January 31, 2020
Kleinfelder Project No. 20202886.001A

Mr. Wayne Mancroni
Central Hudson Gas & Electric Corp.
284 South Avenue
Poughkeepsie, New York 12601

SUBJECT: LITTLE BRITAIN ROAD SERVICE CENTER
INDOOR AIR EXPOSURE EVALUATION
610 Little Britain Road
New Windsor, New York 12553
NYSDEC BCA# C336031

Dear Mr. Mancroni:

Kleinfelder, Inc. (Kleinfelder) is pleased to submit to Central Hudson Gas & Electric Corporation (CHGE) the results of the indoor air exposure evaluation performed for the CHGE Little Britain Road Service Center (the Site) located at 610 Little Britain Road, New Windsor, New York. The objective of this indoor air exposure evaluation is to assess the current and projected indoor air concentrations of site-specific constituents during a proposed two-week shutdown of the on-site sub-slab depressurization system (SSDS). This indoor air exposure evaluation was performed at the request of CHGE and was in response to the results of the air sampling effort performed by Kleinfelder in January 2020. The objective of the January 2020 sampling effort was to assess the current condition of sub-slab vapor and indoor air at the Site.

PROJECT BACKGROUND

Kleinfelder performed sub-slab depressurization system (SSDS) vapor, indoor air, and outdoor air sampling activities on January 5, 2020. The scope of work and sampling methods were performed in accordance with the New York State Department of Health (NYSDOH) *October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New* York (NYSDOH, 2006) and the May 2019 *Sub-Slab Depressurization System Evaluation Work Plan*, prepared by Kleinfelder. It should be noted that all samples were collected while the SSDS was in operation.

A total of 28 air samples (including quality control samples) were collected during the sampling event and were analyzed for volatile organic compounds (VOCs) via United States Environmental Protection Agency (USEPA) Method TO-15. Laboratory analytical results were compared to the NYSDOH Soil Vapor/Indoor Air Decision Matrices A, B, and C, as outlined in the *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, revised May 2017.

These matrices focus on eight (8) key VOC compounds included within the analyte list of USEPA Method TO-15:

- Matrix A provides screening values for trichloroethene (TCE), cis-1,2 dichloroethene (cis-1,2 DCE), 1,1-dichloroethene (1,1-DCE), and carbon tetrachloride (CT);

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- Matrix B provides screening values for tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), and methylene chloride; and
- Matrix C provides screening values for vinyl chloride (VC).

Of the compounds assessed by NYSDOH Matrix A, TCE and cis-1,2 DCE were present at concentrations in SSDS vapor (as sampled from the SSDS extraction wells)/indoor air sample pairs, triggering the following NYSDOH recommended actions:

Table A. Analytical Results Comparison & NYSDOH Recommended Action Summary

Analytical Results Comparison & NYSDOH Recommended Actions				
Sample ID	**TCE Results ($\mu g/m^3$)**	**Recommended Action for TCE**	**cis-1,2 DCE Results ($\mu g/m^3$)**	**Recommended Action for cis-1,2 DCE**
IA-1 EW-1	**0.20** **18**	Monitor	ND (0.2) **1.2**	No Further Action
IA-2 EW-2	ND (0.19) **87**	Mitigate	ND (0.2) **22**	Monitor
IA-3 EW-3	**0.21** **44**	Monitor	ND (0.2) **90**	Mitigate
IA-4 EW-4	**0.26** **52**	Monitor	ND (0.2) **7.3**	No Further Action
IA-5 EW-5	**0.25** **35**	Monitor	ND (0.2) **1.1**	No Further Action
IA-6 EW-6	**2.3** **15**	Mitigate	ND (0.2) ND (0.2)	No Further Action
IA-7 EW-7	**0.26** **6.3**	Monitor	ND (0.2) ND (0.2)	No Further Action
IA-8 EW-8	**0.26** **0.52**	No Further Action	ND (0.2) ND (0.2)	No Further Action

ND: Non-Detect
$\mu g/m^3$: micrograms per cubic meter

Of the compounds assessed by NYSDOH Matrix B, PCE, 1,1,1-TCA, and methylene chloride were present within several SSDS extraction well/IA sample pairs but were detected at concentrations below their respective NYSDOH action levels. The compound assessed by NYSDOH Matrix C, vinyl chloride, was present in one of the samples collected, EW-2, but at a concentration below the NYSDOH action level. The results of the January 2020 sampling event and recommendations were presented in the January 23, 2020 *SSDS and Air Sampling Report*, prepared by Kleinfelder.

Based on the results of the January 2020 sampling effort and the comparison of the results to the NYSDOH guidance values, Kleinfelder recommended that the SSDS remain in operation and continued monitoring be performed. In addition, Kleinfelder recommended a baseline sub-slab sampling event be performed to further evaluate the current conditions of sub-slab vapor. This would require a temporary shutdown of the SSDS to allow for conditions to equilibrate; thereby, allowing for more representative sampling.

INDOOR AIR EXPOSURE EVALUATION

To evaluate if a temporary SSDS shutdown (e.g., two weeks) would pose an exposure risk to occupants of the Site, Kleinfelder performed a limited exposure evaluation utilizing the analytical data collected from the January 2020 sampling event. The results of this exposure evaluation are presented below.

Three chlorinated VOCs were identified as indoor air contaminants of concern (COCs) that may derive from a sub-slab vapor intrusion pathway and pose a potential risk of harm to human health:

Table B. TCE Results Summary

Sampling Stream	NYSDOH Vapor Intrusion Screening Value (Matrix A)	Maximum Concentration Detected in January 2020 Sampling Event	Comments
Sub-slab Vapor	6 µg/m^3	87 µg/m^3	In sample EW-2
Indoor Air	0.2 µg/m^3	2.3 µg/m^3	In sample IA-6 (remainder of sample concentrations were 0.32 µg/m^3 TCE or less)
Outdoor Air	No screening value promulgated by NYSDOH.	<0.19 µg/m^3	-

Table C. cis-1,2 DCE Results Summary

Sampling Stream	NYSDOH Vapor Intrusion Screening Value (Matrix A)	Maximum Concentration Detected in January 2020 Sampling Event	Comments
Sub-slab Vapor	6 µg/m^3	90 µg/m^3	In sample EW-3 (next highest detection: 22 µg/m^3 in sample EW-2)
Indoor Air	0.2 µg/m^3	< 0.2 µg/m^3	-
Outdoor Air	No screening value promulgated by NYSDOH.	<0.19 µg/m^3	-

Table D. Carbon Tetrachloride Results Summary

Sampling Stream	NYSDOH Vapor Intrusion Screening Value (Matrix A)	Maximum Concentration Detected in January 2020 Sampling Event	Comments
Sub-slab Vapor	6 µg/m^3	3 µg/m^3	-
Indoor Air	0.2 µg/m^3	0.46 µg/m^3	Carbon tetrachloride was detected in indoor air and outdoor air sampling indicating that this COC is ubiquitous at the Site.
Outdoor Air	No screening value promulgated by NYSDOH.	0.44 µg/m^3	

To evaluate exposure to indoor air COCs, Kleinfelder assumed that the Site's occupants work eight (8) hours per day, five (5) days per week, 50 weeks per year at the Site. If occupants work a longer day or week, air analytes would pose a higher risk than reported below.

The current average daily exposure (ADE) was calculated for a Site occupant, using the January 2020 maximum detected concentrations in indoor air as the exposure point concentration (EPC). The long-term daily exposure over seven (7) years or more (10% of lifespan) is considered to represent chronic exposure. The lifetime average daily exposure (LADE) over a 70-year lifespan assumes an employment tenure of 27 years.

ADE ($\mu g/m^3$) = EPC ($\mu g/m^3$) * 8 hours / 24 hours * 5 days / 7 days * 50 weeks / 52 weeks

LADE ($\mu g/m^3$) = ADE * 27 years / 70 years lifespan

The ADE of each COC was compared to the chronic reference concentration (RfC, obtained from USEPA Integrated Risk Information System (IRIS)-approved toxicity threshold values). The COC-specific noncancer (NC) health risk from inhalation exposure is expressed as a hazard quotient (HQ). The excess lifetime cancer risk (ELCR) is the increased probability of cancer due to lifetime inhalation exposure. The LADE is factored by the IRIS-approved inhalation unit risk to calculate the ELCR. Toxicity reference values are based on occupationally-exposed human populations or animal dose/response studies, and are derived to be protective of lower environmental exposure levels.

HQ = ADE / chronic RfC ($\mu g/m^3$)

ELCR = LADE * inhalation unit risk $(\mu g/m^3)^{-1}$

Table E. Current Cumulative Employee Receptor Hazard Calculation

Indoor Air Maximum Concentration Detected in January 2020 Sampling Event	Excess Lifetime Cancer Risk	Noncancer Hazard Quotient
2.3 $\mu g/m^3$ TCE	1 E-6	0.26
0.1 $\mu g/m^3$ cis-1,2 DCE	NA	0.004
0.46 $\mu g/m^3$ carbon tetrachloride	2 E-7	0.001
Cumulative Employee Receptor Hazard Index		**0.265**

For inhalation exposure to current indoor air, the combined HQs yield a cumulative employee receptor hazard index (HI=0.265) which is below the acceptable noncancer adverse health effect threshold (HI = 1). Current indoor air TCE concentration yields an increased probability of one cancer case in one million exposed individuals (ELCR=1 E-6). No potentially significant cancer or noncancer risks are posed by January 2020 indoor air COC concentrations. The carbon tetrachloride concentration in indoor air is equivalent to that detected in outdoor air, thus a preferential vapor intrusion pathway from the sub-slab air space into building air is not indicated.

For a two-week duration of SSDS shutdown, the only potentially significant risks would be noncancer effects. A two-week period of exposure would contribute negligibly to cumulative excess lifetime cancer risk (ELCR), relative to the exposure period considered in assessing lifetime average daily exposure (defined as 27 years of employment).

Risk-based indoor air action levels were calculated for TCE and cis-1,2 DCE, the main contributors to noncancer health hazards posed by soil vapor COCs. The following exposure point

concentrations in indoor air are calculated to be protective of employee health over the two-week period of SSDS shutdown.

Table F. Maximum Risk-based Indoor Air Concentrations Protective of Employees

Indoor Air Concentration	NC Hazard Quotient
8 µg/m^3 TCE	0.92
1 µg/m^3 cis-1,2 DCE	0.04

The LADE would not be significantly elevated by a two-week exposure period, thus only the ADE noncancer hazard is relevant to the evaluation of potential harm to health over this time period.

As a point of reference, the NYSDOH, Occupational Health & Safety Administration (OSHA), and National institute for Occupational Safety & Health (NIOSH) have published varying exposure limits for TCE. The NYSDOH immediate action level is based upon sensitive receptors in a residential scenario with continuous exposure (Trichlorethylene (TCE) In Indoor and Outdoor Air, August 2015 Fact Sheet, Bureau of Toxic Substance Assessment, New York State Department of Health). The OSHA permissible exposure limit (PEL) (OSHA Method 1001, May 1999) and NIOSH recommended exposure limit (REL) (NIOSH Pocket Guide to Chemical Hazards, Appendix C) are based upon the time weighted average (TWA) over a standard 10-hour exposure period (simulating a normal business day). These levels are presented below.

Table G. Examples of Permissible Exposure Limits for TCE

Proposed Risk-Based Indoor Air Action Level	NYSDOH Immediate Action Level	OSHA PEL	NIOSH REL
8 µg/m^3	20 µg/m^3	537,000 µg/m^3	134,250 µg/m^3

CONCLUSIONS & RECOMMENDATIONS

Based on the results of the indoor air exposure evaluation, concentrations of COCs detected in the January 2020 indoor air samples do not pose a significant long term (chronic) noncancer hazard (HI=1) or cancer risk (ELCR = 1 in 100,000, or 1 E-5).

The sub-slab vapor migration of TCE and cis-1,2 DCE into indoor air is currently attenuated by at least 40-fold. It is not known to what degree concentrations beneath the building will increase during SSDS deactivation. Thus, to be protective of Site occupants during the SSDS two-week deactivation, threshold indoor air concentrations of COCs (8 µg/m^3 TCE and 1 µg/m^3 cis-1,2-DEC) would not exceed a health hazard threshold of HI=1 or increase lifetime cancer risk. TCE concentrations in employee-occupied areas below 8 µg/m^3 would pose no significant risk of harm to human health. TCE must remain below 20 µg/m^3 to accord with NYSDOH health protective guidelines.

Enclosed spaces representative of occupant exposure points within the building may be continuously air monitored during the proposed two-week shutdown of the SSDS. In the event that monitoring results exceed the above noted risk-based thresholds for cis-1,2 DCE and TCE, the shutdown period of the SSDS would be terminated and the system restarted.

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LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

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Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. It should be recognized that definition and evaluation of geologic and environmental conditions are a difficult and inexact science. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. Although risk can never be eliminated, more-detailed and extensive studies yield more information, which may help understand and manage the level of risk.

CLOSING

We thank you for the opportunity to provide Kleinfelder's professional services. If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

KLEINFELDER

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