APPENDIX E

Air Quality Monitoring & Health/Safety Environmental Monitoring Records

Analytical data is provided on accompanying DVD

Air Monitoring Program

1. INTRODUCTION

As part of the site-specific health and safety program implemented for the DuPont Chambers Works site, personal and perimeter air sampling was conducted for chemical (tetraethyl lead [TEL] and volatile organic compound [VOC] related compounds), dust (total particulates), and radiological contaminants. While airborne contamination by uranium is not an exposure pathway, site workers and the public could potentially have been exposed (from a health-and-safety aspect) to either uranium-bearing dust or DuPont wastes caused by disturbance of subsurface soils during subsurface investigations. Therefore, air quality was assessed primarily as a means to monitor the health and safety of site workers and DuPont employees during intrusive sampling activities.

It should be noted that, due to strict site access control, the public was never exposed to airborne contaminants and no contaminants above action levels were detected beyond the exclusion zones.

Air monitoring results were also used to evaluate appropriate personal protective equipment requirements. The implementation and results of the personal and perimeter air sampling performed in each OU is described in the subsections below.

2. OU 1 SOILS AIR INVESTIGATION

As part of the site-specific health and safety program, personal and perimeter air sampling was conducted for chemical (tetraethyl lead [TEL] and volatile organic compound [VOC] related compounds), dust (total particulates), and radiological contaminants. The results of the air sampling conducted during the non-intrusive geophysical and gamma walkover surveys were used to establish the boundaries of the exclusion zone and the need for additional engineering controls during intrusive investigations.

Two types of air sampling were conducted. The first was to assess the air quality around the personnel conducting the intrusive work as well as personnel in the contaminant reduction zone assisting in the operation. The second type was perimeter air sampling, which addressed air quality upgradient and downgradient of the intrusive work area or the exclusion zone boundary. The perimeter air sampling locations changed daily based on the location of the intrusive work as well as the prevailing direction of wind during the intrusive activities. Perimeter sampling was conducted at a minimum of four locations for both TEL and radiological activity air sampling to a maximum of six locations at the boundary of the exclusion zone.

The analytical methods used for the chemical air sampling were as follows: TEL (National Institute for Occupational Safety [NIOSH] Method 2533) and low-flow VOC sampling (Occupational Safety and Health Administration [OSHA] Method 7). The low-flow VOC sampling was only conducted on personnel within the exclusion zone at the intrusive point of investigation. The radiological samples were analyzed on-site for gross alpha and beta using a Ludlum 2929. The total particulate sampler provided a real-time time weighted average (TWA) for particulate dust in the air. Samples were collected during intrusive work activities using personnel sampling pumps drawing air at a rate of approximately 3.5 liters per minute (L/min) for the radiological air sampling pumps, 0.7 L/min for the TEL air sampling pumps, and 0.180 L/min for the OSHA 7 compounds. The pumps were located 3 to 4 ft above the ground surface or in the breathing zone of the person wearing the personal air sampler. The TEL and volatile organic samples were analyzed at an off-site laboratory with a 24-hour turnaround for the TEL samples. Analytical air sampling results are provided electronically on a CD provided in the back of this Appendix.

2.1 Air Sampling During Non-intrusive Activities

Initial air sampling was conducted in AOC 1 during the non-intrusive geophysical and gamma walkover surveys. This sampling was conducted during the week of 18 March 2002. Sampling consisted of one area sampler (perimeter) placed along the boundary of the enclosed portion of the Central Drainage Ditch (CDD) within the Former Building 845 Area and one personal air monitor being placed on the field geophysicist. The samples were collected with sampling pumps and analyzed for TEL (NIOSH Method 2533). The results of this sampling indicated that the sample collected adjacent to the CDD (0.083 milligrams per cubic meter [mg/m^3] exceeded the OSHA permissible exposure limit (PEL) (0.075 mg/m3) for TEL and the Site Safety and Health Plan (SSHP) (WESTON 2002) action level (0.0375 mg/m3) for TEL. The personal air sample (0.040 mg/m3) exceeded only the SSHP action level for TEL. Based on the results of this air sampling, several actions were recommended and implemented, including area sampling around the site trailers (located within Area of Concern [AOC] 2 at the time) to ensure that the TEL levels were less than the action level. The Technical Memorandum (dated 22 April 2002) submitted to USACE documenting this sampling is provided in the back of this Appendix.

Sampling was conducted over a 2-day period (6 and 7 May 2002) to further investigate the above-mentioned TEL detection and to acquire additional data on VOC concentrations in this area. The sampling approach was documented in a Technical Memorandum (dated 3 May 2002) submitted to United States Army Corp of Engineers (USACE) and provided in the back of this Appendix. This sampling consisted of 12 sampling points placed along both sides of the CDD; outside the USACE office trailer; inside the USACE office trailer; 100, 300, and 500 ft west of the CDD; and on the far west side of the F Parking Corral. These samples were collected using SKC sampling pumps with solid sorbent XAD-2 resin tubes and analyzed for TEL. Also, three summa canisters were collected each day (two by the CDD and one outside the trailer). The summa canisters were configured with an 8-hour critical flow orifice to allow the sample to be collected over an 8-hour period and were analyzed by U.S. Environmental Protection Agency (EPA) Method Toxic Organic (TO)-14. Additionally, three VOC air samples were collected both days using low-flow pump sampling methods and were analyzed by OSHA Method 7.

The results of this sampling indicated that the ambient levels of TEL were below the laboratory detection limits. The sample collected inside the USACE office trailer on the morning of 6 May 2002 indicted a concentration of 0.091mg/m^3 for TEL, which is above the OSHA PEL (0.075 mg/m^3) and SSHP action level. The source of this TEL was never identified, but was believed to be from the close proximity to the CDD and the air handling system from the trailer pulling this air from near the CDD. Details of this sampling effort are presented in the Technical Memorandum (dated 14 May 2002), which is provided in the back of this Appendix.

Results of the low-flow VOC air samples indicated concentrations below the method detection limits. The results of the Summa Canister sampling indicated no contaminants above the OSHA PEL or American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) workplace exposure limits. The results of this sampling are summarized in Technical Memorandum (dated 28 May 2002), which is provided in the back of this Appendix.

Several options were proposed to USACE in a Technical Memorandum (dated 14 May 2002) based on the TEL sample results. The Memorandum is located in the back of this Appendix. The options related to the relocation of the office trailers or engineering controls and sampling that would be needed to document a safe environment for those working inside the trailers. Based on these

options, it was determined that the office trailers would be relocated to the new office trailer complex in the E Parking Corral Area. Prior to this determination, sampling was conducted within the E Parking Corral Area. This sampling is documented in a Technical Memorandum (dated 29 May 2002) provided in the back of this Appendix. The samples collected in the E Parking Corral were analyzed for TEL and VOCs. The results of the analyses of these samples indicated the TEL levels were not detected at levels below the SSHP action levels. The VOC concentrations from the low-flow pump samples were non-detect at levels below the SSHP action levels. The Summa Canister sample results had some detections, but all concentrations were below workplace air exposure limits.

2.2 Air Sampling During Intrusive Activities

Intrusive air sampling was conducted as part of the site-specific health and safety program. Both personal and perimeter air sampling were conducted to evaluate air quality compared to the action levels. Because of the exceedance of the SSHP action level for TEL in air samples collected during the non-intrusive activities as discussed above, Level B respiratory personal protective equipment (PPE) was used within the exclusion zone during intrusive activities. In addition, in order to control potential off-site migration and reduce levels in the breathing zone of TEL during intrusive sampling, an air filtering system composed of a high-efficiency particulate air (HEPA) filter and vapor-phase carbon canister was utilized at the borehole during the initial intrusive program. During the later phases of the investigation, after substantial air data had been acquired, the level of respiratory PPE was downgraded to Level C for certain personnel performing work within the exclusion zone.

As discussed below, there were no exceedances of the TEL action limit during the intrusive sampling activities. Downgrade of the level of respiratory PPE from Level B to C for all personnel was discussed with USACE during the intrusive program based on the air sampling results. It was concluded that Level B respiratory PPE would continue to be used for most workers in the exclusion zone because the core cooling suits that moderated body temperature under the protective suits operated on the supplied air system. Because of high heat indexes during the intrusive work, continued operation of the core cooling suits was recommended for worker safety and productivity. Air sampling was conducted for chemical (TEL and VOC analysis), dust (total particulates), and radiological contaminants. Additional sampling and analysis for VOCs were performed over that

initially planned based on observed high readings on the organic vapor monitor and the presence of non-aqueous phase liquid (NAPL) in several boreholes. The primary concern was the level of benzene, which has a low action level. The dust monitors were used to determine if engineering controls would be needed to suppress particulate dust. The following subsections describe the results of the air sampling programs for AOCs 1 and 2.

2.2.1 Former Building 845 Area – Air Sampling

Air sampling was conducted over a 29-day period in AOC 1 during the intrusive soil and groundwater investigation, which began the week of 10 June 2002. The investigation in this area continued until mid-July. Intrusive work resumed in August for the Uranium Oxide Area and elevator shaft investigations. The number of samples collected depended on the location and predominant wind direction. The minimum number of samples collected on a daily basis was in accordance with the Final SSHP (WESTON, 2002) and Field Sampling Plan (FSP) (WESTON/Cabrera Services, Inc. 2002). On average, four TEL sampling pumps were placed on the perimeter with the remaining two TEL sample pumps being placed at the contaminant reduction zone and a personal sample in the exclusion zone.

Similarly, four radiological air sampling pumps were placed on the perimeter, with one radiological air sampling pump serving as a personal monitor. Generally, four perimeter dust monitors were used per day during intrusive investigations. When VOC sampling pumps were used, they were placed on personnel working within the exclusion zone at the intrusive investigation (worst-case scenario). During the time periods described, no TEL or radiological air samples exceeded the analytical detection limits. The detection limits for the TEL analysis were below the SSHP action levels of 0.0375 mg/m^3.

Results of VOC analysis of the personal air sample collected on 23 August 2002 were above the analytical detection limits for toluene (0.006 parts per million [ppm]) and xylene (0.02 ppm). These results are below the action limits and regulatory limits specified in the Final SSHP (WESTON, 2002) for toluene (action level 50 ppm and regulatory limit 100 ppm) and xylene (action level 50 ppm and regulatory limit 100 ppm). These detections may be a result of exhaust from the excavator and/or other ephemeral sources at the site during the Uranium Oxide Area investigation.

2.2.2 5.7.2.2 F Parking Corral – Air Sampling

Air sampling was conducted over a 25-day period in the F Parking Corral Area during the intrusive investigation, which began the week of 15 July 2002. The investigation in this area continued until the end of August, at which time former Building 845 was further investigated. Air sampling was conducted as described for the Former Building 845 Area. During the time periods described, no TEL or radiological air samples exceeded the analytical detection limits. On two days of sampling, the concentration of three VOCs exceeded the analytical detection limits for OSHA Method 7. These detections above the method detection limit occurred on 26 July and 19 August 2002 as discussed below.

The analysis for VOCs of the personal air sample collected on 26 July 2002 indicated that the concentration in ambient air was above the analytical detection limits for chlorobenzene (0.1 ppm), o-dichlorobenzene (0.08 ppm), and p-dichlorobenzene (0.1 ppm). These results were below the action limits and regulatory limits specified in the Final SSHP (WESTON, 2002) for chlorobenzene (action level 5 ppm and regulatory limit 10 ppm). No action limit was identified within the Final SSHP (WESTON, 2002) for o- and p-dichlorobenzene. These detections may be a result of volatiles escaping from the boreholes investigated that day, which included 2BH004, 2BH009, and 2BH010. The personal analysis for VOCs of the personal air sample collected on 19 August 2002 indicated the concentration in ambient air was above the analytical detection limits for xylene (0.01 ppm). These results were below the action limits and regulatory limits specified in the Final SSHP (WESTON, 2002) for xylene (action level 50 ppm and regulatory limit 100 ppm). This detection may be a result of exhaust from the drill rig and/or from the boreholes investigated that day, which included 2BH027 and 2BH019.

3. OU 2 SOILS AIR INVESTIGATION

Air quality was assessed primarily as a means to monitor the health and safety of site workers and DuPont employees during the intrusive sampling activities. Level C PPE was used by all of the field workers entering the exclusion zone during all field activities. Level C PPE includes the use of gas-impermeable hooded coveralls and full-face air-purifying respirators. This PPE level was selected based on the probability that certain DuPont wastes would be encountered in the subsurface; notably TEL, which was detected during the OU 1 investigation. The reader should refer to the SSHP for OU 2 (CABRERA, 2003) for specific details on health monitoring.

A discussion of the sampling field methods and monitoring results for each AOC are presented in the following subsections. Health and safety environmental monitoring records are provided in Appendix E.

3.1 Methods for Breathing Zone Monitoring

The breathing-zone (BZ) of the intrusive-investigation workers was monitored for radioactive dust, TEL, benzene, total (VOCs), plus phosgene in the AOC 5 area. Workers in the exclusion zone wore personal sampling pumps for benzene, TEL, and radioactive dust. Benzene and TEL samples were analyzed by an off-site laboratory on a rapid-turnaround basis. Dust samples were analyzed for alpha and beta contamination in the on-site laboratory using a Ludlum 2929 meter with 43-10-1 detector. Total VOCs were monitored in the breathing zone using a flame-ionization detector (FID). Phosgene gas detection badges were worn in the Building J-26 Area.

3.2 Methods for Perimeter Monitoring

The perimeter of the exclusion zone was monitored for radioactive dust and tetraethyl lead as a means of documenting the concentrations of air contaminants and that the public was not exposed to those contaminants as a result of the investigation. Air samples were taken daily during intrusive work activities from four locations at the perimeter of the exclusion zone (one up wind and three down wind) to ensure that airborne radioactive materials and TEL were not being emitted.

3.3 AOC 3 Air-Sampling Results

Breathing Zone Monitoring

Two workers wore breathing zone particulate air samplers each day. The filters from these monitors were analyzed on a daily basis for gross alpha and gross beta contamination. None of the 26 samples exceeded the regulatory standard, which was set at a derived air concentration of 2E-11 microcuries per cubic centimeter (µCi/cc) U-238.

Perimeter Monitoring

Particulate air samplers were used at three down-wind locations around each exclusion zone established during the boring and sampling work. The filters from these monitors were measured on a daily basis for gross alpha contamination. None of the 64 samples exceeded the regulatory standard, which was set at a derived air concentration of 2E-11 µCi/cc U-238.

3.4 AOC 5 Air-Sampling Results

Breathing Zone Monitoring

Two workers per day wore breathing zone particulate air samplers. The filters from these monitors were analyzed on a daily basis for gross alpha contamination. None of the 12 samples exceeded the regulatory standard, which was set at a derived air concentration of 2E-11 µCi/cc U-238.

Perimeter Monitoring

Particulate air samplers were used at three down-wind locations around each exclusion zone established during the boring and sampling work. The filters from these monitors were measured on a daily basis for gross alpha contamination. None of the 18 samples exceeded the regulatory standard, which was set at a derived air concentration of 2E-11 µCi/cc U-238.

4. OU 3 SOILS AIR INVESTIGATION

The primary contaminant of interest for this phase of the remedial investigation was refined natural uranium. Evaluations for other contaminants were conducted to determine potential needs for PPE during this and future investigations. Evaluations of breathing zone and perimeter air quality were conducted at each boring location. The methodologies are discussed in the subsections below. The reader should refer to the SSHP for OU 3 (CABRERA, 2005) for specific details on health monitoring.

4.1 Breathing Zone/Perimeter Monitoring

Breathing zone and perimeter vapor monitors were employed to collect organic vapor samples during all rotasonic drilling operations. The air pump and sorbent tubes were used to collect TEL samples. However, during this drilling activity , a passive organic vapor badge (analyzed for benzene) with activated charcoal sorbent was substituted for the battery-operated air pump and sorbent tube assembly used to collect multiple organic contaminants during the earlier subsurface field work.

Passive organic vapor badges are used to determine occupational exposure to solvents and other organic chemicals, and are suitable for a wide range of VOCs, having been validated for over 100 different organic vapors. Analysis can include targeting individual contaminants (in this case, benzene), selected groups of compounds, or screening for unknown compounds. The badges are appropriate for monitoring short term exposures (e.g., 15 minutes), but are also effective in

monitoring an entire work shift. Sample tubes and badges were distributed at the beginning of each day, collected at the end of operations for each day, and submitted to an off-site laboratory for analysis. Samples were analyzed for benzene and TEL.

Breathing Zone Monitoring
A portable air sampler and volatiles badge were worn by the driller, as he was the most likely worker to be exposed to volatile contaminants in the BZ during drilling activities. After the vehicle had mobilized to the first boring location of the day, the BZ monitor pump was turned on and the passive badge was deployed. The "time-on" was recorded, and the pump ran continuously until operations for that day were completed. The "time-off" was recorded, and the total monitoring time was computed.

Perimeter Monitoring
An air pump (for TEL) and passive badge (benzene) were deployed adjacent to the downwind boundary of the exclusion zone established around the boring location. The monitors were activated prior to the drill rig's initial push into the ground surface. After the hole had been grouted, the pump and badge were relocated to the next exploration. "Time-on" and "time-off" were recorded, and the total monitoring time was computed.

4.2 Soil Vapor Analyses

Soil gas head space was sampled in the cone penetrometer test (CPT) holes as a means of anticipating requirements for PPE selection for future soil borings or excavation work. After each CPT was advanced, soil vapors were recovered from the CPT holes using a tubing pump. The CPT holes were sealed at the ground surface after sample tubing was emplaced. Soil vapors were analyzed for VOCs and TEL.

4.2.1 Soil Vapor Results for AOC 4

Of the 63 total boring locations within AOC 4, 31 locations had detectable VOCs and/or TEL in the soil vapors. Eight of these locations exceeded the PEL established by OSHA for TEL. Two of these eight locations also exceeded the established PEL for benzene. Three additional locations exceeded the lower recommended exposure level (REL) for benzene established by NIOSH. Seven locations where the PEL and/or REL exceedances were observed were concentrated in two distinct areas northwest and southwest of Lagoon A, as depicted in Figure G-1. A tabulated report

of the AOC 4 soil vapor data is presented in the back of this Appendix.

4.2.2 Soil Vapor Results for AOC 6

Of the 65 total boring locations within AOC 6, 59 locations had detectable VOCs and/or TEL in the soil vapors. Twenty-eight of these locations exceeded the PEL for TEL, and two separate locations exceeded the established PEL for benzene. An additional 14 locations exceeded the lower REL limit for benzene established by NIOSH. A tabulated report of the AOC 6 soil vapor data is presented in the back of this Appendix. Locations that showed exceedances did not appear to be concentrated in distinct areas as they did in AOC 4. Therefore, no figure is included for the AOC 6 exceedances.

5. GROUNDWATER AIR INVESTIGATION

5.1 Soil Vapors/Air Quality

Air quality was measured within the exclusion zone during field activities. The reader should refer to the SSHP for OUs 1 and 2 groundwater (CABRERA, 2004) for specific details on health and safety considerations. Air was sampled for benzene and TEL concentrations in the workers' breathing zone and at the down-wind perimeter of the exclusion zone. Samples were collected in charcoal- or resin-filled tubes and sampled using NIOSH Method 2549. All measurements of air samples had non-detectable VOC concentrations.

A soil-vapor sample was collected on October 5, 2004 from inside the casing of well 2-MW-05. The sample was collected as a health-and-safety precaution to confirm which organic vapors could potentially enter the breathing zone. The sample was acquired by placing the inlet of an air-sampling pump into the well casing and collecting a 25 L vapor volume. The major contaminants of the soil gas were Chlorobenzene, Naphthalene, and P-Dichlorobenzene. Analysis results are summarized below:

Volatile Organic Compounds Detected in 2-MW-05 Headspace	
Compound	**Concentration [mg/m^3]**
Tetraethyl Lead (as Pb)	0.092
Benzene	1.6
Cellosolve Acetate	1.5
Chlorobenzene	48
Cumene	9.7
Cyclohexanone	0.31
Ethyl Benzene	32
m-Dichlorobenzene	20
Naphthalene	180
o-Dichlorobenzene	7
Octane	0.079
p-Dichlorobenzene	10
Styrene	0.51
Tetrachloroethylene	0.55
Toluene	0.79
Trichloroethylene	0.43
Vinyl toluene	120
Xylene	49

6. REFERENCES

WESTON, 2002. Final Site Safety and Health Plan (Volume IV, A and B). Remedial Investigation for OU No.1 AOC 1, Former Building 845 Area and AOC 2, F Parking Corral. DuPont Chambers Works Site, Deepwater, NJ. May.

WESTON/Cabrera Services Inc. 2002. Final Field Sampling Plan (Volume II). Remedial Investigation for OU No.1 AOC 1, Former Building 845 Area and AOC 2, F Parking Corral. DuPont Chambers Works Site, Deepwater, NJ. May.

Cabrera Services, Inc. (CABRERA). 2003. Work Management Plans, Volume IV, Site Safety and Health Plan for Remedial Investigation at OU 2: AOC 3 and AOC 5, DuPont Chambers Works, Deepwater, New Jersey, 76 pgs.

Cabrera Services, Inc. (CABRERA). 2004. Work Management Plan, Part I, Field Sampling Plan, Part II Quality Assurance Project Plan, Part III, Site Safety and Health Plan Groundwater Investigations at OU 1 and OU 2, DuPont Chambers Works FUSRAP Site.

Cabrera Services, Inc. (CABRERA). 2005. Work Management Plans for the Phase II Soil Investigation at Operable Unit 3, DuPont Chambers Works FUSRAP Site, Deepwater, New Jersey (June)