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ENGINEERING DATA TRANSMITTAL

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7. Abstract

A soil-gas survey was conducted at fuel storage facilities in the 100-NR-1 Operable Unit. The survey was conducted to detect volatile organic compounds associated with petroleum products that were stored or transferred at the study area. Soil-gas collected contained no traces of volatile organic compounds associated with petroleum products. Trace concentrations of perchloroethylene were detected in soil-gas collected near the fuel oil unloading trench. The source of the perchloroethylene appears to be a fuel additive dispensed at the unloading trench. In addition, Total Petroleum Hydrocarbons, combustible gas, and oxygen levels indicated several areas where the soil may contain petroleum products above Washington State cleanup levels.

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CONTENTS

1.0 SUMMARY

A soil-gas survey was conducted for the 100-NR-1 Operable Unit as part of the RCRA Facility Investigation/Corrective Measures Study for the 100-NR-1 Operable Unit (DOE-RL 1992). Soil-gas samples were collected at the 100-N fuel storage facilities where petroleum products were unloaded, stored, and transferred. The soil-gas samples were analyzed for volatile organic compounds (VOC) characteristic of the materials used at each sample site. The findings of the investigation are summarized in this report.

Soil-gas samples collected at the 100-N fuel storage facilities contained no detectable concentrations of VOC associated with petroleum products. The samples did contain elevated levels of combustible gas (primarily methane) and depleted levels of oxygen that are characteristic of biodegradation of petroleum products in the soil. Two soil-gas samples contained trace concentrations of the chlorinated hydrocarbon perchlorethylene. Perchlorethylene was a component of a fuel additive used and dispensed at the 1900-N Fuel Oil Unloading Trench. The perchlorethylene is presumed to be residual contamination from spills of the fuel additive near the unloading station. In addition, field tests of soil samples collected from drill cuttings indicated areas where total petroleum hydrocarbon (TPH) levels exceeded 100 parts-per-million (ppm).

2.0 INTRODUCTION

The 100-NR-1 Operable Unit is a source operable unit located at the 100-N Area at the Hanford Site. This soil-gas survey was conducted based on an agreement with the U.S. Department of Energy (DOE) and the Washington State Department of Ecology (Ecology) (DOE-RL 1992). The work was conduced consistent with the requirements established Draft B of the RFI/CMS work plan for the 100-NR-1 Operable Unit (DOE-RL 1991).

Soil-gas sampling activities began at the 100-NR-1 Operable Unit in August, 1992. Soil-gas probes were installed near the following 100-N fuel storage and unloading facilities.

- 1715-N Diesel Oil Storage Tanks and Unloading Station
- 166-N Fuel Oil Storage Tank
- 166-N Pump Station
- 1900-N Fuel Oil Unloading Trench.

The soil-gas survey results will be used to help identify areas that may be potentially contaminated with VOC associated with petroleum products.

3.0 METHODS

Each site was visually inspected before the soil-gas probes were installed. Applicable Hanford Site drawings were used to locate each study

area using Hanford Site coordinates for 100-N Area. Soil-gas probes were installed in accordance with 100 NPL Agreement/Change Control Form Number 8 (DOE-RL 1992).

Each soil-gas probe consisted of an expendable stainless-steel point attached to a 7 to 8-ft length of ¼-in. O.D. teflon (a trade mark of E.I. DuPont De Nemours Company). A 1-in. hole was drilled to a depth of about 2 ft with an electric rotary hammer at each sampling site. When possible, about 20 g of soil was collected from the drill cuttings for separate analysis. Then a soil-gas probe was driven to a depth of 4 to 6 ft using a pneumatic post pounder. The teflon tubing extends to the soil surface and is capped. The penetration depth for each soil-gas sampling point was recorded. Other information such as soil conditions, texture, and observed signs of contamination was noted in the field logbook. Each soil-gas sampling point was numbered and marked for identification in the field.

The soil samples collected from the drill cuttings were tested in the field for TPH concentrations using an enzyme immunoassay test. The test kit, PETRO RISc Test (a trademark of EnSys Inc.), provides a rapid comparison of sample concentration relative to standard of 100 ppm and 1,000 ppm TPH.

After the probes were installed, each probe was screened for total VOC using a model 580B Organic Vapor Monitor (OVM) (a trademark of Thermo Environmental Instruments Inc.). The instrument was equipped with a 10.6 eV lamp that is capable of detecting volatile organic vapors associated with petroleum products, ketones, and many chlorinated solvents.

The 580B OVM was calibrated at the monitoring site using ambient air filtered through a charcoal filter to provide a zero reading and 101 ppm isobutylene in air as the span gas. The instrument response was checked before the sampling effort using 9.5 ppm isobutylene in air. The instrument probe was then attached to each soil-gas probe using a 1-in. piece of Tygon (a trademark of Norton Company) tubing. The instrument was set to average readings over 5-sec intervals. Readings taken during a span of 1 min were logged for each sample point. After all soil-gas probes had been sampled, the instrument response was again checked using 9.5 ppm isobutylene in air. These screening data were used to indicate areas of detectable soil vapors and to alert the gas chromatograph (GC) operator of any highly contaminated samples that may need to be diluted before analysis.

Also, soil-gas from each probe was screened for combustible gas and oxygen levels using a GasTech Model 1314 (a trademark of GasTech, Inc.) combustible gas/oxygen analyzer. Combustible gas levels were zeroed before the instrument probe was attached to each sample probe. Soil-gas samples were collected for about 1 to 2 min at each sample point.

After each sample point was screened, soil vapor samples were collected for GC analysis. The soil vapor samples were collected in evacuated 100-ml glass sample vials equipped with a butyl-rubber septum. A 60-cc syringe attached to a 3-way valve fitted with a hypodermic needle was used to purge each sample tube and collect the sample. Once the sample tube was purged, the hypodermic needle was put into the septum of an evacuated 100-ml glass vial. The soil vapor was drawn into the 100-ml vial. Additional vapor was added to the vial using the syringe to establish a slight positive pressure and ensure that an adequate sample was collected. Each sample container was labeled and

tracked using a unique HEIS sample number. The sample containers were delivered to the laboratory for analysis. Quality control samples collected included field duplicate samples, equipment blanks, and ambient air samples.

The soil-gas samples were analyzed using a SRI Model 8610 (a trademark of SRI Instruments) GC. A 30-m, wide-bore (0.53 mm) capillary column was used to separate the compounds for analysis. The GC used high-purity helium carrier gas to deliver the samples to a photoionization detector (PID) followed by a flame ionization detector (FID). The carrier gas flow rate was approximately 10 mL/min.

Calibration data for the GC were obtained using pure liquid standards injected into 100-mL sample vials. The standards were used to prepare calibration curves for benzene, toluene, ethylbenzene, o-xylene, m-xylene, trans-1,2 dichloroethylene (t-1,2-DCE), 1,1,1 trichloroethane (1,1,1-TCA), trichloroethene (TCE), and perchloroethylene (PCE).

Injections of 5 mL from each gas sample were analyzed. The samples were injected into the sparge gas during the purge cycle, absorbed onto an absorbent trap, and then desorbed at high temperature into the column for separation. The results of each chromatogram were compared to the calibration data using the Peaksimple (a trademark of SRI Instruments) software package. After any significant amount of instrument down time, blank injections of laboratory air were made to identify potential contaminants from previous analyses.

The principal VOC of concern for the 100-NR-1 Soil-Gas Survey are shown on Table 1. The table contains four compounds associated with petroleum products (benzene, toluene, ethyl benzene, and xylene). The remaining four organic compounds are four solvents potentially used at the study areas.

Table 1. Principal Soil-Gas Analytes for the 100-NR-1 Operable Unit.

Analyte	CAS[a]	Formula	MW[b]	IP[c] (eV)
Benzene	67-64-1	C_6H_6	78.2	9.69
t-1,2-Dichloroethylene (DCE)	156-60-5	ClCH=CHCl	97.0	9.65
Ethyl Benzene	100-41-4	$CH_3CH_2C_6H_5$	106.2	8.76
Perchloroethylene (PCE)	127-18-4	$Cl_2C=CCl_2$	165.8	9.32
Toluene	108-88-3	$C_6H_5CH_3$	92.1	8.82
1,1,1-Trichloroethane (TCA)	71-55-6	CH_3CCl_3	133.4	11.00
Trichloroethylene (TCE)	79-01-6	$ClCH=CCl_2$	131.4	9.45
Xylenes	1330-20-7	$C_6H_4(CH_3)_2$	106.2	8.56

NIOSH (1990), "Pocket Guide to Chemical Hazards," National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Washington, D.C.

[a]Chemical Abstract System.
[b]Molecular weight.
[c]Ionization potential.

4.0 RESULTS AND DISCUSSION

The location of each soil-gas probe for the study area is shown on Figure 1. The probes were placed to detect potential contamination from different sources. Probes 166N-SG-1, 166N-SG-2, 166N-SG-3, and 166N-SG-11 were installed near pipe headers at the unloading stations. Probes 166N-SG-4, 166N-SG-4A, 166N-SG-6, 166N-SG-7, 166N-SG-8, 166N-SG-9, and 166N-SG-10 were installed near the storage tanks inside the bermed containment areas. Probe 166N-SG-5 was installed over the location of an underground transfer pipe that leaked 80,000 galof diesel fuel to soil in 1966.

The analytical results for the study are contained on two tables. Table 2 contains the field screening results for the 100-N fuel storage area. Table 3 contains the gas chromatograph results for the study area.

None of the VOC typically associated with fuel products (benzene, toluene, ethylbenzene, or xylene isomers) were detected in any of the soil-gas samples. No unidentified hydrocarbons were observed on the chromatograms from either the PID or FID (this was not an unexpected result). The documented fuel product spills in this area occurred several years before the study was initiated and have probably been in the soil matrix long enough for the volatile constituents to degrade or evaporate. However, the heavier, nonvolatile, and more persistent constituents may still be in the soil.

The presence of heavy, nonvolatile components of petroleum products appears to be confirmed by the field screening data. These data indicate several areas where TPH levels exceed 100 ppm. These areas correspond to the west end of the 1900-N Fuel Oil Trench, inside the 1715-N tank berm, and at the diesel oil unloading station. The elevated TPH levels may indicate areas where the soil is potentially contaminated with petroleum hydrocarbons above the Washington State cleanup levels.

The combustible gas and oxygen levels also appear to correlate with these areas of potentially contaminated soil. Regions where the combustible gas levels are relatively high and the oxygen levels are relatively low probably represent areas of biodegradation of petroleum products to methane gas and other decomposition products (Ecology 1987).

The VOC are somewhat difficult to interpret. The higher total vapor readings appear to correspond to the regions of hydrocarbon contamination, but it is not certain what compounds the instruments respond to. The total VOC measurements are sometimes affected by moisture in the soil-gas.

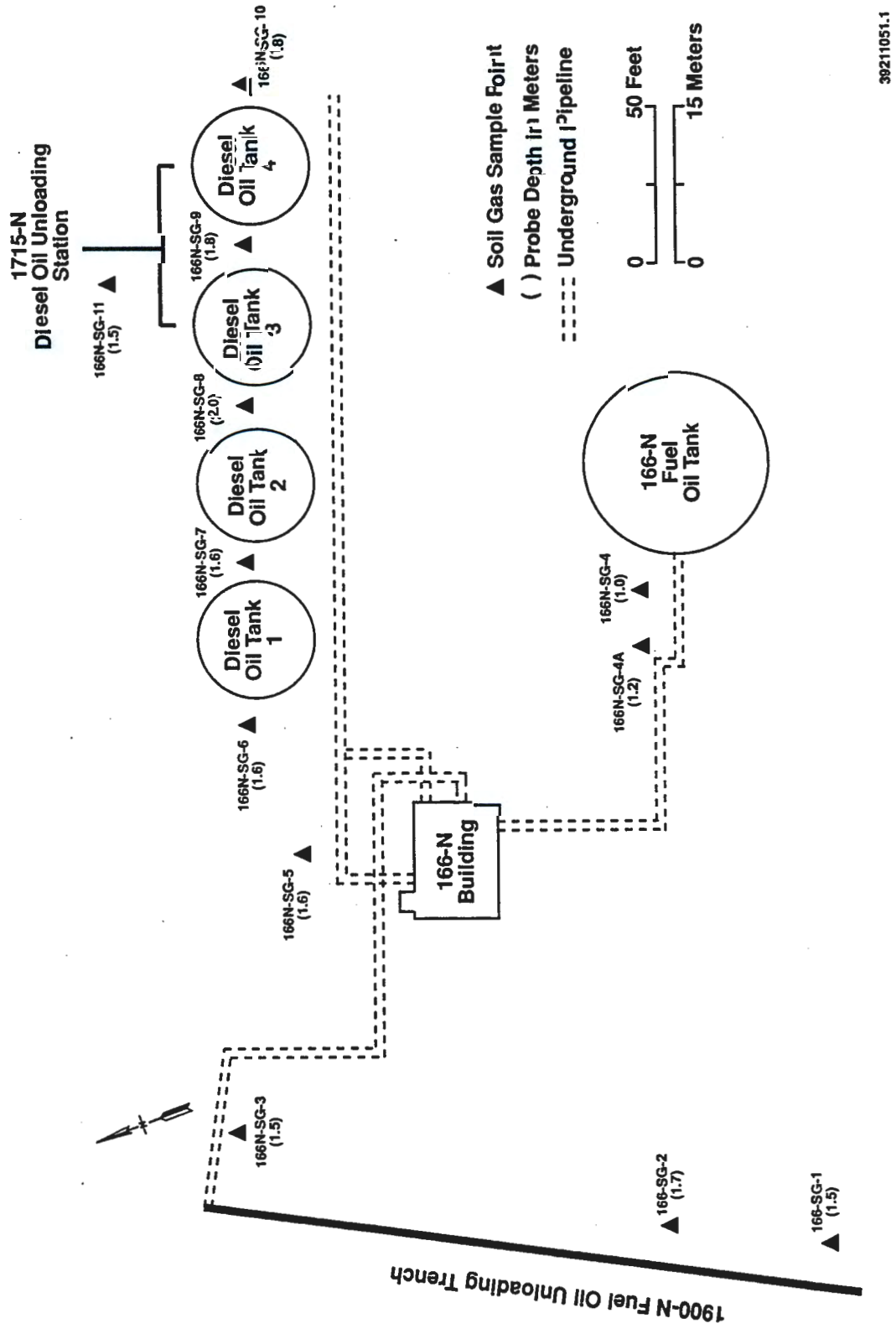

Figure 1. Location and Depth of Soil-Gas Probes at the 100-N Fuel Storage Facilities

Table 2. Field Screening Results at the 100-N Fuel Storage Facilities.

Probe Number	Depth (m)	EnSys	GasTech 1314		OVM 580B
		TPH[a] (ppm)	CG[b] (ppm)	O_2 (%)	VOC[c] (ppm)
166N-SG-1	1.5	>1,000	50	17.5	8.4
166N-SG-2	1.7	<100	30	18.5	1.4
166N-SG-3	1.5	<100	25	18.8	0.2
166N-SG-4	1.0	No sample	0	21.0	0
166N-SG-4A	1.2	No sample	<5	20.5	3.8
166N-SG-5	1.6	Not tested	45	18.0	0.2
166N-SG-6	1.6	No sample	45	19.0	0.3
166N-SG-7	1.6	100 - 1,000	50	18.0	0.3
166N-SG-8	2.0	No sample	55	16.5	0.6
166N-SG-9	1.8	100 - 1,000	55	15.8	1.7
166N-SG-10	1.8	<100	50	17.5	0.1
166N-SG-11	1.5	100 - 1,000	40	18.5	0.4

[a]Total petroleum hydrocarbons.
[b]Combustible gas.
[c]Volatile organic compounds.

The soil-gas results indicated trace concentrations of the chlorinated solvent perchloroethylene (PCE) in two samples obtained near the 1900-N unloading trench, 166N-SG-1 and 166N-SG-3. These results were confirmed with three independent gas chromatograph analyses and field testing using colorimetric tubes. The PCE contamination appears to correspond to areas where Number 6 Fuel Oil was unloaded or transferred.

Operating procedures show that fuel additives were dispensed into the fuel oil when each batch was unloaded at the 1900-N unloading trench. The fuel additive was typically dispensed from 55-gal drums stored on the 1900-N unloading trench and poured into a funnel on the piping system as the fuel was unloaded. Operators and supervisors confirmed that this fuel oil additive was occasionally spilled at the unloading areas. In addition, the additive was periodically used as a solvent to remove oil residue from the top of the 1900-N unloading trench. The additive was spread on the spilled oil and washed to the surrounding soil using a steam cleaner.

Material Safety Data Sheets (MSDS) obtained from the Hanford database for the fuel additives did not list PCE as a constituent. However, conversations with the manufacturer revealed that one of the products used extensively as a fuel oil additive at 100-N Area was Nalco 158 (a trademark of the Nalco Chemical Company). This product, which was manufactured until the spring of 1978, contained as much as 15% PCE by weight.

Table 3. Soil-Gas Results for the 100-N Fuel Storage Facilities.

Soil Gas Measurements (ppm-v)

Probe Number	Sample Date	Analysis Date	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	t-1,2-DCE	1,1,1-TCA	TCE	PCE
166N-SG-1	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	0.64
166N-SG-2	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-3	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	0.28
166N-SG-4	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-4A	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-5	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-6	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-7	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-8	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-9	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-10	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-11	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25

Quality Control Samples (ppm-v)

Type of QC Sample	Sample Date	Analysis Date	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	t-1,2-DCE	1,1,1-TCA	TCE	PCE
Ambient Air	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
Ambient Air	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
Equipment Blank	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-2 Duplicate	09/02/92	09/02/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25
166N-SG-9 Duplicate	09/03/92	09/03/92	<0.05	<0.04	<0.10	<0.30	<1.00	<1.00	<0.20	<0.25

Chlorinated materials such as PCE are not readily biodegraded by soil bacteria and are therefore relatively persistent in the soil matrix. Spills of Nalco 158 near the fuel oil unloading trench probably account for the trace levels of PCE detected in the soil-gas. Because these were probably small, periodic spills, this contamination is likely limited to the soil in the vicinity of the fuel oil unloading trench. It is very unlikely these materials have been transported to the underlying groundwater. The depth to groundwater in this area is about 50 to 60 ft.

Finally, two lessons learned from this study should be highlighted. Important operating information was overlooked in the work plan for this site. Information from personnel who knew the operating processes and materials used was invaluable in determining the use of fuel additives at the site, which was a significant source of potential contamination. Fuel additives were not listed in the work plan as a source of potential contaminants. But in this case even process knowledge was not enough. Detailed product research was needed to determine the historical source of the detected PCE contamination. Operable unit coordinators need to make sure that process and product knowledge is incorporated as much as possible in future operable unit studies to guide the work and interpret the results.

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