	32	89	134	315
Naphthalene	9.8	9.8	45	45	219
PAH	0.063	195	0.68	2,308	4.5

Once RTD had confirmed the screening levels and our calculations with the SWRCB team working on the risk assessment, we calculated the soil screening levels for the Heavy Aromatics, the Primary Indicator Chemical for soil direct contact.

Heavy Aromatics (C9-C12)	Residential	220-mg/Kg
TPHg (highly weathered)	Residential	361-mg/Kg

These results are too high based on professional field experience. At these concentrations, direct contact with these soils will definitely require HAZWOPER training and personal protective equipment.

RTD then changed the Target Hazard Quotient (THQ) from the draft Closure Policy value of 1.0 to the SFBRWQCB ESL standard of 0.2. This resulted in more reasonable results, including:

Heavy Aromatics (C9-C12)	Residential	44-mg/Kg
TPHg (highly weathered)	Residential	72-mg/Kg

These screening levels are reasonable based on professional field experience and do not likely require rise to the level that would require HAZWOPER training and/or personal protective equipment. RTD recommends that the SWRCB team working on the risk assessment use the TPHCWG method to calculate screening levels for Heavy Aromatics.

CONCLUSIONS AND RECOMMENDATIONS

The draft Closure Policy is a much needed improvement for helping to focus UST site investigation, remediation and closure. With the exception of excluding TPH fractions and the high soil vapor biodegradation factor, RTD supports the Closure Policy.

We recommend some focused fine tuning of this draft Closure Policy to include TPH fractions as Primary Indicator Chemicals, development of screening levels without biodegradation for Light Aliphatics for soil vapor and Heavy Aromatics for soil direct contact. Once these changes are made, RTD recommends the Board adopt the Closure Policy.

REMARKS

The signature and stamp below of the registered professional attests, under penalty of perjury, that this report is true and accurate to the best of my ability given the standard industry practices currently employed. Please call (831) 458-1612 with any questions or comments.

Sincerely,

REMEDIATION TESTING AND DESIGN, INC.

Howard E. Whitney, #PG 4860, #CHG 193

Professional Geologist, Certified Hydrogeologist