Pfizer Inc.
100 Route 206 North, MS LLA-401
Peapack, NJ 07977
Tel: 908-901-8630

Via e-mail

July 19, 2017

Mr. Luis Negron
Project Manager
US EPA-Region 2
Caribbean Environmental Protection Division
City View Plaza II, Suite 7000
Guaynabo, Puerto Rico 00968

RE: Pfizer Pharmaceuticals, LLC, Barceloneta Site, EPA ID PRD090346909
CMS - Soil Vapor Cleanup Level for Benzene

Dear Mr. Negron:

On behalf of Pfizer Pharmaceuticals, LLC (PPLLC), please find attached a technical memorandum prepared by TRC Solutions that provides soil-gas cleanup levels for benzene based on site-specific conditions and USEPA's Johnson & Ettinger model. It would be helpful to schedule a meeting with you to discuss the technical memorandum and any questions you may have.

Sincerely,

William G. Gierke, P.G., Senior Manager
Pfizer Inc.

cc. Jorge Esquilin and Ruth Llorens (Pfizer)

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July 18, 2017

Bill Gierke
Manager, Site Remediation and Due Diligence
Pfizer Global Engineering - Pfizer Inc.
100 Route 206 North M/S 611
Peapack, NJ 07977

Subject: Barceloneta, PR Facility
Benzene Cleanup Level for Soil Vapor

Dear Bill:

Per your request, please find attached to this letter, a technical memorandum summarizing our work to develop a soil-gas cleanup value for benzene at the above referenced facility.

The work was performed by Dr. Karen Vetrano who can be reached at 860-298-6351 if you have any questions. You may also contact me 978-656-3560. Thank you for the opportunity to work with you on this effort.

Sincerely;

Dale S. Weiss
Senior Vice President

TECHNICAL MEMORANDUM

INTRODUCTION

TRC previously prepared a RCRA Facility Investigation Report for the Pfizer Facility in Barceloneta, Puerto Rico in 2007. As part of the investigation, TRC prepared a human health risk assessment evaluating future construction workers and current/future commercial/industrial workers. The results of the risk assessment showed that construction worker and commercial/industrial worker exposures to soils and groundwater were below the target levels of 1E-04 and 1E+00 for cancer risks and non-cancer hazards, respectively. Using USEPA's Johnson and Ettinger (J&E) Model (SG-SCREEN, version 3.1; 02/04) and RFI data (TRC 2007), the model evaluation showed a potential exposure risk from soil vapor intrusion of benzene to indoor air. Currently, the benzene in soil gas is being remediated by soil vapor extraction (SVE).

This memo provides calculated soil vapor clean-up levels for benzene under two commercial/industrial worker scenarios so that Pfizer, in cooperation with EPA, can determine when the remediation is complete.

METHODOLOGY

The J&E Model used for the human health risk assessment is still the current version of the model. All site specific input parameters used for the J&E Model during the RFI risk assessment (TRC 2007) were used for the calculation of the clean-up values, including the assumption of the presence of a concrete slab for each indoor air scenario. TRC calculated soil gas clean-up values under two different commercial/industrial worker scenarios (See Attachment A for J&E spreadsheets):

Current/Future Pfizer Worker – TRC calculated a soil gas clean-up value based upon a current/future Pfizer worker exposure as originally evaluated in the risk assessment (TRC 2007). The clean-up value was calculated based upon the OSHA PEL of 1 ppm (3.19 mg/m^3) as the benchmark value. This assumes that Pfizer employees have gone through OSHA Hazard Communication (HAZCOM) training for chemicals used/stored on site (i.e. benzene). The soil gas clean-up value was back-calculated from an "allowable" indoor air concentration (i.e. the PEL) and the indoor air attenuation coefficient which was calculated with the J&E Model. The attenuation coefficient is used as a measure of the decrease in concentration that occurs during vapor migration and may vary with space and time.

Future Commercial/Industrial Worker – TRC calculated a risk-based soil gas clean-up value based upon a future commercial/industrial worker scenario. This assumes that the property is eventually sold and another commercial/industrial business is conducted in existing buildings or newly constructed on the site. There is no assumption that the employees would be trained under OSHA HAZCOM, therefore, the clean-up value is based upon USEPA's cancer slope factor and non-cancer reference concentration for benzene with USEPA default commercial/industrial worker input parameters. The workers are assumed to work 8 hours per day, 250 days per year for 25 years. The soil gas clean-up value was back-calculated from an "allowable" risk-based indoor air concentration and the indoor air attenuation coefficient which was calculated with the J&E Model. The target cancer risk was set at 1E-04 and the Hazard Quotient was set at 1.

RESULTS

Table 1 presents the soil gas clean-up values calculated for the two scenarios. Attachment A provides the J&E spreadsheets for each scenario.

Scenario	Benzene Soil Gas Value (ppmv)	Benzene Soil Gas Value (mg/m^3)
Current/Future Pfizer Worker - OSHA	1371	4375
Future Commercial/Industrial Worker – USEPA Risk Based	57	180

CONCLUSIONS

Pfizer has indicated that the site would be deed-restricted to commercial/industrial use; therefore, the risk-based clean up value of 57 ppmv (180 mg/m^3) would be most applicable for a remediation cleanup goal.

REFERENCES

TRC 2007. Draft RCRA Facility Investigation Supplemental Report. Pfizer Pharmaceuticals, LLC, Barceloneta, Puerto Rico. EPA I.D. No. PRD-090346909. June.

ATTACHMENT A

JOHNSON & ETTINGER WORKSHEETS

COMMERCIAL/INDUSTRIAL WORKER – OSHA PEL BASED CLEAN-UP VALUE

DATA ENTRY SHEET

SG-SCREEN
Version 3.1; 02/04

Reset to Defaults

Current/Future Commercial/Industrial Worker
OSHA PEL

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical	ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type used to estimat soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
71432			46650.11	Benzene	15	504.75	25	S		

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

INTERMEDIATE CALCULATIONS SHEET

Chemical	Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)
Benzene	489.75	0.321	0.003	1.02E-07	0.998	1.02E-07	6.71E+03	1.49E+08	5.63E+04	2.79E+06	1.44E-04	15	7,967	5.54E-03

Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	OSHA PEL (mg/m^3)
2.26E-01	1.80E-04	1.42E-02	489.75	15	1.49E+08	0.06	8.33E+01	1.42E-02	4.00E+02	3.99E+63	7.29E-04	1.09E+05	3.2E+00

RESULTS SHEET

Current/Future Commercial/Industrial Worker
OSHA PEL Based Risk and Clean-Up Value

Chemical	OSHA PEL (mg/m3)	Infinite source bldg. conc., $C_{building}$ (mg/m3)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Clean-Up Value: Soil Gas Conc (ppmv) Conc/PEL = 1	Clean-Up Value: Soil Gas Conc (mg/m3) Conc/PEL = 1
Benzene	3.19	108.57	34.04	1371.74211	4375.857
			34.04		
				= HQ>1	

HQ = Infinite Source Bldg Conc/OSHA PEL

Clean-up Value =

ppmv = ((Cbuilding/HQ)/Infinite Source Indoor attenuation coefficient)/3.19
where 3.19 mg/m3 = 1 ppm benzene

mg/m3 = ((Cbuilding/HQ)/Infinite Source Indoor attenuation coefficient)

FUTURE COMMERCIAL/INDUSTRIAL WORKER – USEPA RISK-BASED CLEAN-UP VALUE

DATA ENTRY SHEET

Future Commercial/Industrial Worker

SG-SCREEN Version 3.1; 02/04

USEPA Risk-Based

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_a ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_a (ppmv)	Chemical
71432			46650.11	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	504.75	25	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	Fraction of Exposure Unitless
70	25	25	250	3.3E-01

END

(Model is set up to assume continual residential inhalation (24 hr/day), so adjusted down for non-residential exposure (e.g., 8 hr/day instead of 24 hr/day))

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
489.75	0.321	0.003	1.02E-07	0.998	1.02E-07	6,706	1.49E+08	5.63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
2.79E+06	1.44E-04	15	7,967	5.54E-03	2.26E-01	1.80E-04	1.42E-02	489.75

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	1.49E+08	0.06	8.33E+01	1.42E-02	4.00E+02	3.99E+63	7.29E-04	1.09E+05

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.8E-06	3.0E-02

RESULTS SHEET

Future Commercial/Industrial Worker
USEPA Risk- Based Risk and Clean-Up Value

INCREMENTAL RISK CALCULATIONS:

Chemical	Infinite source bldg. conc., $C_{building}$ (mg/m3)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Soil Gas Conc (ppmv) Cancer Risk <1E-4, HQ<1	Soil Gas Conc (mg/m3) Cancer Risk <1E-4, HQ<1
Benzene	1.09E+02	6.9E-02	8.3E+02	56.51	180.27

MESSAGE SUMMARY BELOW:

Target Cancer Risk = 1E-04
Target HQ = 1

Clean-up Value =

ppmv = ((Cbuilding/HQ)/Infinite Source Indoor attenuation coefficient)/3.19
where 3.19 mg/m3 = 1 ppm benzene

mg/m3 = ((Cbuilding/HQ)/Infinite Source Indoor attenuation coefficient)