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ECBC-SP-021

DEMONSTRATION/VALIDATION OF THE TC-60 CONTROLLED DETONATION CHAMBER, PORTON DOWN, UK FINAL DEMONSTRATION TEST REPORT

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14. ABSTRACT
The Demonstration/Validation testing conducted at Porton Down, UK, between July 2004 and July 2006 proved that CH2M HILL's Controlled Detonation Chamber (CDC) technology could safely and effectively destroy munitions containing CW agents without generating large quantities of process wastes. The TC-60 CDC system successfully met all the test objectives and goals of the August 2004 Final Test Plan. Residual chemical agents were completely destroyed before the carbon filters used in the CDC system and were never detected outside of the CDC engineering controls. The testing demonstrated enhanced TC-60 CDC system throughput capacity. A total of 74 munitions were destroyed during a 2 week test period. The maximum throughput was achieved during the second week when 42 munitions were destroyed in <14.5 hr. Munitions were packaged two per detonation event, and the average cycle time stabilized at 35 min/detonation. Based on the results of this testing, the CH2M HILL TC-60 CDC is considered ready for operational testing and deployment in support of CW materiel demilitarization activities.

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Executive Summary

System productivity was enhanced by recommendations contained in the Demonstration/Validation of the TC-25 Donovan Blast Chamber, Porton Down, UK Final Demonstration Test Report, April-September 2003, issued by the U.S. Army Edgewood Chemical Biological Center. Process improvements included a new concept for applying donor explosive to the munitions, reconfiguring the firing circuit, and an improved human-machine interface. These improvements allowed operators to prepare munitions more easily and load them without entering the detonation chamber, guarded against the occurrence of a misfire, and allowed some routine operations to become automated. Other improvements to the system reduced operator personal protective equipment requirements and reduced solid wastes.

Air emissions from the system were characterized during the period of highest productivity. The resulting emissions would be considered a minor source, in any state, for determining Title V permitting applicability.

Solid waste samples of pea gravel and waste lime were collected following the CDC system decontamination and were characterized in accordance with current U.S. regulatory procedures and methods. Results indicated that pea gravel and waste lime would be considered a RCRA hazardous waste due to the concentration of lead, per 40 CFR 261.24. The presence of lead is attributed to the composition of the target munition body, not the TC-60 CDC process.

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PREFACE

The work described in this report was authorized under MIPR No. 6FRDECOM02. The work was started in July 2004 and completed in July 2006.

The use of either trade or manufacturers' names in this report does not constitute an official endorsement of any commercial products. This technical report may not be cited for purposes of advertisement.

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The authors acknowledge all those from U.S. Army Edgewood Chemical Biological Center (ECBC) and Defence Science Technology Laboratory for their efforts in the daily operations of the TC-60 CDC. In addition, the authors would like to thank the engineers and scientists from ECBC, DeMil International, and DSTL for their efforts in collecting, analyzing, and compiling the data. Finally, a special thank you to all U.S. and British officials who contributed to the realization of the project.

The following organizations are acknowledged for their interest in visiting the test site during the TC-60 CDC testing: Department of Health and Human Services, Defense Threat Reduction Agency, Deputy Assistant Secretary of the Army (Elimination of Chemical Weapons), Project Manager Non-Stockpile Chemical Materiel, Department of Defense Explosives Safety Board, and Corp of Engineers Huntsville Division.

The authors would like to thank the U.S. Army Material Systems Analysis Activity and MITRETEK Systems for their independent evaluation of the demonstration/validation test.

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1. INTRODUCTION

In the FY04, FY05, and FY06 defense appropriation bills, Congress mandated that the U.S. Army conduct a demonstration/validation program regarding use of transportable, controlled detonation chamber (CDC) technology in the disposal of recovered CW materiel. Demonstration/validation testing is conducted to demonstrate scale-up and operability of a proposed process or equipment. The demonstration includes testing and measuring the operating parameters that are critical to successful execution of the mission. Developmental testing is conducted to assess compliance with critical technical parameters, identify technological and design risks, and evaluate readiness to proceed to operational testing. Appropriate operational testing is conducted to evaluate operational effectiveness and the suitability of the system under realistic conditions. Demonstration/validation testing is normally conducted separately from developmental testing, but it may be integrated or conducted concurrently when the objectives of both types of testing can be met and when significant cost or time benefits would result.

The demonstration/validation test program was conducted under contract to the U.S. Army Corps of Engineers, Huntsville Center (COE/Huntsville). The program was executed by the U.S. Edgewood Chemical Biological Center (ECBC). Defence Science Technology Laboratory (DSTL) provided the test facilities in Porton Down, U.K., and logistical support for the program. CH2M HILL Demilitarization Inc. provided the controlled detonation chamber (CDC) and support equipment.

COE/Huntsville issued Task Order 11 under Contract DACA87-00-D-0047 for the first phase (referred to as Phase I) of the test program, which was conducted in 2003. The results of the Phase I testing have been reported previously.*

Task Order 12 was issued to continue the demonstration/validation test program. It covers the Phase II test program from 2004 through 2006, which is the subject of this report.

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* Blades, T.A.; DiBerardo, R.; Misko, G.; McFarlene, N. *Demonstration/Validation of the TC-25 Donovan Blast Chamber Porton Down, UK, Final Demonstration Test Report, April–September 2003*; ECBC-TR-362; U.S. Army Edgewood Chemical Biological Center: Aberdeen Proving Ground, MD, 2004; UNCLASSIFIED Report (AD-A425 237).

1.1. Background.

The demonstration/validation testing was conducted at Porton Down, U.K., during two distinct test phases. Phase I testing started in May 2003 and was completed in September 2003. During this testing, operating concepts were demonstrated and validated, and lessons were learned from test sequences as the process performance was validated. As a result of lessons learned in Phase I, process improvements were designed and implemented during the Phase II test program that:

1. Reduced significantly the time required to attach the donor explosives to the target munition

2. Eliminated the necessity for operators to enter the chamber to place the donor explosive and munition package

3. Improved the vapor containment at the face of the chamber

4. Improved the handling of lime and allowed for the recycling of spent lime in the process

5. Improved the automation of the process

The final activities of Phase II focused on throughput testing, which began in February 2006 and were completed in March 2006. Site closure and equipment demobilization commenced in April 2006, and the equipment arrived back in the United States in July 2006. More details on these improvements and operational testing are provided in Sections 2, 4, and 5. Table 1-1 presents the significant milestones of the demonstration/validation test program. A detailed calendar schedule of the demonstration/validation test program is included in Appendix A.

1.2 System Description.

The CDC system described in Section 2 of this report represents the system's configuration at the completion of the demonstration/validation testing in 2006.

1.2.1 Process Equipment.

Based on test results and observations in the 2003 demonstration/validation testing, the TC-25 detonation chamber, expansion tank, and loading vestibule were replaced with new units to provide increased productive capacity. Other process improvements were made as described in Section 2.

Table 1-1. Demonstration/Validation Testing Program Milestones

Date	Significant Milestone
Phase I	
May through September 2003	Phase I Testing in Porton Down
October 2003 through June 2004	Incorporated lessons learned from Phase I into design, operating procedures, and explosive package
Phase II	
July 2004 through November 2004	Remobilized to Porton Down, replaced TC-25 CDC with TC-60 CDC, replaced cross-over pipes, conducted agent testing, decontaminated the system, and demobilized
December 2004 through November 2005	Incorporated additional refinements into explosives package design. Tested reconfigured explosive package in the U.S.
December 2005 through January 2006	Remobilized to Porton Down, removed damaged heat exchanger, installed new heat exchanger and conducted refresher training
February 2006	Pre-op survey
March 2006	Productivity testing
April 2006	Site closure activities began
May 2006	Site closure activities completed, equipment shipped, and demobilized from Porton Down

1.2.2 Donor Explosives.

Several donor explosives were used during the test program.

In Phase I (2003), the donor explosive was a commercially available sheet explosive with pentaerythritol tetra nitrate and nitrocellulose as the primary explosive compounds. This formulation performed well and required approximately 1 hr to cut, form and fit the sheet to match the target munition. This degree of handling represented the single largest time commitment in preparing, loading, and detonating each explosive event.

In an effort to reduce processing time, the sheet explosive was replaced with a Composition C-4 formulation of cyclotrimethylenetrinitramine (RDX) explosive with a shaped charge element. This formulation did not meet the reliability criteria necessary to proceed with operations.

The configuration was then changed to an RDX sheet, precut to fit the test items, and enclosed in a polystyrene case. The change in geometry and fit resulted in a reliable donor explosive for the munition and agent destruction while reducing the preparation time to less than 7 min.

1.2.3 Test Munitions.

The demonstration/validation testing was scaled to provide data on munitions from nominal 3-in. (76 mm) size up to 6.1-in. (155mm) size with various agents. In Phase I, various agents were tested in munitions or steel cylinders up to 105mm size. During Phase II, the final testing focused on throughput using one type of munition, UK 25 pdr recovered shells, with a chemical agent (mustard) fill.

Testing also destroyed simulated 155mm projectiles using a 5-in. Schedule 40 steel pipe of sufficient length to contain 11.7 lb of mustard agent at a liquid loading volume ratio of 90% full. No explosives were added to the steel cylinder. The total explosive load in this set of tests was from the donor explosive. These tests were conducted in November 2004.

The productivity tests were conducted using an inventory of 25 pdr artillery projectiles of various marks and models that had been developed in the 1930s for the howitzer. An inventory of more than 100 of these projectiles was available for test purposes. All projectiles were explosively configured. A donor explosive package that facilitated preparation and handling of these projectiles was developed, and the system was tested to determine how many projectiles could be safely and effectively destroyed in the TC-60 system in a specified time period while simulating actual production operating conditions. These tests occurred in March 2006.

1.3 Testing.

The final test plan was published by ECBC in May 2004.* A copy of the test plan is included in Appendix A.

The objectives of the Phase II demonstration/validation testing program were as follows:

- Demonstrate that the TC-60 CDC can safely and effectively destroy recovered chemical munitions with or without explosive components.

- Demonstrate that the TC-60 CDC can reduce the hazardous properties of the chemical fill without release of hazardous wastes or materials to the soil or water. Data were collected during this test to quantify the reduction.

- Develop the data necessary to demonstrate to the U.S. Army, Department of Defense (DoD) and other federal, state, and local environmental agencies: (1) the safety, integrity, and efficacy of the TC-60 CDC, and (2) the ability of the operator to collect waste samples.

1.3.1 Demonstration/Validation Subtests.

The final test plan divided the test activities and data collection efforts into four subtests-transportation, pre-operations, operations, and closeout. These subtests had different criteria and information collection requirements specific to successful completion of each subtest.

The following questions provided a focus for subtest criteria development, data collection activities, and specific decisions for proceeding with the test (not all were quantifiable):

- Can the TC-60 CDC be transported to a treatment location without damage that would impede its effectiveness?

- Is the TC-60 CDC safe to operate and maintain?

  - Can munitions be placed into the TC-60 CDC without injury to operators or contamination of soil or water?

  - Can the TC-60 CDC dispose of the munition and contain blasts, fragments, and hazardous vapors to acceptable levels?

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* Blades, T.A.; DiBerardo, R.; Misko, G.; McFarlene, N. *Demonstration/Validation of the TC-25 Donovan Blast Chamber Porton Down, UK, Final Demonstration Test Report, April–September 2003*; ECBC-TR-362; U.S. Army Edgewood Chemical Biological Center: Aberdeen Proving Ground, MD, 2004; UNCLASSIFIED Report (AD-A425 237).

- Can the hazardous properties of the chemical fills be reduced in the TC-60 CDC?

- Can the TC-60 CDC destroy chemical agent fills (blister) and industrial chemicals that have been used as war gases (such as CG and smokes) to acceptable levels?

- Can the CDC operators obtain representative samples of wastes without injuring themselves or contaminating soil or water?

- Are available monitoring systems capable of verifying chemical agent vapor at or below acceptable levels, as defined in the Test Monitoring Plan?

  - Can the TC-60 CDC be decontaminated to a 3X level to allow transport from the treatment location?

  - Can it meet all applicable federal, state, and local regulations?

Transportation

The transportation subtest was conducted in several stages to match the test schedules. During the course of the test program, the process equipment was transported:

- By truck
- By rail
- By ship

Delivery was accomplished with minimal damage that did not preclude or degrade conduct of the testing. Section 3 describes the transportation subtest in greater detail.

2004 Pre-operations

From 12 July 2004 through 20 August 2004, the test equipment was modified to incorporate equipment changes resulting from the lessons learned during the testing conducted in 2003.

Chemical/explosive operators were trained on operating the mechanical loader and preassembled explosive system. Operators/supervisors were trained on the function and operation of the automatic control system using the human-machine interface (HMI). Technicians were trained on maintenance, inspection, daily process setup, and weekly process cleanup procedures. All three types of training occurred from 23 August 2004 through 27 August 2004.

From 31 August 2004 through 4 September 2004, a pre-operations survey was conducted by the Risk Reduction Office of the Chemical Biological Services Directorate, ECBC. The system was found to be ready to start operations.

2004 Operations

In 2004, operations began on October 17 with workup tests (described in Section 5) and concluded on 4 November 2004 with the destruction of steel cylinders containing 11.7 lb of mustard agent.

2005 and 2006 Pre-operations

From 5 December through 9 December 2005, the process equipment was prepared for restart. Training for operators, supervisors, and technicians was conducted from 12 December through 14 December 2005.

The pre-operations survey was conducted from 20 February through 24 February 2006. The system was found to be ready to start operations.

2006 Operations

Phase II testing focused on demonstrating CDC throughput and implementing the following recommendations from the Phase I Final Report:

- Further evaluation and subsequent development of the firing system to increase system reliability and improve accessibility.

- Development of additional systems and procedures focused on reducing the degree of human participation in munition preparation, chamber loading, and chamber unloading operations (human factors).

- Further minimization of process wastes, including spent lime and personal protective equipment (PPE), by developing an appropriate combination of engineering controls and operating procedures.

During the operations subtest, these recommendations were validated and demonstrated. Section 5 provides detailed information.

In 2006, operations began on 27 February and concluded on 23 March, with the total consumption of all 101 recovered mustard projectiles (including 27 pre-operations munitions and 74 throughput testing munitions). Final thermal decontamination was accomplished by
31 March.

Closeout

The closeout subtest began immediately after final thermal decontamination. Equipment monitoring and clearance for disassembly began on 10 April 2006. The test site was cleared, and all equipment was packed and was ready for pickup on 4 May 2006, at which point the site was shut down. Section 7 provides additional information.

1.3.2 Environmental Characterization.

Environmental characterization sampling and analysis were added to the test program to generate data on the process emissions and the spent products of the process. These data will be necessary to initiate environmental permitting and regulatory evaluation as the technology is deployed for operations in the U.S.

The following were sampled and analyzed during the environmental characterization task:

- Air stream leaving the vapor containment structure (VCS) and entering the building air filter units prior to atmospheric discharge.
- Air stream leaving the building air filter units discharged to atmosphere.
- Spent lime from the reactive bed filter.
- Spent pea gravel from the detonation chamber (a one-time waste generated at the end of the project).

Various analyses were performed on the process streams as part of environmental characterization. Analyses for residual chemical agent or agent decomposition products were performed as part of the monitoring plan. The environmental characterization task is further described in Section 6 of this report.

2. SYSTEM DESCRIPTION

The TC-60 CDC is a proprietary technology developed by CH2M HILL Demilitarization, Inc. (Denver, CO),which is a wholly owned subsidiary of CH2M HILL, for destroying recovered CW munitions. The system uses controlled, enclosed detonation to destroy recovered chemical materiel for ultimate disposal. In the course of the treatment, the carbon monoxide resulting from detonation of high explosives is oxidized, and the chemical fill materials are either chemically oxidized or chemically reduced to destroy the reactivity and toxicity of the chemical agents.

Detonation is controlled by balancing the energy necessary to open the munitions and then vaporizing and destroying the chemical contents with the temperature and pressure generated from detonating energetic materials. Sufficient oxygen is added to chemically oxidize organic chemical fills. Water from the detonation or the added water is used to reduce the inorganic chemical fill materials. This sequence is a batch process tailored for each chemical agent and does not rely on controlled combustion.

The off-gas treatment system is designed to remove particulate matter and neutralize any acid gases resulting from the reactions of sulfur, phosphorus, or halogen components in the explosives or chemical fill. After the particulate matter and acid gases are

removed, the resulting volatile organic compounds (VOCs) are oxidized in a catalytic oxidizer. A dual-bed carbon filter provides a final treatment to remove any residual chemical agent that is not destroyed in the previous stages. The final treated gas is monitored to confirm the elimination of the chemical species contained in the munitions' toxic fill.

The test facility VCS was a steel building approximately 65.6 ft (20 m) by 65.6 ft (20 m), with a concrete floor, a door of suitable size to accommodate the TC-60 CDC, and clearances on all sides. Exhaust air from the VCS was controlled by two high efficiency particulate air (HEPA)/carbon/carbon/HEPA filtration systems with a ventilation flow capacity of 5,000 standard cubic feet per minute (scfm) each.

Figure 2-1 shows the layout of the equipment at the test facility in 2004 and 2006.

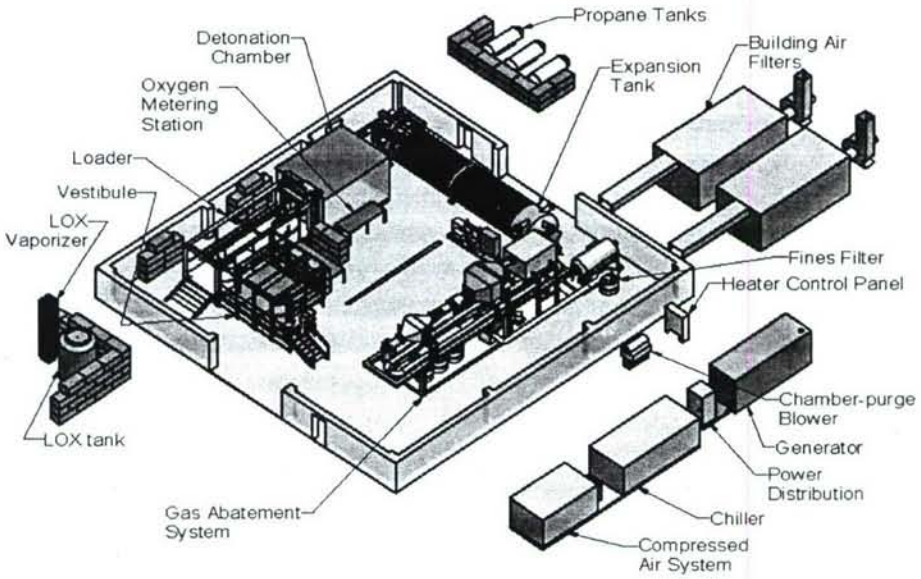


Figure 2-1. Equipment Layout

2.1 Modifications to the System Following Phase I (2003).

The Phase I testing of 2003 provided lessons learned based on operations of the TC-25 CDC, and the final report contained recommendations for changes to and additional testing of specific CDC subsystems. As a result, the TC-25 detonation chamber and other components were replaced with the larger TC-60 detonation chamber and other upgraded components. The following subsections describe these changes. Several engineering modifications incorporated during Phase II are discussed as well.

2.1.1 Detonation Chamber and Expansion Chamber.

The size of the Phase I detonation chamber made it confining when operators had to enter it in Occupational Safety and Health Administration (OSHA) Level B PPE. The interior dimensions of the TC-25 were 6 ft 6 in. x 7 ft 6 in. x 9 ft 4 in. The interior dimensions of the TC-60 are 8 ft x 8 ft x 12 ft. In addition, the TC-60 armor protective plating is held to the wall by bolts. This replaced the TC-25 wedge pin design that was susceptible to broken pins and increased repair.

A purge blower (discussed in Section 2.2.6) replaced the air amplifiers. The purge air blower replacement improved ventilation of the detonation chamber between detonations. Air amplifiers provided approximately 400 scfm of purge air, while the purge blower provided 600 scfm.

Three hanging brackets, bolted to the ceiling, were used to hang water bags and munitions by use of a mechanical jib. For the TC-60, a specially designed steel bracket was used to hold the water bag and munition assembly. The bracket is fabricated with a 3-in. hole in the bracket into which the water bag or munition hanger is placed. The bracket design is integrated with the design and operations of the mechanical jib so that the hanging procedure can be accurately repeated using pre-set movements that eliminate the possibility of variations.

As part of the chamber replacement in 2004, a removable panel was inserted at the inner door opening. The panel covered the lower half of the door area. This had the effect of increasing the average face velocity at the door opening as an additional control to inhibit vapor diffusion from the chamber interior. On three occasions during testing in 2004, mustard vapor was detected at the chamber entrance. This was caused by excessive air turbulence created when opening the inner door. This was resolved in 2006 by placing a flow restrictor on the hydraulic feed line for door opening, reducing the rate of the door opening, and reducing the local turbulence caused by the moving door.

The expansion chamber was changed to the design basis of a pressure vessel. The TC-60 expansion chamber has a maximum allowable working pressure of 125 lb per square inch gauge (psig) at 600 ^{0}F. In addition, the TC-60 expansion chamber has electrical resistance heaters, on the outside shell, to assist thermal decontamination. The TC-25 expansion chamber was not designed as a pressure vessel and had no integrated heating capability. This was not an issue in Phase I testing in 2003, but the change in 2004 resulted in increased capacity and a better design basis in case the expansion chamber was contaminated with liquid-persistent CW agents.

2.1.2 Explosives Handling and Loading.

In Phase I testing in 2003, munitions were manually loaded in each test, requiring a chamber entry by an operator in OSHA Level B PPE. It was obvious this practice would limit daily productivity. In 2004, a mechanical loading jib was provided for operators to load munitions manually from outside the chamber entrance. This made OSHA Level C loading operations possible and substantially improved productivity.

The vestibule ventilation was modified by ducting the discharge air entering the off-gas treatment system downstream of the catalyst and upstream of the closed loop heat exchanger. This provided 2,000 scfm of ventilation in the vestibule, while cooling the chamber operators.

The munitions and donor explosive were assembled outside the vestibule. Once assembled, the munitions and donor explosive were transferred through a sliding door onto a scissor lift, inside the vestibule. This resulted in lower munitions handling by an operator, which was identified as the highest hazard in the Hazardous Operations Assessment. The scissor lift allowed operators to raise the munition to the height of the mechanical jib and transfer the munition to the jib using polypropylene straps to secure it.

2.1.3 Supplemental Oxygen Delivery.

During Phase I testing in 2003, the concept of using supplemental oxygen to improve the effectiveness of the detonation was demonstrated. Supplemental oxygen was delivered to the detonation chamber in compressed gas cylinders. The cylinders were detonated with flexible linear shape charges, initiated with an exploding bridgewire (EBW) in series on the munition package. This was an effective technique for introducing oxygen, but it generated a lot of scrap metal waste that was awkward to handle and dispose of. An alternative automated oxygen delivery system was provided in Phase II, as described in Section 2.2.5.

2.1.4 Lime Removal Technique.

During Phase I testing in 2003, lime that accumulated in the particulate filter was emptied occasionally by opening a pneumatic slide gate that isolated waste solids from the ambient air. A steel drum with double plastic lining was used to receive the solid waste. During Phase II testing, a screw conveyor was added below the existing pneumatic slide gate to transfer the hot solids to a steel drum double-lined with plastic. The conveyor also had the capability to reverse direction and feed the waste lime into the receiving hopper of the lime delivery system. This afforded semi-automated recycling of lime to reduce the total quantity of lime solid waste that was generated.

2.1.5 Firing System.

During Phase I operations in 2003, the chamber operators wearing OSHA Level B PPE manually loaded munitions and connected detonators. The final connection of the detonator was cumbersome for an operator wearing thick butyl rubber gloves. The detonator wire connection was made to a Romex cable. Often the Romex cable would be consumed in the detonation fireball and had to be replaced. This was an awkward, time-consuming exercise for the chamber operators.

During Phase II, a new chamber pass-through interface was developed that allowed for pre-assembly of the detonator wire to a one-time use plug. The plug fit onto a rigid connector mounted on the inside wall of the detonation chamber (the inside portion of the pass-

through interface), enabling the operator to reach into the chamber with a gloved arm and make the connection. Refer to Section 2.2.3 for a description of the final firing system configuration.

During the testing of the fire system improvements during Phase II (2004), operators observed the fireset was not reliably indicating electrical continuity. Troubleshooting procedures did not identify any circuit issues with the high voltage wires or pass-through interface. In 2005, the problem was identified as a lack of precision with the connector plug and the connector rods of the pass-through interface. This was corrected by inserting minilam connectors into the plug body, which made positive latching contact with the male rods on the pass-through interface. This change improved the reliability of the continuity tester. No discrepancies with the continuity check of the completed detonator circuit occurred during testing in 2006.

2.1.6 Heat Exchanger.

During Phase I in 2003, the thermal decontamination event created extra moisture in the air processed by the off-gas treatment system because there were two hot gas generators burning propane. This moisture condensed in the heat exchanger and accumulated in the carbon drums. This was resolved in 2004 by automating the chilled water flow rate to the heat exchanger. A control loop in the programmable logic controller (PLC) was programmed to maintain the airflow temperature at the inlet of the carbon beds at approximately 100 °F. This temperature was sufficient to prevent moisture condensation at the discharge side of the heat exchanger.

2.1.7 Addition of a Final Filter.

According to the carbon system supplier, a carbon replacement will result in discharge of 1 to 2% of the total carbon weight. This carbon is discharged as fine particulate matter that is caused by physical attrition during transport and loading activities. In 2004, a final filter was incorporated at the discharge of the process fan to capture the carbon particles and prevent their deposition inside the VCS.

2.1.8 Control System.

During Phase I (2003), it was recognized that it would be difficult for operators to replace components of the PLC and Ethernet modules because they were located inside the VCS and operators were required to wear PPE, including rubber gloves. The decision was made to transfer the PLC components to outside the VCS.

In Phase I, the operator had to enter set points in the HMI for procedures related to startup, shutdown, and detonation. From the operating knowledge gained in Phase I, the HMI communications with the PLC were modified in 2004 to be more automated, resulting in less operator involvement with routine operations during Phase II. The operator has the ability to start the system, perform detonation routines, and shut down the system remotely with the touch of an active command (icon driven subroutine).

To start the system, the operator selects and initiates a startup sequence icon. The PLC automates the valves' positions and automatically starts the process fan and initiates the hot gas generator. The PLC controls the propane gas feed rate to the hot gas generator to increase the temperature to programmed set points. When the process temperatures are achieved, the purge blower is automatically activated to supply ambient air through the detonation chamber and downstream equipment. Once startup is complete, the HMI notifies the operator that the system is ready for detonation events.

A detonation sequence is activated by the operator pressing the detonation sequence icon. The PLC automatically closes the purge valves and deactivates the purge blower. Oxygen (if required) is injected into the detonation chamber based on a prescribed menu selection for each munition type. Following the introduction of oxygen and pneumatic valve positioning, the PLC activates the reactive bed filter system to inject alkali powder. Following this step, the PLC powers the fireset. Once the fireset is powered, the operator can check continuity of the firing circuit. If continuity is not made, the operator follows standard troubleshooting operating procedures to prevent a misfire event. On successful continuity, a detonation event is initiated by depressing the fire button.

After a detonation, there is a rise in static pressure in the detonation chamber and expansion chamber. The static pressure is allowed to decay to ambient pressure. Once ambient pressure is achieved, the purge blower and associated pneumatic valves are activated by the PLC. Ambient air purges the chamber and conveys the contents downstream to the off-gas treatment equipment. The PLC automatically deactivates the alkali feed system of the reactive bed filter after a pre-set time period. After a period of approximately 15 min from the time of detonation, the operators are allowed to open the chamber doors and load the next munition.

A shutdown operation is automatically executed when the HMI operator selects the shutdown sequence icon. The hot gas generator is automatically shut down and the purge blower is shut down. The process fan shuts down and the isolation valves are closed. Auxiliary equipment is either left operating or is shut down manually. An automated shutdown occurs during a "Warm Shutdown" sequence. Manual shutdown of auxiliary equipment occurs during a "Cold Shutdown" sequence.

2.1.9 Utilities.

During Phase I (2003), the diesel generator consumed an excessive amount of lubricating oil. This condition was caused by not loading the engine-generator to the optimum operating level for the engine. Oil consumption was reduced in Phase II (2004) by the addition of a load bank to draw parasitic power from the generator.

During Phase II (2005-2006), the ambient temperature was slightly above freezing for most of the operational period. There was a risk of freezing the water used in the closed loop heat exchanger, especially over weekends and extended break periods. Ethylene glycol was added to the water to create an antifreeze solution (50% solution of ethylene glycol).

2.2 Final System Configuration.

The TC-60 CDC system that was demonstrated from 2004 to 2006 comprised the following subsystems:

- Vestibule
- Mechanical loader
- Firing system
- Detonation chamber
- Oxygen feed system
- Purge blower
- Expansion tank
- Hot gas generator
- Reactive bed filter
- Catalytic converter
- Direct air dehumidifier
- Closed loop off-gas heat exchanger
- Carbon filtration
- Process fan
- Final filter
- HMI control system

2.2.1 Vestibule.

The TC-60 CDC is equipped with a steel-framed vestibule to accommodate installation of plastic sheeting, after erection, for a total enclosure. The vestibule is designed to prevent the escape of chemical vapor outside of engineering controls and contains two separate sections. The first section (entrance section) is an area for gross personnel decontamination, using soapy water and bleach solutions for cleaning boots and the outer surface of PPE, as well as for storing scrap metal waste. If chemicals are released from activities such as clearing scrap metal from the chamber or from surface contamination on PPE, the vapors in the vestibule would be purged into the detonation chamber or directly to the off-gas treatment system and cleared from the vestibule without release to the VCS. The entrance section also has provisions for storing air lines for OSHA Level B air-supplied respirators, as well as equipment needed for chamber interior maintenance. The second section of the vestibule contains a mechanical jib for loading munitions and a scissors lift table for transferring munitions onto the mechanical jib without the need for operators to lift munitions.

The design incorporates continuous air purging that discharges directly into the off-gas treatment system. The ventilation flow rate of the entire vestibule is 2,000 scfm. The source of supply air is the ambient air within the VCS.

Munitions are not typically prepared for detonation in the vestibule. The process of preparing a munition, which consists of placing the donor explosive around the munition, is performed on a work table that is adjacent to the vestibule. The work table is not part of the

CDC system because preparation can be performed independently of the actual detonation process.

2.2.2 Mechanical Loader.

The loader consists of a structural frame and floor pan with a beam fitted to the frame to carry a rolling jib. A scissors lift table is located adjacent to the mechanical loader. Munitions to be treated are passed from the work table outside the vestibule through a sliding door and placed on the lift table. The lift table lifts the prepared package to the jib on the loader. The package is secured to the jib with a hook and the lift table is lowered. The jib is then moved to position the prepared munition at the chamber door, where an exploding bridgewire (EBW) detonator is attached to the donor explosive. The jib is then moved into the detonation chamber to load the package onto a hanger inside the detonation chamber. This loader is also used to load water bags into the chamber. The loader precludes the necessity for an operator to enter the detonation chamber during routine operations. The final step is to connect the EBW detonator wire, as described below, and the detonation chamber door is closed.

2.2.3 Firing System.

The firing system transmits appropriate energy to detonate the EBW detonator. The system consists of a Teledyne/RISI fireset that generates high voltage from the discharge of a capacitor. The discharge voltage is conveyed through a coaxial cable. The other end of the coaxial cable terminates at a removable connector located on the outside of the detonation chamber that transmits the voltage via a pass-through interface. The pass-through interface is constructed of a steel body with electrical insulation on the inside of the body and stainless steel rods that transmit the high voltage. The interface is bolted with gaskets on the outside and inside of the detonation chamber. On the inside of the detonation chamber, a single-shot, removable, high-temperature plastic plug connects to the high voltage rods of the pass-through interface. An EBW detonator with lead wire is connected to the internal removable plug. The detonator and lead wire assembly are connected to the internal removable plug prior to shooting operations. The operator does not have to enter the chamber when inserting or removing the internal plug. The interface is shown in Figure 2-2.

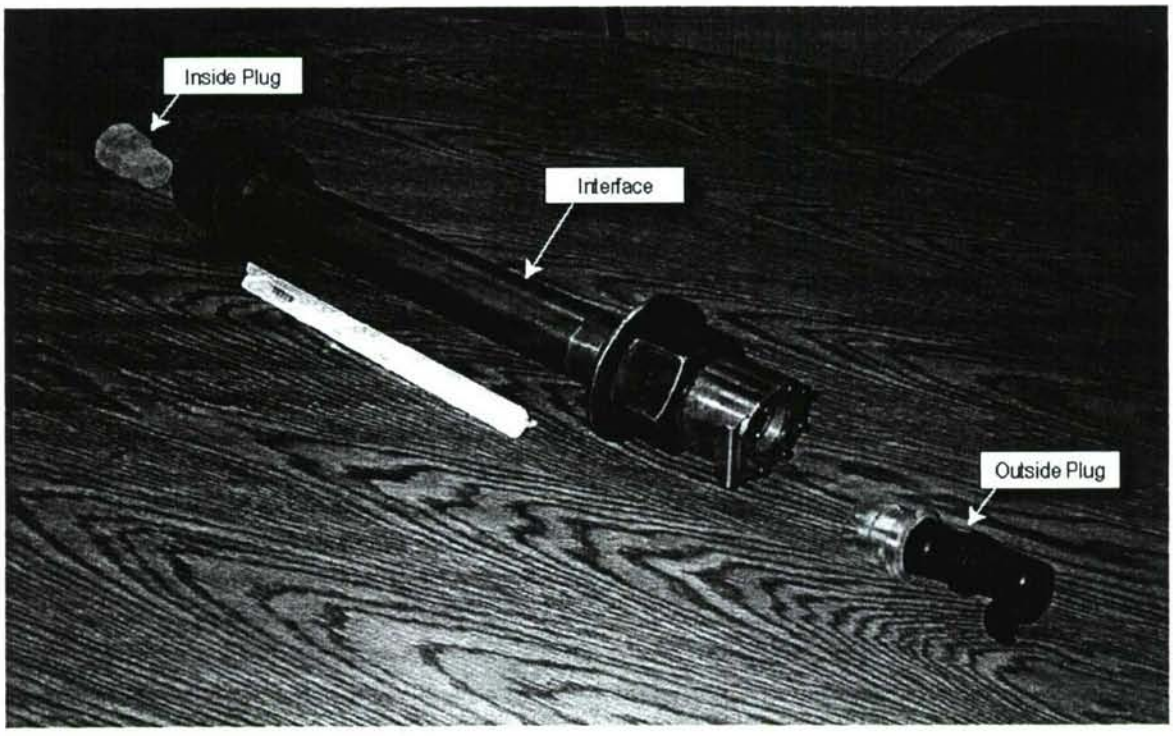


Figure 2-2. Firing System Interface

The fireset box incorporates a circuit continuity feature. In the continuity test setting, a low-voltage signal is delivered from the fireset through the detonator and back. When a proper voltage signal is received from the fireset, a green light indicates that the circuit is reliable for detonation. When a red light registers on the fireset, continuity is suspect and troubleshooting procedures are initiated to restore continuity.

2.2.4 TC-60 Detonation Chamber.

The TC-60 detonation chamber is constructed of mild steel reinforced with wide flanges and an outside skin of mild steel plate. The chamber volume is approximately 760 ft^3. The water bags and munition package are hung in the middle of the chamber from hooks that are engaged in hanging brackets mounted in the chamber ceiling. After the package is hung in the chamber, the detonator circuit is connected by inserting a plug into the interface connector inside the chamber. After the doors are closed, the detonator circuit is completed by inserting a plug into the outside connection of the interface connector.

The area is then cleared and the firing circuit is closed to detonate the package inside the detonation chamber.

Detonation gases from the explosion are vented to an expansion tank. An automatic flow-control valve system releases the detonation gases at a constant rate to the air pollution control system. When the pressure is vented down to atmospheric pressure, fresh air

from outside the process is pumped into the chamber for a pre-set period of time sufficient to clear the chamber of the detonation gases.

The detonation chamber is equipped with an inner and outer door system to prevent leakage during the detonation event. The inner blast door has a high-temperature silicone seal designed to withstand the heat and pressure of the detonation event. However, the outer vapor door provides secondary containment of any leakage that may occur during the detonation. The space between the two doors is vented directly to the off-gas treatment system.

2.2.5 Oxygen Feed System.

In 2004, DSTL leased a 3000-L liquid oxygen tank for adding supplemental oxygen gas into the detonation chamber. This tank was oversized for the requirements but was available when needed. The feed system consists of a liquid oxygen tank and evaporator, which converts liquid oxygen to gas phase oxygen. A series of hand-operated ball valves isolate the oxygen tank from process equipment. When the ball valves are open, gaseous oxygen is controlled by a regulator and automatically metered into the detonation chamber by a manifold fitted with pneumatic valves. Oxygen feed is controlled by the programmable logic controller (PLC) in the detonation sequence.

2.2.6 Purge Blower.

A purge blower is incorporated to accelerate purging of the detonation chamber after a detonation event. Ambient air is delivered to the chamber through a purge manifold assembly on the face of the detonation chamber to clean the chamber and subsequent downstream components. Gases that are contained in the detonation chamber, following a detonation event, are flushed with ambient air for at least 15 min before opening the vapor door and inner blast door of the detonation chamber.

2.2.7 Expansion Tank.

The expansion tank is a cylindrical vessel capable of operating at pressures of up to 125 lb/in.^{2}. Its function is to contain the gases and pressure resulting from the detonation of the explosives and resulting oxidation of any chemical fill in the munitions treated in the detonation chamber. Flow from the detonation chamber to the expansion tank is unrestricted and occurs through flanged piping. Flow from the expansion tank to the off-gas treatment system is controlled by two automatic flow control valves arranged in parallel at the exit of the tank. This configuration allows the gases instantaneously generated from the detonation to be contained and then vented at a constant rate for treatment. The expansion tank exterior shell is supplied with electrical resistance heaters for decontamination.

2.2.8 Hot-Gas Generator.

Ambient air is heated directly by a contained propane flame to a temperature of approximately 1,500 °F. The hot air is vented to the ductwork connecting the expansion tank to the reactive bed filtration system. As detonation gas is exhausted from the expansion tank, it is

mixed with an equal volume of hot air. At this point, the system is under slightly negative pressure with respect to atmospheric pressure. The resulting heated air will normally be at approximately 800 °F and is used to heat the duct work, reactive bed filter, and catalytic converter.

2.2.9 Reactive Bed Filter.

The reactive bed filter consists of a dry solids feeding system to introduce acid gas reactive solids (hydrated lime and/or sodium bicarbonate), upstream of the particle filtration system. The reactive solids will react with acid gases in situ. In addition, further acid gas reactions take place on the solids cake that develops on the surface of the filters. Acid gases and particulate matter are generated from the destruction of a munition (smoke, industrial chemical, or chemical agent) in the detonation chamber. The addition of reactive solids is only necessary just prior to a detonation and lasts until the detonation and expansion chambers have been purged sufficiently with ambient air.

The filtration system consists of rigid ceramic candle filters that remove particulate matter from the gas stream. Particulate matter typically consists of the reactive solids, soot generated from blasting, and pea gravel dust. Applying a short burst of compressed gas inside the filter cleans the filtration substrate, dislodging the particles on the filter substrate and allowing them to settle by gravity into the bottom of the housing for removal. The solids typically consist of inert salts, unreacted solids, pea gravel dust, and soot.

The reactive bed filter has the capability to be heated above 1,100 °F by using hot air generated by the hot gas generator. The pressure is slightly negative, approximately-1 in. of water with respect to atmospheric pressure. The performance of this unit is monitored by measuring the inlet and outlet temperature and pressure drop.

2.2.10 Catalytic Converter.

The catalytic converter is a precious metal catalyst supported on alumina ceramic. Approximately 8 ft^3 of catalyst are contained in the housing. A catalyst converts organic vapors and carbon monoxide to carbon dioxide and water. The operating performance of the catalyst can be assessed by measuring the temperature, upstream and downstream of the catalyst. The TC-60 CDC also has sampling point locations, upstream of the electric dehumidifier and downstream of the catalyst, to measure the conversion performance of carbon monoxide. The upper temperature limit of the catalyst is 1,250 °F. Temperature can be controlled by the output of the hot gas generator (temperature and flow are variable).

2.2.11 Direct Air Dehumidifier.

Gas discharged from the catalytic converter is mixed with ambient air from the munitions loading vestibule for cooling the off-gas stream prior to entering a heat exchanger. Ambient air is introduced based on the vacuum provided by the process fan. The ambient air cools the hot gas from approximately 1,200 °F to 400 °F. Approximately 4,000 scfm of air passes through the heat exchanger, with an inlet temperature of approximately 400 °F.

2.2.12 Closed Loop Off-gas Heat Exchanger.

The heat exchanger cools the hot gas to prepare it for carbon adsorption. Water (55 °F) is used as the heat transfer fluid in a closed loop design. The return water (70 °F) is cooled in a refrigerator located outside of the secondary containment building. The capacity of the heat exchanger, coupled with the refrigerator (chiller), cools the 4,000 scfm of gas at approximately 400 °F to approximately 100 °F. The exhaust gas can be cooled further with addition of ambient air, downstream of the heat exchanger. Performance indicators for the heat exchanger and chiller include liquid side pressure, gas outlet temperature, and liquid flow rate. Varying the liquid flow rate can control gas discharge temperature.

2.2.13 Carbon Filtration.

The carbon filtration system consists of six carbon vessels connected in series. Three vessels in series provide primary control and a second set of three vessels serve as a redundant backup. The carbon vessels capture any trace organic compounds that may have not been destroyed in the process. Each vessel has a fill capacity of 500 lb of carbon. Gas sampling locations are provided upstream of the carbon vessels, between carbon vessels, and prior to the process exhaust fan.

2.2.14 Process Fan.

A process fan conveys gases from the detonation chamber through the off-gas treatment components (filtration, catalytic conversion, and carbon adsorption) while maintaining a negative pressure of an approximately 1-in. water column in the system. The fan discharges at a positive pressure with respect to atmosphere. Performance indicators for the fan and motor consist of include: rpm, voltage, amperage, temperature, and vibration limits.

2.2.15 Final Filter.

A final particulate filter is located after the process fan. The final filter is designed with a removable cartridge that is not cleanable. The purpose of the final filter is to capture activated carbon particles that occur when carbon is removed and replaced. Discharge from the final filter is into the VCS.

2.2.16 Human-Machine Interface Control System.

The HMI serves as the operating interface between the system operator and the TC-60 CDC engineered system components PLC. The HMI uses resistive touch screen technology that allows operation with fingers or pointers. The heart of the control system is the PLC processor. The processor stores and executes a customized computer program. Remote input/output (I/O) channels are assigned to points in the remote I/O panels. Communication between the I/O devices, PLC, and HMI is accomplished through an Ethernet network.

All pneumatically controlled valves, safety interlocks, air-handling fans, and support equipment, including utilities, can be opened, closed, started, stopped, or held in a predetermined state by allowing the operator a single point of access through the HMI.

In addition, the HMI provides continuous feedback to the operator about critical process variables including temperatures, pressures, air flows, communication status, alarm indicators, door positions, and valve positions for safe and effective system operation. Each system component is available for monitoring and control.

2.2.17 Auxiliary Support Equipment.

Necessary support equipment to be used with the TC-60 CDC includes the following:

- Fuel supply (propane and diesel)
- Decontamination hot gas generator
- Electrical power generation and distribution
- Water supply tank, pumps, and electrical chiller
- Compressed air supply

A description of each of the auxiliary systems follows.

Propane.

Propane fuel used during the test program was supplied by DSTL. The propane delivery system consists of three 1,000-gal tanks, each with a vaporizer and manual fuel shut-off valve. The propane delivery piping is provided by the propane system supplier and terminates inside the test building. The gas piping from inside the building contains the appropriate pressure and control valves to supply propane to the hot gas generator that is part of the normal operation of the TC-60 CDC and the decontamination hot gas generator.

Decontamination Hot Gas Generator.

A portable hot gas generator is supplied for decontaminating the detonation chamber and expansion chamber. A connection is supplied at the outer door of the detonation chamber to deliver hot gas with a maximum temperature of 1,500 ^{0}F. The inner door of the detonation chamber is open during decontamination operations to allow delivery of hot gas into the chamber. A perforated duct is connected to the inside flange of the outer door so that hot gas is distributed uniformly in the detonation chamber. Decontamination takes place at an elevated temperature in the range of 350-450 °F.

Electrical Power Generation and Distribution.

Electrical power is supplied by a diesel-fired generator and distributed to an electrical power distribution panel that is connected to local power disconnect boxes for major equipment. All equipment is grounded to the diesel generator to achieve the same electrical

potential. The diesel generator is equipped with a 300-gal fuel tank that is filled from a storage tank onsite.

Water Supply Tank, Pumps, and Chiller.

Cooling water is contained in a 1,000-gal tank. A closed loop design is used to provide cooling water to the heat exchanger. The chiller is used to cool the water that has been heated in the heat exchanger. The supply temperature of water is 55 °F, and the return water temperature is 70 °F.

Compressed Air Supply.

Compressed air (100 psig) is used to operate the pneumatic-actuated valves and the pulse-cleaning manifold of the reactive bed filter.

2.2.18 Required Support Systems and Services.

Although the following were not part of the TC-60 CDC, they were required support systems or services for this test.

- Assessment of munitions to be treated
- Test facility at Porton Down
- VCS Vapor containment structure and filtration system
- Electric generator (for non-CDC equipment)
- Waste collection and disposal
- Personnel decontamination
- Site security
- Monitoring and laboratory support

Recovered munitions were non-intrusively assessed to identify the fill and explosive configuration. Portable Isotopic Neutron Spectroscopy (PINS) and x-ray were the primary methods by which this assessment is performed. The results were reviewed by DSTL personnel, who make an identification of the chemical fill.

3. TRANSPORTATION

3.1 Transportation Subtest Criteria.

The criteria for successful completion of the transportation subtest, enumerated in the TC-60 Controlled Detonation Chamber Test Plan for Defense Science and Technology Laboratory Porton Down, UK.*

* Blades, T.A.; DiBerardo, R.; Misko, G.; McFarlene, N. *Demonstration/Validation of the TC-25 Donovan Blast Chamber Porton Down, UK, Final Demonstration Test Report, April–September 2003*; ECBC-TR-362; U.S. Army Edgewood Chemical Biological Center: Aberdeen Proving Ground, MD, 2004; UNCLASSIFIED Report (AD-A425 237).

- **REQUIREMENT:** Transportation should not cause any damage that would preclude or seriously degrade the conduct of the test.

- **GOAL:** Transportation should not cause any damage requiring other than routine maintenance upon unloading.

- **INDICATOR:** Procedures for stowage and packaging are adequate to prepare and protect the TC-60 CDC against movement damage.

This subtest included:

- Transporting the TC-60 CDC, expansion tank, mechanical loader, and supporting equipment from the United States to the United Kingdom.

- Removing the TC-25 CDC and expansion tank and returning these to the United States.

- Removing the TC-60 CDC, expansion tank, air pollution control equipment, generator, utilities, support equipment, tools, and spare parts from the United Kingdom and returning these to the United States.

These tasks were accomplished in 2004, 2005, and 2006 in concert with the execution plans for the conduct of the test.

3.2 Transportation Subtest Results.

The transportation subtest was divided into three distinct parts to meet the demands of the project schedules.

3.2.1 Transporting the TC-60 CDC to the United Kingdom.

In June 2004, the TC-60 CDC, expansion tank, and two intermodal containers were shipped from Crescent City, Illinois, to the DSTL test site at Porton Down, UK. These items were shipped by truck to the railhead in Chicago and thence by rail to the Port of Baltimore, MD, and the Port of New York. The CDC and expansion tank were shipped as break-bulk cargo from the Port of Baltimore aboard ship. The containers were shipped as containerized freight from the Port of New York aboard ship. Both ships offloaded at the Port of Southampton, United Kingdom, and the materials were shipped from the port to the test site by truck. The purge air blower and heat exchanger were shipped later as air freight from the United States to the United Kingdom.

Upon arrival, the equipment was offloaded and inspected. No damage was found except for one cracked weld on the floor pan of the mechanical loader. This was repaired in the field. Receipt of the TC-60 Controlled Detonation Chamber and the Expansion Tank is shown in Figures 3-1and 3-2.

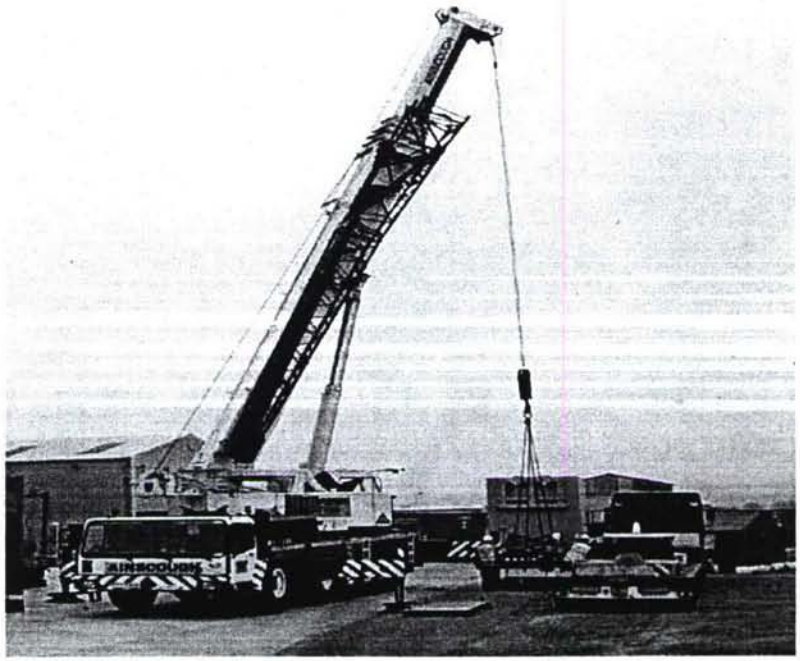


Figure 3-1. TC-60 Detonation Chamber Being Unloaded

3.2.2 Returning the TC-25 CDC to the United States.

Upon the arrival of the TC-60 chamber and expansion tank, the TC-25 CDC and expansion tank were removed from the test site and stored pending return to the United States. The detonation chamber, expansion tank, and one container with steel plate, chamber pedestals, instruments, and an insulation blanket for the chamber were shipped from the United Kingdom in May 2005 to the United States. The detonation chamber and expansion tank arrived in the Port of Baltimore and were then trucked to Aberdeen Proving Ground, Maryland. The container arrived in the Port of New York and was trucked from New York to Crescent City, Illinois. The equipment was offloaded and inspected. No damage to the equipment was noted during the inspection.

3.2.3 Returning the TC-60 CDC and Remaining Equipment to the United States.

At the end of the testing and upon clearance of the equipment for shipping, the TC-60 CDC, expansion tank, generator, and seven intermodal containers were prepared for shipment back to the United States. The seven containers and the generator left the United Kingdom on 3 June 2006 and arrived at the Port of Charleston, South Carolina on 15 June 2006. The detonation chamber and expansion tank left the United Kingdom on 30 June 2006 and arrived in the Port of Baltimore on 12 July 2006.

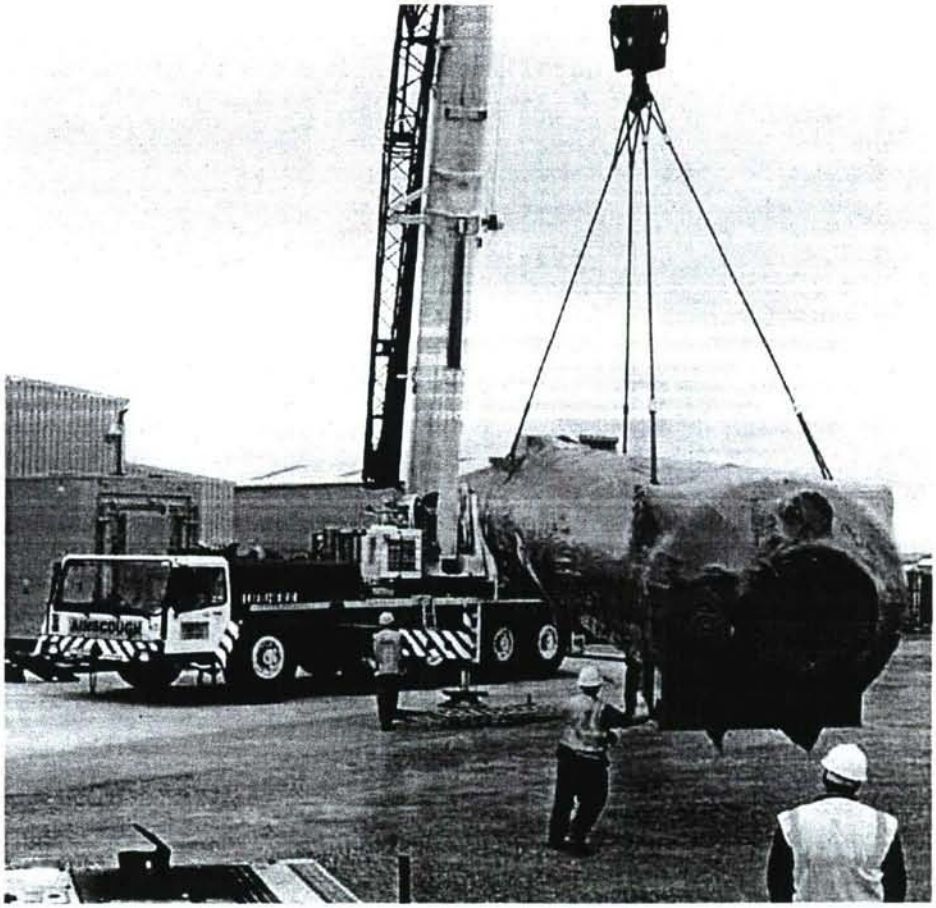


Figure 3-2. TC-60 Expansion Tank Being Unloaded

The only damage noted upon arrival of the returned shipments in the United States was a set of two small dents in the aluminum jacket covering the rock wool insulation on the expansion tank. The jacket was not pierced and the weather protection for the rock wool was not compromised. The insulating functionality of the rock wool was not affected. This is regarded as superficial damage.

3.3 Conclusions.

REQUIREMENT: Transportation should not cause any damage that would preclude or seriously degrade the conduct of the test.

No damage occurred in the transportation of the equipment that precluded or degraded the conduct of the testing. The requirement of the Test Plan was successfully demonstrated.

GOAL: Transportation should not cause any damage requiring other than routine maintenance upon unloading.

Damage found during post-transportation inspections included one cracked weld securing the floor pan of the mechanical loader to the frame of the loader. This was successfully field-welded and repaired as a maintenance measure. The aluminum jacket covering the insulation on the TC-60 expansion tank was slightly dented upon arrival in Baltimore. The functionality of the insulation was not affected. The goal of the Test Plan was successfully achieved.

INDICATOR: Procedures for stowage and packaging are adequate to prepare and protect the TC-60 CDC against movement damage.

The packing, shoring, and bracing of the equipment for shipping met the requirements of the shipping company. No movement damage, other than the one cracked weld and two dents in the insulating jacket, were found. The damage to the weld was not conclusively determined to be due to movement damage. This indicator was successfully demonstrated. Shipping reports were prepared by the freight forwarders. No impediments to shipping on time were encountered in the movement from the United States to the United Kingdom.

4. PREOPERATIONS

4.1 Preoperations Subtest Criteria.

The specific criteria for the successful completion of the pre-operations subtest, enumerated in the Test Plan, were as follows:

- **REQUIREMENT:** The TC-60 CDC system shall be complete and ready to conduct test operations.

- **REQUIREMENT:** Health and safety documents and procedures shall be complete and approved. Safety and emergency response equipment and supplies shall be in place and ready for use.

- **REQUIREMENT:** The TC-60 CDC procedures (standard operating procedures [SOPs] and checklists) shall be complete and approved.

- **GOAL:** The required inventory of TC-60 CDC components, tools, spare parts, and expendables should be on hand, complete, and undamaged.

- **INDICATOR:** Operators are to be capable of operating the TC-60 CDC.

4.2 Preoperations Subtest Results.

Preoperations activities were conducted in two separate campaigns. From July through September 2004, the lessons from Phase I testing in 2003 were implemented. The Preoperations Survey was completed in the first week of September 2004, and operations started with explosives-only tests. During these tests, one of the expansion joints in the crossover pipes

between the detonation chamber and the expansion tank failed. This compelled a shutdown of the process while replacements were fabricated. Testing resumed in October 2004 and was terminated early when the explosive package design did not perform to expectation.

The explosive package was redesigned in 2005 and additional lessons learned were implemented in December 2005. During this startup, the original heat exchanger was replaced with a heat exchanger assembled at the DSTL Engineering Shop, as mentioned in Section 4.2.2. Pre-operations activities were completed in February 2006 and operations recommenced.

4.2.1 July thru October 2004.

4.2.1.1 July 12 - August 20 – Installation and Systemization.

From 12 July 2004 through 20 August 2004, the test equipment was modified to implement the lessons learned during the Phase I testing conducted in 2003. These modifications have been described in Section 2 of this report.

Chamber and Expansion Tank Replacement.

The TC-25 CDC and expansion tank were removed from the process test area. They were replaced with the TC-60 CDC and expansion tank. Piping modifications to the crossover pipes and the exhaust pipe were made at the same time. The new chamber and expansion tank are shown in Figure 4-1.

Reactive Bed Filter System Modification.

A reversing conveyor and control panel for the conveyor were added to the reactive bed filter system.

Loader and Vestibule.

A self-contained loader for the detonation chamber was added. This system also provided an enclosed work space for the operators. In addition, an enclosed stage assembly was provided as a vestibule. This entire assembly was ventilated at the detonation chamber face to direct air flow from the vestibule to the chamber face, providing vapor containment in the entire work space. The loader is shown in Figure 4-2.

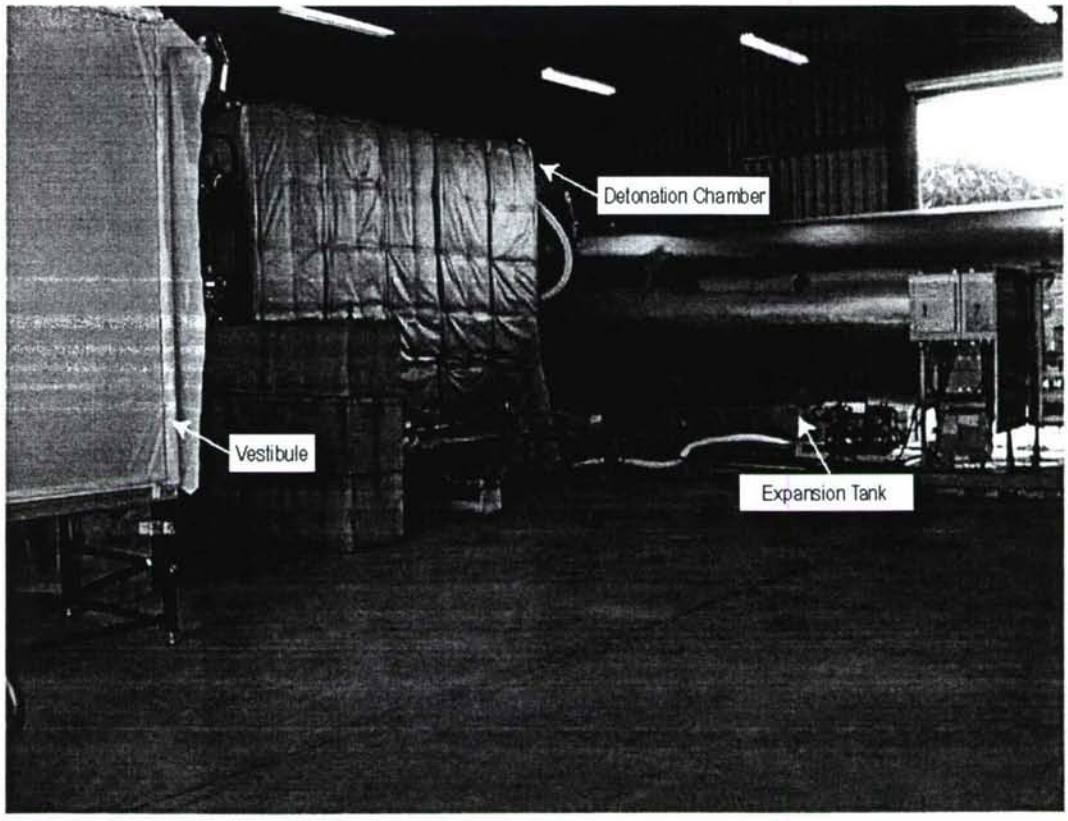


Figure 4-1. TC-60 Chamber and Expansion Tank

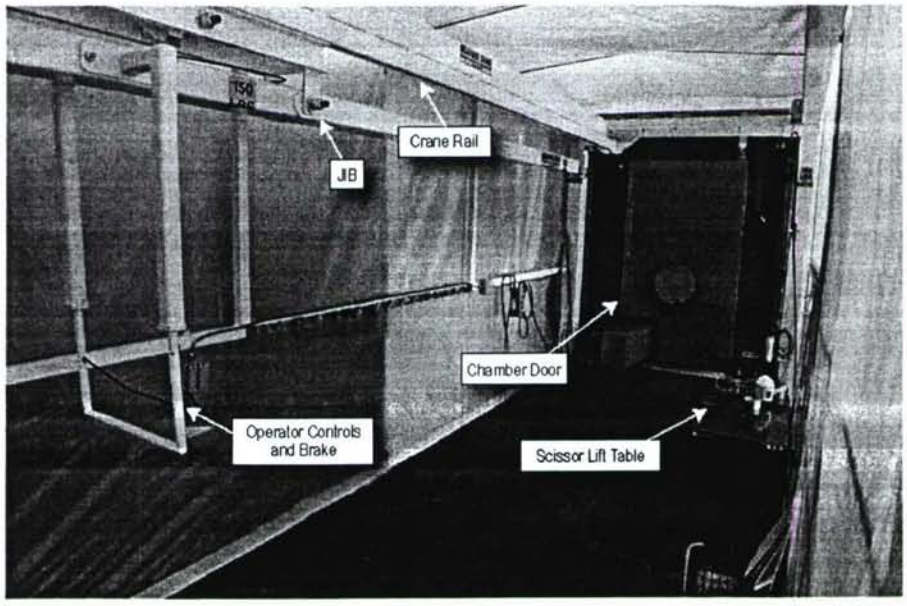


Figure 4-2. Loader Inside Vestibule

Firing System Replacement.

The FS-61B firing system was replaced with a similar system that incorporated a continuity check in the firing system. The interface for the firing system was redesigned and located on the front face of the detonation chamber. A different connection for the detonators was designed and installed. New firing cables were installed for this firing system to connect the firing box to the interface.

Purge Air Blower.

A separate air blower was installed to provide a reliable air flow to the detonation chamber after detonation while the chamber is ventilated.

Removal of the PLC from Operating Area.

The PLC system was removed from a cabinet on Skid 1A inside the test building and relocated to a cabinet outside the test building.

Temperature Control Loop on the Heat Exchanger.

A flow control valve on the chilled water supply and temperature control loop was added to the control system to more closely control the temperature of the air stream leaving the heat exchanger.

Addition of Carbon Filtration System.

In 2004, a cartridge filter was added to the exhaust of the process fan to trap entrained carbon. During the training period and initial startup period, the cartridges were changed when the pressure drop increased. Immediately prior to the start of toxic operations, the pressure drop across the cartridge stabilized and remained constant for the duration of the testing.

Resistance Heaters on Expansion Tank.

Resistance heaters and a controller for the heaters were installed on the expansion tank. These heaters independently heat the expansion tank during the thermal decontamination step. They may also be used to heat the tank independently during operations if agent accumulation is suspected in the tank.

4.2.1.2 August 23 - August 27 Training.

Explosives Operations Training.

Chemical/explosive operators were trained on the mechanical loader and preassembled explosive system. All operators successfully completed training and demonstrated proficiency with the operations.

Control System Training.

Operators/supervisors were trained on the function and operation of the automatic control system using the HMI. All operators/supervisors demonstrated proficiency with the controller and the interface of the controller with the operations.

Maintenance Training.

Technicians were trained on maintenance, inspection, daily process setup, and weekly process cleanup procedures. All technicians demonstrated proficiency with these requirements.

Procedures Development and Turnover.

Draft operating and maintenance procedures were available before the start of the training. At the end of the training, these procedures were modified and accepted for use during operations.

4.2.1.3 August 31 - September 4 Preoperations Survey and Corrections.

Preoperational surveys conducted by the ECBC Risk Reduction Office, ECBC, confirmed that all the criteria for the pre-operations subtest had been met.

Table 4-1 presents a summary of the findings of the Pre-operations Survey Team.

Table 4-1. 2004 Preoperations Survey Summary

Category	Number Of Findings	Description of Category
1	0	Items which are considered essential to the safety of personnel or the operational readiness of the system. These items must be resolved prior to the start of the operations.
2	6	Items which are not considered critical to the safety of personnel or the operational readiness of the system, but which are considered deficiencies that must be corrected. Suspense for correction of these items will be established prior to recommendation to start operations.
3	18	Items noted by the evaluation team but which were corrected while the survey was being conducted.
4	2	No response required.

The pre-operations survey findings were addressed, and the subtest was successfully completed.

4.2.2 December 2005 - February 2006.

4.2.2.1 December 5 - 9 – Installation and Systemization.

Firing System.

The interface for the firing system was replaced with a different design that alleviated the binding of the interior plugs that had been experienced in 2004. New firing cables that matched the connections for the new interface were installed.

Equipment Checkout.

The cooling water in the refrigeration unit was replaced with a 50% ethylene glycol/50% water mixture to avoid freezing in the circulating system. The flow controller in the hydraulic system for the inner door was installed and tested. The mechanical loader and hangers in the detonation chamber were checked for alignment. This system remained aligned even though the system had been inactive for 13 months. The dredge hose in the crossover pipes between the CDC and expansion tank was replaced. The expansion joint in the exhaust pipe between the expansion tank and the air pollution control unit was replaced. These were replaced as a preventive maintenance measure because they had been subjected to a thermal decontamination exercise in 2004.

Heat Exchanger Checkout and Overheat.

During startup and checkout of the system, the control valve for the cooling fluid flow to the heat exchanger was found to be operating with reverse logic. This resulted in overheating and boiling the glycol/water solution in the tubes of the heat exchanger causing excessive vibration. A small quantity of gravel was also found in the heat exchanger that resulted in rupturing of the tubing in three places (confirmed after the fact). The gravel was believed to have entered the system when the piping was re-connected. Additionally, one weld on a pressure transmitter leg was found to be defective.

The result was that the heat exchanger was unusable. A replacement heat exchanger bundle was ordered from the manufacturer, and the bundle was replaced by the DSTL Engineering Shop.

4.2.2.2 December 12 - 14 – Training and Heat Exchanger Removal.

During this period, refresher training on operations, control systems, and maintenance was provided to the operators. On 14 December, the heat exchanger was removed from the system and sent to the DSTL Engineering Shop.

The site was shut down and operations rescheduled to begin after the heat exchanger was replaced.

4.2.2.3 January 23 - 29 – Heat Exchanger Installation and Training.

On 24 January, the heat exchanger was replaced and all process connections were made. Training for operators and maintenance technicians resumed for the balance of the week.

Explosives Operations Training.

Chemical/explosive operators were trained on the mechanical loader and preassembled explosive system. All operators successfully completed training and demonstrated proficiency with the operations.

Control System Training.

Operators/supervisors were trained on the function and operation of the automatic control system using the HMI. All operators/supervisors demonstrated proficiency with the controller and the interface of the controller with the operations.

Maintenance Training.

Technicians were trained on maintenance, inspection, daily process setup, and weekly process cleanup procedures. All technicians demonstrated proficiency with these requirements.

Procedures Development and Turnover.

Draft operating and maintenance procedures were available before the start of the training. At the end of the training, these procedures were modified and accepted for use during operations.

4.2.2.4 February 20 - 24 – Remobilization and Preoperations Survey.

The project team was remobilized and the pre-operations survey began. Operating and maintenance procedures were reviewed and accepted. Health and safety plans were reviewed and approved.

Preoperational surveys conducted by the ECBC Risk Reduction Office, confirmed that all the criteria for the pre-operations subtest had been met.

Table 4-2 presents a summary of the findings of the Pre-operations Survey Team.

Table 4-2. 2006 Preoperations Survey Summary

Category	Number Of Findings	Description Of Category
1	0	Items which are considered essential to the safety of personnel or the operational readiness of the system. These items must be resolved prior to the start of the operations.
2	2	Items which are not considered critical to the safety of personnel or the operational readiness of the system, but which are considered deficiencies which must be corrected. Suspense for correction of these items will be established prior to recommendation to start operations.
3	5	Items noted by the evaluation team but which were corrected while the survey was being conducted.
4	0	No response required.

The preoperations survey findings were addressed, and the subtest was successfully completed. Test operations began 27 February and are described in Section 5.

4.3 Documentation.

Health and safety documents and procedures were reviewed and approved during the pre-operations surveys in 2004 and 2006. Safety and emergency response equipment and supplies were also confirmed to be in place and ready for use.

The TC-60 CDC procedures (SOPs and checklists) were reviewed and found to be complete and approved during the pre-operations surveys.

The operators demonstrated they were capable of operating and maintaining the system.

The required inventory of TC-60 CDC components, tools, spare parts, and expendables were inspected and deemed acceptable by the Pre-operations Survey Team.

4.4 Conclusions.

All the criteria for the pre-operations subtask were satisfied in 2004 and 2006. The pre-operations subtest was successfully completed.

- **REQUIREMENT:** The TC-60 CDC system shall be complete and ready to conduct test operations.

The TC-60 CDC system was inspected and found to be complete and ready to conduct test operations at the completion of the pre-operations survey.

- **REQUIREMENT:** Health and safety documents and procedures shall be complete and approved. Safety and emergency response equipment and supplies shall be in place and ready for use.

Health and safety documents and procedures were reviewed and approved. Safety and emergency response equipment was found to be in place and ready for use.

- **REQUIREMENT:** The TC-60 CDC procedures (SOPs and checklists) shall be complete and approved.

Operating procedures were reviewed during the pre-operations survey and approved.

- **GOAL:** The required inventory of TC-60 CDC components, tools, spare parts, and expendables should be on-hand, complete, and undamaged.

The inventory of components, tools, spare parts, and expendables were observed to be on hand, complete, and undamaged prior to the pre-operations survey.

- **INDICATOR:** Operators are to be capable of operating the TC-60 CDC.

The operators demonstrated their proficiency in operating the TC-60 CDC system during the pre-operations survey.

5. OPERATIONS

The operations subtest was divided into four separate sequences to accommodate the execution of the test plan. These sequences consisted of (1) workup tests and (2) chemical-filled munitions tests for the 2004 and 2006 events.

5.1. Operations Subtest 2004.

5.1.1 Workup Testing 2004.

Workup testing validated the training accomplished in the pre-operations test, actively tested the TC-60 CDC system's operability, and identified any necessary changes to procedures prior to initiating chemical agent munitions testing. The Test Plan did not establish specific criteria for the workup tests.

September 7 - October 16, 2004.

Workup tests were conducted with high explosives (HE) only. The explosive was pentaerythritol tetranitrate (PETN) plastic sheet explosive. One of the 22 workup tests incorporated an empty 25 pdr munition in the proposed donor package. Another of the tests incorporated the detonation of two empty 25 pdr munitions detonated simultaneously (referred to as a double shot) with the proposed donor package.

The proposed donor package for a 25 pdr consisted of plastic molded forms assembled as a container for the donor explosive and munition. The forms were designed to fit together as two halves. Each half-section consisted of an inner plastic shell and an outer plastic shell. Shaped charges and C4 explosive were placed between the outer shell and inner shell.

There were 2.5 lb of C4 plastic explosive in each half-section of the container. Each half-section also contained four aluminum linear shaped charges inserted into 2 quadrants (45° apart). The shape of the plastic molds fit the contour of a 25 pdr munition. There was a shaped charge from the nose cone to the ogive and a separate shaped charge from ogive to the base. The shaped charges were driven by C4 plastic explosive. The inner plastic shell (closest to the munition) had a polyurethane foam section to act as a standoff for the linear shaped charge when the 25 pdr was placed into one half-section of the container. The other half-section, placed on top of the 25 pdr, completed the donor package, with a total weight of 5 lb of C4 explosive. The donor package was assembled with zip ties and duct tape. A detonator placed on top of the container, with a ball of C4, completed the explosive assembly package for a 25 pdr.

Tests were planned for the destruction of 5-in. DOT bottles containing 11.7 lb of mustard, which was drained from recovered 4.2-in. mortars. This sacrificed the 4.2-in. mortar body but the remaining fuse/burster assemblies had to be destroyed. Therefore, plans were developed to destroy the fuse/bursters generated from draining the mortars.

The proposed donor package assembly for the destruction of the 5-in. DOT bottles and fuse/bursters was similar to the 25 pdr donor design except there was no ogive section. Also, given the increased diameter of the 5-in. cylinder relative to the 25 pdr, the C4 weight was 5 lb per half-section (10 lb of C4 for the assembled container). This assembly included the plastic molded forms, with an inner and outer plastic shell for each half of the container. Also included were aluminum shaped charges and C4 plastic explosive between the inner and outer liner shells, as well as C4 to drive the shaped charges. However, because there was no ogive, the shaped charges were reduced to two for each half-section of the container. All the other assembly details were consistent with the 25 pdr package.

It was determined onsite that the fuse/bursters from the 4.2-in. UK mortars could be packaged in 5-in. (inner diameter) polyvinyl chloride tubes. The tubes were cut to length to fit into the pre-assembled 5-in. DOT donor explosive assemblies containing the C4 explosive and linear shaped charges. The practice for destroying fuse/bursters was not intended to represent an efficient use of explosives to do the job, but did demonstrate onsite flexibility to accomplish a necessary task with available resources. Two 4.2-in. mortar fuse/bursters were fitted into a single container. A double shot consisted of two containers (four fuse/bursters) and 20 lb of C4 explosive.

5.1.2 Workup Test Results.

5.1.2.1 September 7 - October 16, 2004.

All the workup testing during this period was achieved without personnel injury. Table 5-1 summarizes the workup tests. Workup tests 1 through 18, 21, and 22 were conducted with PETN donor sheet explosive; workup tests 19 and 20 used the C4 donor package assembly for a 25 pdr. Workup test 19 used a single, hollow, 25 pdr. Workup test 20 was a double shot, with two hollow 25 pdrs. The detonators were RP-81 detonators. Oxygen was added to some of the workup tests to demonstrate the control system and reproducibility of the addition. Test results established that operators were appropriately trained on the system, SOPs were fully developed and explosive operations could be conducted safely.

Table 5-1. Workup Test Shot Description (2004)

Test Name	Date	HE (lbs)	E-Tank Peak Pressure (psig)	Oxygen (cubic feet)
Workup 1	7-Sep	2	1.7	—
Workup 2	7-Sep	2	1.7	—
Workup 3	7-Sep	4	2.4	—
Workup 4	8-Sep	4	2.4	—
Workup 5	8-Sep	8	4.1	200
Workup 6	8-Sep	8	4.1	—
Workup 7	9-Sep	12	4.8	200
Workup 8	9-Sep	12	4.8	200
Workup 9	13-Sep	2	1.7	—
Workup 10	13-Sep	2	1.7	—
Workup 11	14-Sep	4	2.4	—
Workup 12	14-Sep	4	2.4	—
Workup 13	15-Sep	12	5.4	400
Workup 14	15-Sep	12	5.4	400
Workup 15	16-Sep	6	3.5	200
Workup 16	16-Sep	6	3.5	200
Interruption – Test stopped for replace- ment of expansion joints	17 Sep – 13 Oct	—	—	—

Table 5.1. Workup Test Shot Description (2004) (Continued)

Test Name	Date	HE (lbs)	E-Tank Peak Pressure (psig)	Oxygen (cubic feet)
Workup 17	14-Oct	10	4.5	400
Workup 18	14-Oct	10	4.5	400
Workup 19*	15-Oct	5	4.5	400
Workup 20**	15-Oct	10	6.7	400
Workup 21	16-Oct	10	4.3	200
Workup 22	16-Oct	20	6.8	400

* Denotes C4 donor package assembly with a single 25 pdr
** Denotes a double shot (25 pdr) with donor package assembly

5.1.2.2 September 17 - Cracked Expansion Joint in Crossover Pipe.

At the end of the explosives-only testing, an operator discovered that one of the expansion joints in the crossover pipes between the detonation chamber and expansion tank had cracked. The crack was just outside the heat-affected zone of the longitudinal weld of the expansion joint. The second installed expansion joint was intact. Because the failure of the joint could be attributed to fatigue as well as other possible failure mechanisms, the decision was made to replace the expansion joints in the crossover pipes and exhaust pipe from the expansion tank to the air pollution control system. This compelled the shutdown of the system while replacement joints were procured. The cracked expansion joint is shown in Figure 5-1.

No chemicals were released to the VCS building because the rupture occurred before destruction of the chemical munitions had started. It is believed the rupture was the result of a fatigue failure in the heat-affected zone of the longitudinal weld. This bellows design was used for the first time during the Phase I testing. The solution was to replace the metal bellows-style expansion joints at the pipe connections with a more reliable flexible connector. For the detonation chamber connection, two spool pieces of schedule 40 carbon steel pipe were connected with dredge hose. The dredge hose was isolated from the exhaust gases by a layer of stainless steel sheet. The dredge hoses were clamped on each side by clamshell clamps. Two clamps were used on each connection, offset by 180° so the clamping forces would be even around the perimeter of the pipe. This design has been used on previous CDC systems without any failures.

Figure 5-1. Cracked Expansion Joint

At the exit of the expansion tank, a polymeric composition of ethylene-propylene-diene terpolymer (EPDM) rubber was used to mate the flange of the expansion tank with the flange of the off-gas treatment connection. These changes in expansion joint connections proved to be successful for the remainder of Phase II. These are shown in Figure 5-2, prior to installation.

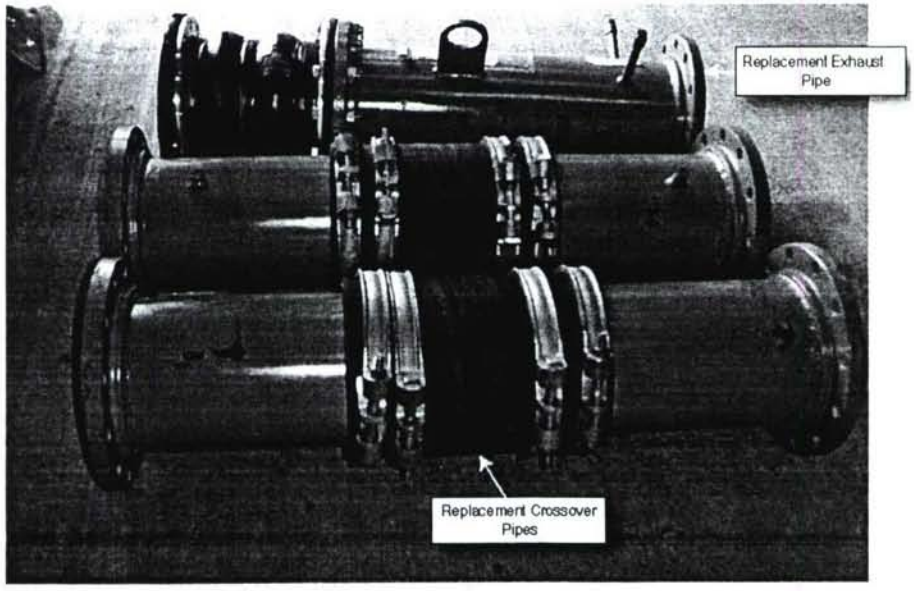


Figure 5-2. Replacement Expansion Joint

5.1.3 Chemical Agent Munitions Tests 2004.

Requirements and Goals of the Chemical-filled Munitions Tests

The Test Plan established the following subtest criteria for agent-filled munitions testing:

- **REQUIREMENT:** The test munition shall be handled, assembled with a donor explosive charge, loaded into the detonation chamber, and the door closed in accordance with approved procedures.

- **REQUIREMENT:** The donor explosive charges shall destroy the munition.

- **GOAL:** The donor explosive charge should detonate the burster (if present).

- **REQUIREMENT:** The chemical fill in the munition should be destroyed such that the resultant products are not detected above the associated applicable time-weighted average (TWA) downstream of the CDC carbon filter system.

- **REQUIREMENT:** Solid residues shall be removed from the detonation chamber using approved procedures and packaged to meet requirements for transportation to an approved disposal facility.

- **GOAL:** No personnel injuries requiring more than first aid should result from TC-60 CDC operations or hardware.

- **REQUIREMENT:** No agent will be detected at the site perimeter (the site perimeter is established at the distance where a downwind hazard analysis for the maximum credible event that predicts the vapor hazard will not exceed the general population limit [GPL]) monitors above the GPL (72-hr TWA).

- **REQUIREMENT:** Waste samples shall be capable of being analyzed, using approved analytical methods, to a detection level appropriate to validate destruction.

5.1.4 Chemical Agent Munitions Testing Results 2004.

October 18-November 4, 2004.

Chemical agent munitions demonstration testing for this period resulted in the following tests: nine mustard-filled and fused 25 pdrs, ten mustard-contaminated 4.2-in. UK fuse/bursters, and three 5-in. DOT bottles, each filled with 11.7 lb of mustard that was drained from 4.2-in. mortars. In addition, there were four HE-only clean up shots. One empty 5-in. DOT bottle was destroyed prior to shooting the mustard-filled bottles to demonstrate that the explosive package was adequate for 5-in. DOT bottles. Two empty 25 pdr munitions were destroyed as a means to diagnose reproducibility issues with destroying 25 pdrs. There were three tests of double 25 pdrs (six 25 pdrs total, or two per test); the remaining three 25 pdrs were destroyed in

single shots. One double shot of UK 4.2-in. fuse/bursters destroyed four bursters (two bursters per container). The remaining six bursters were destroyed in three single shots. Testing results, sorted chronologically, are summarized in Table 5-2.

A summary of the types of munitions and agent fills destroyed during testing are as follows:

- Recovered 25 pdr UK munitions: 1.54 lb of mustard, 6 shots and 9 munitions.
- 4.2-in. UK mortar fuse/burster assemblies: negligible H weight , 4 shots and 10 fuse/bursters.
- DOT bottles: 5-in. outer diameter filled with 11.7 lb of mustard, 3 shots

The total weight of mustard destroyed was just under 50 lb, based on measured and theoretical quantities. The DOT bottles represent measured quantities and the recovered 25 pdr munitions represent theoretical quantities. A negligible quantity of residual mustard was present on the 4.2-in. UK mortar fuse/bursters.

Additional detail on each test is presented below.

Agent/Munitions Tests 1-3 (10180401, 10190401, 10190402)

The first two tests of single 25 pdr munitions were successful. Visual examination of the fragments by the explosive operators confirmed that destruction of the munition had occurred. On the third test (10190402), the explosive operators noticed a black tar-like material on the inside corner of the inner chamber door. The material was sampled and analyzed by DSTL, and the results confirmed it to be mustard. The mustard tar was left in place overnight and cleaned off the door the following day with standard decontamination procedures by DSTL. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Test 4 (10200401)

Test 4 was the first test of shooting a double munition package that included two 25 pdrs. The test was successful. Visual examination of the fragments by the explosive operators confirmed that destruction of the munition had occurred. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Table 5-2. Agent and Munitions Test Descriptions (2004)

Test	Date	Item	Detonator	Total Fill	Explosives	Oxygen (cubic feet)	Peak Pressure (psig)
10180401	18-Oct-04	25 pdr	1 RP 81	H 1.54 lb	C4 Container 5 lb	No	9.8
10190401	19-Oct-04	25 pdr	1 RP 81	H 1.54 lb	C4 Container 5 lb	No	9.4
10190402	19-Oct-04	25 pdr	1 RP 81	H 1.54 lb	C4 Container 5 lb	No	9.6
10200401	20-Oct-04	25 pdr x 2	2 RP 81	H 3.08 lb	C4 Container 5 lb x 2	200	19.2
10200402	20-Oct-04	4.2" UK Fuse/Bursters x 2	1 RP 81	H residual	C4 Container 10 lb	400	15
10210401	21-Oct-04	25 pdr x 2	2 RP 81	H 3.08 lb	C4 Container 5 lb x 2	400	17.2
10210402	21-Oct-04	25 pdr x 2	2 RP 81	H 3.08 lb	C4 Container 5 lb x 2	400	18.8
10210403	21-Oct-04	10 lb PETN	1 RP 81	None	PETN	400	9.6
10220401	27-Oct-04	10 lb PETN	1 RP 81	None	PETN	400	11.4
10220402	27-Oct-04	10 lb PETN	1 RP 81	None	PETN	400	10
10280401	28-Oct-04	25 pdr	1 RP 81	None	C4 Container 5 lb	200	9.8
10280402	28-Oct-04	25 pdr	1 RP 81	None	C4 Container 5 lb	200	9.8
11020401	2-Nov-04	DOT	1 RP 81	None	PETN 17.5 lb	230	14.4
11020402	2-Nov-04	DOT	1 RP 81	H 11.7 lb	PETN 17.5 lb	230	24.2
11030401	3-Nov-04	DOT	1 RP 81	H 11.7 lb	PETN 16 lb	417	23.4
11030402	3-Nov-04	DOT	1 RP 81	H 11.7 lb	PETN 19 lb	422	24.4
11030403	3-Nov-04	4.2" UK Fuse/Bursters x 2	1 RP 81	H residual	C4 Container 10 lb	424	14.8
11040401	4-Nov-04	4.2" UK Fuse/Bursters x 2	1 RP 81	H residual	C4 Container 10 lb	422	14.8
11040402	4-Nov-04	Double 4.2" UK Fuse/Bursters 4 ea.	2 RP 81	H residual	C4 Container 10 lb x 2	411	31.8
11040403	4-Nov-04	22 lb PETN	1 RP 81	None	PETN/AL	420	17.2

Agent/Munitions Test 5 (10200402)

Test 5 was the first test to demonstrate the capability to destroy mustard-contaminated 4.2-in. UK fuse/bursters. The test was successful. However, the initial continuity circuit test indicated a lack of continuity. The lack of continuity was attributed to a loose wire on the outer plug connection to the interface. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Tests 6 and 7 (10210401, 10210402)

These were the second tests of shooting double 25 pdrs (two in one detonation event). In the first test (10210401), the explosive operators reported that there was black material on the walls of the detonation chamber.

In the first test (10210401), there was a Miniature Chemical Agent Monitoring Systems (MINICAMS) detection of mustard at the chamber entrance sampling location. It took four cycles of the MINICAMS (20 min) to establish a not-detectable response. This location is in the vestibule area that is under engineering controls. The vestibule vents to the off-gas treatment system, prior to the closed loop heat exchanger. The readings are summarized in Table 5-3. Mustard was not detected in the VCS, at the inlet to the carbon beds, or in the system exhaust to the outside environment. A procedural change was implemented for opening the inner blast door. This included steps to open the door in increments. These changes were deemed necessary to reduce air wake effects of personnel standing in front of the door as it opened. In addition, the step function in door opening and slower opening speed allowed a stable air flow pattern and a stable face velocity to be established at each successive door position. This procedure minimizes the effects of the turbulence created by the door swinging through the air inside the chamber.

On chamber inspection following the second test (10210402), the explosive operators noticed that the munitions were not broken into pieces demonstrating conclusively that the munition was completely destroyed. One was split in half and one other had a missing base plate but was not entirely cut from top to bottom. Later examination revealed black staining on the inside cavity of the wall. In the second test (10210402), there was a MINICAMS detection of mustard at the chamber entrance sampling location. It took three cycles of the MINICAMS (15 min) to establish a not-detectable response. This location is in the vestibule area that is under engineering controls. The vestibule vents to the off-gas treatment system, prior to the closed loop heat exchanger. Mustard was not detected in the VCS, at the inlet to the carbon beds, nor in the system exhaust to the outside environment. The readings are summarized in Table 5-3.

Agent/Munitions Tests 8-10 (10210403, 10220401, 10220402)

Tests 8-10 were HE-only shots of 10 lb of PETN to clean the interior of the chamber. The fireset indicated variable continuity on test 10210403. The continuity test resulted in flashing red and green signals. The firing button was pressed and the detonation occurred. The chamber feed through interface was subsequently changed.

Agent/Munitions Tests 11 and 12 (10280401, 10280402)

These tests were single shots of inert 25 pdrs. The purpose of these tests was to verify that the donor package assembly was effectively destroying the rounds. A chamber entry by operators in OSHA Level B PPE was conducted the next day.

A 25 pdr was identified by explosive operators as having a fuse that was not destroyed and as still being partially intact (i.e., only superficial destruction cracks in the walls of the munition and the munition lacked the base plate). In addition, there were an undetermined number of other 25 pdr munitions that were only cut in half and had the appearance of black tar material on the inside surfaces.

Based on these results, the throughput demonstration testing plans were placed on hold. The Test Director, along with advisors from DSTL, deemed it necessary to halt the use of an integrated shaped charge in an explosively configured container. The conclusion was that the donor assembly package was not reliable for effectively destroying 25 pdrs. Additional development work would be required to provide an acceptable donor assembly package that would reliably destroy the 25 pdrs.

Table 5-3. Mustard Detected at the Chamber Face, Tests 10210401 & 10210402

Date - Time	Location	Detection by MiniCAMS
21 October – 0830 - 1237	Above the chamber door	ND*
21 October – 1238-1242	Above the chamber door	11.3 STEL*
21 October – 1242 - 1247	Above the chamber door	0.90 STEL
21 October – 1247 - 1252	Above the chamber door	0.31 STEL
21 October – 1253 - 1540	Above the chamber door	ND
21 October – 1541 - 1546	Above the chamber door	0.51 STEL
21 October – 1546 - 1551	Above the chamber door	0.04 STEL
21 October – 1552 - 1715	Above the chamber door	ND

*ND = not detected; STEL = short term exposure limit

Agent/Munitions Test 13 (11020401)

The purpose of this test was to demonstrate that the PETN sheet explosive wrapping procedure would shatter an inert 5-in. DOT bottle. The PETN sheet explosive wrapping procedure was required to be used because of the lack of repeatable performance with the shaped charge and donor explosive container used for the 25 pdrs. The PETN wrapping test was successful The DOT bottle was shattered in multiple pieces.

Agent/Munitions Tests 14 - 16 (11020402, 11030401, 11030402)

These tests were conducted to demonstrate that the TC-60 CDC could destroy 11.7 lb of mustard—the same quantity contained in a US 155mm projectile. The tests were successful and the DOT bottles were shattered in multiple pieces. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

The fireset continuity tester showed an electrical continuity problem forshots 2 and 3 of the mustard-filled 5-in. DOT bottles. Troubleshooting of the firing circuit could not identify a short or other discontinuity. The fireset was replaced on 3 November.

Agent/Munitions Tests 17 and 18 (11030403, 11040401)

These two tests were repetitions of Test 5, destruction of contaminated fuse/bursters from a UK 4.2-in. mortar. The tests were successful. The bursters were shattered in multiple pieces.

After test shot 11030403, there was a MINICAMS detection of mustard at the chamber entrance. It took three MINICAMS cycles (15 min) to establish a non-detect response. These are summarized in Table 5-4. The vestibule is under engineering controls because it vents to the off-gas treatment system, prior to the closed loop heat exchanger

Mustard was not detected in the VCS, at the inlet to the carbon beds, or in the system exhaust to the outside environment. The administrative procedures implemented to reduce turbulence and wake effects in the door opening procedure, as learned in Tests 10210401 and 10210402, were not followed. An engineering solution was requested by the Test Director.

Table 5-4. Mustard Detections at the Chamber Face, Test 11030403

Date - Time	Location	Detection by MiniCAMS
3 November – 0830 - 1551	Above the Chamber Door	ND
3 November – 1551 - 1556	Above the Chamber Door	6.14 STEL
3 November – 1556 - 1601	Above the Chamber Door	0.62 STEL
3 November – 1601 - 1606	Above the Chamber Door	0.18 STEL
3 November- 1606 - 1750	Above the Chamber Door	ND

Agent/Munitions Test 19 (11040402)

This test was to demonstrate the destruction of multiple items, similar to Tests 4, 6, and 7, except that Test 19 was to destroy a double package of 4.2-in. fuze/bursters (four

fuze/bursters in total). The test was successful. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment. During the loading operation of the double munition package, it was noticed that the transfer hook was bent and failed to transfer to the target hanging point. This was corrected by bending the target hook into the proper position. In addition, there was a failure of the outer door "proof of closure" switch to make contact after the munition was loaded. This was corrected by tightening the clamps that secure closure of the outer door.

Agent/Munitions Test 20 (11040403)

This test was an HE shot to clean the interior of the chamber with 22 lb of PETN explosive, prior to thermal decontamination in preparation for a site shutdown. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

The demonstration testing was halted to allow for a re-design of the donor explosives and testing confirming the effectiveness of the new donor explosive package.

5.2 Operations Subtest 2006.

5.2.1 Workup Tests 2006.

February 27-28, 2006

During this period, workup tests were again conducted with HE only. The workup tests were to confirm that:

the operators were appropriately trained on the system,

- the SOPs were fully developed,
- explosive operations could be conducted safely, and
- the new donor package assembly was effective and reliable.

No requirements, goals or indicators for workup testing were included in the Test Plan.

Six tests were conducted with eight simulated 25 pdrs filled with approximately 90% water. Four of the tests were conducted with single 25 pdrs. The remaining two tests were conducted on a double shot, with simulated 25 pdrs. All of the tests were conducted using the re-designed donor package assembly.

The new donor package assembly consisted of the outer plastic shell used previously (two pieces, each forming one half of the container). The inner plastic mold was eliminated, as well as the shaped charges. A glued section of polyurethane foam was applied to each half-shell of the container, and a contoured section of SX2 plastic explosive, 3.25 lb each, was placed on top of the foam. The 25 pdr munition was placed in one of the half-shell containers. The other half-section was placed on top of the 25 pdr, resulting in a total donor explosive weight of 6.5 lb. The assembly was zip-tied and duct taped. A PETN-filled booster

cup was placed into the top of the assembly. A detonator was placed into a receiving tube of the PETN booster cup. Application of the detonator completed the explosive assembly package.

5.2.2 Workup Test Results 2006.

February 27-28, 2006

All workup testing during this period was achieved safely. Table 5-5 summarizes the workup tests. The detonators used were RP-81 detonators. Each of the test results verified that the 25 pdr munitions were shattered in small pieces, about 1 to 2 inches long and 1 inch wide.

Test results established that operators were appropriately trained on the system, SOPs were fully developed, explosive operations could be conducted safely, and the new donor package assembly was effective and reliable. The workup testing was thereby satisfied.

Table 5-5. Workup Test Description (2006)

Test	Date	Item	Detonator	Fill	Explosives	Oxygen (cubic feet)	Peak Pressure (psig)
02270601	27 Feb 06	Inert round	1 – RP81	water	SX2 – 6.5 lb	263	8.6
02270602	27 Feb 06	Inert round	1 - RP81	water	SX2- 6.5 lb	326	8.8
02280601	28 Feb 06	Inert round	1 – RP81	water	SX-2 – 6.5 lb	214	8.6
02280602	28 Feb 06	Inert Round	1 – RP81	water	SX-2 – 6.5 lb	222	8.4
02280603	28 Feb 06	Inert round x2	2 – RP81	water	SX-2 – 13 lb	436	13.6
02280604	28 Feb 06	Inert round x2	2-RP81	water	SX-2 – 13 lb	445	13.8

5.2.3 Chemical Agent Munitions Tests 2006.

Requirements and Goals of the Chemical-filled Munitions Tests

The requirements and goals of the *Test Plan* published in 2004 remain the same for 2006.

Chemical Agent Munitions Testing Results 2006

March 1 - March 23, 2006

Following the workshop testing on February 27 and 28, the demonstration test operations were resumed on March 1, 2006. The objective of this round of demonstration testing was to assess the TC-60 CDC production capability. A throughput exercise was conducted during March 14-16 and March 21-23 to demonstrate how many munitions the TC-60 could destroy in 6 operating hours per day. This was repeated for 6 shooting days. Explosive operator crews (2 people) were changed out every 3 to 4 hours. During throughput testing, the TC-60 CDC remained operational 24-hr a day, starting the day before scheduled throughput testing and ending on the last day of throughput testing, following the last shot.

There were 101 recovered 25 pdrs in inventory at DSTL, which were fuzed and filled with mustard that were available for this testing period. The entire inventory of mustard-filled 25 pdrs was destroyed during demonstration testing. The 58 individual tests consisted of 15 single shots and 43 double shots. The highest production rate was achieved on March 22, when 16 munitions were destroyed in eight shots (double 25 pdrs shot). All 25 pdrs were completely destroyed, including many that contained solidified mustard. Mustard was not detected in the VCS, at the inlet to the carbon beds, or in the system exhaust to the outside environment during any of the throughput testing.

There also were four shots of HE only to clean the interior of the chamber prior to scrap metal removal (destroyed 25 pdrs and hanging assembly scrap metal). Scrap metal removal was a planned weekly exercise. The largest number of munitions cleaned out of the chamber at the end of the week was 42 (March 21-23 testing). Demonstration testing results are summarized in Table 5-6, in chronological order.

Table 5-6. Agent And Munitions Test Descriptions (2006)

Test	Date	Item	Detonator	Fill	Explosives	Oxygen (cubic feet)	Peak Pressure (psig)
3010601	1-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	214	9.8
3020601	2-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	214	9.9
3020602	2-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	238	10.3
3020603	2-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	485	16.6
3030601	3-Mar-06	1 HE	1 RP 81	None	C4 10 lb	213	9.7
3060601	6-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	214	10.6
3060602	6-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	216	10.1
3060603	6-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	437	17.8
3070601	7-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	236	10.3
3070602	7-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	495	17
3070603	7-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	440	16.7
3080601	8-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	213	10.1
3080602	8-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	223	10.3
3080603	8-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	440	17.3
3080604	8-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	448	17.2
3090601	9-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	445	17.3
3090602	9-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	470	16.9
3090603	9-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	480	17.3
3090604	9-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	223	10.3
3090605	9-Mar-06	1 HE	1 RP 81	None	PETN 10 lb	240	9.9
3140601	14-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	622	18.6
3140602	14-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	612	17.1
3140603	14-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	559	17.1
3140604	14-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	638	17.9
3140605	14-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	569	18
3140606	14-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	330	10.9

Table 5-6. Agent And Munitions Test Descriptions (2006) (Continued)

Test	Date	Item	Detonator	Fill	Explosives	Oxygen (cubic feet)	Peak Pressure (psig)
3140607	14-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	344	10.9
3140608	14-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	355	10.8
3150601	15-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	438	17.9
3150602	15-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	440	17.6
3150603	15-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	447	17.9
3150604	15-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	449	18.4
3150605	15-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	218	10.9
3150606	15-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	218	11
3150607	15-Mar-06	25 pdr	1 RP 81	H 1.54 lb	SX2 - 6.5 lb	220	11.2
3150608	15-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	439	19.4
3160601	16-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	442	18.5
3160602	16-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	621	17.8
3160603	16-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	520	18.2
3160604	1[illegible]-Mar-06	1 HE	1 RP 81	None	PETN 10 lb	334	10.3
3210601	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	439	19.2
3210602	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	445	17.6
3210603	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	443	19.9
3210604	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	17.9
3210605	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	447	18.5
3210606	21-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	18.7
3220601	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	445	18.1
3220602	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	447	18.1
3220603	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	447	18
3220604	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	20.1
3220605	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	18.8
3220606	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	19

Table 5-6. Agent And Munitions Test Descriptions (2006) (Continued)

Test	Date	Item	Detonator	Fill	Explosives	Oxygen (cubic feet)	Peak Pressure (psig)
3220607	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	442	19.4
3220608	22-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	445	20.4
3230601	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	18.6
3230602	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	446	19
3230603	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	444	19.2
3230604	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	443	19
3230605	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	441	19.7
3230606	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	443	19.4
3230607	23-Mar-06	25 pdr x 2	2 RP 81	H 3.08 lb	SX2 - 13 lb	443	18.4
3230608	23-Mar-06	HE	1 RP 81	None	PETN 10 lb	218	10.9

During the period of March 1-9, the explosive operators gained experience in preparing and shooting single shots and double shots with the new explosives package. There were twenty-seven 25 pdrs destroyed. Of these 27 munitions, nine were single shots and nine were double shots.

The total weight of mustard destroyed was approximately 155 lb, based on the theoretical fill weight of a 25 pdr (1.54 lb each). Individual results of agent and munitions tests are discussed in subsequent sections.

Agent/Munitions Tests 1-3 (3010601, 3020601, 3020602)

These tests demonstrated the destruction of a fuzed 25 pdr with mustard fill. The test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

After the first 25 pdr detonation (3010601), the water pump that supplied cooling water to the heat exchanger tripped the circuit breaker. The issue was resolved by resetting the circuit breaker.

A broken bolt inside the chamber was observed by the explosive operators after the third shot (3020602). The bolt was identified to be in the bottom left corner of the hinge plate that attaches the armor- resistant steel to the wall of the chamber. A single lost bolt from a plate was deemed not critical because there are multiple (a least 5) bolts that attach the armor plate to the wall.

The system had to be manually shut down at the end of the day after test 3020602 because of a loss of power to the pneumatic valves at the face of the chamber. The problem, which was caused by a loose 24V wire in the detonation chamber junction box, was diagnosed the following day (3 March, a scheduled maintenance day). The wire was reattached to the terminal strip, restoring communication with the PLC and HMI. The issue was resolved after corrective actions were implemented.

Agent/Munitions Test 4 (3020603)

This test was to demonstrate the destruction of a double 25 pdr. The test result was successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Test 5 (3030601)

This test was to detonate 10 lb of C-4 explosive. The test result was successful. This test demonstrated the ability to accomplish cleanup of the chamber with explosives prior to chamber entry for inspection and cleanout.

Agent/Munitions Tests 6 and 7 (3060601 and 3030602)

These tests were to repeat the single 25 pdr shots. The test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Test 8 (3060603)

This test was to demonstrate the destruction of a double 25 pdr (identical to Test 4). The test result was successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Test 9 (3070601)

This test was to repeat the single 25 pdr shots. The test result was successful. The 25 pdr was shattered in multiple pieces. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule nor in the system exhaust to the outside environment.

Agent/Munitions Tests 10 and 11 (3070602 and 03070603)

These tests were to repeat the destruction of a double 25 pdr. The test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Tests 12 and 13 (3080601 and 03080602)

These tests were to repeat the destruction of a single 25 pdr. The test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

A Depot Area Agent Monitoring System (DAAMS) sample was collected after Test 12. This sample represented the air between the detonation chamber and expansion chamber. The result was 0.25 times the short-term exposure limit of 0.003 mg/m^3 for mustard.

Agent/Munitions Tests 14 - 18 (3080603, 3080604, 3090601, 3090602, and 3090603)

These tests repeated the destruction of double 25 pdrs. The test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

A DAAMs sample was collected after Test 15. This sample represented the air stream between the detonation chamber and expansion tank. The result was 16.8 times the short-term exposure limit of 0.003 mg/m^3.

On Test 16, the PLC aborted the detonation sequence because the flow-indicating transmitter for air flow from the vestibule had registered a 5-millisecond value that was below the set-point value. This was identified as an electronic noise spike. A program change was made, increasing the 5-milliseconds value to 10 millisecond, and the condition did not reoccur.

Agent/Munitions Test 19 (3090604)

This test was to repeat the single 25 pdr shots. The test result was successful. The 25 pdr was shattered in multiple pieces. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

Agent/Munitions Test 20 (3090605)

This test was to detonate 10 lb of PETN explosive for chamber cleanup. The test result was successful.

A DAAMS sample was collected after Test 20, representing the air between the detonation chamber and expansion chamber. The result was 1.2 times the short-term exposure limit of 0.003 mg/m^3.

Scheduled maintenance was performed on the next day, March 10, which included an OSHA Level B entry into the chamber. During the maintenance entry, samples were

collected inside the chamber consisting of pea gravel and surface wipe samples. Scrap was removed and stored in four 30-gal drums. A spent lime sample was also collected for analysis.

The six pea gravel samples and one lime sample were analyzed for mustard, 1,4-thioxane, and 1,4-dithiane. The results for these analyses were all non-detect at a level of 0.001 μg/g of sample.

The 10 surface wipe samples were analyzed for the same constituents. Eight of the wipe samples were non-detect for all constituents at a level of 0.013 μg/wipe. Two of the wipe samples were non-detect for mustard and 1,4-thioxane. The 1,4-dithiane was detected at levels of 0.019 and 0.020 μg/wipe.

Agent/Munitions Tests 21 - 28 (3140601, 3140602, 3140603, 3140604, 3140605, 3140606, 3140607, and 3140608)

These tests represented the start of the throughput testing. The first five tests represented the destruction of double 25 pdrs. The last three tests represented the destruction of single 25 pdrs. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

The first shot detonation sequence was aborted because of a PLC communication error at Skid 6 that lasted for 4 sec. Grease was applied to the Skid 6 cabinet weather stripping to prevent condensation. The discrepancy was rectified and did not reoccur during the test program.

Agent/Munitions Tests 29 - 36 (3150601, 3150602, 3150603, 3150604, 3150605, 3150606, 3150607, and 3150608)

These tests represented continuation of throughput testing. The first four tests represented the destruction of double 25 pdrs. The next three tests represented the destruction of single 25 pdrs. The last test represented a double 25 pdr. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment. A DAAMS sample was collected after Test 36 representing the air between the detonation chamber and expansion tank. The result was 1.3 times the short- term exposure limit of 0.003 mg/m^3.

Agent/Munitions Tests 37 - 39 (3160601, 3160602, and 3160603)

During the evening of March 15, the HMI operator had trouble maintaining the operating temperatures in the system. The system was shut down and restarted at 5:00 am. At 8:00 a.m., the purge blower had shut down. The problem was diagnosed to be a loose fan belt. The belt was tightened. This issue was resolved within approximately 1.5 hr. However, during troubleshooting a set point position switch on the pressure monitor of the purge blower was inadvertently changed. This caused the purge blower to automatically shut off. The set-point

position was reset to the proper control point. Diagnosis and resolution of this problem required approximately 3 hr. As a result, the throughput testing for 16 March was truncated.

These tests represented continuation of throughput testing and the destruction of double 25 pdrs. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, or in the system exhaust to the outside environment.

Agent/Munitions Test 40 (3160604)

This test was to detonate 10 lb of PETN explosive. The test result was successful. This was a cleanup test to prepare the chamber for inspection and cleanout.

Scheduled maintenance was performed on March 17 that included an OSHA Level B entry into the chamber. Pea gravel and surface wipe samples were obtained inside the chamber. Three 30-gal drums of metal scrap were collected. A spent lime sample was also collected for analysis. The six pea gravel samples and one lime sample were analyzed for mustard, 1,4-thioxane, and 1,4-dithiane. The results for all but one of these analyses were non-detect at a level of 0.001 μg/g of sample. The lime sample was non-detect for mustard at a level of 0.003 μg/g of lime.

The 10 surface wipe samples were analyzed for the same constituents. Nine of the wipe samples were non-detect for all constituents at a level of 0.013 μg/ wipe. One wipe sample was non-detect for 1,4-thioxane and 1,4-dithiane. Mustard was detected at a level of 0.47 μg/wipe.

Two additional bolt heads were found mixed in with the scrap and were identified as coming from the left wall of the chamber and used to attach the armor-resistant plates. The bolts were from different locations from the first discovery and were not critical to operations. Attempts to remove the stem of the bolt from the retaining nut, which is welded in place, were unsuccessful.

The inside plug that connects the detonator circuit to the pass-through interface was found to be broken off. Maintenance was performed to remove the plug.

Agent/Munitions Tests 41 - 46 (3210601, 3210602, 3210603, 3210604, 3210605, and 3210606)

These tests represented continuation of throughput testing and the destruction of double 25 pdrs. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, or in the system exhaust to the outside environment.

The "proof of closure" switch at the inner chamber door was lost during the ventilation period after shot 3210602. The explosives operator was required to tighten the mounting screws for the switch to reestablish the proof of closure.

In shot 3210603 there was a continuity failure recorded at the fireset. The lack of continuity was traced to a broken coaxial wire connection to the outer interface plug connection. A spare plug was available and the failed continuity issue in the firing circuit was resolved. Maintenance repaired the broken wire after the last shot of the day.

A DAAMS sample was collected after Test 46, representing the air between the detonation chamber and expansion chamber. The result was 0.4 times the short-term exposure limit for mustard of 0.003 mg/m^3.

Agent/Munitions Tests 47 - 54 (3220601, 3220602, 3220603, 3220604, 3220605, 3220606, 3220607, and 3220608)

These tests represented continuation of throughput testing and the destruction of double 25 pdrs. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

In shot 3220607, a continuity failure was recorded at the fireset. The lack of continuity was traced to lose wire on the outer connection to the feed through interface. The wires on the failed connector were repaired and operations continued.

Agent/Munitions Tests 55 - 61 (3230601, 3230602, 3230603, 3230604, 3230605, 3230606, and 3230607)

These tests represented continuation of throughput testing and the destruction of double 25 pdrs. The remaining inventory of recovered 25 pdrs was destroyed. All test results were successful. The 25 pdrs were shattered in multiple pieces for each shot. Mustard was not detected in the VCS, at the inlet to the carbon beds, in the vestibule, nor in the system exhaust to the outside environment.

During shot 3230605, a continuity failure was recorded at the fireset. The lack of continuity was traced to a broken coaxial wire connection to the outer interface plug connection. A spare plug was available for immediate replacement and the failed continuity issue in the firing circuit was resolved and operations continued. Maintenance repaired the broken wire following the last shot of the day.

Agent/Munitions Test 62 (3230608)

This test was to detonate 10 lb of PETN explosive for chamber cleanup. The test result was successful. This represented the end of throughput testing. Thermal decontamination and closeout were the next program elements.

A DAAMS sample was collected after Test 62, representing the air between the detonation chamber and expansion tank. The result was 0.49 times the short-term exposure limit for mustard of 0.003 mg/m^3.

Scheduled maintenance was performed on March 24, which included an OSHA Level B entry into the chamber. Pea gravel and surface wipe samples were obtained inside the chamber. A spent lime sample was not collected for this week.

The six pea gravel samples were analyzed for mustard, 1,4-thioxane and 1,4-dithiane. The results for these analyses were all non-detect at a level of 0.001 μ/g of sample.

The 10 surface wipe samples were analyzed for the same constituents. Eight of the wipe samples were non-detect for all constituents at a level of 0.013 microgram per wipe. Two of the wipe samples were non-detect for mustard and 1,4-thioxane. The 1,4-dithiane was only just detected at 0.013 μg/wipe.

5.2.4 Productivity.

The TC-60 CDC successfully processed 101 mustard-filled (25-pdr UK) munitions during testing in 2006. Table 5-7 summarizes the number of mustard-filled munitions processed by the TC-60 CDC between March 1 and March 23, 2006. Munition throughput tests were conducted during the last two weeks of testing to assess system productivity under actual operating conditions. Several factors affecting productivity were observed and documented during throughput testing.

Table 5-7. Chemical Warfare Materiel Processing Summary

Test Phase	Processing Dates	Test Item	Single Munition Packages	Double Munition Packages	Total Munitions
Mustard Pre-Trials	01-Mar to 09-Mar-2006	25-lb UK	9	9	27
Throughput Test Week 1	14-Mar to 16-Mar-2006	25-lb UK	6	13	32
Throughput Test Week 2	21-Mar to 23-Mar-2006	25-lb UK	0	21	42
Total Munitions Processed	—	—	15	43	101

Munitions processed during Phase II testing included 43 double munition packages and 15 single munition packages. As shown in Table 5-7, the number of munitions processed increased during the test period. The mustard pre-productivity test phase processed 27 munitions, followed by 32 munitions, during the first week of throughput testing and then 42 munitions during the second week of throughput testing.

Throughput testing was conducted over 6 shooting days between March 14 and March 23, 2006. Tables 5-8 and 5-9 present the munition processing activities, including munition package detonation and cycle times. The cycle time for processing munition packages began with the daily safety brief for the first cycle and ended when the munition package was detonated. Subsequent munition package cycle times began when the previous munition packages were detonated and ended when the current munition package was detonated. Munition package (single and double packages) processing cycle times ranged from 31 min to 1 hr 38 min. No significant difference in the cycle time was observed in processing single and double munition packages.

Table 5-8. Throughput Cycle Times, First Week

Shot No.	Munition Package Type[1]	Start Time	Detonation Time	Cycle Time	Test Interruptions
14-Mar-2006					
1	D	9:10	10:07	0:57	personnel accountability, detonation sequence alarm
2	D	10:07	10:45	0:38	—
3	D	10:45	11:21	0:36	—
4	D	10:54	11:29	0.35	
					Lunch
5	D	13:03	13:51	0:48	lime added
6	S	13:51	14:29	0:38	—
7	S	14:29	15:07	0:38	—
8	S	15:07	15:48	0:41	—
15-Mar-2006					
1	D	9:00	9:44	0.44	
2	D	9:44	10:19	0:35	—
3	D	10:19	10:54	0:35	—
4	D	10:54	11:29	0:35	—
					Lunch
5	S	12:58	13:40	0:42	lime added
6	S	13:40	14:15	0:35	—

Table 5-8. Throughput Cycle Times, First Week (Continued)

Shot No.	Munition Package Type	Start Time	Detonation Time	Cycle Time	Test Interruptions
7	S	14:15	14:54	0:39	—
8	D	14:54	15:38	0:44	—
16-Mar-2006					
1	D	13:18	14:02	0:44	—
2	D	14:02	14:37	0:35	—
3	D	14:37	15:13	0:36	—

Notes:1 - single (S) or double (D) munition package

Total operating hours for the first and second weeks of throughput testing were 12 hr 39 min and 14 hr 27 min, respectively. The average munition package and munition cycle times are shown in Table 5-10. These operating times do not include lunch breaks taken during daily operations.

Three-day throughput of 42 munitions (21 double packages) in an average 4 hr 49 min per day of operation.

Maximum daily throughput of 16 munitions (8 double packages) in 5 hr 17 min of operation.

Average munition processing time was reduced to a 35.7-min cycle for one double package (2 munitions) during the last day (March 23, 2006) of throughput testing.

Table 5-9 Throughput Cycle Times, Second Week

Shot No.	Munition Package Type [1]	Start Time	Detonation Time	Cycle Time	Test Interruptions
21-Mar-2006					
1	D	9:05	10:31	0:48 [2]	personnel accountability
2	D	10:31	11:11	0:40	inner door alarm
3	D	11:11	12:49	1:38	continuity alarm
4	D	12:49	13:25	0:36	—
5	D	13:25	14:05	0:40	lime added
6	D	14:05	14:43	0:38	—
22-Mar-2006					
1	D	8:57	9:32	0:35	—
2	D	9:32	10:07	0:35	—
3	D	10:07	10:44	0:37	—
4	D	10:44	11:19	0:35	—
5	D	11:19	12:00	0:41	lime added
6	D	12:20	12:56	0:36	—
7	D	12:56	13:56	1:00	continuity alarm, inner door alarm
					Lunch
8	D	15:05	15:43	0:38	—
23 March 2006					
1	D	9:23	9:54	0:31	—
2	D	9:54	10:27	0:33	—
3	D	10:27	11:02	0:35	—
4	D	11:02	11:37	0:35	—
5	D	11:37	12:24	0:47	lime added, continuity alarm
6	D	12:49	13:20	0:31	—
7	D	13:20	13:58	0:38	—

Notes:1 - single (S) or double (D) munition package; 2 - Cycle time does not include a 38-minute delay in starting due to environmental testing setup.

Table 5-10. System Throughput Test Summary

Test Phase	Processing Date	Operating Hours (hrs:min)	Single Munition Packages	Double Munition Packages	Total Munitions Processed	Average Munition Package Cycle Time (min)
Throughput Test Week 1	14-Mar-2006	5:35	3	5	13	41.9
	15-Mar-2006	5:09	3	5	13	38.6
	16-Mar-2006	1:55	0	3	6	38.3
	Weekly Total/Average	12:39	6	13	32	39.6
Throughput Test Week 2	21-Mar-2006	5:00	0	6	12	50.0
	22-Mar-2006	5:17	0	8	16	39.6
	23-Mar-2006	4:10	0	7	14	35.7
	Weekly Total/Average	14:27	0	21	42	41.8

Factors affecting throughput included administrative procedures, operator experience, and equipment operation. Specific factors affecting productivity during throughput testing are noted in Tables 5-8 and 5-9.

All personnel working within the test area were accounted for prior to initiation of the firing sequence. Personnel accountability delays ranged from 4 to 7 min. However, no personnel accountability delays were observed during the last two days of throughput testing (see Table 5-9).

Productivity improved as operators became more experienced with the process. Two operator teams of 2 persons each worked each day. Each team processed up to four munition packages per day. Two different operator teams were mobilized during the second week of throughput testing. The average munition processing cycle time for munition packages decreased each week of throughput testing. During the first week, the average cycle time decreased from 41.9 min to 38.3 min and during the second week the average cycle time decreased from 50.0 min to 35.7 min. This continuing improvement in a short-term test indicates that the system productivity will become more consistent and reproducible with more experience in an operating environment.

Several system alarms were activated during operations, which reduced productivity. System alarms activated during throughput testing included inner chamber door, firing system continuity, and detonation sequence alarms. Delays resulting from system alarms ranged from 2 to 46 min. None of these alarms caused system shutdown for corrective maintenance. The overall system availability during the entire testing period was greater than

95%, as calculated from the time the system was ready to operate to the time the testing was ended each day. The availability calculations are in Appendix D.

5.2.5 Chemical Agent Monitoring Results.

A summary of work area chemical agent monitoring results is provided in Tables 5-11 and 5-12.

During operations, chemical agent monitoring by DAAMS was performed periodically at the crossover pipes between the detonation chamber and the expansion tank. The results of this monitoring are given in Tables 5-13 and 5-14. It is particularly noteworthy that these detections are the only locations where mustard agent was detected in the process. There were no detections during operations downstream of the crossover pipes. No detections were made in the exhaust pipe leaving the expansion tank. No detections were made in the ductwork before the carbon beds. No detections were made in the duct work leaving the carbon beds. No detections were made in the exhaust from the building.

Table 5-11. Operations Monitoring Summary – 2004

Sample Location	Description	Detections
CF1	West AHU – mid-Bed	No Detections 15 Oct – 8 November
CF2	East AHU – mid-Bed	No Detections 15 Oct – 8 November
S1	West AHU Stack	No Detections 15 Oct – 8 November
S2	East AHU Stack	No Detections 15 Oct – 8 November
CP	Command Post	No Detections 15 Oct – 8 November
VCS1	NW Corner –Test Bldg	No Detections 15 Oct – 8 November
VCS2	SW Corner - Test Bldg	No Detections 15 Oct – 8 November
VCS3	NE Corner – Test Bldg	No Detections 15 Oct – 8 November
VCS4	SE Corner – Test Bldg	No Detections 15 Oct – 8 November
01-400	Before CDC Carbon Beds	No Detections 15 Oct – 8 November
01-401	After CDC Carbon Beds	No Detections 15 Oct – 8 November
MWT	Munition Wrapping Table	No Detections 15 Oct – 8 November
PDS	Personnel Decontamination Station	No Detections 15 Oct – 8 November
DCV1	Mechanical Loader	Detections by MiniCAMS were made on 21 October and 3 November.. No other detections by MiniCAMS were made.
DCV2	Vestibule	No Detections 15 Oct – 8 November

Table 5-12. Operations Monitoring Summary – 2006

Sample Location	Description	Detections
CF1	West AHU – mid-Bed	No Detections 1 March - 30 March
CF2	East AHU – mid-Bed	No Detections 1 March – 30 March
S1	West AHU Stack	No Detections 1 March – 30 March
S2	East AHU Stack	No Detections 1 March – 30 March
CP	Command Post	No Detections 1 March – 30 March
VCS1	NW Corner –Test Bldg	No Detections 1 March – 30 March
VCS2	SW Corner - Test Bldg	No Detections 1 March – 30 March
VCS3	NE Corner – Test Bldg	No Detections 1 March – 30 March
VCS4	SE Corner – Test Bldg	No Detections 1 March – 30 March
01-400	Before CDC Carbon Beds	No Detections 1 March – 30 March
01-401	After CDC Carbon Beds	No Detections 1 March – 30 March
MWT	Munition Wrapping Table	No Detections 1 March - 27 March*
PDS	Personnel Decontamination Station	No Detections 1 March – 30 March
DCV1	Mechanical Loader	No Detections 1 March – 30 March
DCV2	Vestibule	No Detections 1 March – 30 March

*Monitoring at the wrapping table ceased after 27 March

Table 5-13. Crossover Pipes Between Detonation Chamber and Expansion Tank During Operations – 2004

Date - Time	Location	Detections
21 October – 1658-1710	Cross 1	15.7 STEL
22 October – 0858-0910	Cross 1	11.4 STEL

Note: STEL = Short-Term Exposure Limit. The STEL for mustard is 0.003 mg/m^3.

Table 5-14. Crossover Pipes Between Detonation Chamber and Expansion Tank During Operations – 2006

Date - Time	Location	Detections
8 March 0833 - 0845	Cross 1	0.25 STEL

Table 5-14. Crossover Pipes Between Detonation Chamber and Expansion Tank During Operations – 2006 (Continued)

Date - Time	Location	Detections
8 March 1613 - 1625	Cross 1	16.8 STEL
14 March 1633 - 1645	Cross 1	0.55 STEL
15 March 1630 - 1642	Cross 1	1.3 STEL
16 March 1628 - 1640	Cross 1	0.2 STEL
21 March 1619 - 1631	Cross 1	0.4 STEL
22 March 1615 - 1627	Cross 1	0.82 STEL
23 March 1643 - 1655	Cross 1	0.49 STEL

Note: STEL = Short-Term Exposure Limit. The STEL for mustard is 0.003 mg/m^3.

5.2.6 Summary of Agent and Munitions Testing Results Related to the Test Plan.

Chemical munitions testing of the TC-60 CDC system met all program requirements and goals established in the Test Plan. The most significant testing accomplishments are summarized below.

- Munitions preparation, handling, and TC-60 CDC operations were conducted without any injuries to testing personnel or exposures to chemical agent.

- No fugitive chemical agent vapors were detected outside the TC-60 CDC at any time during the testing.

- Chemical agent was never detected by DAAMS, or MINICAMS, at any location within the VCS perimeter.

- Residual chemical agent that was detected in the detonation chamber off-gas was destroyed in the initial stages of the off-gas treatment system prior to entering the carbon adsorption unit.

- Munitions (including DOT bottles) were destroyed by the donor explosives.

- All fuses and bursters were destroyed by the donor explosives.

- Metal scrap was decontaminated in-situ using HE detonations to the Worker Protection Limit detection level (one data point).

- Solid residues were removed from the detonation chamber using approved procedures and packaged to meet requirements for transportation to a DSTL-approved disposal facility.

- Waste samples were capable of being analyzed, using approved analytical methods, at a detection level appropriate to validate destruction.

6. ENVIRONMENTAL CHARACTERIZATION

6.1 Environmental Characterization Subtest Objectives.

Environmental characterization was added as a subtest objective to prepare for the environmental assessment and permitting tasks that will be required for deployment in the United States or elsewhere. The criteria were to develop a measurement for the environmental parameters that will be significant in a National Environmental Policy Act evaluation, a Clean Air Act permit, and a Resource Conservation and Recovery Act (RCRA) permit.

Overall, the goal of this environmental characterization was to gather data to support future permitting of the TC-60 CDC system for use in the United States. To that end, specific goals of the environmental characterization were established in the Sampling and Analysis Plan TC-60 CDC Demonstration/Validation Phase II (Final -February 24, 2006). These goals were:

- Determine concentrations of total hydrocarbons and VOCs from the VCS air filtration unit #2

- Determine the final mass emission rates of chlorides, particulate matter, metals, polychlorinated dibenzo-dioxins/polychlorinated dibenzo-furans (PCDDs/PCDFs), semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), oxygen, carbon dioxide, sulfur dioxide, nitrogen oxides, and carbon monoxide from the VCS building air filters

- Determine the hazardous characteristics of spent lime and pea gravel following system decontamination.

• Details of the environmental characterization sampling and analysis techniques are provided in Appendix C of this report. The following text describes the general sampling and analysis approach used for the characterization as well as the results. Also discussed, are the significance of the results with respect to U.S. permitting issues.

6.2 Environmental Air Emissions Testing and Results.

To characterize the air emissions from the process and develop representative emission factors, sampling and analysis was conducted during the period of highest productivity where the throughput rate of 25 pdr mustard-filled munitions was maximized. Three sampling events were conducted on three consecutive days. The sampling periods for these three runs were 280 min, 290 min, and 230 min in duration, and the mass of agent destroyed in each test run was 18.84 lb, 21.98 lb, and 18.84 lb, respectively.

As part of the overall testing program, air emissions from two locations in the process were sampled and analyzed for selected parameters. Sample Location 1 was in the exhaust gas duct between the VCS building and the HEPA/Carbon filtration unit as shown in Figure 6-1. Sample location 2 (Figure 6-1) was from the temporary, horizontal exhaust "stack" that was connected to the Air Filtration Unit #2 exhaust fan. Multiple sampling ports were located on the sides of the temporary exhaust duct to accommodate all of the air sampling systems and to enable a 12-point (4 x 3) sampling matrix prescribed by the U.S. Environmental Protection Agency (EPA) for characterization of velocity and determination of volumetric flow rate.

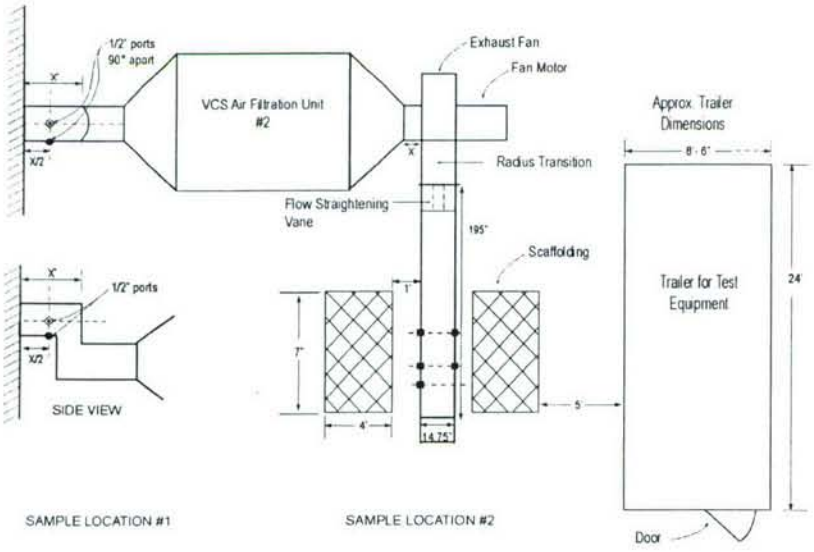


Figure 6-1. Schematic of Exhaust Ducting and Sampling Locations (Between VCS Bldg and HEPA/Carbon Filtration Unit)

The EPA stack sampling methods shown in Table 6-1 were used to quantify the emission products released during the detonation of munition items selected for testing.

These methods were selected based on the chemical composition of the items to be detonated and predictions of the expected detonation products and the known chemical composition of the items to be destroyed as part of this test.

Table 6-1. Sampling and Analytical Methods for Test Parameters

Test Parameter	Sampling Method	Analytical Method
Sampling Point Selection, Gas Velocity and Volumetric Flow Rate Determination	EPA Methods 1 and 2	S-type pitot tube
Oxygen (O_2)	EPA Method 3A	Continuous Emission Monitor
Carbon Dioxide (CO_2)	EPA Method 3A	Continuous Emission Monitor
Moisture (H_2O)	EPA Method 4	Gravimetric
Sulfur Dioxide (SO_2)	EPA Method 6C	Continuous Emission Monitor
Nitrogen Oxides (NO_x)	EPA Method 7E	Continuous Emission Monitor
Carbon Monoxide (CO)	EPA Method 10	Continuous Emission Monitor
Total Hydrocarbons (THC) [1]	EPA Method 25A	Continuous Emission Monitor
Particulate Matter (PM)	EPA Method 5	Gravimetric
Hydrogen Chloride/Chlorine (HCl/Cl_2)	EPA Method 26A	IC Method SW9057
Metals	EPA Method 29	ICPAES Method SW6010B
C1-C6 Hydrocarbons	ASTM D2820	GC-FID
Volatile Organic Compounds [1]	Compendium Method TO-14A	GC/FID – GC/MS
Semi-volatile Organic Compounds	SW-846 Method 0010	GC/MS Method SW8270C
Polychlorinated dibenzo-dioxins/-furans	SW-846 Method 0023A	HRGC/HRMS Method SW8290

Notes: (1) Sample Point 1 (upstream of the VCS Air Filtration Unit) was sampled only for total hydrocarbons and volatile organic compounds. . All methods were performed on samples from Sample Point 2.

The results of the environmental air emissions testing indicated very low emissions as further described in Section 6.2.1 and in Appendix C. Some metals emissions,

although low, could not be definitively quantified due to field sampling errors. These errors are further described in section 6.2.5 and in Appendix C. A brief summary is provided as follows:

- Gaseous emissions of criteria pollutants and total hydrocarbons were in the single digit ppm concentration range
- Total hydrocarbons was primarily due to the propane fuel for the hot gas generator
- Toxic volatile organic compound (VOC) emissions, of speciated compounds, were in the part per billion concentration range
- There were virtually no semi-volatile organic compounds emitted to the atmosphere
- The dioxin/furan toxic equivalent concentration was in the low femtogram (fg) per normal cubic meter concentration range, or about 10,000 times lower than would be typically expected to raise a permitting issue
- Total Particulate Matter emissions were less than 0.03 lb/hr (0.6 mg/ normal cubic meter).
- HCl and chlorine emissions were extremely low [0.02 parts per million volume (ppmv) as Cl^-]
- The metal emitted of the highest concentration was iron, which is not toxic.

The TC-60 would be considered a minor source for Title V (Clean Air Act Amendments of 1990) applicability determination purposes because none of the threshold emission rate triggers that determine program applicability were exceeded. A Subpart X (Miscellaneous Treatment Unit) permit would be required for a RCRA-affected facility if a RCRA permit is required for a response action.

6.2.1 Gaseous Emissions.

The stack discharge from the VCS Air Filtration Unit #2 was monitored continuously, using EPA Reference Methods as defined in Table 6.1. Samples were collected during destruction operations from March 21-23, 2006 for the following parameters:

- oxygen (O_2)
- carbon monoxide (CO)
- carbon dioxide (CO_2)
- sulfur dioxide (SO_2)
- nitrogen oxides (NOx)
- total hydrocarbons (THC)

Total hydrocarbons were also measured at the inlet of the VCS Air Filtration Unit #2. The mean and maximum concentrations for these gases are presented in Table 6-2.

Integrated samples for VOCs were collected at the inlet and outlet of the VCS Air Filtration Unit #2. The results of inlet and outlet VOCs are presented in Table 6-3. Ambient air concentrations of the VOCs were determined from a sample collected at the front of the VCS, to the right (east) of the door to the Command Post at the louver for admitting ambient air to the VCS. This sampling location is shown in the photographs in Appendix C.

Table 6-2. Gaseous Emissions at Air Filtration Unit #2

Test Parameter	Average Concentration	Maximum Concentration
oxygen (O_2)	19.3%	20.1%
carbon monoxide (CO)	0.5 ppmv	3.5 ppmv
carbon dioxide (CO_2)	0.4%	0.8%
sulfur dioxide (SO_2)	0.7 ppmv	0.9 ppmv
nitrogen oxides (NO_x)	2.0 ppmv	5.2 ppmv
total hydrocarbons (THC) (stack outlet)	1.4 ppmv	2.5 ppmv
total hydrocarbons (THC) (inlet)	2.3 ppmv	4.0 ppmv

Table 6-3. VOC Results from the Inlet and Outlet to the VCS Air Filtration Unit #2

Volatile Organic Compound	Inlet Concentration ppbv	Outlet Concentration ppbv	Ambient Concentration ppbv
methane	756.7	810.3	637.5
propane	3437.5	3142.8	ND
acetone	99.2	624.0	1416.3
chloromethane	4.3	4.1	4.0
dichlorodifluormethane	11.7	11.5	14.1
methyl ethyl ketone	11.6	53.0	47.6
toluene	6.0	184.8	105.1
trichlorofluoromethane	7.4	6.1	8.3

The results of Table 6-3 (above) are interpreted as follows:

- The THC contribution is due almost entirely to propane. Propane was the fuel used in the hot gas generator and the few ppmv of propane is attributed to unburned propane.

- The presence of chloromethane, dichlorodifluoromethane, and trichlorofluormethane are attributed to the ambient air. The off-gas treatment system will not destroy these compounds and carbon has no capability to adsorb these compounds.

- Toluene, MEK, and acetone are predominantly from the ambient air contribution. The off-gas treatment system has the capability to destroy these compounds. The carbon contained in the VCS Air Filtration System will also adsorb these compounds to the point of saturation. The ambient concentrations and the exit concentrations for all the species except propane are similar. There is the potential that the carbon in the air handling unit has been saturated at the ambient level for all the species. This would not be unexpected because the air handling units operated 24 hr/day, 7 days/week to maintain a positive control of the ventilation from the test building.

Semi-Volatile Organic Compound Emissions

Integrated samples, using SW-846 Method 0010, were collected at the VCS Air Filtration Unit #2 exhaust stack during testing. Except for the semi-volatile compound "di-N-butyl phthalate" (< 0.3 $\mu g/Nm^3$), there were no other SVOCs measured consistently in all three samples. Butyl benzyl phthalate, 1,4-dichlorobenzene, and naphthalene were detected at low levels (similar to the concentration of di-N- butyl phthalate) in the sample extracts from the first run sample, but they were not measured in any samples from subsequent runs. The off-gas treatment system combined with the VCS Air Filtration Unit is effective in virtually eliminating SVOC emissions.

6.2.2 Air Emissions of PCDDs and PCDFs.

Selected PCDD and PCDF congeners were detected in each of the three samples collected during testing at the VCS Air Filtration Unit #2 exhaust stack. The PCDDs and PCDFs were predominantly octachlorinated and heptachlorided species. There were no "tetra," "penta," or "hexa" chlorinated dioxins/furans detected. Therefore, the dioxins detected were the least toxic forms of dioxins and furans. Based on the reported concentrations for the detected congeners, the average equivalent toxicity of the emissions was determined to be 0.006 picograms [pg]/Nm^3. This concentration of 0.006 pg/Nm^3 is negligible and below the concentration of ambient air in many cities worldwide. A typical process standard for these emissions would be $200pg/Nm^3$.

6.2.3 Particulate Matter.

Total particulate matter samples were collected at the VCS Air Filtration Unit #2 exhaust stack during testing. Particulate matter emissions averaged 0.6 mg/Nm^3. Because there were two VCS Air Filtration Units, total particulate emissions were doubled to achieve an emission rate less than 0.03 lb/hr total.

6.2.4 Chlorides and Chlorine.

Samples of chlorides (as HCl) and chlorine were collected at the VCS Air Filtration Unit #2 exhaust stack during testing. The average HCl concentration was 29 ug/Nm^3, and the average chlorine concentration was 8 µg/m^3. The combined Cl^- emissions were equivalent to 0.024 ppmv. Because there were two VCS Air Filtration Units, total emissions were doubled to achieve an emission rate of 5.7E-4 lb/hr for HCl and 1.7E-4 lb/hr for chlorine.

6.2.5 Air Emissions of Metals.

Samples of metals were collected at the VCS Air Filtration Unit #2 exhaust stack during testing. A glass fiber filter substrate was used in testing instead of the quartz filter required by the method. The glass fiber filter media substrate had high background contamination for the following metals:

- Arsenic
- Antimony
- Barium
- Iron
- Lead
- Vanadium
- Zinc

Subtraction of the glass fiber filter and reagent blank data is necessary to arrive at more accurate, semi-quantitative, estimates of metal emissions. Table 6-4 represents the metal emissions that are corrected for filter and reagent contamination.

Table 6-4. Air Emissions of Metals (Corrected for Filter and Reagent Contamination)

Component	Average Concentration	Units	Emission Rate [1] (lbs/hr)
Antimony	< 0.406 J	µg/Nm^3	<1.58E-05
Arsenic	11.3 J	µg/Nm^3	4.39E-04
Barium	< 0.0881 J	µg/Nm^3	<3.42E-06
Beryllium	< 0.0488 J	µg/Nm^3	<1.91E-06
Cadmium	0.373 J	µg/Nm^3	1.45E-05
Chromium	< 0.978 J	µg/Nm^3	<3.81E-05
Cobalt	< 0.161 J	µg/Nm^3	<6.24E-06
Copper	< 0.315 J	µg/Nm^3	<1.23E-05
Iron	35.5 J	µg/Nm^3	1.38E-03
Lead	< 0.210 J	µg/Nm^3	<8.16E-06

Table 6-4. Air Emissions of Metals (Corrected for Filter and Reagent Contamination) (Continued)

Component	Average Concentration	Units	Emission Rate[1] (lbs/hr)
Mercury	0.196 J	$\mu g/Nm^3$	7.67E-06
Nickel	< 0.812 J	$\mu g/Nm^3$	<3.16E-05
Selenium	ND (1.21)	$\mu g/Nm^3$	<4.70E-05
Silver	< 0.107 J	$\mu g/Nm^3$	<4.16E-06
Thallium	ND (0.599)	$\mu g/Nm^3$	<2.33E-05
Vanadium	0.830 J	$\mu g/Nm^3$	3.23E-05
Zinc	7.32 J	$\mu g/Nm^3$	2.85E-04

[1] The emission factors and the emission rates were determined by doubling the emissions flow rate data collected from the outlet of the VCS Air Filtration Unit #2. It is assumed that the air filtration system exhaust fan speeds for Units #1 and #2 were the same and that the building exhaust air flow is split evenly between the Unit #1 and Unit #2 air filtration units.

Iron was determined to be the metal with the highest concentration, and there was significant interference from the filter media. The iron concentration was 36 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.0014 lb/hr when considering both air filtration units. Iron was also found to be the largest measurement of the metals analyzed in the spent pea gravel and spent lime samples. Therefore, it would be expected for iron to be the largest metal emission. There are many sources of iron. The fresh pea gravel and fresh lime samples had iron present, and the munitions and detonation chamber are constructed of iron metal.

Arsenic was the second largest metal emission at a concentration of 11 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.0004 lb/hr when considering both air filtration units. The presence of arsenic is suspect because the glass fiber filter had nearly 50 times more arsenic than can be attributed to the sample. Arsenic was not found at high concentration in the spent pea gravel or spent lime samples.

Zinc was the third largest metal emission at a concentration of 7 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.00028 lb/hr when considering both air filtration units. Zinc was also found at high concentration in the spent pea gravel and spent lime samples. Therefore, it would be expected that zinc would be part of the total particulate emissions. The predominant source of zinc is attributed to the brass parts of the munitions. There were small quantities of zinc in the fresh pea gravel and fresh lime.

Chromium was the fourth largest metal emission at a concentration of 1 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 3.8E-5 lb/hr when considering both air filtration units.

Chromium was also found in the spent pea gravel and spent lime samples. Therefore, it would be expected that chromium would be part of the total particulate emissions. The predominant source of chromium is attributed to the munitions and explosives package, because the fresh pea gravel had significantly lower quantities of chromium.

Vanadium and nickel were the fifth and sixth largest metal emissions to the air at 0.8 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.00003 lb/hr (each) when considering both air filtration units. The source of nickel was attributed to munitions and explosives package because the spent pea gravel content of nickel was greater than the fresh pea gravel. The source of vanadium is uncertain.

Cadmium and antimony were the seventh and eighth largest metal emissions to the air at 0.4 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.000015 lb/hr when considering both air filtration units. Cadmium and antimony were identified in the spent pea gravel and lime samples. The predominant source of cadmium is attributed to the munitions and explosives package.

Copper was the ninth largest metal emission to the air at 0.3 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.000012 lb/hr when considering both air filtration units. Copper was also found at high concentration in the spent pea gravel and spent lime samples. Therefore, it would be expected that copper would be part of the total particulate emissions. The predominant source of copper is attributed to the brass fittings in the munitions.

Lead is the tenth largest metal emission to the air at 0.2 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. This concentration calculates to an emission rate of 0.000008 lb/hr when considering both air filtration units. Lead was also found at high concentration is the spent pea gravel and spent lime samples. Therefore, it would be expected that lead would be part of the total particulate emissions. The predominant source of lead is attributed to the munitions.

Mercury samples were obtained correctly. The average concentration was 0.196 $\mu g/Nm^3$ or 0.0000077 lb/hr when considering both air filtration units. The source of mercury is unknown because mercury was not measured in the fresh pea gravel or fresh lime.

Other trace metal emissions included barium and cobalt. The source of barium was attributed to the fresh lime and the source of cobalt was from the pea gravel. The average concentration emitted to the air was approximately 0.1 to 0.2 $\mu g/Nm^3$ when subtracting the contamination in the glass fiber filter and reagent blank. However, the quantities for these metals on the glass fiber filter and reagent blank samples were greater than or equivalent to the actual samples. Therefore, the results of actual emissions are questionable.

6.3 Solid Waste Testing and Results.

6.3.1 Sampling and Analysis.

To evaluate possible disposal options for the solid waste materials generated from the TC-60 CDC throughput test, samples of pea gravel waste and spent lime were collected and submitted for waste characterization. Following decontamination, five individual grab samples of pea gravel were taken from the floor of the detonation chamber at the center of the four quadrants as well as from the center of the floor to a depth of about 5 cm. These five samples were combined to form a single composite and submitted for the analyses indicated in Table 6-5.

Table 6-5. Waste Analytical Methods

Analytical Fraction	Extraction and Analytical Method
TCLP-Metals	SW846-1311/6010B
TCLP-SVOCs	SW846 1311/8270C
TCLP-VOCs	SW846 1311/8260B
Corrosivity (pH)	SW846-9045C
Reactive Sulfide	SW846 Chapter 7.3.4.2
Reactive Cyanide	SW846 Chapter 7.3.4.2
Energetics	Sw846 Methods 3540C/8330 and 8332
Dioxins/Furans	SW846-8290
Total Metals	SW846-3052/6010B

A composite sample of spent lime was also collected from the drummed waste material generated during the production run. The composite was taken from the drum of lime in the process at the completion of the production run and the thermal decontamination step. The composite sample was submitted for the analyses given in Table 6-5. In additional, a grab sample of fresh lime and pea gravel were also submitted for toxicity characteristic leaching procedure (TCLP) and total metals.

6.3.2 RCRA Hazardous Waste Characterization Results.

Results from the characterization of solid wastes (spent pea gravel and spent lime) were compared to regulatory criteria established in 40 CFR 261.24 and are discussed in the following text.

Metals: For TCLP metals, only lead exceeded the TCLP criterion in pea gravel result at 6,340 µg/L and in spent lime result at 47,000 µgL. Therefore, these two waste streams would be characteristically hazardous per 40 CFR 261.24 for lead.

TCLP VOC: For the spent pea gravel, only two TCLP VOC parameters (tetrachloroethylene (PCE) and trichloroethylene (TCE)) were detected above the reporting limits or minimum detection limits. These results were 6.36 µg/L for PCE and 0.55 µg/L for TCE. However, both results were below their respective RCRA limits. All spent lime TCLP VOC laboratory results were rejected as part of the data validation as a result of low surrogate recoveries from the matrix. This is not regarded as a significant data gap because the normal operating temperature of the reactive bed filter is above 800 °F (>420 °C), and volatile organic compounds would be vaporized in the reactive bed filter.

TCLP SVOC: These target parameters were not detected in either spent pea gravel or spent lime and; therefore, these waste are non-hazardous for SVOCs.

Corrosivity and Reactivity: The pH of the spent pea gravel from the chamber floor was 4.82, whereas the spent lime was 12.42. Pea gravel and lime are, therefore, characteristically non-hazardous for corrosivity.

Cyanide was not detected in either waste. Sulfide was detected in the spent pea gravel at 400 mg/kg and in the spent lime at 170 mg/kg. Therefore, both waste streams are considered characteristically non-hazardous for reactivity.

6.3.3 Additional Waste Characterization Results.

Fresh pea gravel, fresh lime, spent pea gravel, and spent lime were also submitted for analysis of total metals. It was noted that there was an increase in some of the metals in the waste pea gravel and waste lime as compared to the virgin source material. Analytical results are represented in Table 6-6. There were significant metal concentration increases in the solid waste (pea gravel and lime) for the following metals:

- iron
- copper
- zinc
- lead

There were small increases in the pea gravel waste for barium, chromium, and nickel.

Table 6-6. Selected Total Metals Result in Solid Waste

Test Parameter	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel (from Detonation Chamber Floor)	Spent Lime (from Lime Injection System)
Total Metals (mg/kg)				
Antimony	2 UJ	40 UJ	30.3 J	154 J
Arsenic	2.78 J	100 U	10 U	25.9 J
Barium	5 U	100	31	50 U
Beryllium	0.241 J	1.56 J	0.287 J	8 U
Cadmium	1 U	20 U	2.73	3.36 J
Chromium (total)	8.81	40 U	53	23.8
Cobalt	5.53	3.14 J	6.26	2.49 J
Copper	4 U	80 U	9380	3400
Iron	14300	885	30100	5440
Total Metals (mg/kg)				
Lead	2.17	20 U	1840	4400
Nickel	5.75	80 U	84.3	24.8 J
Selenium	6 U	120 U	12 U	60 U
Silver	2 U	4.45 U	4 U	20 U
Thallium	2 U	40 U	1.62 J	20 U
Vanadium	8.39	100 U	6.06 J	50 U
Zinc	15.6	24.4 J	3850	1900

Notes: J – Either detected above the minimum detection limit and below the reporting limit, where the result is qualified and considered an estimate; or the analyte was detected above the minimum detection limit, but during validation the result was determined to be estimates due to QC issues.
U - Analyte was not detected above the minimum detection limit, with the detection limit and reporting limit considered accurate.

Energetic compounds were not detected in either spent pea gravel or spent lime at a detection limit of 0.5 mg/kg (0.5 ppm) ,which is indicative of complete destruction of explosive material in the system.

The PCDDs/PCDFs congeners were detected in pea gravel, as well as spent lime. Total toxicity equivalent concentrations (TEQ, expressed as 2,3,7,8-TCDD) were

5740 pg/g or 5.74 ppb in spent pea gravel and 7.91 pg/g in spent lime or 7.91 parts per trillion. Individual congener concentrations generally followed this pattern being two to three orders of magnitude higher in pea gravel than in spent lime. However, air emissions results show that, on a total TEQ basis, the TC-60 CDC is not emitting significant amount of PCDDs/PCDFs. The predominant species were octa-, hept-, and hexa- chlorinated dioxins and furans. Results of PCDDs/PCDFs are represented by Table 6-7.

6.4 Conclusions.

6.4.1 Air Emissions.

There does not appear to be any impediment to obtaining an air quality permit for the TC-60 CDC based on the results of sampling and analysis. The TC-60 would be considered a minor source for Title V (Clean Air Act Amendments of 1990) applicability determination purposes because all air emissions were below emission thresholds used for a rule applicability determination. A Subpart X (Miscellaneous Treatment Unit) permit would be required for a RCRA-affected facility because the munitions to be treated would be a hazardous waste and the miscellaneous unit designation is the most appropriate for this process.

Overall, data quality was found acceptable and met the stated objectives. However, three sampling anomalies were noted that which would have some effect of the results.

- For PM sampling, sampling run 1 and 2 had visible Teflon brush fibers (from probe cleaning) that resulted in much higher sample mass on the filter than run 3. The resulting emission average emission rate of 0.60 mg/Nm^3 should, therefore, be considered biased high.

- For all metals emission sampling runs, samples were collected below the lower isokinetic limit as a result of incorrect probe nozzle selection. Given the low concentration of particulate matter, significant impacts on usability of results are not expected as a result of this condition.

- The largest impact to data quality results from the use of glass fiber rather than quartz filters, which resulted in biasing the results high for some target metals (iron, arsenic, zinc, and vanadium), and the contribution from air emissions is difficult to quantify in the presence of this background. Therefore, the results for the metals analysis should be considered semi-quantitative.

6.4.2 Solid Wastes.

Spent lime and pea gravel were analyzed to determine if they would be treated as hazardous waste. For both waste streams, lead concentrations in TCLP exceeded the RCRA criterion, and these wastes would be characteristically hazardous per 40 CFR 261.24 for lead only.

Table 6-7. PCDDs/PCDFs in Pea Gravel and Lime

Test Parameter	Fresh Pea Gravel (pg/g)	Fresh Lime (pg/g)	Spent Pea Gravel - from Detonation Chamber Floor (pg/g)	Spent Lime - from Lime Injection System (pg/g)
Equivalent Toxicity(as 2,3,7,8-TCDD)	NA	NA	5,740	7.91
2,3,7,8-TCDD	NA	NA	39.3	0.141 J
1,2,3,7,8-PeCDD	NA	NA	245	0.443 J
1,2,3,4,7,8-HxCDD	NA	NA	397	0.912 J
1,2,3,6,7,8-HxCDD	NA	NA	1570	1.6J
1,2,3,7,8,9-HxCDD	NA	NA	775 J	0.967 J
1,2,3,4,6,7,8-HpCDD	NA	NA	20900	24.9
OCDD	NA	NA	67700	155
2,3,7,8-TCDF	NA	NA	671	0.743
1,2,3,7,8-PeCDF	NA	NA	1880	2.7
2,3,4,7,8-PeCDF	NA	NA	3570	2.51 J
1,2,3,4,7,8-HxCDF	NA	NA	10500	26.3
1,2,3,6,7,8-HxCDF	NA	NA	5380	6.88
2,3,4,6,7,8-HxCDF	NA	NA	5600	3.48
1,2,3,7,8,9-HxCDF	NA	NA	4710	5.33
1,2,3,4,6,7,8-HpCDF	NA	NA	29100	67.5 J
1,2,3,4,7,8,9-HpCDF	NA	NA	10500	33
OCDF	NA	NA	61300	498
Total TCDD	NA	NA	1060	1.94
Total PeCDD	NA	NA	3770	3.58
Total HxCDD	NA	NA	16200 J	11.8
Total HpCDD	NA	NA	36300	36.8
Total TCDF	NA	NA	13300	8.12
Total PeCDF	NA	NA	28100	18.5
Total HxCDF	NA	NA	47300	62.2 J
Total HpCDF	NA	NA	54400	126

Notes: J – Either detected above the minimum detection limit and below the reporting limit, where the result is qualified and considered an estimate; or the analyte was detected above the minimum detection limit, but during validation the result was determined to be estimates due to QC issues. U - Analyte was not detected above the minimum detection limit, with the detection limit and reporting limit considered accurate.

7. CLOSEOUT

7.1 Closeout Subtest Objectives.

The specific subtest criteria for successful completion of the closeout subtest were enumerated in the Test Plan as follows:

- **REQUIREMENT:** The TC-60 CDC system shall be capable of being cleaned, decontaminated, and monitored to verify the efficacy of decontamination methods using approved procedures.

- **REQUIREMENT:** There shall be no contamination of soil or of the test facility outside the TC-60 CDC spill control barrier.

- **REQUIREMENT:** Analytical results of all final 3X verification samples are to be below established criteria set forth in AR 385-61.

- **REQUIREMENT:** All wastes shall be packaged for transport over roads and be accepted by the DSTL-approved disposal facility.

- **REQUIREMENT:** The TC-60 CDC system shall meet AR 385-61, environmental, and transportation requirements for transport from the treatment location over public roads.

- **REQUIREMENT:** No agent will be detected at the site perimeter monitors above the GPL (72-hr TWA).

7.2 Site Closure Operations.

7.2.1 Interim Shutdown 2004.

When operations were suspended in November 2004, the process equipment was decontaminated and the site prepared for an extended shutdown. The process equipment was thermally decontaminated between 5 and 8 November. Site shutdown and cleanup was accomplished between 9 and 12 November. Confirmatory monitoring was conducted to verify decontamination. Analytical results of all final 3X verification samples were below established criteria set forth in AR 385-61. No agent was detected at the site perimeter monitors above the GPL. Wastes were accepted and disposed of at DSTL-approved facilities, in accordance with established DSTL procedures.

Monitoring results for the thermal decontamination step are summarized in Table 7-1.

Table 7-1. Monitoring during Thermal Decontamination, 2004

Date - Time	Location	Detections – MINICAMS – Maximum Recorded Value During the Period
6 Nov – 0830-1201	Cross 1	ND
6 Nov – 1201-1206	Cross 1	1.55 STEL
6 Nov – 1206-1251	Cross 1	5.85 STEL
6 Nov – 1251-1316	Cross 1	35.2 STEL
6 Nov – 1316-1351	Cross 1	35.1 STEL
6 Nov – 1351-1406	Cross 1	29.0 STEL
6 Nov – 1406-1501	Cross 1	18.7 STEL
6 Nov – 1501-1606	Cross 1	9.81 STEL
6 Nov – 1606-1805	Cross 1	4.81 STEL
6 Nov – 1805-2000	Cross 1	1.99 STEL
7 Nov – 0830-0934	Cross 1	3.80 STEL
7 Nov – 0934-1034	Cross 1	3.49 STEL
7 Nov – 1034-1134	Cross 1	3.15 STEL
7 Nov – 1234-1329	Cross 1	3.12 STEL
7 Nov – 1329 - 1750	Cross 1	ND
8 Nov – 0830-1640	Cross 1	ND

As part of the interim shutdown, scrap metal, pea gravel, and lime were removed from the system, monitored, and disposed of by DSTL. The approximate quantities of these wastes are listed in Table 7-2.

Table 7-2. Solid Wastes Generated in 2004 Closeout

Waste	Quantity (estimated)	Disposition
Pea Gravel	26 drums/2,000 kg	DSTL Incinerator
Spent Lime	10 bags/250 kg	DSTL Incinerator
Scrap metal	4 drums/320 kg	DSTL Incinerator

7.2.2 Final Shutdown 2006.

Toxic operations with chemical munitions containing mustard concluded on 24 March, 2006. Upon completion of operations, preparations began for thermal decontamination and disassembly of the equipment. Preparations also began for transportation of all of the equipment back to the United States.

The system was prepared for thermal decontamination on 27 March with the placement of the decontamination hot gas generator. The scrap metal accumulated from the test operations was placed in back of the chamber for thermal decontamination. Heating of the chamber and its contents began on 28 March and concluded on 29 March. The system was allowed to cool down through 30 March, and the site was shut down for a scheduled crew break.

Chemical agent monitoring was conducted in the crossover pipe from the detonation chamber to the expansion tank during the thermal decontamination period. Monitoring was conducted using the MINICAMS near-real-time monitor. The results that were recorded are presented in Table 7-3. The recorded values are the maximum values observed during the reported period of time. As expected, the residual mustard agent or breakdown products started evolving from the detonation chamber, progressed to a peak, and then disappeared at the end of the thermal decontamination step, 25 hr later. Twice during the thermal decontamination step, samples were taken with the DAAMS monitoring system to confirm mustard evolution. Both samples showed a non-detectable level of mustard. The MINICAMS results are indicative and useful for monitoring progress of the decontamination step, but these readings are not confirmed to be mustard agent.

Closeout resumed on 10 April and continued through 21 April. Scrap metal and pea gravel were cleaned out of the detonation chamber on 10 April. Equipment disassembly began on 12 April with the disconnection of the crossover and exhaust piping, and continued until 20 April with the removal of the carbon from the building ventilation units. On 21 April the building ventilation system and the air monitoring systems were shut down. Confirmatory monitoring was conducted to verify decontamination. Analytical results of all final 3X verification samples were below established criteria set forth in AR 385-61. No agent was detected at the site perimeter monitors above the GPL. In accordance with established DSTL procedures , wastes were accepted and disposed of at DSTL-approved facilities,.

Packing of equipment began on 24 April and continued through 4 May, at which time the packed containers and equipment were turned over to the freight forwarder for return to the United States.

The wastes generated from processing or closeouts during 2006 are listed in Table 7-4 and are further described below.

Table 7-3. Monitoring during Thermal Decontamination, 2006

Date - Time	Location	Detections – MINICAMS – Maximum Recorded Value During the Period
28 March 1630-1952	Cross 1	ND
28 Mar 1957-2007	Cross 1	0.8 STEL
28 Mar 2007-2017	Cross 1	ND
28 Mar 2017-2217	Cross 1	0.95 STEL
28 Mar 2217-0042	Cross 1	0.95 STEL
29 Mar 0042-0757	Cross 1	0.95 STEL
29 Mar 0907-1107	Cross 1	5.01 STEL
29 Mar 1107-1307	Cross 1	6.92 STEL
29 Mar 1307-1507	Cross 1	10.8 STEL
29 Mar 1507-1657	Cross 1	12.0 STEL
29 Mar 1703-1903	Cross 1	11.4 STEL
29 Mar 1903-2037	Cross 1	6.98 STEL
29 Mar 2037-2400	Cross 1	ND

Table 7-4. Solid Wastes Generated in 2006 Closeout

Waste	Amount	Disposition
Scrap metal	543 kg	DSTL incinerator
Pea Gravel	1939 kg	DSTL incinerator
Lime	325 kg, estimated	DSTL incinerator
Carbon	1100 kg,	DSTL incinerator
Waste water, 50% ethylene glycol, 50% water	3000 L	Waste oil contractor for DSTL
Diesel Fuel and Crankcase Oil from the generator	1000 L	Waste oil contractor for DSTL

7.3 Scrap Metal Collection and Disposal.

Scrap metal generated from testing in 2006 was collected on 24 March and loaded in the chamber for thermal decontamination. During the thermal decontamination step, this metal was heated along with the chamber structure and pea gravel. At the end of the thermal decontamination step, the scrap metal was allowed to cool. On 10 April, the metal was removed

from the chamber and collected into plastic drums. A total of 543 kg of scrap metal was collected and turned over to DSTL for disposal.

7.4 Lime and Carbon Collection Disposal.

The lime system was emptied on 24 March at the cessation of testing and again on 30 March at the cessation of the thermal decontamination step. When the lime hopper was disassembled on 20 April, the hopper was vacuumed out and additional lime was collected. A total of 13 bags of lime, nominally 25 kg each, were collected and turned over to DSTL for disposal.

Carbon drums removed from process area were opened and vacuumed out by a DSTL contractor. The prefilters, HEPA filters, and carbon filters were removed from the air filtration units by ECBC and DSTL personnel. All the spent carbon from the testing was turned over to DSTL for disposal.

7.5 Pea Gravel Collection and Disposal.

Pea gravel was removed from the detonation chamber on 10 April simultaneously with the scrap metal and was shoveled into plastic drums. A total of 1939 kg of pea gravel was collected from the testing site in 2006 and turned over to DSTL for disposal.

7.6 Liquids Collection and Disposal.

The cooling water tank on the utilities skid was pumped out by a DSTL contractor. A total of 3000 L of combined ethylene glycol and water was collected and disposed of by DSTL. The fuel tank and lubricating oil sump in the diesel engine was pumped out by a DSTL contractor. A total of 1000 L of combined oil and fuel was disposed of by DSTL.

7.7 Monitoring for Clearance.

Workplace monitoring was conducted during the closeout period by ECBC Monitoring personnel using MINICAMS and DAAMS. At no time during the 11-day closeout period was there a detection on the MINICAMS monitors.

Confirmatory monitoring for the work place was conducted using DAAMS. There were no detections on any of the DAAMS samples at the work place locations.

Clearance monitoring of the equipment was conducted by the ECBC Monitoring personnel using DAAMS set to monitor the equipment at the GPL, in accordance with the revised AR 385-61 protocols. The detonation chamber was monitored for mustard at the Worker Protection Level and cleared for transport.

The expansion joint from the exhaust pipe was dismounted from the piping and bagged, and the air space within the bag was monitored for clearance at the GPL. The result of this monitoring showed a detection of mustard. The expansion joint was removed and

decontaminated using a bleach solution in accordance with the practices of ECBC. The decontaminated expansion joint was rebagged again, and the air space within the bag was monitored at the GPL. The final result was that the expansion joint was clean and was released.

Monitoring was completed on 21 April, with the finding that all the other equipment on site was clear to the GPL. On 21 April, the monitoring equipment was shut down.

No detections of mustard were found in the test facility at the conclusion of the Phase II testing, and no agent was ever detected in the site perimeter monitoring system during the testing.

7.8 Conclusions.

All requirements for the closeout subtest were satisfied.

The TC-60 CDC system was cleaned, decontaminated, and monitored to verify the efficacy of decontamination methods using approved procedures.

There was no contamination of soil or of the test facility outside the TC-60 CDC spill control barrier.

Analytical results of all final 3X verification samples were below established criteria set forth in AR 385-61.

All wastes were packaged for transport over roads and were accepted by the DSTL-approved disposal facility.

The TC-60 CDC system did meet AR 385-61, environmental, and transportation requirements for transport from the treatment location over public roads.

No agent was detected at the site perimeter monitors above the GPL (72-hr TWA).

8. CONCLUSIONS/RECOMMENDATIONS

8.1 Conclusions.

The demonstration/validation testing conducted at Defence Science and Technology Laboratory (DSTL), UK, successfully demonstrated that the CH2M HILL's Controlled Detonation Chamber (CDC) technology could safely and effectively destroy munitions containing CW agents, smoke, or industrial chemicals, with or without explosive components, and without generating large quantities of process wastes.

This report describes the second and final phase of this test program. During Phase II, the TC-60 CDC system successfully met all the test objectives of the August 2004 Final Test Plan. The following objectives were achieved:

- Demonstrate that the TC-60 CDC can safely and effectively destroy recovered chemical munitions with or without explosive components.

- Demonstrate that the TC-60 CDC can reduce the hazardous properties of the chemical fill without release of hazardous wastes or materials to the soil or water.

- Develop the data necessary to demonstrate (1) the safety, integrity, and efficacy of the TC-60 CDC and (2) the ability of the operator to collect waste samples to the U.S. Army, Department of Defense (DoD), and Federal, state, and local environmental agencies. .

The critical test issues, as described in the Final Test Plan, were addressed as follows:

- *Can the TC-60 CDC be transported to a treatment location without damage that which would impede effectiveness?* The TC-60 CDC system was successfully constructed, transported from the United States, and set up at DSTL's facility in Porton Down, United Kingdom, without damage that impeded its effectiveness.

- *Is the TC-60 CDC safe to operate and maintain?* The CDC system was safely operated during the entire test program. Operators did not enter the chamber during routine operations. During the throughput test phase, all munitions were reliably and completely destroyed without any detectable release of residual chemical agent.

- *Can reduction of the hazardous properties of the chemical fills be accomplished in the TC-60 CDC?* The following results were achieved:
  - Safe and effective destruction of multiple recovered chemical munitions with and without explosive components, using controlled detonation.

  - Detonation of recovered CWM and DOT cylinders, resulting in the destruction of all but residual quantities of chemical agent. Residual agent detected between the detonation chamber and the expansion tank was destroyed by the off-gas treatment system prior to the CDC carbon filters

  - Reliable destruction of the munitions fuse and burster (when present).

  - Effective destruction of 11.7 lb of mustard contained in DOT steel cylinders. This quantity of mustard is equivalent to the chemical fill of a US 155-mm M104 or M110 artillery shell.

  - Operators were able to safely collect waste samples using approved procedures. Wastes were packaged to meet requirements for transportation to an approved DSTL disposal facility. There was no contamination of the soil or water.

  - Fugitive vapor emissions of chemical agents from the TC-60 CDC system were not detected at any time during testing. Monitoring systems that have been approved by cognizant authorities in the U.S. and UK were used.

- Munition fragments were successfully decontaminated using high explosives (HE)- only detonations to levels below the Worker Protection Limit (one data point).

- The ability to reduce contamination of chemical fills in the detonation chamber, to below the Short Term Exposure Limit using HE detonations only, was demonstrated.

• *Can the TC-60 CDC be decontaminated to a 3X level to allow transport from the treatment location?* Following testing, the CDC system was decontaminated, disassembled, monitored, and shipped back to the United States. Decontamination of the entire TC-60 CDC was demonstrated to meet the 3X level.

• *Can the TC-60 CDC it meet all applicable Federal, State, and Local regulations?* Data were acquired to demonstrate the safety, integrity, and efficacy of the TC-60 CDC to the U.S. Army, DoD, and federal, state, and local environmental agencies the safety, integrity, and efficacy of the TC-60 CDC. The test results proved that there were no discharges of contaminants to the ambient air that would prevent obtaining an air quality permit. Air emissions from CDC operations would be considered a minor source, in any state, for determining Title V permitting applicability. Destruction of RCRA waste would require a Subpart X (Miscellaneous Treatment Unit) permit under Resource Conservation and Recovery Act (RCRA) regulatory requirements, unless there was an emergency condition attributed to deployment.

8.2 System Throughput.

A major objective of the Phase II testing was to demonstrate the throughput capacity of the TC-60 CDC under realistic operating conditions. The testing confirmed that the TC-60 CDC system could repeatedly and reliably process either one or two munitions in a single detonation cycle. Use of the preassembled donor explosives, described previously, was applied to the fused munitions safely and reliably. The application of the donor explosive and booster was accomplished in <7 min. Donor explosives were applied to munitions (either single or double munitions) while the CDC system was processing the residual off-gas from the previous detonation. Because the CDC off-gas processing duration was the controlling event, the munitions could be prepared concurrently without adding time to the destruction cycle.

Demonstration testing involved four separate explosive operating crews of two people with one safety link. Therefore, variability in personnel was accounted for in operations. A total of 74 munitions were destroyed during the 2 weeks of throughput testing. The maximum throughput was achieved during the second week of testing, when 42 munitions were destroyed in 14.5 hr. The average time for a complete destruction cycle declined during the production test period as operating crews became familiar with routine operations. The average cycle time stabilized at 35 min for destruction of two munitions per detonation cycle. During productivity testing, the CDC system was not shut down and remained operational 24 hr/day. The system availability during the entire test period in 2006 was >95%, as measured from the start of operations to the conclusion of operations each day.

8.3 Recommendations.

Based on the results of this testing, it is recommended that the CH2M HILL CDC continue with developmental and operational testing, and that necessary administrative documentation and approvals be completed so this technology can achieve operational status to support chemical demilitarization activities as soon as possible.

Blank

µg	microgram
CDC	controlled detonation chamber
CO	carbon monoxide
CO_2	carbon dioxide
COE/Huntsville	U.S. Army Corps of Engineers, Huntsville Center
DAAMS	Depot Area Agent Monitoring System
DoD	Department of Defense
DTSL	Defence Science Technology Laboratory
EBW	exploding bridgewire
ECBC	Edgewood Chemical Biological Center
EPA	U.S. Environmental Protection Agency
GPL	general population limit
HCl	hydrogen chloride
HE	high explosive
HEPA	high efficiency particulate air
HMI	human-machine interface
I/O	input/output
MINICAMS	Miniature Chemical Agent Monitoring Systems
Nm^3	normal cubic meters
NO_x	nitrogen oxides
O_2	oxygen
OSHA	Occupational Safety and Health Administration
PCDDS/PCDFs	polychlorinated dibenzo-dioxins/polychlorinated dibenzo-furans
PCE	tetrachloroethylene
25 pdr	25-pounder, 1930s Royal Artillery terminology to describe a projectile for an artillery tube of 88.9 mm diameter, the common round for which weighs 25 pounds
PETN	pentaerythritol tetranitrate
pg/g	picograms per gram (10^{-12} grams/gram)
PINS	Portable Isotopic Neutron Spectroscopy
PLC	programmable logic controller
PPE	personal protective equipment
ppmv	parts per million by volume
psig	pounds per square inch gauge
RCRA	Resource Conservation and Recovery Act
RDX	cyclotrimethylenetrinitramine
scfm	standard cubic feet per minute
SO_2	sulfur dioxide

SOP	standard operating procedure
STEL	short term exposure limit
SVOC	semi-volatile organic compound
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
TEQ	toxicity equivalent concentration
THC	total hydrocarbons
UK	United Kingdom
VCS	vapor containment structure
VOC	volatile organic compound

APPENDIX A
TC-60 CONTROLLED DETONATION CHAMBER TEST PLAN FOR DEFENSE SCIENCE AND TECHNOLOGY LABORATORY PORTON DOWN, UK

Foreword

This test plan provides objectives and descriptions for testing the TC-60 Controlled Detonation Chamber (TC-60 CDC), which is a transportable controlled detonation chamber (CDC), at Defense Science and Technology Laboratory, Salisbury, UK. The TC-60 CDC is a transportable system designed for the treatment of conventional munitions (i.e. smoke), energetic materials and recovered World War I and World War II vintage chemical munitions. For chemical munitions, the TC-60 CDC uses donor explosive charges to detonate the munition's shell, energetic components, and chemical fill. The TC-60 CDC system includes the detonation chamber, expansion chamber and the offgas treatment system. A test will be conducted in a facility located at Porton Down in the United Kingdom. This test of the TC-60 CDC is a combined demonstration/validation (DemVal) with the intent of using the results to support a developmental test (DT).

A Test Evaluation Plan will be prepared by AMSAA with input from MITRETEK Systems to outline and document the independent evaluation of the TC-60 CDC Test.

The test is designed to provide the Army, the U.S. Environmental Protection Agency, and State environmental agencies with data upon which to base decisions regarding the technology's efficacy and its potential readiness for developmental testing.

Changes to the approved Test Plan, if required, will be coordinated with the Non-Stockpile Test Integrated Product Team prior to implementation.

In the context of this test plan, the following terms are used to describe general criteria for performance of theTC-60 CDC

Destroy is used to mean rupture of munitions casings and chemical reaction of the energetic and agent contents to a less toxic or reactive form. Data will be collected during this test to quantify the reduction.

Threshold criterion is a performance level that should be met in order to successfully complete the demonstration/validation testing of the TC-60 CDC.

Objective criterion is a performance goal that is desired in order to meet future demilitarization criteria in the, next generation CDC. The objective criterion may be revised based on the results of the demonstration/validation testing. During the demonstration/validation testing sufficient information is expected to be gathered to evaluate the probability that the CDC design meets objective criteria.

SECTION 1

Introduction

Recovered CWM (RCWM) consists of those items that have been recovered and placed in storage. Historically, upon discovery of CWM, explosive ordnance disposal (EOD) technicians would identify and assess the condition of the munition and determine whether the ordnance was filled with chemicals, and determine whether it was safe for transportation and storage. Chemical munitions that were determined to be safe were overpacked (that is, placed into a container with packing material as appropriate) and stored onsite or transported by the U.S. Army Technical Escort Unit (TEU) to an appropriate chemical storage facility. Those CWM items that could not be transported or stored due to unacceptable risks were destroyed onsite using emergency destruction procedures.

To supplement the need for onsite destruction of CWM-filled munitions, DeMil International, a subsidiary of CH2M HILL, has developed a transportable destruction system that can safely destroy munitions that may be moved manually and should not be dismantled or reconfigured. This system, which is referred to as the Controlled Detonation Chamber (CDC), is a controlled detonation chamber (CDC). Three versions of the transportable CDC are currently in use or under development: the T-10 CDC, TC-25 CDCand the TC-60 CDC. Other modular and fixed units are also under development. The TC-60 CDC is the subject of this plan. The TC-60 CDC version is designed to handle the explosive force of up to the equivalent of 60 pounds of TNT. ("TC" denotes the system is Transportable and designed for destruction of Chemical agents.)

In the FY03 and FY04 Defense Appropriation Bills, Congress mandated that the U.S. Army conduct a demonstration/validation of the use of transportable detonation chamber technology in the disposal of recovered chemical warfare materiel. Demonstration/validation testing is conducted to demonstrate scale-up and operability of a proposed process or equipment. The demonstration shall include testing and measurement of those operating parameters that are critical to successful execution of the mission. Developmental testing is conducted to assess compliance with critical technical parameters, identify technological and design risks, and determine readiness to proceed to operational

testing. Appropriate operational testing is conducted to determine operational effectiveness and suitability of the system under realistic conditions. Demonstration/validation testing is normally conducted separately from developmental testing, it may be integrated or conducted concurrently when the objectives of both types of testing can be met and when significant cost or time benefits would result.

1.1 Operational Requirements

Published operational requirements have been developed for the CDC (Ref.1). The following operational requirements have been developed to evaluate CDC performance:

Performance:

(1) The system must be able to treat CWM (inclusive of the chemical fill and the munition's explosive train). Data will be collected during this test to quantify the treatment.

(2) The system must have threshold capability to treat CWM that contain up to 4 pounds of agent fill. Test results will be used to scale up future CDCs to achieve an objective capability of 28 pounds of agent fill.

(3) The system must have a threshold capability to destroy one CWM item in a 10-hour workday with an objective capability to destroy as many as five items per day.

(4) Munitions fill to be destroyed in the threshold system:

(a) Chemical agents: Blister agent (mustard), Nonpersistent nerve agent (GB) and Industrial chemical (phosgene)

(b) In addition to the munitions fill material listed above; the systems objective capability is to destroy:

Chemical agents: Lewisite, Persistent nerve agent (VX), Industrial chemicals (AC, CK, Cl2, PG, PS, BA, CA, CS, CN, CNB, CNS, DA, NC, PD, DM, BZ, ED) and Smoke producing compounds.

(5) The system must provide or facilitate CWM decontamination of toxic liquids and solids resulting from the systems operation.

(6) The system must have the threshold capability of containment of neat agents where there is no release of hazardous vapors above the general population limit at the site perimeter (72-hour Time Weighted Average), reference AR 385-61, Table 2-3 or immediately around the device in the test facility (72-hour time weighted average). The system objective is no detectable release.

(7) The system's interior must be easily accessible for ease in munition loading, decontamination or other frequently performed maintenance/operation related functions.

(8) The system must be capable of agent destruction verification and facilitate safe sampling of decontamination liquids and chamber gases prior to accessing the chamber after each destruction event.

(9) Internal surfaces must be easily decontaminated (3X) and resist attack from decontamination solutions and corrosive gases.

a. Logistics and Readiness:

(1) System must be road transportable over improved and unimproved roads and must be capable of movement over rough terrain for short distances. Air transport, via a military aircraft (e.g. C141 or C17) is desirable.

(2) The threshold system must be capable of being set up and operational with 24 work hours of arrival at a site, with an objective set-up time of 12 work hours.

b. Other Characteristics:

(3) The system shall have the capability to provide liquid (such as may be required following decontamination operations) and vapor samples.

(4) The system must have the capability to operate in conjunction with an air monitoring system.

(5) The system must be able to be operated by personnel dressed in PPE up to and including Occupational Safety and Health Administration Level B personal protective clothing.

(6) The system must be able to be decontaminated to applicable environmental criteria and regulations so it can be transported to another site within 48 work hours of operation.

(7) The system must be capable of operating in temperatures between +30F and +100F.

(8) Secondary waste streams (such as spent carbon, pea gravel, filters, and spent hydrated lime) must be minimized and capable of being disposed of at a commercial treatment, storage and disposal facility (TSDF) or permitted landfill.

1.2 Objectives

1.2.1 Test Objectives The overall objectives of the TC-60 CDC Test are to:

1. Demonstrate that the TC-60 CDC can safely and effectively destroy recovered chemical munitions with or without explosive components.
2. Demonstrate that the TC-60 CDC can reduce the hazardous properties of the chemical fill without release of hazardous wastes or materials to the soil or water. Data will be collected during this test to quantify the reduction.
3. Develop the data necessary to demonstrate to the U.S. Army, Department of Defense (DoD), and Federal, state, and local environmental agencies: (1) the safety, integrity, and efficacy of the TC-60 CDC; (2) the ability of the operator to collect waste samples.

1.2.2 Critical Test Issues Using the overall objectives, critical test issues are developed. The following issues are used to provide a focus for subtest criteria development, data collection activities, and specific decisions to proceed with the test; not all are quantifiable:

a. Can the TC-60 CDC be transported to a treatment location without damage which would impede effectiveness?

b. Is the TC-60 CDC safe to operate and maintain?

(1) Can munitions be placed into the TC-60 CDC without injury to operators or contamination of soil or water? Data will be collected during the this test to quantify the reduction.

(2) Can the TC-60 CDC access the munition and contain blasts, fragments, and hazardous vapors to acceptable levels?

c. Can reduction of the hazardous properties of the chemical fills be accomplished in the TC-60 CDC?

(1) Can the TC-60 CDC destroy chemical agent fills (blister and G agents) and industrial chemicals that have been used as war gases (such as CG and Smokes) to acceptable levels?

(2) Can the CDC operators obtain representative samples of wastes without injury to CDC operators or contamination of soil or water?

(3) Are available monitoring systems capable of verifying chemical agent vapor at or below acceptable levels as defined in the Test Monitoring Plan?

d. Can the TC-60 CDC be decontaminated to a 3X level to allow transport from the treatment location?

e. Can it meet all applicable Federal, State, and Local regulations?

For the test of the TC-60 CDC, three types of criteria can be used to evaluate performance: requirements, goals, and indicators. A requirement is a condition based on Federal, State, or local laws and regulations, or as defined by the user. A goal is a criterion that can be quantified and for which established supporting documentation, statistics, or analyses exist, but does not have a legal requirement to achieve. Lastly, an indicator is a subject area for which no published standards exist but can be used as qualitative measures of performance.

A Test Evaluation Plan will be prepared by AMSAA with input from MITRETEK Systems to outline and document the independent evaluation of the TC-60 CDC Test.

1.2.3 Evaluation Topics: The evaluation of the TC-60 CDC will examine the following topics:

- Effectiveness
- Human Factors
- Supportability
- Process Information
- Transportation, Setup, and Closeout
- Safety and Environmental.

Issues and data requirements for these evaluation topics are listed below. All of these issues may not necessarily be addressed during the test at Porton Down (i.e. supportability).

Effectiveness. The purpose of this evaluation topic is to determine the degree to which the TC-60 CDC can handle and reduce the properties for which CWM is considered lethal. The specific issues are as follows:

- What are the operating parameters while processing varying loadings in the chamber?
- Do the donor explosive charges destroy the munition?
- How effectively does the TC-60 CDC system destroy the fill?
- Can the TC-60 CDC detonation chamber be decontaminated sufficiently in order to remove the munition remnants and other solid waste?
- What assessment of process throughput can be made?
- What flexibility does the TC-60 CDC have to respond to the varying demands of a recovery action?

Data on effectiveness will be collected primarily during the munition subtests and includes the following:

- Munition type and identification number
- Portable isotopic neutron spectroscopy (PINS) and x-ray assessment of the chemical fill for munitions

- Ambient weather conditions: wind speed and direction, temperature, barometric pressure, and relative humidity
- Site layout of air monitors
- Air monitor readings (as a function of time) for those monitors that detect chemicals of concern during munitions processing with a summary of concentration levels
- History of response during non-agent testing of air monitors that detect chemicals of concern, such that the monitoring equipment does not detect interferants (false positives)
- Results of Depot Area Air Monitoring System (DAAMS) tube analysis for air monitoring stations with alarms
- Timeline of representative process activities, to include: moving munition to the TC-60 CDC, unpacking the munition (if required), preparing and securing the munition in the detonation chamber, destroying the munition within the detonation chamber, decontaminating the system, collecting samples, laboratory processing and verifying completion, and packaging the wastes

Process data will be recorded for various purposes to demonstrate the effectiveness of the proposed system, validate the destruction of energetics and chemical fill, and demonstrate the operability of the system within the limitations of the test program. To facilitate these objectives, the following table is sorted to conform to the Requirements, Goals, and Indicators hierarchy of the test program.

Measurement	Location	Expected Value	Comment
Requirements			
Chemical Agent Emission	Outlet of second carbon adsorber	Not Detectable	Success to be determined by stack discharge limitations
Goals			
Chemical Agent	Outlet of First carbon Adsorber	<TWA	
Indicators			
Solid Waste Sampling	Pea Gravel and Munition Debris in Chamber	Representative sample taken	Demonstrate ability to take sample
Solid Waste Sampling	Lime waste drum	Representative sample taken	Demonstrate ability to take sample

- Results of laboratory sample analyses
- Decontamination information for the solid wastes
- Reports of incidents and anomalies.

Human Factors. This evaluation topic is to determine the effects of the man-machine interface as it affects the ability of the TC-60 CDC to handle and destroy CWM. Human Factors Engineering is the systematic application of knowledge about human capabilities, limitations, and behavior to the system design to achieve desired performance requirements through the most effective use of human capabilities. Human factors issues are as follows:

- To what degree does the TC-60 CDC conform to applicable Army and NIOSH documents?
- To what extent does the TC-60 CDC hardware facilitate the operator's ability to operate and maintain the equipment while wearing appropriate protective clothing under all anticipated operational and environmental conditions?

- To what extent are the operators capable of performing each step of each standing operating procedure (SOP) and checklist to complete the missions defined for the test while using prescribed SOPs and PPE?
- How well do the operators handle incidents and anomalies?
- What training will be required for operators and maintenance personnel?
- What is the minimum number of people required to operate and maintain the TC-60 CDC?

The operators must be capable of performing critical tasks safely, efficiently, and effectively under all expected operational conditions. Human factors data will be collected throughout CDC test operations, and includes the following:

- Number and specialty function of personnel performing work
- Observation data on operator performance during normal operation and maintenance to verify that appropriate procedures were followed
- Reports on incidents and anomalies and the actions taken
- Adequacy of labels, markings, and coding methods
- Communications quality and speech intelligibility during all modes of operation
- Adequacy of system failure/warning indicators

Supportability. Supportability is an evaluation topic that addresses the degree to which the system can be supported in its intended operational environment. Supportability data will be collected throughout TC-60 CDC test operations, and includes the following:

- Adequacy of publications covering diagnostics, repair, and operations
- List of repair parts used
- Description of maintenance performed
- Maintenance times
- Number of personnel required

- Requirements for crew or support maintenance
- Operating hour times
- Down time due to failures or maintenance actions (time the CDC is not operational due to a failure, scheduled maintenance, or unscheduled maintenance)
- Reports of incidents and anomalies
- Complete description of all test incidents that required maintenance (scheduled or unscheduled) and a complete description of the maintenance actions taken.

Process Information. This evaluation topic is designed to determine whether adequate process information is available to provide adequate control over normal and off-normal operating conditions. Process information issues are as follows:

- Does the TC-60 CDC equipment operate in accordance with design documentation?
- What is the normal operating envelope for process equipment when processing the munition and its chemical fill?
- Does this envelope fall within the design specifications for that equipment?

Process information will be collected primarily during the munition subtests, and includes the following:

- Reports of incidents and anomalies
- Accuracy and completeness of daily inspections and maintenance forms
- Ambient temperatures and pressures under all operating conditions

Transportability, Setup, and Closeout. This evaluation topic includes the planning associated with the movement of the TC-60 CDC. Special movement precautions, calibration, and pre-operational checks will be assessed. Issues are as follows:

- Can the TC-60 CDC be decontaminated to a level that complies with applicable regulations in preparation for transport?
- After hot operations, can the TC-60 CDC be prepared for transportation?

- Can the TC-60 CDC be transported using planned modes of transportation?
- After transport, can the TC-60 CDC be set up in preparation for operations?

Transportability, setup, and closeout data will be collected primarily during those particular subtests, and includes the following:

- Time required for decontamination and verification thereof
- Level of contamination before and after decontamination and verification of results
- Times for disassembly, assembly, and setup
- Number of personnel performing work for disassembly, assembly, and setup
- Reports of incidents and anomalies
- Trailer weights and measurements
- Requirements for preventive or corrective maintenance prior to operations

Safety and Environmental. These topics address the concern of providing a safe work environment and protection against release of hazardous materials and/or waste to the environment during handling and treatment of CWM. Issues are as follows:

- Do all components and processes of the TC-60 CDC operate sufficiently to maintain safety and environmental protection?
- Do the operators follow appropriate procedures to ensure safety and environmental protection?
- How effective are the waste management and handling techniques?
- What process steps are required before the TC-60 CDC can be shut down at the end of an operational day?
- Reports of incidents regarding safety or spill/release of hazardous materials and/or waste

- Results from waste characterization (laboratory sample results)

1.3 Test Concept

1.3.1 Scope of Test The TC-60 CDC Test will be performed in a test facility at Porton Down, which is near Salisbury, Wiltshire, United Kingdom. The TC-60 CDC at Porton Down will be tested with vintage munitions that have previously been recovered. Prior to testing, these munitions will be non-intrusively assessed via PINS and x-ray by Porton Down personnel. The types of munitions that may be tested are listed in Table 1-1.

For this test, subtests are included for transportation, setup, processing of each munition, and closeout. The current plan is to test RCWM or simulated munitions with chemical fill. Subtests for the treatment of chemically filled munitions are described in section 4 for the different types of munitions listed in Table 1-1. The criteria for each subtest are outlined in the particular subtest.

Table 1-1: Test Munitions

		Agent Fill		Energetics		
Test Phase	**Munition/Test Item**	**Type**	**Weight (lbs)**	**Type**	**Weight (lbs)**	**Quantity**
Work Up						
	Donor charge only	N/A	N/A	N/A	N/A	5-10
	UK 25 Pdr Shell	Water or None	None	Gunpowder[(2)]	N/A	3-5
G	Nerve Agent Container (assembled by DSTL)					
	Test 1	GB	1.3 lb	N/A	N/A	1
	Test 2	GB	1.3 lb	N/A	N/A	1
	Test 3	GB	1.3 lb	N/A	N/A	1
H	Contaminated bursters (assembled by DSTL)	H				3
	Test 1	H	N/A	Tetrytol	0.26	
	Test 2	H	N/A	Tetrytol	0.26	
	Test 3	H	N/A	Tetrytol	0.26	
H	UK 25 Pdr Shell	H				3

Test Phase	Munition/Test Item	Agent Fill Type	Agent Fill Weight (lbs)	Energetics Type	Energetics Weight (lbs)	Quantity
	Test 1	H	1.54 lb[1]	Gunpowder[2]	0.08	
	Test 2	H	1.54 lb[1]	Gunpowder[2]	0.08	
	Test 3 (One in plastic)	H	1.54 lb[1]	Gunpowder[2]	0.08	
H	H in 25 Pdr (Two per event)					6
	Test 4	H	1.54 lb[1]	Gunpowder[2]	0.08	
	Test 5	H	1.54 lb[1]	Gunpowder[2]	0.08	
	Test 6 (One in plastic)	H	1.54 lb[1]	Gunpowder[2]	0.08	
H	H in DOT bottle	H				3
	Test 9	H	11.7	N/A	N/A	
	Test 10	H	11.7	N/A	N/A	
	Test 11	H	11.7	N/A	N/A	
Production Tests						
H	25 Pdrs	H				TBD
	Day 1	H	1.54 lb	Gunpowder	0.08	
	Day 2		1.54	Gunpowder	0.08	
	Day 3		1.54	Gunpowder	0.08	
H	25 Pdrs	H				TBD
	Day 1	H	1.54	Gunpowder	0.08	
	Day 2	H	1.54	Gunpowder	0.08	
	Day 3	H	1.54	Gunpowder	0.08	

Notes:

(1) The fill weight varies from 0.33 lbs to 1.54 lbs (0.15 kg to 0.7 kg)

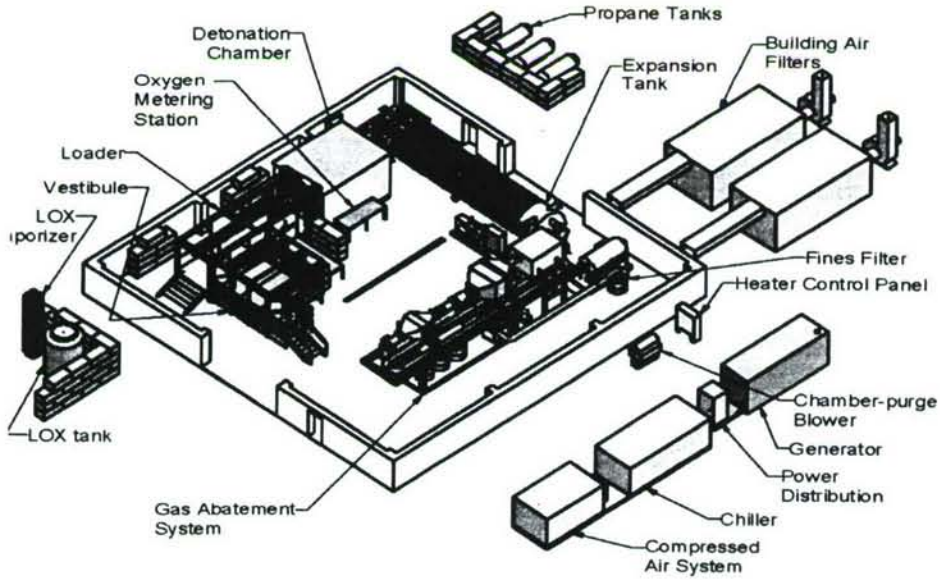
(2) The exact composition of the gunpowder will be determined by DSTL

Operators for the TC-60 CDC will consist of personnel from ECBC in appropriate PPE. DSTL is an establishment of the United Kingdom Ministry of Defence (MOD), which owns and operates the Porton Down facility and will provide a safety link during testing of the TC-60 CDC. The estimated number of operators needed is to be determined by field

practices and requirements. Personnel from DeMil International, the designer and fabricator of the TC-60 CDC, will be available for consultation when repairs are necessary. The test will be conducted following procedures developed by Demil International and approved by Porton Down safety, environmental, and management personnel. A test director will be appointed from ECBC to oversee all aspects of the test; Trials Conducting Officer also will be appointed from DSTL. The responsibilities of these and other organizations supporting the TC-60 CDC Test are delineated in appendix B.

A diagram of the Porton Down test facility, with proposed equipment layout is depicted in Figure 1-1. The test facility is a steel building that is approximately 65.6feet (20 meters) by 65.6 feet (20 meters) and has a concrete floor, a door of suitable size to accommodate the TC-60 CDC, and clearances on all sides. A munitions unpack area and a temporary waste storage area(TWSA) will be available. Utilities such as electrical power and water will be provided via portable generators and water tanks. Storage areas for equipment and spare parts will be available near the test facility.

Figure 1-1



TC-60 Laboratory support will be provided by Porton Down. Edgewood Chemical Biological Center (ECBC) personnel will provide air monitoring support.

The United Kingdom is responsible for Chemical Weapons Convention (CWC) compliance. Test munitions have been declared as 1925 to 1946 chemical munitions, but unusable.

During the test, data will be collected electronically and by visual observations. The following data will be collected during the subtests:

- Assessment results for each munition
- Equipment set-up times
- Decontamination times
- Processing times
- Configuration, type and amount of explosives used
- Temperatures and pressures of the TC-60 CDC system during CWM destruction
- Chemical analysis of liquid, vapor, and solid samples, as available
- Visual inspection of solid wastes
- Test facility monitoring results
- Test facility ambient conditions (meteorological information)
- Waste volumes generated and/or weights generated
- Procedure evaluation and adherence
- Safety and environmental compliance
- Reports of incidents and anomalies and the actions taken
- Usage and consumption of spare parts and expendables
- Maintenance activities

1.3.2 Limitations of Test The test at Porton Down has the following limitations:

- The chemical fills in the munitions to be tested are not indicative of the full range of chemical fills that may be recovered. This test will not demonstrate the full capability to handle all chemical fills the TC-60 CDC may eventually process.
- The accuracy of the munition assessment process will not be evaluated during the test at Porton Down

- The test is not intended to determine the capability of the full range of CDCs manufactured by Demil International, Inc..

1.4 Schedule

Testing of the TC-60 CDC at Porton Down is scheduled to begin in July of 2004 and is expected to be completed in 4-5 months.

1.5 System Description

The TC-60 Controlled Detonation Chamber (CDC) is comprised of the following subsystems:

- Mechanical Loader
- Detonation Chamber
- Expansion Tank
- Hot Gas Generator
- Reactive Bed Filter
- Catalytic Converter
- Direct Air Dehumidifier
- Closed loop off-gas heat exchanger
- Carbon Filtration
- Process Fan

A description of the function of each of these subsystems is provided below.

Mechanical Loader –The loader consists of a frame and pan fitted with a beam to carry a rolling jib and scissor table. The pieces to be treated are passed from the work table to a scissors lift table. The scissors lift table lifts the prepared package to the jib on the loader. The package is secured to the jib with a hook and the scissors table is lowered. The jib is then positioned to load the workpiece onto a hanger inside the detonation chamber. This loader is also used to load water bags into the chamber. Use of the loader allows the loading of the chamber without the necessity for an operator to enter the detonation chamber.

Detonation Chamber – The detonation chamber is constructed of mild steel reenforced with wide flanges and an outside skin of mild steel plate. The chamber volume is approximately 760 cubic feet. The water bags and explosive packages are hung in the middle of the chamber on hooks which engage a target hanger. Exploding Bridgewire Detonators are fixed to the explosive package at the door of the chamber. After the package is hung in the chamber, the detonator circuit is connected by inserting a plug into an interface connector inside the chamber. After the doors are closed, the detonator ciucuit is completed by inserting a plug into the outside connection of the interface connector. The area is then cleared and the firing circuit closed to detonate the package inside the detonation chamber.

Detonation gases from the explosion are vented to the expansion tank and then flow-controlled to release the gases at a constant rate to the air pollution control system. At the time that the pressure is vented down to atmospheric pressure, fresh air from outside the process is pumped into the chamber for a period of time sufficient to clear the chamber of the detonation gases.

Expansion Tank – The expansion tank is a cylindrical vessel capable of operating at up to 125 pounds per square inch pressure. The purpose of the expansion tank is to contain the gases and pressure resulting from the detonation of the explosives and resulting oxidation of any chemical fill in the munitions treated in the detonation chamber. Flow from the expansion chamber is controlled by valves at the exit of the expansion chamber. This allows for the process to contain the instantaneous generation fo gases from the detonation and then vent at a constant rate for treatment of the detonation gases.

Hot Gas Generator—Ambient air is heated directly by a contained propane flame to a temperature of 1,500 ^{0}F. The hot air is vented to the ductwork connecting the expansion tank to the reactive bed filtration system. As ambient air is exhausted from the expansion tank it is mixed with an equal volume of hot air . At this point, the system is under slightly negative pressure with respect to atmospheric pressure. The resulting temperature will normally operate at 800 ^{0}F and serve to heat the duct work leading to the reactive bed filter system. The hot gas generator will heat the duct work, reactive bed filter, and catalytic converter to 800 ^{0}F.

In addition, the hot gas generator has sufficient capacity to heat the system for thermal decontamination. The hot gas generator is mobile and can direct hot gas to the detonation chamber, expansion tank, and other locations as deemed necessary for thermal decontamination. There are never any contaminated air streams that pass through the propane flame of the hot gas generator.

Reactive Bed Filter—The reactive bed filter consists of a dry solids feeding system to introduce acid gas reactive solids (hydrated lime and/or sodium bicarbonate), upstream of the particle filtration system. The reactive solids will react with acid gases in-situ. In addition, further acid gas reactions take place on the solids cake that develops on the surface of the filters. Acid gases and particulate matter are generated from the destruction of a munition (smoke, chemical or agent) in the detonation chamber. The addition of reactive solids is only necessary just prior to a detonation and lasts until the detonation chamber has been flushed sufficiently with ambient air.

The filtration system consists of rigid ceramic candle filters that remove particulate matter from the gas stream. Particulate matter would consist of the reactive solids, soot generated from blasting, and fragmentation of the pea gravel upon blasting. Applying a short burst of compressed gas inside the filter cleans the filtration substrate. The burst of air dislodges the particles on the filter substrate, and allows them to settle by gravity into the bottom of the housing for removal. The solids would consist of inert salts, unreacted solids, pea gravel dust and soot.

The reactive bed filter has the capability to be heated above 1,100 °F by using hot gas generated by the hot gas generator. The ceramic candle filters will withstand a 5-X decontamination criterion of 1,000°F. The pressure is slightly negative, approximately –10

inches of water with respect to atmospheric pressure. Measurement indicators of temperature and pressure drop are all that are necessary to assess safe performance of this unit operation.

Catalytic Converter—The catalytic converter is a precious metal catalyst supported on alumina ceramic. Approximately eight cubic feet of catalyst are contained in the housing. A catalyst serves to convert organic vapors and carbon monoxide to carbon dioxide and water. Operating performance of the catalyst can be determined by measuring the temperature, upstream and downstream of the catalyst. The TC-60 CDC also has sampling point locations, upstream of the electric dehumidifier and downstream of the catalyst to measure the conversion performance of carbon monoxide. The upper temperature limit of the catalyst is 1,250°F. Temperature can be controlled by the output of the hot gas generator (temperature and flow are variable).

Direct air dehumidifier—Gas discharged from the heat exchanger will be mixed with ambient air for cooling of the off-gas stream prior to entering a heat exchanger. Ambient air is introduced based on the vacuum provided by the process fan. The ambient air will cool the hot gas of approximately 1,200 ^{0}F to 400 ^{0}F. Approximately 4,000 scfm of air will pass through the heat exchanger with an inlet temperature of approximately 400 ^{0}F.

Closed loop off-gas heat exchanger—A heat exchanger will be used to cool the hot gas to prepare the gas for carbon adsorption. Water (55 ^{0}F) will be used as the heat transfer fluid in a closed loop design. The return water (70 ^{0}F) is cooled by use of a refrigerator that will be located outside of the secondary containment building. The capacity of the heat exchanger, coupled with the refrigerator (chiller), will cool 4,000 scfm of gas at approximately 400 ^{0}F to approximately 110 ^{0}F. The exhaust gas can be cooled further with addition of ambient air, downstream of the heat exchanger. Performance indicators for the heat exchanger and chiller include liquid side pressure, gas outlet temperature, and liquid flow rate. Varying the liquid flow rate can control gas discharge temperature.

Carbon Filtration—There will be two carbon vessels in series. The carbon vessels serve to capture any trace organic compounds that may have not been destroyed in the process. Each carbon vessel has a carbon fill capacity of 1,500 lbs carbon. There will be gas sampling locations upstream and downstream of each carbon vessel. The vessels can be cleaned to a 3-X condition by removal of the carbon and purging the vessel interior with heated off-gas, in a closed-loop fashion. The heated off-gas would be introduced upstream of the reactive bed filter.

Process Fan—A process fan is used to convey gases from the detonation chamber through the gas cleaning components (filtration, catalytic conversion, and carbon adsorption) while maintaining a negative pressure in the system. The fan discharge will be at a positive pressure with respect to atmosphere.

Performance indicators for the fan and motor include: rpm, voltage, amperage, temperature, and vibration limits.

Auxiliary Support Equipment—Identification of the necessary support equipment to be utilized with the TC-20 DBC include the following:

- Fuel supply (Propane and Diesel)

- Decontamination Hot Gas Generator
- Electrical Power Generation and Distribution
- Water supply tank, pumps, and electrical chiller
- Compressed air supply
- Vestibule for decon of personal protective equipment and containment of contamination.
- A description of each of the auxiliary systems follows.

Propane and Diesel—Propane fuel will be supplied by DSTL. The propane delivery system will consist of three 1,000-gallon tanks, each with a vaporizer and manual fuel shut off valve. The propane delivery piping will be provided by the propane system supplier and terminate inside the test building. The gas train from inside the building will contain the appropriate pressure and control valves to supply propane to two hot gas generators: The hot gas generator that is part of the normal operation of the TC-60 CDC and the Decontamination hot gas generator.

Decontamination hot gas generator—A portable hot gas generator is supplied for decontamination of the detonation chamber and expansion chamber. A connection will be supplied at the outer door of the detonation chamber to deliver hot gas with a maximum temperature of 1,500 ^{0}F. While in operation the inner door of the detonation chamber is open to allow delivery of hot gas into the chamber. A perforated duct will be connected to the interior of the outer door so that uniform distribution of hot gas is accomplished. Decontamination can be practiced at an elevated temperature for slow volatilization of contaminants.

Electrical Power Generation and Distribution—Electrical power will be supplied by a diesel fired generator. Power will be distributed to an electrical power distribution panel that will connect to local power disconnect boxes for major equipment. All equipment will be grounded to the diesel generator and have the same electrical potential. The diesel generator is equipped with an 300 gallon fuel tank. Filling of the fuel tank will be from a storage tank on site. The fuel connection to the 300-gallon tank is the responsibility of DSTL.

Water Supply Tank, Pumps, and Chiller—Cooling water will be contained in a 1,000-gallon tank. A closed loop design is used to provide cooling water to the heat exchanger. The chiller is used to cool down the water that has been heated in the heat exchanger. The supply temperature of water is 55 ^{0}F and the return water temperature is 70 ^{0}F.

Compressed air supply—Compressed air at 100 psig is used to operate the following equipment:

- Pneumatic actuated valves
- The pulse cleaning manifold of the reactive bed filter
- Air amplifiers at the detonation chamber.

Vestibule for Containment—A vestibule is provided to minimize the potential for contamination during periods when the detonation chamber inner and outer doors are open and personnel in PPE have come in contact with surfaces inside the detonation chamber. The vestibule is under slight vacuum at all times and is vented through the TC-60 CDC system.

Required Support Systems

Although the following are not part of the TC-60 CDC, they are required support systems for this test:

- Assessment results of munitions to be treated
- Test Facility at Porton Down
    - Building
    - Electric Generator
    - Water
    - Waste Collection and Disposal
    - Site Security
- Monitoring and laboratory support

Recovered munitions will be non-intrusively assessed to determine the fill and explosive configuration. PINS and x-ray are the primary methods by which this assessment is performed. The results are reviewed by Dstl personnel who make a recommendation of the chemical fill. As part of the testing program the filling of DOT bottles with chemical or agent will be provided by Dstl personnel.

1.5.1 Functional Description

Normal operations of the TC-60 CDC can be divided into distinct procedural steps, as follows:

- Arrive and set up at the deployment location
- Perform background air monitoring
- Obtain assessment of the munition fill and explosive configuration
- Unpack the munition (if necessary)
- Prepare munition with donor explosive charge and place detonator
- Load munition into TC-60 CDC detonation chamber and close door
- Detonate the donor explosive charge
- Monitor the TC-60 CDC system temperature and pressure as necessary to assure safe operation
- Perform air monitoring
- Open TC-60 CDC detonation chamber door
- Prepare for next item or decontaminate and demobilize the TC-60 CDC for re-deployment

Pre-Operations. Upon arrival at the Porton Down test facility, the TC-60 CDC will be set up, inspected, and prepared for operations. Electrical power will be supplied by an electrical generator. Electrical equipment will be checked for operability.

After the TC-60 CDC system has been set up and inspected, but before destruction of recovered chemical munitions can begin, background air monitoring will be completed by ECBC personnel.

Detonating Munitions with Donor Explosive Charges. Once a recovered munition has been placed in the TC-60 CDC detonation chamber, the recovered chemical munition and its fill will be blasted. This process is accomplished using a donor explosive charge. The munition is detonated with a two-part system, including a donor explosive charge and a high-voltage modular firing system. This two-part system is described in the following paragraphs:

- *Donor Explosive Charge:* The donor explosive charge is detonated around the munition body and its chemical fill. The shape and length of the donor explosive charge will vary depending upon the type of the munition.

- Detonators are connected to the donor explosive charge. Cables are connected to the detonators, strain relieved, and then electrically shorted until the unit is positioned into the TC-60 CDC detonation chamber.

- *Water Bags:* One of the design criteria for the TC-60 CDC is to use water as a heat sink to limit the temperature and pressure resulting from the detonation of the donor charges, supplemental charges, munition energetics and destruction of the chemical fill. The amount of water is based on the amount of donor charge. Ammonia, bleach, calcium, magnesium or sodium hydroxides may be added to the water to react with acid gases, particularly for the smoke and CG experiments.

- *Firing System and Detonators*: The firing system used to initiate the donor explosive charge is the Risi Firing System188-4387. The detonators selected to initiate the donor explosive charge are exploding bridge wire (EBW).

- *Once the entire assembly* – munition and donor explosive charge has been placed inside the TC-60 CDC detonation chamber, the final detonator connections are made via plug

connectors. Following door closure, the firing sequence is initiated after system operational parameters are verified as normal.

Chemical Destruction; Destruction of the munition and chemical fill and decontamination of the munition fragments are accomplished in the principal components of the TC-60 CDC (detonation chamber and expansion tank). Upon detonation the chemical fill is subject to a chemical reaction evolving heat and pressure. Detonation is a reaction that proceeds through the reacted material toward the un-reacted material (exposed chemical fill) at supersonic velocity. A vapor sample can be taken after the detonation and expansion chambers to define the chemical agent vapor concentration in the detonation and expansion chambers, respectively.. The door of the detonation chamber is then opened, and the solid wastes are visually inspected and may be manually removed from the chamber when necessary. Additionally, a vapor sample can be taken from the detonation chamber when the door is opened. The anticipated frequency of solid waste removal will be one of the results of the test program. The solid wastes are placed into a waste container and sealed. Containers containing waste products are stored in a temporary waste storage area (TWSA) and managed as hazardous waste.

Preparation for Next Item. Prior to processing of each subsequent chemical munition, the TC-60 CDC detonation chamber may be systematically cleaned and inspected when necessary. This process includes visually inspecting the detonation chamber and its door; making any necessary repairs and replacing the electrical connection feed-throughs, as necessary.

Closeout. Upon completion of the test, operations of the TC-60 CDC will be closed out. Closeout activities include cleaning and decontaminating the TC-60 CDC system, stowing all equipment and supplies and preparing the TC-60 CDC for movement out of the Porton Down test facility.

1.6 Unique Personnel Requirements for Chemical Agent Operations

In the U.S., all personnel working with military chemical agents must be in compliance with the requirements of Army Regulation (AR) 385-61, *Army Toxic Chemical Agent Safety*

Program, and Department of the Army (DA) Pamphlet (Pam) 385-61, *Toxic Chemical Agent Safety Standards*. These requirements specify minimum safety criteria and standards for processing, handling, storage, transport, disposal, and decontamination of the various chemical agents.

Although recovered chemical munitions are not considered surety materiel per AR 50-6, *Chemical Surety*, ECBC personnel, who will operate the TC-60 CDC system at the Porton Down test, comply with the Chemical Personnel Reliability Program (CPRP) standards as part of their certification. This ensures that the personnel meet the stringent requirements for training, reliability, and certification to perform chemical agent operations on recovered chemical munitions.

United Kingdom workers receive initial training, annual refresher training, and are certified in accordance with DSTL requirements to work with and dispose of toxic chemical agents.

1.7 Quality Assurance

Quality Assurance (QA) for the test will follow the requirements discussed below:

a. ECBC will apply the QA requirements to enhance its confidence that the following objectives are met: (1) maximization of protection for personnel, the general public, and the environment; and (2) assurance that data is representative, accurate, and defensible.

b. Monitoring systems and equipment provided by ECBC shall meet the certification and validation requirements outlined in the *Chemical Agent Standard Analytical Reference Material (CASARM) Quality Assurance Plan for Chemical Agent Air Monitoring* Research Development and Engineering Command (RDECOM) most recent version], which ECBC has implemented in the Monitoring Branch Quality Control Plan for CASARM (ECBC, most recent edition). For purposes of this test, the DA-approved CASARM QA Plan and ECBC established procedures shall be the acting quality plan for monitoring applications. ECBC will provide onsite QA oversight to perform quality control functions.

1.8 Risk Management

Risk management provides a framework in which the test can be performed safely within the bounds of security, surety, and environmental limitations. System safety is applied with the goal of improving operational effectiveness by conserving valuable resources and reducing inherent risks. The safety assessment procedures will follow guidelines contained in MIL-STD-822C and appendix F of DA Pam 385-61.

1.8.1 Health and Safety

Safety requirements for conducting operations or tests with CWM are contained in AR 385-61, *Army Toxic Chemical Agent Safety Program*, and DA Pam 385-61, *Toxic Chemical Agent Safety Standards*. AR 385-61 assigns responsibilities for safety studies and reviews, and prescribes general safety precautions for both DA and contractor operations. DA Pam 385-61 identifies minimum safety criteria and standards for use in processing and handling CWM. For the explosives, AR 385-64, *Ammunition and Explosives Safety Standards*, and its associated DA Pam apply.

The Health and Safety Plan (HASP) identifies, evaluates, and provides guidelines for controlling safety and health hazards involved with testing and operating the TC-60 CDC System. The HASP is developed in compliance with Code of Federal Regulations (CFR) 1910.120, *Hazardous Waste Operations and Emergency Response*, is considered to be a "living document," and will be updated as required to make it site-specific.

Additional safety tasks are required to be completed to ensure the safety of the TC-60 CDC operation. These include a system hazard analysis, hazard tracking and risk resolution, and site safety plan. These will be utilized to safeguard personnel and the environment.

The HASP is utilized to identify health hazards, evaluate hazardous materials, and propose protective measures to reduce associated risks to an acceptable level. The HASP is organized into eleven sections. Section 1, Introduction, provides a description of the TC-60 CDC System. Section 2 outlines the health and safety organization and individual responsibilities. Section 3 addresses potential health and safety hazards. Section 4 is the Air Monitoring Subplan. An analysis of the PPE required for each operation is provided in

section 5 and respiratory protection is covered in section 6. Section 7 covers decontamination for personnel, equipment, and decontamination waste disposal. Section 8 is the Emergency Response/Contingency Plan. Section 9 covers general safety for personnel and the site. Section 10 is Medical Surveillance to include health monitoring and documentation/record keeping. Lastly, section 11 covers employee training requirements.

Contingency support for the test will be coordinated with Porton Down and with the SOPs for operating the Porton Down test facility.

1.8.2 Surety Recovered chemical munitions are considered hazardous waste, not chemical surety materiel, per AR 50-6. As such, the surety regulations delineated in AR 50-6 are not applicable.

1.8.3 Security The physical security procedures in force for the Porton Down test facility satisfy the requirements for the TC-60 CDC test and its associated test items and materials. The chemical munitions will be transported from storage to the test facility by DSTL personnel.

Porton Down is a restricted area. The compound is fenced and controlled by a MOD guard force. Entry is by permit only and is enforced by guards at the entry control point. The munitions to be treated and the test facility are within a separate fenced area with an additional entry control point. The storage area is further controlled and entry is only allowed after donning PPE and being issued a respirator for emergency escape. Entry to the test facility will be controlled by the Dstl Trials Conducting Officer.

Security of explosives used for the TC-60 CDC test is provided by the ammunition supply point. Security is similar to that required by U.S. Army ammunition storage procedures. When the demolition materials (that is, the donor explosive charges) are onsite, range control regulations will be in effect. These procedures include, but are not limited to, security patrols and the posting of signs in the immediate vicinity of the test facility.

1.8.4 Environmental The demonstration/validation test will address the development of operational parameters, waste-handling procedures, and will evaluate the treatment process efficacy for safe and practical operation of the TC-60 CDC.

A Test Monitoring Plan will be prepared for testing the TC-60 CDC. The Test Monitoring Plan is a supporting document to the HASP and provides the site-specific technical and administrative requirements for monitoring and support analyses during the TC-60 CDC test. The strategy for monitoring and sampling of CWM and other regulated chemicals are provided along with the frequency and types of air monitoring and the environmental sampling techniques and instrumentation used to collect test data.

The Sampling and Analysis Plan will be prepared for testing of the TC-60 CDC. The Sampling and Analysis Plan provides information regarding hazardous waste management procedures, including waste descriptions, waste characterization procedures, and waste analysis methods and instrumentation. The procedures by which samples are to be collected, labeled, analyzed or characterized, and disposed of will be covered by DSTL specific procedures, processes, and protocols.

1.9 Public Outreach

DSTL Public Affairs officers will coordinate requests for release of any public information with the ECBC and RDECOM Public Affairs Office.

1.10 Test Report

A TC-60 CDC Test Report will be delivered after completion of the TC-60 CDC Test.

SECTION 2

Subtest Number 1 – Transportation

This section provides a general description of the planned modes of transportation for the TC-60 CDC System.

2.1 Subtest Objective

The objectives of this subtest are to demonstrate that the TC-60 CDC is transportable by road (interstate, two-lane, and gravel roads); to determine the effects of these modes of transportation on TC-60 CDC components; and to develop logistical data to support deployment planning. All steps in the transportation of the TC-60 CDC will be evaluated for compliance with applicable procedures and checklists to ensure that these steps can be safely performed.

2.2 Risk Management

This subtest is concerned with the transportation of the TC-60 CDC and its ancillary equipment only; hazardous materials will be shipped separately.

2.3 Subtest Criteria

a. Transportation should not cause any damage that would preclude or seriously degrade the conduct of the test. **REQUIREMENT**

b. Transportation should not cause any damage resulting in other than routine maintenance upon unloading. **GOAL**

c. Procedures for stowage and packaging are adequate to prepare and protect the TC-60 CDC against movement damage. **INDICATOR**

2.4 Subtest Setup and Procedures

This subtest will be conducted by transporting the TC-60 CDC via the following modes:

- By road on interstate, two-lane, and gravel roads
- By sea

The current plan is to begin this subtest upon shipment of the equipment from Crescent City, Illinois to Porton Down by sea transport.

Prior to beginning transportation, the TC-60 CDC will be inspected and prepared for movement. After shipment, the TC-60 CDC will be visually inspected for damage.

2.5 Data Requirements

Data requirements are as follows:

a. Physical characteristics (weight, cube, dimensions) of the TC-60 CDC trailers

b. Results of pre- and post-transportation inspections

2.6 Data Analysis Methods and Procedures

Transportation of the TC-60 CDC by road will be done by commercial means. After each segment of transportation, the TC-60 CDC will be visually inspected for damage.

Operational and logistical data will be collected and examined for frequency of failures and time to perform scheduled and unscheduled maintenance. Operational, logistical, and personnel hours will be recorded.

2.7 Disposition/Residual Management

No hazardous wastes are expected to be generated during the transportation subtest.

2.8 Specific Decision to Proceed Criteria

The TC-60 CDC will be verified as ready to begin pre-operations if no damage resulting from transportation would preclude or seriously degrade the conduct of the test.

SECTION 3

Subtest Number 2 – Pre-Operations

This section provides general procedures for setting up, inspecting, and preparing the TC-60 CDC for testing. TC-60 CDC SOPs, checklists, and technical manuals apply.

3.1 Subtest Objective

The objectives of this subtest are to verify that the TC-60 CDC system is complete, and in satisfactory condition to conduct the test, and to verify that the TC-60 CDC operators are trained. All steps in the setup of the TC-60 CDC will be evaluated for compliance with the SOPs and checklists to ensure that these steps can be safely performed by the operators.

3.2 Risk Management

Setup of the TC-60 CDC will be done according to SOPs, checklists, and general safety guidance.

3.3 Subtest Criteria

a. The TC-60 CDC system shall be complete and ready to conduct test operations. **Requirement**

b. Health and safety documents and procedures shall be complete and approved. Safety and emergency response equipment and supplies shall be in place and ready for use. **Requirement**

c. The TC-60 CDC procedures (SOPs and checklists) shall be complete and approved. **Requirement**

d. Operators are to be capable of operating the TC-60 CDC. **Indicator**

e. The required inventory of TC-60 CDC components, tools, spare parts, and expendables should be on-hand, complete, and undamaged. **Goal**

3.4 Subtest Setup and Procedures

This subtest will be conducted in the Porton Down test facility. The TC-60 CDC will be set up, inspected, and prepared for treatment of munitions as described in paragraph 1.5, the SOPs, and the checklists. The TC-60 CDC will also be inspected by safety and environmental professionals. Site air monitoring shall be functional and shall have successfully met Test Monitoring Plan background air monitoring requirements.

3.5 Data Requirements

Data requirements are as follows:

a. Results of pre-operational checks

b. Record of maintenance activities performed (including any calibrations)

c. Inventory and shortage list(s)

d. Health and Safety documents – HASP (Material Safety Data Sheets and safety and emergency response equipment and supplies are subsets of the HASP.)

e. Validated and signed SOPs and checklists

f. Porton Down test facility background air monitoring results

g. Sound levels

h. Training records

i. Preoperational survey results

3.6 Data Analysis Methods and Procedures

The setup and inspection of the TC-60 CDC will be accomplished by DSTL, ECBC and CH2M HILL personnel and will be observed first hand. All procedures will be documented and evaluated for compliance with the SOPs and checklists. The TC-60 CDC, including its associated test items and materials (such as spare parts and expendables, and safety and emergency response equipment and supplies) will be inventoried and inspected for

damage. Pre-operational checks will be done as part of the initial inspection. Any necessary calibrations will be performed. Background air monitoring results will be collected while performing operations with simulated CWM.

Operator training records will be examined to verify that the operators are trained.

Operational and logistical data will be collected and examined for frequency of failures and time to perform scheduled and unscheduled maintenance. Operational, logistical, and personnel hours will be recorded.

3.7 Disposition/Residual Management

All wastes (primarily air monitoring wastes for this subtest) generated during the test will be containerized and managed as hazardous waste. All wastes will be disposed of by DSTL, primarily in their thermal treatment unit.

3.8 Specific Decision to Proceed Criteria

The TC-60 CDC and its associated test items and materials will be verified as ready to test if no damages, shortages, or inoperable items would preclude or seriously degrade the conduct of the test.

SECTION 4

Subtest Number 3 – Chemical-Filled Munitions

This section provides general procedures for performing TC-60 CDC testing on chemical-filled munitions or simulated munitions. The types of chemical-filled munitions to be tested may include the following:

- 25 pounder (UK)

4.1 Subtest Objective

The objectives of this subtest are to 1) demonstrate that the TC-60 CDC can safely and effectively destroy recovered chemical munitions with or without explosive components 2) demonstrate that the TC-60 CDC can reduce the hazardous properties of the chemical fill without release of hazardous wastes or materials to the soil or water (Data will be collected during this test to quantify the reduction) 3) develop the data necessary to demonstrate to the U.S. Army, Department of Defense, and Federal, state and local environmental agencies: a) the safety, integrity, and efficacy of the TC-60 CDC and b) the ability of the operator to collect waste samples and c) gather the data necessary to transition to a developmental test. All steps in the destruction of a munition will be evaluated for compliance with the SOPs and checklists to ensure that the operators can safely perform these steps.

4.2 Risk Management

The SOPs and the checklists for the TC-60 CDC cover its use for the destruction of chemical munitions and address explosive, chemical, and physical hazards. The hazard controls include explosive safety procedures, chemical handling and storage, perimeter monitoring, protective clothing and equipment, first aid and firefighting equipment, decontamination

station, chemical agent handling and transfer procedures, sample handling, cleanup, and disposal of the wastes.

4.3 Subtest Criteria

a. The test munition shall be handled, assembled with a donor explosive charge, loaded into the detonation chamber and the door closed in accordance with approved procedures. **Requirement**

b. The donor explosive charges shall destroy the munition. **Requirement**

c. The donor explosive charge should detonate the burster (if present). **Goal**

d. The chemical fill in the munition should be destroyed such that the resultant products are not detected above the associated applicable TWA downstream of the CDC carbon filter system. **Requirement**

e. Solid residues shall be removed from the detonation chamber using approved procedures and packaged to meet requirements for transportation to an approved disposal facility. **Requirement**

f. No personnel injuries requiring more than first aid should result from TC-60 CDC operations or hardware. **Goal**

g. No agent will be detected at the site perimeter (the site perimeter is established at the distance where a downwind hazard analysis for the maximum credible event that predicts the vapor hazard will not exceed the GPL) monitors above the general population level (72-hour Time Weighted Average). **Requirement**

h. Waste Samples shall be capable of being analyzed, using approved analytical methods, to a detection level appropriate to validate destruction. **Requirement**

4.4 Subtest Setup and Procedures

This subtest will be conducted in the Porton Down test facility. The TC-60 CDC system is described in paragraph 1.5 and in this section. Before operations with actual chemical -filled munitions begin, pre-tests will be performed with non-explosively configured test items

4.5 Data Requirements

Data requirements are as follows:

a. Evaluation of procedure adherence (including PPE usage)

4.5.1.1.1.1 Times for processing and decontamination

4.5.1.1.1.2 Daily log of actions taken (via logbook(s) and data collection sheets)

4.5.1.1.1.3 First aid and injury report(s)

4.5.1.1.1.4 Ambient conditions

4.5.1.1.1.5 Test facility monitoring results

4.5.1.1.1.6 Munition description and assessment results

4.5.1.1.1.7 Pressures and temperatures in TC-60 CDC system

4.5.1.1.1.8 Results of vapor sampling/analysis, as available

4.5.1.1.1.9 Results of liquid sampling/analysis, as available

4.5.1.1.1.10 Volume of decontamination liquids and water used for cleanup

4.5.1.1.1.11 Results of solids sampling/analysis, as available

4.5.1.1.1.12 Results of visual inspection of solid wastes

4.5.1.1.1.13 Chamber inspection results

4.5.1.1.1.14 List of expendable materials used

4.5.1.1.1.15 Record of maintenance activities performed

4.5.1.1.1.16 Waste container volumes/weights and agent analytical results

4.6 Data Analysis Methods and Procedures

Operations of the TC-60 CDC system will be observed visually via the command post. The procedures for handling and processing a munition will be documented and evaluated for compliance with the SOPs and checklists.

Vapor, liquid, and solid samples will be taken and analyzed for chemical agent per the Sampling and Analysis Plan.

Operational and logistical data will be collected and examined for frequency of failures and time to perform scheduled and unscheduled maintenance. Operational, logistical, and personnel hours will be recorded.

4.7 Disposition/Residual Management

All wastes generated during the test will be containerized, screened for chemical agent, and managed as hazardous waste. All wastes will be disposed of by DSTL, primarily in their thermal treatment unit.

4.8 Specific Decision to Proceed Criteria

The subtest for a given munition will be considered complete when the data requirements are met. Successful accomplishment of test issues and criteria will be determined during preparation of the test report. Following successful completion, the TC-60 CDC system will be prepared for the next munition or for closure.

SECTION 5

Subtest Number 4 – Closeout

This section provides general procedures for closeout of the TC-60 CDC system at the completion of testing. TC-60 CDC SOPs, checklists, vendor manuals, and AR 385-61 for decontamination standards apply.

5.1 Subtest Objective

The specific objectives of this subtest are to evaluate the ability of the operators to clean and decontaminate the TC-60 CDC system and prepare the system for transportation from the Porton Down location. All steps in the closeout of the TC-60 CDC will be evaluated for compliance with the SOPs and checklists to ensure that the operators can safely perform these steps.

5.2 Risk Management

The SOPs and the checklists for the TC-60 CDC cover its use for the destruction of chemical munitions and address explosive, chemical, and physical hazards. The hazard controls include explosive safety procedures, chemical handling and storage, perimeter monitoring, protective clothing and equipment, first aid and firefighting equipment, decontamination station, chemical agent/industrial chemical handling and transfer procedures, sample handling, cleanup, and disposal of the wastes.

5.3 Subtest Criteria

a. The TC-60 CDC system shall be capable of being cleaned, decontaminated, and monitored to verify the efficacy of decontamination methods using approved procedures. **Requirement**

b. There shall be no contamination of soil or of the test facility outside the TC-60 CDC spill control barrier. **Requirement**

c. Analytical results of all final 3X verification samples are to be below established criteria per AR 385-61. **Requirement**

d. All wastes shall be packaged for transport over roads and be accepted by the DSTL approved disposal facility. **Requirement**

e. The TC-60 CDC system shall meet AR 385-61, environmental, and transportation requirements for transport from the treatment location over public roads. **Requirement**

f. No agent will be detected at the perimeters monitors above the general population level (72-hour Time Weighted Average). **Requirement**

5.4 Subtest Setup and Procedures

This subtest will be conducted in the Porton Down test facility. The TC-60 CDC system will be closed out as described in paragraph 1.5, the SOPs, and the checklists. Logistics support requirements for TC-60 CDC deployment are to be captured and/or proposed.

5.5 Data Requirements

Data requirements are as follows:

a. Evaluation of procedure adherence (including PPE usage)
b. Times for closeout activities
c. Sample analysis results
d. Monitoring results
e. Waste container volumes/weights and agent analytical results
f. List(s) of spare parts, expendables, etc. used
g. Personnel requirements

5.6 Data Analysis Methods and Procedures

Operations of the TC-60 CDC will be observed first-hand from the command post. The procedures for closing out the TC-60 CDC will be documented and evaluated for compliance with the SOPs and checklists.

Appropriate vapor, liquid, and solid samples will be taken and submitted for chemical agent analysis.

Operational and logistical data will be collected and examined for frequency of failures and time to perform scheduled and unscheduled maintenance. Operational, logistical, and personnel hours will be recorded.

5.7 Disposition/Residual Management

The liquid wastes from the cleaning and decontaminating of the TC-60 CDC system will be sampled and analyzed to determine that the level of residual chemical agent. All wastes generated during the test will be containerized, screened for chemical agent, and managed as hazardous waste. The wastes will be disposed of by DSTL, primarily in their thermal treatment unit.

5.8 Specific Decision to Proceed Criteria

If the TC-60 CDC system is cleaned and decontaminated such that all wastes are properly disposed of, and the system is prepared for transportation from the Porton Down test facility, the subtest will be deemed successful.

APPENDIX A

Acronyms and Abbreviations

AC	hydrogen cyanide
AMSAA	Army Materiel Systems Analysis Activity
ANSI	American National Standards Institute
AR	Army Regulation
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
BA	bromoacetone
CA	bromobenzyl cyanide
CAM	chemical agent monitor
CASARM	Chemical Agent Standard Analytical Reference Material
CDC	Controlled Detonation Chamber
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	phosgene
CK	cyanogen chloride
CN	chloroacetophone
CNB	chloroacetophenone in benzene and carbon tetrachloride
CNS	chloroacetophenone and chloropicrin in chloroform
CPRP	Chemical Personnel Reliability Program
CWC	Chemical Weapons Convention
CWM	chemical warfare materiel
DA	Department of the Army
DAAMS	Depot Area Air Monitoring System

DAG	Data Authentication Group
DOD	Department of Defense
DOT	Department of Transportation
DSTL	Defense Science and Technology Laboratory
EBW	Exploding Bridge Wire
ECBC	Edgewood Chemical Biological Center
EPA	Environmental Protection Agency
FM	titanium tetrachloride
FS	sulfur trioxide/chlorsulfonic acid
FY	fiscal year
GB	Sarin, a nerve agent
H	mustard agent
HASP	Health and Safety Plan
HD	distilled mustard agent
HHA	Health Hazard Assessment
HS	sulfur mustard agent
HT	60/40 mixture of HD and T
L	Lewisite
MIL-STD	military standard
MOD	Ministry of Defence
NC	tin tetrachloride/chloropicrin
NEMA	National Electrical Manufacturer's Association

OPCW	Organisation for the Prohibition of Chemical Weapons
OSHA	Occupational Safety and Health Administration (or Act)
Pam	Pamphlet
PD	phosgene/phenyldichloroarsine
PETN	pentaerythritol tetranitrate
PG	chloropicrin/phosgene
PINS	portable isotopic neutron spectroscopy
PMNSCM	Product Manager for Non-Stockpile Chemical Materiel
PPE	personal protective equipment
PS	chloropicrin
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RDECOM	Research Development and Engineering Command
RDX	cyclonite
SOP	standing operating procedure
T	dichloroethylthiodiethylether
TECOM	Test and Evaluation Command
TNT	trinitrotoluene
TSDF	treatment, storage, and disposal facility
TWA	time weighted average
TWSA	temporary waste storage area
U.S.	United States
VX	a nerve agent

APPENDIX B

Organizational Responsibilities

The organizations supporting the test and evaluation of the TC-60 CDC System and their responsibilities are as follows:

1. Office of the Deputy Assistant Secretary of the Army (Environment, Safety, and Occupational Health)
    a. Provides funding to Edgewood Chemical Biological Center in support of Demonstration/Validation Testing of the TC-60 CDC.
    b. Approves the demonstration/validation test results, conclusions and recommendations.
2. Edgewood Chemical Biological Center
    a. Provides overall TC-60 CDC direction and funding.
    b. Provides a Project Manager to coordinate test requirements between DSTL and ECBC thru the European Research Office.
    c. Provides personnel for on-site activities to include set-up, operation and maintenance of the TC-60 CDC, air monitoring, equipment decontamination and site closure.
    d. Provides safety oversight during conduct of the test.
    e. Provides chemical protective clothing for U.S. personnel as required.
    f. Conducts pre-operational survey prior to testing with chemical agent-filled bottles and recovered chemical warfare materiel.
    g. Develops documentation required to support TC-60 CDC testing: Test Plan, Health and Safety Plan, and Test Monitoring Plan.
    h. Analyzes the test data and prepares a test report.
    i. Co-chairs the Data Authentication Group (DAG).
    j. Provides qualified personnel to perform explosive operations during the TC-60 CDC test. Provides explosive operators for munition unpack and loading operations.

3. Product Manager for Non-Stockpile Chemical Materiel
    a. Reviews documentation in support of the TC-60 CDC demonstration/validation test.
    a. Serves as a member of the DAG.
4. U.S. Army Corps of Engineer Support Center-Huntsville
    a. Reviews documentation in support of the TC-60 CDC demonstration/validation test.
    b. Provides contract support to award a task order to CH2M Hill.
5. CH2M HILL
    a. Provides the TC-60 CDC System for demonstration/validation testing.
    b. Provides TC-60 CDC spare parts and expendable materials for operations during testing.
    c. Acts as a consultant for operation and maintenance of the TC-60 CDC during testing.
    d. Develops documentation required to support TC-60 CDC testing: System Hazard Analysis, Standing Operating Procedures/Checklists and Maintenance Procedures/ Checklists, Sampling and Analysis Plan.
    e. Develops data collection forms, provides a data collector, collects, and verifies the quality of the test data.
    f. Supports training of DSTL and ECBC personnel in the operation and maintenance of the TC-60 CDC.
    g. Coordinates the DAG meetings and documents DAG meeting results.
6. Defense Science and Technology Laboratory (DSTL)
    a. Provides a Project Manager to coordinate test requirements between ECBC and DSTL thru the European Research Office.
    b. Coordinates DSTL personnel requirements and support activities for the test.
    c. Provides a test location with utilities to support the TC-60 CDC test.
    d. Provides chemical agent-filled bottles and recovered chemical warfare materiel for TC-60 CDC testing.
    e. Provide personnel for on-site activities to include set-up, Personnel Decontamination Station operation, laboratory analysis, and site closure.
    f. Provides safety oversight during conduct of the test.

g. Participates in the pre-operational survey prior to testing with chemical agent-filled bottles and recovered chemical warfare materiel.

h. Develops documentation required to support TC-60 CDC testing at Porton Down.

i. Arranges for final disposal of waste generated during the test.

7. Army Materiel Systems Analysis Activity (AMSAA)

a. Develops the CDC Test Evaluation Plan.

b. Prepares a Test Evaluation Report assessing the capabilities of the TC-60 CDC during demonstration/validation testing.

c. Co-chairs the DAG.

8. MITRETEK Systems

a. Provides input related to safety and environmental evaluation to the Test Evaluation Plan prepared by AMSAA.

b. Prepares a Test Evaluation Report of the TC-60 CDC test operation with respect to environmental compliance and safety.

c. Serves as a member of the DAG.

APPENDIX C

References

1. Memorandum from Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health) OASA (I&E), 20 September 2002, subject: Operational System Requirements for On-Site Destruction of Chemical Warfare Materiel Recovered During Environmental Restoration Activities.

July

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
				1	2	3
4	5	6	7	8	9	10
11	12 Installation and Systemization (I&S)	13 Installation and Systemization (I&S)	14 Installation and Systemization (I&S)	15 Installation and Systemization (I&S)	16 Installation and Systemization (I&S)	17 Installation and Systemization (I&S)
18	19 Installation and Systemization (I&S)	20 Installation and Systemization (I&S)	21 Installation and Systemization (I&S)	22 Installation and Systemization (I&S)	23 Installation and Systemization (I&S)	24
25	26 Installation and Systemization (I&S)	27 Installation and Systemization (I&S)	28 Installation and Systemization (I&S)	29 Installation and Systemization (I&S)	30 Installation and Systemization (I&S)	31

2004

August

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
1	2 Installation and Systemization (I&S)	3 Installation and Systemization (I&S)	4 Installation and Systemization (I&S)	5 Installation and Systemization (I&S)	6 Installation and Systemization (I&S)	7
8	9 Site Shutdown	10 Site Shutdown	11 Site Shutdown	12 Site Shutdown	13 Site Shutdown	14
15	16 Site Shutdown	17 Site Shutdown	18 Installation and Systemization (I&S)	19 Installation and Systemization (I&S)	20 Installation and Systemization (I&S)	21
22	23 Training	24 Training	25 Training	26 Training	27 Training	28
29	30 Public Holiday/UK	31 Pre-Operational Survey	**Notes:**			

2004

September

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
			1 Pre-Operational Survey	2 Pre-Operational Survey	3 Pre-Operational Survey	4
5	6 Pre-Operational Survey Corrections	7 Pre-Operational Survey Corrections Explosive only shots	8 Pre-Operational Survey Corrections Explosive only shots	9 Pre-Operational Survey Corrections Explosive only shots	10 Pre-Operational Survey Corrections Explosive only shots	11
12	13 Explosive Only Shots	14 Explosive Only Shots	15 Explosive Only Shots	16 Explosive Only Shots	17 Maintenance Day	18
19	20 Removal of Crossover Pipe Site Closure	21 Site Shutdown	22 Site Shutdown	23 Site Shutdown	24 Site Shutdown	25
26	27 Site Shutdown	28 Site Shutdown	29 Site Shutdown	30 Site Shutdown	**Notes:**	

2004

October

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
					1 Site Shutdown	2
3	4 Site Shutdown	5 Site Shutdown	6 Site Shutdown	7 Site Shutdown	8 Site Shutdown	9
10	11 Crossover Pipe Modification	12 Crossover Pipe Modification	13 Crossover Pipe Modification	14 Explosive Testing	15 Explosive Testing	16 Explosive Testing
17	18 H Single 25 Pdr – 1 test	19 H Single 25 Pdr – 2 tests	20 H Double 25 Pdr – 1 test H Double Contaminated Burster – 1 test	21 H Double 25 Pdr – 2 tests Explosive Only Shot 10#PETN	22 Maintenance Day	23
24	25 Maintenance Day	26 Maintenance and Inspection Day	27 Explosive Only Shots (2) 10#PETN	28 Inert Single 25 Pdr - 2 tests	29 Maintenance and Inspection Day	30

Notes:

2004

November

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
	1 Safety Stand Down Day	2 Empty DOT Bottle – 17.5# PETN (1 test) H DOT Bottle with 11.7 lb	3 H DOT Bottle with 11.7 lb – 2 tests H Contaminated Burster – 1 test	4 H Contaminated Burster – 1 test H Double Contaminated Burster – 1 Test Explosive Only Shot 22# PETN	5 Equipment Changeover for Thermal Decontamination	6 Thermal Decontamination (24 hour operation)
7 Thermal Decontamination (24 hour operation)	8 System Cool Down	9 Disassemble Decon HGG	10 Remove Munition Scrap and Pea Gravel From Chamber	11 Site Shutdown & Winterization of System	12 Site Shutdown	13
14	15	16	17	18	19	20
21	22	23	24	25 THANKSGIVING	26	27
28	29	30				

2004

December

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25 **CHRISTMAS**
26	27	28	29	30	31	

2004

December

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
				1	**2**	**3**
4	**5** Remobilization and Systemization	**6** Remobilization and Systemization	**7** Remobilization and Systemization	**8** Remobilization and Systemization	**9** Remobilization and Systemization	**10**
11	**12** Refresher Training And Pre-Operational Survey Preparation	**13** Refresher Training And Pre-Operational Survey Preparation	**14** Heat Exchanger Removal	**15** Demobilization/Site Closure	**16** Demobilization/Site Closure	**17**
18	**19** Holiday Break	**20** Holiday Break	**21** Holiday Break	**22** Holiday Break	**23** Holiday Break	**24**
25	**26** Holiday Break	**27** Holiday Break	**28** Holiday Break	**29** Holiday Break	**30** Holiday Break	**31**

2005

January

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
1	**2** Holiday Break	**3** Holiday Break	**4** Holiday Break	**5** Holiday Break	**6** Holiday Break	**7**
8	**9**	**10**	**11**	**12**	**13**	**14**
15	**16**	**17**	**18**	**19**	**20**	**21**
22	**23** Remobilization and Preparation for Heat Exchanger Installation	**24** Remobilization and Heat Exchanger Installation	**25** HMI Refresher Training and System Startup/Operation	**26** HMI Refresher Training and System Startup/Operation	**27** HMI Refresher Training and System Startup/Operation	**28** Demobilization and System Shutdown
29	**30**	**31**				

2006

February

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
			1	**2**	**3**	**4**
5	**6**	**7**	**8**	**9**	**10**	**11**
12	**13**	**14**	**15**	**16**	**17**	**18**
19	**20** Remobilization, Refresher Training and Pre-Operational Survey Preparation	**21** Remobilization, Refresher Training and Pre-Operational Survey Preparation	**22** Pre-Operational Survey & Corrections	**23** Pre-Operational Survey & Corrections	**24** Pre-Operational Survey & Corrections	**25**
26	**27** Explosive Only Tests	**28** Explosive Only Tests				

2006

March

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
			1 Explosive Only Tests and Mustard Pre-Trials	**2** Mustard Pre-Trials	**3** Mustard Pre-Trials	**4**
5	**6** Mustard Pre-Trials	**7** Mustard Pre-Trials	**8** Mustard Pre-Trials	**9** Mustard Pre-Trials	**10** Mustard Pre-Trials	**11**
12	**13** H- Throughput Test Week #1 (CDC Overnight Support)	**14** H- Throughput Test Week #1 (CDC Overnight Support)	**15** H- Throughput Test Week #1 (CDC Overnight Support)	**16** H- Throughput Test Week #1	**17** System Maintenance and Environmental Characterization Equipment Installation	**18** System Maintenance and Environmental Characterization Equipment Installation
19 Environmental Characterization Equipment Installation (If Necessary)	**20** H- Throughput Test Week #2 (CDC Overnight Support)	**21** H- Throughput Test Week #2 (CDC Overnight Support) & Environmental Characterization	**22** H- Throughput Test Week #2 (CDC Overnight Support) & Environmental Characterization	**23** H- Throughput Test Week #2 & Environmental Characterization	**24** System Maintenance and Cleanup	**25**
26	**27** H- Thermal Decontamination Equipment Changeover	**28** H – Thermal Decontamination (CDC Overnight Support)	**29** H – Thermal Decontamination (CDC Overnight Support – If Necessary)	**30** H- Thermal Decontamination Cool Down	**31** H- Thermal Decontamination Cool Down	

2006

April

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
						1
2	**3** Site Shutdown	**4** Site Shutdown	**5** Site Shutdown	**6** Site Shutdown	**7** Site Shutdown	**8**
9	**10** Monitor and Clear Detonation/Expansion Chambers	**11** Monitor and Clear Detonation/Expansion Chambers	**12** Monitor and Clear Detonation/Expansion Chambers	**13** Monitor and Clear Detonation/Expansion Chambers	**14** **Good Friday (UK Official Bank Holiday)**	**15**
16 EASTER	**17** **Easter Monday (UK Official Bank Holiday)**	**18** Demobilization/Site Closure	**19** Demobilization/Site Closure	**20** Demobilization/Site Closure	**21** Demobilization/Site Closure	**22**
23	**24** Demobilization/Site Closure	**25** Demobilization/Site Closure	**26** Demobilization/Site Closure	**27** Demobilization/Site Closure	**28** Demobilization/Site Closure	**29**
30						

2006

May

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
	1 **May Day (Official UK Bank Holiday)**	**2** Demobilization/Site Closure	**3** Demobilization/Site Closure	**4** Demobilization/Site Closure	**5** Demobilization/Site Closure	**6**
7	**8**	**9**	**10**	**11**	**12**	**13**
14	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23**	**24**	**25**	**26**	**27**
28	**29**	**30**	**31**			

2006

APPENDIX B

I'C-60 CONTROLLED DETONATION CHAMBER MONITORING PLAN FOR DEFENCE SCIENCE AND TECHNOLOGY LABORATORY PORTON DOWN, UK

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1.0 Introduction

1.1 Purpose

This document presents the Site Monitoring Plan (SMP) for the TC-60 Controlled Detonation Chamber (CDC) test operations at Porton Down, United Kingdom. The SMP includes the objectives, procedures, and responsibilities in support of the CDC.

1.2 Scope

The scope of this document is to provide guidance for the monitoring program and to describe the rational for monitoring strategies used during operations. The monitoring concepts and requirements for this SMP are defined for operations conducted in a Vapor Containment Structure (VCS). The plan focuses on monitoring requirements for test operations involving mustard (H and HD).

1.3 Monitoring Objectives

During testing, monitoring data will be used for the following:

- Protect workers, general public, and the environment
- Provide quantitative and qualitative data to decision-makers
- Evaluate the effectiveness of the CDC in containment of chemical agents
- Provide historical data

In addition to data being collected by the Government as described above, the Equipment Supplier, Demil International, will also be collecting engineering process control data using the TC-60 CDC System Control and Data Acquisition (SCADA) custom software.

1.4 Chemicals of Concern

Chemical agents of concern for test operations conducted at Porton Down, U.K with the CDC are HD.

1.5 Project Description

Testing will occur inside a concrete and steel building 63' x 63'. The building will be equipped with two 5000 CFM carbon filtration units. The components of the CDC will be configured inside the VCS. The TC-60 CDC consists of the following major components:

- Vestibule
- Detonation Chamber
- Expansion Chamber
- Air Pollution Control Unit (APCU) comprised of a hot gas generator, hydrated lime blower, lime supply bin, candle filter, catalytic oxidizer, heat exchanger, and two in-line carbon absorbers.
- Generator, Chiller, Oxygen Supply, and Air/Water supply located outside the VCS.

1.6 Project Organization and Responsibilities

Project Organization and Responsibilities can be obtained from the TC-60 CDC Test Plan.

2.0 Monitoring Standards and Control Limits

2.1 General Types of Monitoring

Air monitoring procedures rely on the following types of monitoring:

- Near Real-Time (NRT) air monitoring
- Confirmation air monitoring
- Historical/ Background air monitoring
- Worker Population Limit (WPL) air monitoring
- Gross-Level NRT air monitoring (Optional)

Table 2.1 Airborne and Relative Exposure Limits for Chemical Agents

Chemical Agent	Short Term Exposure Limit[1] (mg/m^3)	Worker Population[2] Limits (mg/m^3)
Mustard (HD)	0.003	0.0004

[1]Value based on a 15 minute exposure.

[2] For HD, U.S. Army Implementation Guidance Policy for Revised Airborne Exposures Limits, June 2004

2.1.1 Near Real-Time Monitoring

Devices for sampling and analyzing workplace and VCS exhaust air shall measure and alarm within 15 minutes when chemical agent is present in excess of the STEL concentrations. During treatment operations, MINICAMS will be used to meet standards by automatically collecting, analyzing, and reporting the sample results. The MINICAMS will activate an alarm if the analysis results exceed the alarm set point.

Table 2.1.1 MINICAMS Alarm Levels

Chemical Agent	Alarm Set-Point (STEL)
Mustard (HD)	0.70

2.1.2 Confirmation Air Monitoring

Confirmation sample collection will be performed simultaneously with the continuous quantitative NRT monitors to confirm alarm responses. Results from the confirmation sample will be used to verify a chemical detected by a NRT monitor. During treatment operations, Depot Area Air Monitoring System (DAAMS) tubes will be collected and analyzed to provide confirmation of the detection of HD at the required monitoring levels in the event of a MINICAMS alarm. If the NRT monitor does not alarm, confirmation samples need not be analyzed, but may be analyzed for historical purposes. Personnel will collect the DAAMS sample for analysis after the first MINICAMS alarm.

2.1.3 WPL Monitoring

WPL monitoring will be performed in locations that may have potential for low-level chemical detection. Similar to confirmation monitoring, process monitoring will be performed using DAAMS for HD. A Type II method may be used for this purpose. WPL readings above the excursion level will result in the activation of the WPL excursion response plan (Appendix L of the TC-60 CDC Health and Safety Plan (HASP)). An upgrade in PPE levels based on WPL historical monitoring results will be in accordance with Table 5.1 of the TC-60 HASP.

2.1.4 Gross Level NRT air monitoring (Optional)

Gross-Level NRT monitoring will be conducted within the immediate work area of the VCS. Gross-Level monitoring is intended to provide indication and quantification at gross-levels of a chemical release during test operations. Gross-Level monitoring will be performed, as requested by the ECBC test director, during test operations, but only in addition to low-level detectors. The Dstl Personal Decontamination Station personnel will perform gross Level Monitoring using an ICAM.

2.2 Monitoring System Criteria

Monitoring Systems must be qualified by meeting or exceeding qualification requirements as specified in the Monitoring Branch Quality Control (QC) Plan for Chemical Agent Standard Analytical Reference Material (CASARM), and applicable Monitoring Branch Internal Operating Procedures (IOPs).

2.2.1 Acceptance Testing Requirements

Acceptance testing will demonstrate the ability of the equipment to properly collect, detect, and generate quantitative results for the chemical of interest. Acceptance test pass/fail criteria and detailed requirements for equipment criteria are specified in the Monitoring Branch QC Plan.

2.2.2 Initial Baseline Monitoring Requirements

The baseline study demonstrates the ability of a method and instrument to properly monitor for all chemicals of concern in samples collected at the test project site. Baseline monitoring is important in determining possible machinery or environmental interferences to the monitoring equipment. As a minimum, the initial baseline study requires monitoring instruments to be calibrated and challenged in accordance with the Monitoring Branch QC Plan. In addition, a background study will be conducted for two day by sampling select monitoring positions prior to chemical test operations, but possibly during explosive only operations.

2.2.3 Closure Monitoring

Closure Monitoring will consist of performing monitoring procedures to ensure that potentially contaminated components of the CDC have been demonstrated safe for transport. Closure procedures and monitoring will be performed in accordance with Department of the Army (DA) Pamphlet (Pam) 385-61 and

Army Regulation (AR) 50-6. Vapor closure monitoring of the CDC components will be performed at STEL levels for the Recovered Chemical Warfare Material (RCWM) processed during test operations. Vapor closure monitoring shall consist of vapor headspace monitoring of the CDC components for a minimum of two consecutive MINICAMS cycles or DAAMS monitoring after the components are maintained at a minimum temperature of 70°F and for a period of four or more hours. If DA criteria are not achieved, the equipment will be decontaminated and monitoring procedures will be repeated. Closure Monitoring will be performed following TC-60 CDC test operations of each chemical agent processed to ensure adequate decontamination and to maintain consistency in data collection.

2.3 Corrective Action

Corrective action will be initiated through the development and implementation of routine internal QC checks. Corrective action will be initiated when potential or existing conditions are identified that may adversely impact data quality. Events that require corrective action to be taken include violation of approved analytical procedures, out-of-control conditions, and non-conformances as described in the Monitoring Branch QC Plan (Revision 6/Draft 7, January 2003).

The need for corrective action must be documented and reported immediately. The corrective action may be immediate or long term. An immediate corrective action may be the recalculation of results, reanalysis of samples, or repeat of sample collection. A long term corrective action may require an increase in QC samples such as more frequent calibration and checks or replacing monitoring equipment.

3.0 Monitoring and Sampling Equipment

3.1 Monitoring Systems Used to Support Test Operations

The sampling and monitoring equipment will be used to verify control of chemical agent migration in air and effluent processes. Air in and surrounding the test site will be monitored continuously for protection of workers and the public. The types of monitoring equipment to be used during TC-60 CDC test operations are as follows:

- Miniature Chemical Agent Monitoring Systems (MINICAMS)
- Depot Area Air Monitoring System (DAAMS) sorbent tubes
- Gas Chromatograph/ Mass Selective Detector (GC/MSD) system
- Carbon Monoxide Detectors
- ICAM

All monitoring and sampling equipment will be maintained and operated in accordance with Monitoring Branch Internal Operating Procedures (IOPs).

3.2 Miniature Chemical Agent Monitoring Systems (MINICAMS)

The MINICAMS consists of a monitor (sample collection, analysis, detection, and alarm equipment), vacuum pump, heated sample transfer lines, compressed gases, and computer. During the sample cycle, a vacuum pump pulls air into the MINICAMS system through a heated sample line. Heated sample lines prevent condensation of any Chemical Warfare Material (CWM) on the walls of the transfer line. The current maximum length of any heated sample line shall not exceed 150 feet. The air sample is

drawn through an automated gas chromatograph that first collects agent on a solid sorbent for HD and then thermally desorbs agent into a separation column for analysis. A direct result, in units of the hazard level, is provided. A permanent record of the analysis is stored in the computer. If chemical agent is detected at or above the MINICAMS preset alarm level the alarm will activate and workers will be notified. MINICAMS is considered a NRT monitor because air sampling is stopped during thermal desorption.

3.3 DAAMS

DAAMS will be used to confirm MINICAMS alarms and provide process information for HD. DAAMS consists of a vacuum pump, sorbent tubes, flow control devices, and sample tubing.

Air monitoring with DAAMS employs air aspiration through a sorbent tube for a predetermined period of time and at a measured airflow rate. Contaminants in the air are adsorbed to the sorbent material in the tube. Collected samples are then analyzed for chemical agent on a GC/MSD.

3.4 GC/MS System

3.4.1 The GC/MS will be used to analyze collected DAAMS samples. The GC/MS is a combination of a chromatograph and spectral method, which is capable of generating qualitative and quantitative information about a sample. Thermal Desorption equipment (Dynatherm) is used to introduce the DAAMS into the GC/MS.

3.4.2 A GC/MS (operated by Dstl personnel) will be used to analyze solid material and liquids (if present) from inside the detonation chamber. The solid material, including surface wipes, as well as liquid samples will be collected from the chamber and extracted with an appropriate solvent prior to analysis . (Refer to section 4.5)

3.5 Equipment Maintenance and Decontamination

Preventive maintenance of monitoring equipment is routinely performed by analysts/operators in accordance with applicable internal operating procedures (IOPs). Monitoring equipment contamination is minimal due to destruction of the sample when analyzed by the detectors. Potentially contaminated equipment is considered consumable parts and is routinely removed to the appropriate Hazardous Waste (HW) container.

3.6 Monitoring Equipment Lowest Levels of Detection

Monitoring Equipment	Chemical of Concern		
		HD	
MINICAMS		0.00075 mg/m^3	
DAAMS		0.00008 mg/m^3	

4.0 Monitoring Operations

4.1 Monitoring Strategy

Selection of monitoring positions and sample locations is critical to an effective monitoring program. During testing and evaluation of the TC-60 CDC, safety of the workers is of first importance, however it is also important to collect as much possible data concerning the chamber for a successful evaluation. This means that additional monitoring and sampling may be required to obtain sufficient data. The positions chosen are based on maximum protection to the workers and the environment as well as determining possible points of chemical release. In addition, it is interesting to study specific points in the TC-60 where destruction of chemical agent occurs. Determining these points inside the TC-60 CDC can aid in decontamination where monitoring will also be critical.

4.2 Basic Monitoring Design

Locations to be monitored during the testing are identified in Figure 4.1 (building layout). The following text describes each of these locations.

4.2.1 MINICAMS

4.2.1.1 Locations for HD Operations

- At Primary Vestibule to the Detonation Chamber (M1)
- Stream-Selector
  - After Heat Exchanger, but before first Carbon Filter (M2) – Following detonation, when no personnel are inside VCS
  - At the Munitions Wrapping Table (M3) – When personnel are inside VCS
- VCS Command Post (M4)
- Midbed of VCS Filter Unit 1 (M5)
- Midbed of VCS Filter Unit 2 (M6)
- Personal Decontamination Station (M7

4.2.2 DAAMS

4.2.2.1 Locations for HD Operations (MINICAMS Confirmation and/or STEL)

- Primary Vestibule to the Detonation Chamber (VEST-1)
- Vestibule staging area (VEST-2)
- After Heat Exchanger, but before first Carbon Filter (01-400)
- Between First and Second Carbon Filters (01-401)
- At the Munitions Wrapping Table (MWP)
- VCS Command Post (CP)
- Between the first and second banks of the carbon filter systems (MID-1, MID-2)
- At VCS carbon system stacks (EXH-1, EXH-2)
- Personnel Decontamination Station (PDS)

4.2.2.2 WPL Monitoring

- Perimeters inside the VCS (VCS-1, VCS-2, VCS-3, VCS-4)
- Primary Vestibule to the Detonation Chamber (VEST-1)
- After Heat Exchanger, but before first Carbon Filter (01-400)
- At the Munitions Wrapping Table (MWP)
- VCS Command Post (CP)
- Between the first and second banks of the carbon filter systems (MID-1, MID-2)
- Personnel Decontamination Station (PDS)

4.3 Additional Monitoring Positions

During Test and Evaluation, additional monitoring is sometimes necessary. The following are locations that will not be monitored regularly during CDC operations, however it is possible these positions may become of interest as data is collected. These positions will be monitored outside of normal operations. These positions can be monitored using MINICAMS and/or DAAMS.

4.3.1 Locations

- Inside Detonation Chamber
- After detonation chamber before expansion chamber
- After Expansion Chamber
- After Candle Filter

4.4 Decontamination Monitoring

It is expected that the TC-60 CDC will be decontaminated at the end of the HD agent testing campaign. During Decontamination, the basic monitoring schematic will be employed. In addition, individual parts or components of the CDC can be headspace monitored in accordance with applicable IOPs.

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Appendix A: Acronyms/Abbreviations

AEL	Airborne Exposure Limit
APCU	Air Pollution Control Unit
CAS	Chemical Abstract Service
CASARM	Chemical Agent Standard Analytical Reference Material
CDC	TC-60 Controlled Detonation Chamber
CEM	Continuous Emission Monitor
CFM	Cubic Feet per Minute
CWM	Chemical Warfare Material
DA	Department of the Army
DAAMS	Depot Area Air Monitoring Systems
DQO	Data Quality Objectives
GC/MSD	Gas Chromatograph/ Mass Selective Detector
GPL	General Population Limit
HD	Mustard
HW	Hazardous Waste
ICAM	Improved Chemical Agent Monitor
IOP	Internal Operating Procedure
IR	Infrared Spectrometer
MINICAMS	Miniature Chemical Agent Monitoring Systems
NRT	Near-Real Time
OSHA	Occupational Safety and Health Administration
QC	Quality Control
RCWM	Recovered Chemical Warfare Material
SCADA	System Control and Data Acquisition
SMP	Site Monitoring Plan
STEL	Short Term Exposure Limit
SOP	Standing Operating Procedure
VCS	Vapor Containment Structure
VOC	Volatile Organic Compounds
WPL	Worker Population Limit

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Appendix B: Terminology

Action Level: A point that is a measurable value and requires a facility to take action. The action level may be equivalent to the alarm set point or method detection limit.

Airborne Exposure Limit (AEL): The maximum allowable concentration in the air for worker and general population exposures to any Chemical Warfare Material.

Background Level: Amount of material present in the sample matrix due to natural sources

CASARM: The certified chemical agent standards used by support laboratory to prepare stock agent solutions and subsequent working standards

Chemical Agent: A substance that is intended for the use in military operations to kill, injure, or incapacitate persons through it physiological effects.

Closure: Phase of a project that encompasses activities associated with the dismantling of the facility or removal of the mobile system, disposal or decontamination of the components, and the restoration of the site.

Decontamination: Process of decreasing the amount of chemical agent or industrial chemical on any person, object, or area by absorbing, neutralizing, destroying, and venting.

Levels of Decontamination :

1. An agent symbol with a single "X" indicates the item has been partially decontaminated of the indicated agent. Further decontamination processes are required before the item is moved or any maintenance or repair is performed without the use of chemical protective clothing and equipment. This degree applies to the item as it stands in place after being used and subjected to only routine cleaning.
2. An agent symbol with three "Xs" (XXX) indicates the item has been surface decontaminated by approved procedures, bagged or contained in an airtight barrier to permit sampling of the air inside. The inside air must be sampled, analyzed, and verified that chemical levels are below the STEL
3. An agent symbol with four "Xs" (XXXX) indicates the item has been cleaned IAW locally approved procedures and monitored with a vapor screening procedure equivalent to less than the WPL. The tools and equipment will not leave governmental control and will not be modified or disassembled.
4. An agent symbol with five "Xs" (XXXXX) indicates the item has been decontaminated completely of the indicated agent and can be released to a (non-agent) facility/installation employee for unlimited use, with an

approved Equipment Decontamination Plan and certified to the GPL. An item is completely decontaminated when it is subjected to procedures known to completely degrade the agent.

5. An agent with a zero "0" indicates an item, though located in an area with agent, has not been contaminated.

Classification Level (1)	Decontamination Level	Vapor Screening Level (Concentration value mg/m^3)	Health Based/Risk Analysis(2)
Contaminated – Do Not Release Specific Safeguards Required	X	≥STEL	No
Release to Agent Workers Clean – Restricted	XXX	<STEL	Yes
Release to Non-Agent Worker Clean – Restricted	XXXX	<WPL(3)(4)	Yes
Unrestricted Release to Public (Clean – Unrestricted)	XXXXX	<GPL(4)	Yes
Never Contaminated (Clean)	0	N/A	Yes

(1) Restrictions may include requirements that preclude disassembly or applying heating, or friction (such as grinding) without special controls.

(2) Health-Based Criteria/Risk Analysis allows for other methods to be used or developed to determine which classification level applies.

(3) Restricted – Maintenance or disassembly of items will only be done by personnel knowledgeable in agent symptoms and characteristics, and in facilities equipped with appropriate safeguards to control potential hazards. Unrestricted – Items have been previously disassembled and is cleaned so that it can be released to the worker population level without risk of agent release.

(4) Release must be IAW approved decontamination plan.

GPL: The maximum concentration to which the general population may be exposed 24 hours per, 7 day week, for a 70 year lifetime. Applies to the entire general population, including all ages and medical conditions.

Hazardous Waste: A solid waste as defined in 40 CFR 260.

HD: Distilled mustard, bis (2-chloroethyl) sulfide, CAS number 505-60-2 is mustard that has been purified by washing and vacuum distillation. HD is a blister agent. The rate of detoxification in the body is very slow, and repeated exposures cause a cumulative effect. HD is highly toxic through inhalation, ingestion, and absorption hazards.

Internal Operating Procedure (IOP): Approved written documents used by the Edgewood Chemical and Biological Center outlining specific monitoring and analysis procedures.

Quality Control: Overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that it meets stated requirements.

Standard Operating Procedure (SOP): A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the method for performing certain routine or repetitive tasks.

STEL: The maximum concentration to which unprotected chemical workers may be exposed to for up to 15 minutes continuously.

WPL: Maximum allowable 8-hour time weighted average concentration that an unmasked worker could be exposed to for an 8-hour workday in 40 hours per week for 30 years without adverse effect.

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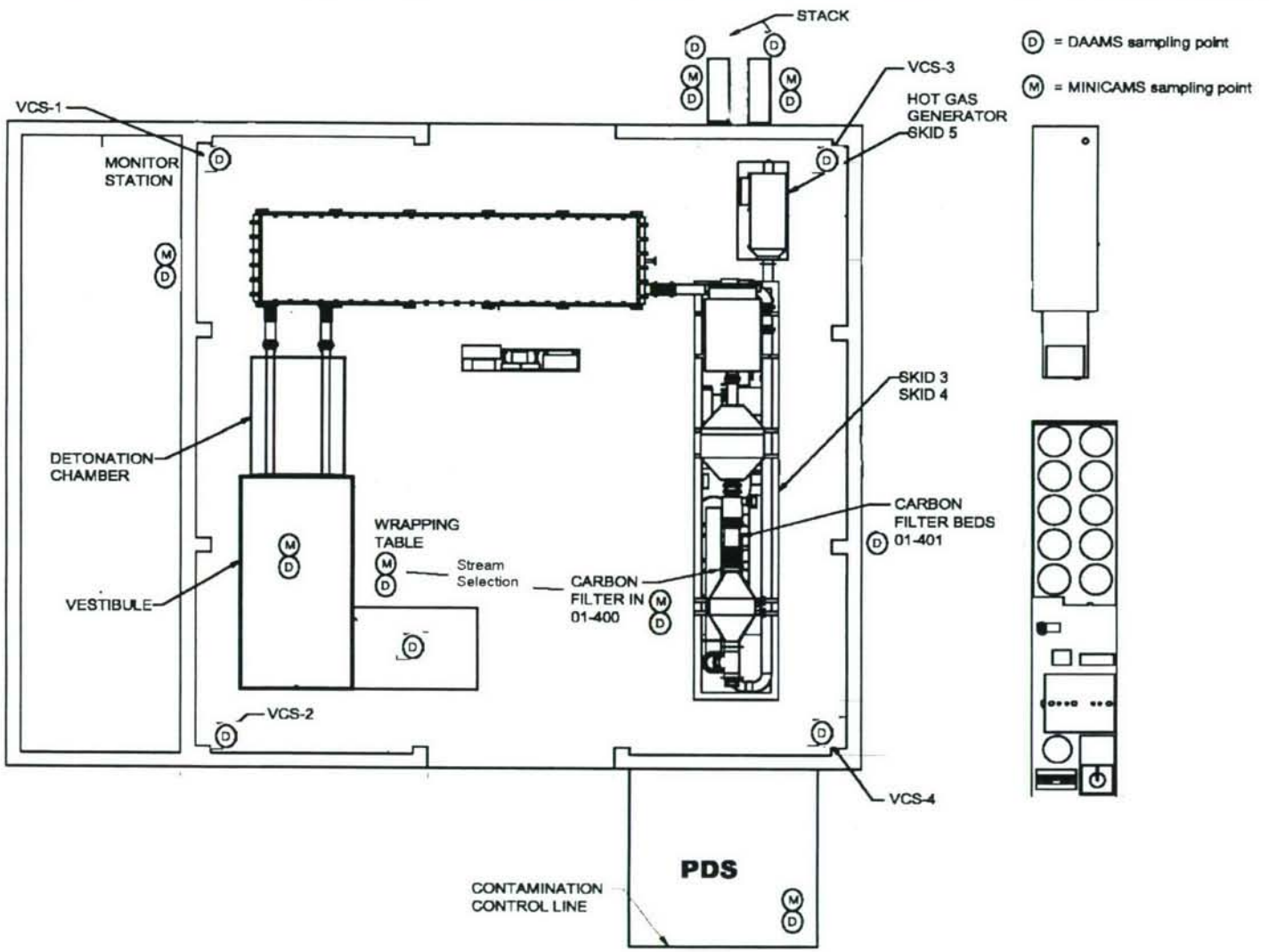
Appendix C.: Applicable Monitoring Branch Internal Operating Procedures (IOPs)

MT-2: Operation and Maintenance Procedures for MINICAMS in a Fixed Site.

MT-8: Analysis of Chemical Warfare Agents in Extracts using a Gas Chromatograph/ Mass Spectrometer System

MT-11: DAAMS Tubes Monitoring Procedures

MT-13: Operation and Maintenance Procedures for Gas Chromatography Systems


STACK
D = DAAMS sampling point
M = MINICAMS sampling point
VCS-1
VCS-3
HOT GAS GENERATOR SKID 5
MONITOR STATION
SKID 3
SKID 4
DETONATION CHAMBER
CARBON FILTER BEDS 01-401
WRAPPING TABLE
Stream Selection
CARBON FILTER IN 01-400
VESTIBULE
VCS-2
VCS-4
PDS
CONTAMINATION CONTROL LINE

APPENDIX C
ENVIRONMENTAL TEST REPORT FOR THE TC-60 CONTROLLED DETONATION CHAMBER (CDC) DEMONSTRATION/VALIDATION PHASE II

Acronyms and Abbreviations

µg	micrograms
µm	micrometer
ΔP	"Delta" (difference) in pressure
acfm	actual cubic ft per minute
APCU	Air Pollution Control Unit
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CDC	Controlled Detonation Chamber
CEM	continuous emission monitor/monitoring
CFM	contractor-furnished material
Cl_2	chlorine
CO	carbon monoxide
CO_2	carbon dioxide
CVOCs	Chlorinated Volatile Organic Compounds
CW	chemical weapons
CWM	chemical weapons materiel
D	Difference
dscf	dry standard cubic feet
dscfm	dry standard cubic feet per minute
dscm	dry standard cubic meter
ECBC	Edgewood Chemical Biological Center
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
fps	ft per second
ft	foot, feet
ft^3	cubic foot
GC-FID	Gas Chromatograph—Flame Ionization Detector
GC-MS	Gas Chromatograph—Mass Spectrometer
GFM	government-furnished material
HCl	hydrogen chloride
HE	high explosive
HEPA	high-efficiency particulate-absorbing
HPLC	high-performance liquid chromatography
IATA	International Air Transport Association
IC	ion chromatography
ICP/MS	Inductively Coupled Plasma Mass Spectrometry
ICB	Initial Calibration Blank
ICV	Initial Calibration Verification
L	liters

lb(s)	pound(s)
LCS	Laboratory Control Sample
lpm	liters per minute
MDL	Method Detection Limit
mg	milligram(s)
mg/kg	milligrams per kilogram
MRL	Method Reporting Limit
ml	milliliter(s)
mm	millimeter
MS	matrix spike
MSD/MD	matrix spike duplicate, matrix duplicate
MB	method blank
NA	not applicable
ND	non-detect
Nm^3	normal cubic meter
NOx	nitrogen oxides
O_2	oxygen
PAL	Project Action Limit
PCDDs	polychlorinated dibenzo-dioxins
PCDFs	polychlorinated dibenzo-furans
pg	picogram
PM	particulate matter
PNR	Probe and Nozzle Rinse
ppbv	part per billion volume
ppm	parts per million
ppmv	parts per million volume
PVC	polyvinyl chloride
°R	degrees Rankine
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SO_2	sulfur dioxide
SVOC	semivolatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
THC	total hydrocarbons
TIC	tentatively identifiable compounds
v/v	volume per volume
VCS	vapor containment structure
VOCs	volatile organic compounds

SECTION 1

Introduction

AST Environmental, Inc. (AST) has prepared this report to present the results from specific environmental sampling activities associated with the Demonstration/Validation (DEM/VAL) Phase II Testing of the TC-60 Controlled Detonation Chamber (CDC). Testing was conducted the week of March 20, 2006, at the Defence Science and Technology Laboratory (DSTL) in Porton Down, United Kingdom. AST performed the source emission testing and waste characterization under contract with CH2M HILL Demilitarization, Inc. (Contract No. 700159). This environmental testing was part of CH2M HILL's contract with the U.S. Army Corps of Engineers Huntsville District (Contract No. DACA87-00-D-0047 [Task Order 12]).

The objectives of DEM/VAL Phase II Testing were:

1. Discover whether parent chemical agent (mustard [H]) or associated decomposition products are present following detonation of recovered H-filled legacy munition items (25-pound howitzer munitions). *The field effort to achieve this objective was performed by Edgewood Chemical and Biological Command (ECBC), DSTL and CH2M HILL Demilitarization personnel and is not discussed in this Appendix C..*

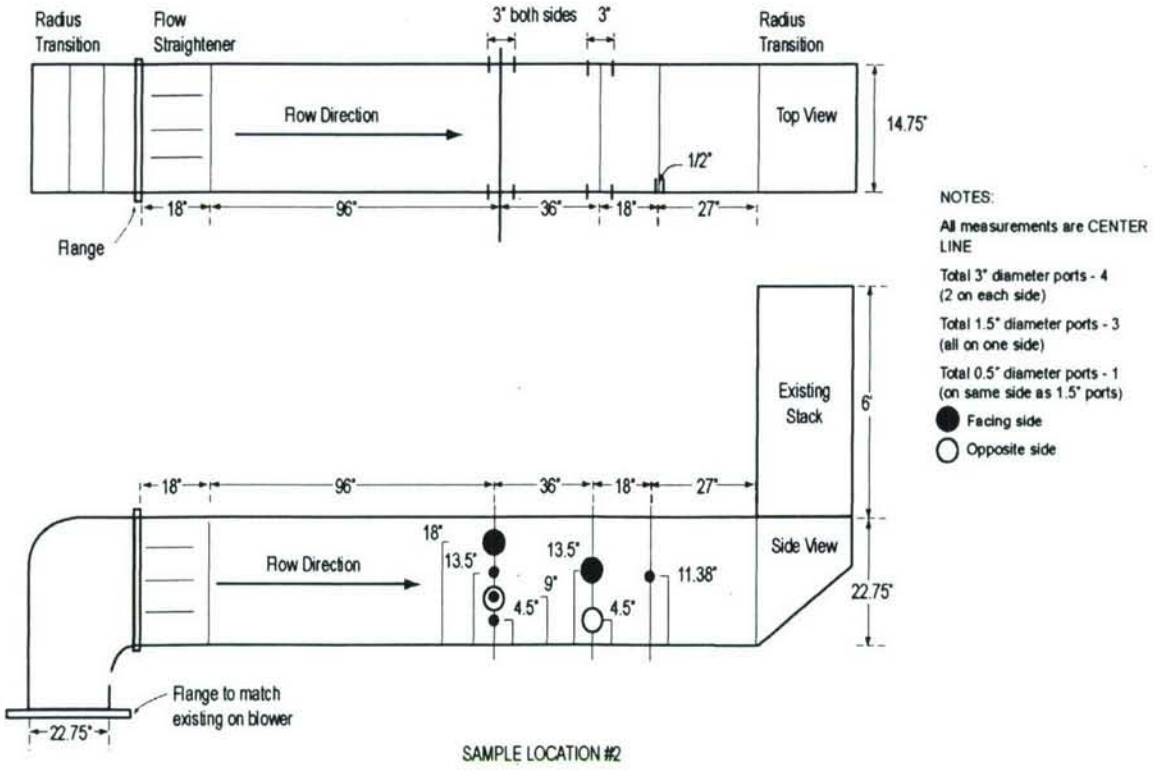
2. Measure concentrations of total hydrocarbons (THC) and volatile organic compounds (VOCs) from the vapor containment structure (VCS) just prior to Air Filtration Unit #2.

3. Calculate the final mass emission rates of chlorides (as HCl), chlorine (Cl_2), particulate matter (PM), metals, polychlorinated dibenzo-dioxins/polychlorinated dibenzo-furans (PCDDs/PCDFs), semi-volatile organic compounds (SVOCs), VOCs, oxygen (O_2), carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen oxides (NOx), and carbon monoxide (CO) from the VCS Building Air Filtration Unit #2 exhaust.

4. Analyze the hazardous characteristics of spent lime and pea gravel collected from the TC-60 CDC following decontamination.

Air emission samples were collected by AST from the VCS Air Filtration Unit #2 exhaust stack for measuring PM, HCl, Cl_2, metals, PCDDs/PCDFs, SVOCs, VOCs, O_2, CO_2, SO_2, NOx, THC, and CO. Air samples were also collected from the inlet to the VCS Air Filtration Unit #2 for THC and VOCs. Figure 1-1 provides a schematic showing these sample locations.

FIGURE 1-1
Sample Port Locations



Solid waste samples were taken following the completion of testing and thermal decontamination. These samples included the pea gravel from the floor of the detonation chamber and spent lime recovered from the dry lime injection system. These samples were initially analyzed for H and H decomposition products (oxathiane and dithiane) by ECBC and DSTL. Once cleared for H, waste sample aliquots were analyzed for total metals, Toxicity Characteristic Leaching Procedure (TCLP) VOCs, TCLP-SVOCs, TCLP-metals, reactivity, corrosivity (pH), and PCDDs/PCDFs. Fresh pea gravel and lime were also analyzed for TCLP-metals and total metals.

All air and solids samples were shipped to the United States for analysis. Dioxin and furan analyses were performed by ALTA Analytical Laboratory (ALTA) in El Dorado Hills, California. Particulate matter was analyzed by AST in Morgantown, West Virginia, and all other samples were analyzed by CH2M HILL's Applied Science Laboratories (ASL) in Corvallis, Oregon.

The data from the environmental tests were used to generate emission factors for specific analytes in terms of pound of analyte per pound of H destroyed and in terms of pounds per hour for the purpose of air quality permit generation. Only the emissions from VCS Air Filtration Unit #2 were tested. Because the VCS is equipped with two air filtration units (Unit #1 and Unit #2) and the VCS exhaust air ventilation is split between these two units, the results of emission rates (lbs./hr.) from Unit #2 testing were doubled to account for the total discharge from the VCS. The flow rate from Unit #1 was not measured and was

assumed to be equal to the flow rate from Unit #2 for the purposes of calculating emission factors and mass emission rates.

Solid waste characterization data were used to indicate whether the residuals from the detonation process would be considered characteristically hazardous per the disposal requirements of the Resource Conservation and Recovery Act (RCRA).

1.1 Test Program Organization

The overall testing program organization and responsibilities were as follows:

- ECBC – Overall chamber operations and chemical weapons materiel (CWM) monitoring
- DSTL –facility and logistics support, safety and environmental management
- CH2M HILL Demilitarization, Inc. (CH2M HILL) – consultation for maintenance, preparation of operating and maintenance procedures
- ASL – HCl, Cl_2, total metals, VOCs, TCLP-metals, TCLP-VOCs, and TCLP-SVOCs analysis
- ALTA – Dioxins/furans analysis
- AST - Source emission sampling for the following parameters: chlorides, particulate matter, metals, PCDD/PCDF, SVOCs, VOCs, oxygen, carbon dioxide, sulfur dioxide, nitrogen oxides, total hydrocarbons, and carbon monoxide. Additionally, AST managed the solid waste sampling collected by others.

1.2 TC-60 CDC System Description

The TC-60 CDC consists of a detonation chamber, an expansion chamber, and an air pollution control system, all housed and operated inside a VCS. Exhaust air from the TC-60 CDC was removed from the VCS using two air-handling systems. Each system contained an exhaust fan and a combined carbon/high- efficiency, particulate-absorbing (HEPA) filter. A more detailed discussion of the TC-60 CDC is found in the *Demonstration/Validation Report, Controlled Detonation Chamber, 2004-2006.*

1.3 Report Organization

Section 2 describes the sampling and analytical procedures used during the emissions and waste solids testing. The analytical test results are presented and discussed in Section 3 of this report, and Section 4 discusses quality control (QC) sample results and other related data quality issues. Attachments containing the sampling and laboratory data are as follows:

- Attachment A - Photographic Documentation
- Attachment B - Field Data
- Attachment C - Laboratory Results
- Attachment D - Field QC Results

SECTION 2

Environmental Sampling and Analytical Procedures

Testing has been separated into two categories for discussion in this section: (1) source emission testing and (2) solid waste sampling. The appropriate test methods and procedures were selected as part of the development of the Sampling and Analysis Plan (February 2006) with regard to their ability to achieve the overall project objectives. In addition, the test conditions and TC-60 operations played a contributing role in method selection. This section describes how the test samples were collected, prepared, and analyzed, and includes a description of the daily test activities and conditions.

2.1 Source Emission Testing of Air Contaminants

Table 2-1 summarizes the methods used to quantify the emission products released during the detonation tests.

TABLE 2-1
Source Emissions Sampling and Analytical Procedures

Test Parameter	Sampling Method	Analytical Method*
Sampling Point Selection, Gas Velocity and Volumetric Flow Rate Determination	EPA Methods 1 and 2	S-type pitot tube
Oxygen (O_2)	EPA Method 3A	Continuous Emission Monitor
Carbon Dioxide (CO_2)	EPA Method 3A	Continuous Emission Monitor
Moisture (H_2O)	EPA Method 4	Gravimetric
Sulfur Dioxide (SO_2)	EPA Method 6C	Continuous Emission Monitor
Nitrogen Oxides (NO_x)	EPA Method 7E	Continuous Emission Monitor
Carbon Monoxide (CO)	EPA Method 10	Continuous Emission Monitor
Total Hydrocarbons (THC)	EPA Method 25A	Continuous Emission Monitor
Particulate Matter (PM)	EPA Method 5	Gravimetric
Hydrogen Chloride/Chlorine (HCl/Cl_2)	EPA Method 26A	IC Method SW9057
Metals	EPA Method 29	ICPES Method SW6010B
C1-C6 Hydrocarbons	ASTM D2820	GC-FID

TABLE 2-1
Source Emissions Sampling and Analytical Procedures

Test Parameter	Sampling Method	Analytical Method*
Volatile Organic Compounds (VOCs)	Compendium Method TO-14A	GC/FID – GC/MS
Semi-volatile Organic Compounds (SVOCs)	SW-846 Method 0010	GC/MS Method SW8270C
Polychlorinated dibenzo-dioxins/-furans (PCDDs/PCDFs)	SW-846 Method 0023A	HRGC/HRMS Method SW8290

*Notes:

IC= ion chromatography

GC/FID = gas chromatography/flame ionization detector

GC/MS = gas chromatography/mass spectrometry

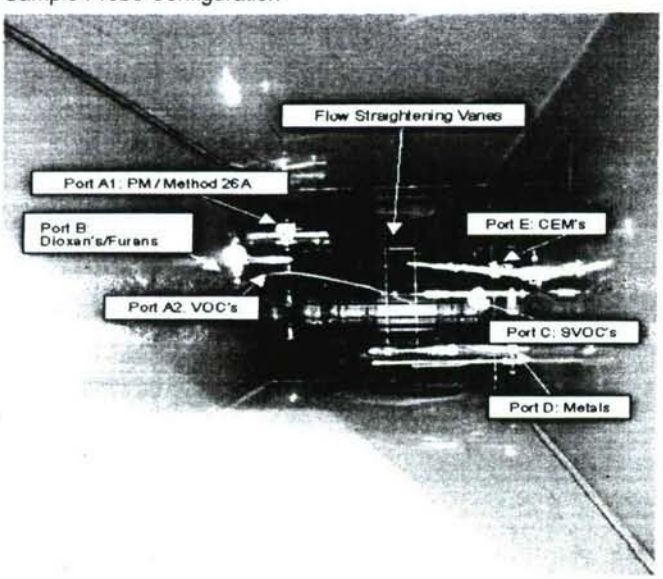
ICPES = inductively coupled argon plasma emission spectroscopy

HRGC/HRMS= high-resolution gas chromatography/high-resolution mass spectrometry

Source emission samples were collected from a temporary, horizontal exhaust "stack" that was connected to the Air Filtration Unit #2 exhaust fan. As shown in Figure 1-1, multiple sampling ports were located on the sides of the exhaust duct to accommodate all of the air sampling systems and to enable a 12-point (4 x 3) sampling matrix prescribed by U.S. Environmental Protection Agency (EPA) Method 1 for characterization of velocity and determination of volumetric flow rate.

Figure 2-1, a photo, illustrates the configuration of the exhaust duct and identifies the location of the sampling probes of the individual sampling trains within the exhaust duct.

FIGURE 2-1
Sample Probe Configuration



2.1.1 Description of Sampling Approach

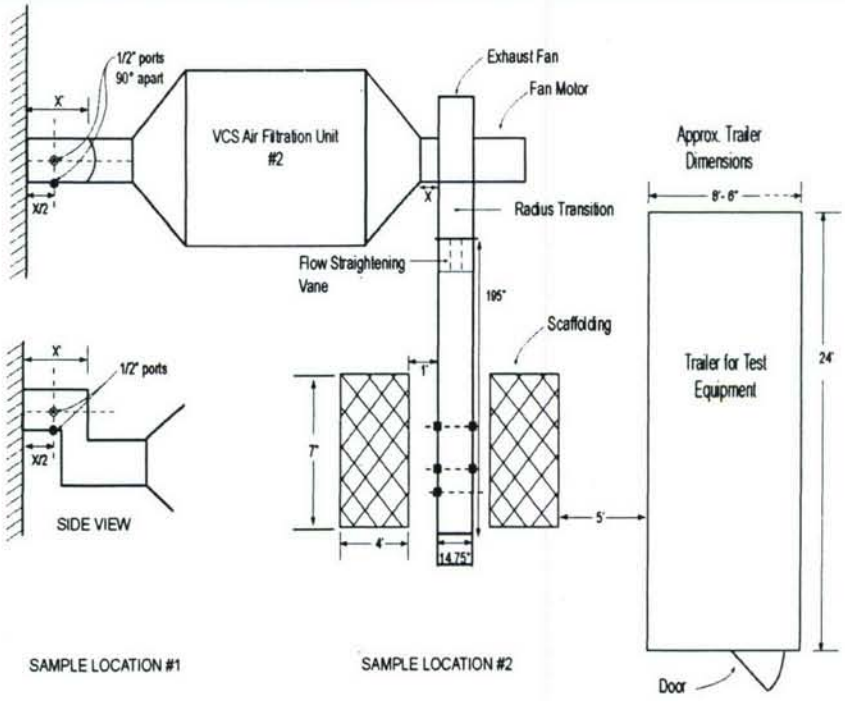
Three individual test runs were completed in three consecutive days (March 21–23, 2006). In the days preceding the test runs, AST personnel set up, tested, and calibrated the continuous emissions monitoring systems, prepared chemical reagents, assembled the sampling trains, conducted initial velocity traverses and cyclonic flow checks, collected initial measurement readings, identified the appropriate sampling rates, and confirmed the sampling approach with the appropriate test personnel.

In consideration of site safety concerns and access restrictions, the sampling approach was devised to minimize the number of personnel in the exclusion zone during the test, maximize the effective sampling and agent processing period, and provide a mechanism for timely sample recovery without adversely affecting other site operations and activity.

Each test day began with a safety briefing, followed by preparation and installation of the sampling trains and monitoring systems. A pre-test velocity profile was obtained at the inlet to Air Filtration Unit #2 and from the exhaust duct, and the continuous emission monitors (CEMs) were calibrated.

During detonation events, only two AST personnel were permitted inside the exclusion zone. All sampling systems were located and monitored from within a portable office trailer located adjacent to the Filtration Unit #2 exhaust duct. These individuals were responsible for operating the sampling equipment, checking the CEMs , recording critical sampling data, and making adjustments to ensure that isokinetics were maintained for the wet method sampling trains. The location of this trailer is provided in Figure 2-2.

FIGURE 2-2
Testing Trailer Location



AST personnel began source emission sampling approximately 5 to 7 minutes before to the first detonation and stopped sampling approximately 30 minutes after the last detonation. A total of 4 hours of active source emissions sampling was planned for each test run, with two agent-filled munitions being processed in a single detonation at a nominal rate of 1 detonation every 40 minutes.

The two remaining AST personnel returned after approximately 4 hours of continuous sampling to conduct the final leak checks on the sampling trains, perform a post-test velocity traverse, conduct the final system bias checks of the CEMs, relocate the sampling trains to a safe area, and proceed to recover the samples. Sample recovery was conducted in Building 399.

The subsections below provide details the various methods implemented to complete the testing.

2.1.2 Sampling Point Selection and Volumetric Flow Rate Calculation

A 12-point velocity traverse and a cyclonic flow check was performed at the inlet duct of Air Filtration Unit #2 and after the exhaust fan in the temporary exhaust duct prior to the test. This was done to obtain a complete cross-sectional characterization of the gas velocity and to identify the air flow characteristics, given the possibility of zones of variable velocity within the duct. Also, a 12-point velocity traverse was conducted prior to each sampling run (pre-test) and immediately following (post-test) at both sample locations.

The velocity measurements were performed by recording the differential pressure across an S-Type pitot tube, and by monitoring the gas temperature with an attached type K thermocouple. The pre-test and post–test velocity traverse measurements for each test run were averaged and the resulting values combined with the stack gas moisture results, the stack gas molecular weight, and the cross-sectional area of the stack to calculate the average volumetric flow rate for each test run. The flow rates obtained from the pre- and post-test velocity profiles were also used to calculate mass emission rates.

The pre- and post-test velocity profiles were also used to locate the isokinetic sampling probes. The probes were located such that each probe was at a sampling location in the 12-point grid that exhibited a gas velocity near the average velocity of the duct and provided the least amount of interference from sampling probes located upstream in the duct. With the aid of straightening vanes installed at the end of the duct nearest the exhaust fan, the stack gas velocity was relatively consistent across the inner-most sampling traverse points. Figure 2-1 shows the location of the sampling probes within the exhaust duct.

2.1.3 Continuous Emissions Monitoring Measurements

The CEM system was composed of a sample collection and distribution system, a series of instrumental analyzers for O_2, CO, CO_2, SO_2, NO_x, and THC, a data acquisition system, and a computer interface. The instrument analyzers measured specific gas concentrations using various detector technologies, such as pulsed fluorescence, chemiluminescence, paramagnetic, and infrared.

The sample collection and distribution system was composed of a sampling probe with a particulate filter, a heated sample line, a sample conditioner to eliminate moisture from the sample gas, and a flow manifold board. The data acquisition system collected the analogue output voltages from the individual analyzers and recorded the results as either part per

million (ppm) or percent (%). The computer interface allowed the operator to visually inspect the process in real time, chart the multiple analogue inputs, calibrate the analyzers, and log and store all data from the sampling process.

EPA Method 3A was used for measuring O_2 and CO_2. The results of these measurements were used to calculate the molecular weight of the air emissions and to identify concentration variations and any notable effects on the emissions caused by the detonation of the munitions and agent.

SO_2 was measured by a source-level (ppm) CEM equipped with an ultraviolet absorbance detector in accordance with EPA Method 6C. NOx was measured by CEM with a chemiluminescence detector in accordance with EPA Method 7E.

EPA Methods 10 and 25A were used to measure CO and THC, respectively. CO was measured using an infrared absorbance detector and the THC was measured by a flame ionization detector (FID).

2.1.4 Volatile Organic Compound (VOC) Sample Collection

For each of the three test runs, an evacuated 6-liter stainless steel canister was used to collect integrated VOC samples at the inlet of Air Filtration Unit #2 and from the exhaust duct (Port A2). These samples were collected from each duct through Teflon tubing and a flow controller. The controller was set at the laboratory at a sampling rate of approximately 20 milliliters (ml)/minute to integrate the sample collection over a 4-hour sampling period for each test run.

The background VOC sample was collected on March 23, 2006, the third day of testing, concurrent with the Sample Test Run #3. This sample was collected at the air intake louver to the VCS. Photographic documentation of the VOC sampling systems is provided in Attachment A. Attachment B provides the initial and final vacuums of the 6-liter canisters. The sample canisters were shipped to ASL for analysis by GC/FID and GC/MS using EPA Compendium Methods TO-14A and TO-15.

2.1.5 Particulate Matter, Hydrogen Chloride and Chlorine Measurements

The samples for measuring PM, HCl, and Cl_2 emissions were collected isokinetically at a fixed sampling rate in a single sampling train that combined EPA Method 5 (PM) and Method 26A (HCl/Cl_2).

The isokinetic sampling rate and appropriate sampling nozzle diameter were selected during the pre-test velocity profile for the sampling point selected in Port A1. At a planned sampling rate of 0.5 dry standard cubic feet per minute (dscfm) and a 240-minute sampling period, a minimum gas sample volume of 120 dry standard cubic feet (dscf) was targeted. The actual sampling rates for each of the three test runs were between 0.51 and 0.57 dscfm. The actual sample volumes collected for Runs 1, 2 and 3 were 143.8 dscf (3.795 normal cubic meter [Nm^3]), 165.4 dscf (4.365 Nm^3), and 130.0 dscf (3.431 Nm^3), respectively.

The sampling system was equipped with a glass sampling nozzle, a glass-lined probe, a glass filter holder containing a pre-weighed, 3-inch-diameter, Teflon-coated glass-fiber filter, and a set of six ice-cooled glass impingers. The first two impingers were Smith Greenburg type impingers; each contained 100 ml of 0.1 normal sulfuric acid solution for collecting HCl. The third and fourth impingers were modified Smith Greenburg (straight tip) impingers; each contained 100 ml of 0.1 normal sodium hydroxide solution for

collecting Cl_2. The final impinger contained approximately 250 grams of silica gel for absorbing any remaining moisture in the sample gas. A pump and a dry gas meter for measuring volume completed the sampling train.

At the conclusion of the sampling run, the sampling probe and impinger train assembly were removed from the duct, and a leak check was performed to assess the integrity of the sampling system. The end of the sampling nozzle was sealed with Teflon tape, and the train was taken immediately to Building 399 for sample recovery.

At the recovery location, the filter was removed and sealed within a petri dish, and the interior parts of the sampling nozzle, probe, and filter holder were brushed and rinsed with acetone. This "probe and nozzle rinse" was recovered in a clean 250-ml glass sample bottle. Each impinger was then weighed to obtain the net weight gain of the impingers, and the total net increase in mass was used to calculate the moisture content of the stack gas.

During the brushing and rinsing of the probe and nozzle for the first two sample runs, the Teflon probe brush bristles were scraped by a sharp edge at the union between the nozzle and glass probe liner. The Teflon shards were recovered in the acetone rinse samples and were included in the measured mass for the acetone PNR sample fraction. This explains the elevated particulate loading results obtained for Runs 1 and 2. The glass probe liner and union were replaced before Run 3, so this anomaly was avoided thereafter. After the impingers were weighed, the contents of the first two impingers (H_2SO_4) were transferred to a clean 500-ml sample bottle. The impingers were then rinsed three times with deionized water and the rinses were added to the sample bottle. This sample was shipped to ASL for analysis for chloride ion by ion chromatography using EPA Method 26A. The results represent the amount of HCl present in the gas sample.

The contents of the third and fourth impingers (NaOH) were transferred to a separate 500-ml sample bottle. These impingers were also rinsed three times with deionized water and the rinses added to the sample bottle. Following the collection of the sample, 1 ml of 1.0 normal sodium thiosulfate solution was added to the sample to reduce any hypochlorite ion remaining from the dissociation of chlorine to the stable chloride ion. This sample was shipped to ASL and also analyzed for chloride ion by ion chromatography using EPA Method 26A. The results of this analysis represent the amount of chlorine (Cl_2) present in the gas sample.

The filter and the acetone probe and nozzle rinse were sent to AST's Morgantown, West Virginia office, where the net weight gain of the filter and the PM associated with the acetone rinse sample were measured in accordance with EPA Method 5. The mass for each sample fractions was summed and divided by the volume of stack gas collected (corrected to standard conditions) to arrive at average particulate mass concentration for each sampling run. All PM, HCl, and Cl_2 sample fractions were shipped in compliance with the International Air Transport Association (IATA) Dangerous Goods Regulations.

2.1.6 Metals Measurements

The samples for measuring metal emissions in the stack gas were collected isokinetically at a fixed sampling point using EPA Method 29. The isokinetic sampling rate and sampling nozzle diameter were selected during the pre-test velocity profile for the sampling point selected in Port D. At a planned sampling rate of 0.5 dscfm and a 240-minute sampling period, a minimum gas sample volume of 120 dscf was targeted. However, an error in the selection of the nozzle diameter resulted in an actual sampling rate of 0.38 dscfm for each of

the three test runs and so the actual sample volumes collected for Runs 1, 2 and 3 were 107.1 dscf (2.826 Nm3), 112.8 dscf (2.975 Nm3), and 88.9 dscf (3.345 Nm3), respectively.

The sampling system was equipped with a glass sampling nozzle, a glass-lined probe, a glass filter holder containing a 3-inch-diameter filter, and a set of six ice-cooled glass impingers. The second impinger was a Smith-Greenburg design (jet tip with impinger plate) and the remaining impingers were all modified Smith Greenburg design (straight tip). Impingers 1 and 2 each contained 100 ml of a 5 percent nitric acid/10 percent hydrogen peroxide solution, and the third impinger was empty. Impingers 4 and 5 each contained 100 ml of a 4 percent potassium permanganate/10 percent sulfuric acid solution. The final impinger contained approximately 250 grams of silica gel for absorbing any remaining moisture in the sample gas. A pump and a dry gas meter for measuring volume completed the sampling train.

At the conclusion of the sampling run, the sampling probe and impinger train assembly were removed from the duct, and a leak check was performed to assess the integrity of the sampling system. The end of the sampling nozzle was sealed with Teflon tape, and the train was taken immediately to Building 399 for sample recovery.

At the recovery location, the filter was removed from the filter holder and sealed within a petri dish. The interior parts of the sampling nozzle, probe, and filter holder were rinsed with 0.1 normal nitric acid solutions. The "probe and nozzle rinse" was recovered in a 250-ml glass sample bottle. Each impinger was weighed to obtain the net weight gain of the impingers, and the total net increase in mass was used to calculate the moisture content of the stack gas.

After the impingers were weighed, the contents of the first two impingers (HNO_3/H_2O_2) were transferred to a clean 500-ml glass sample bottle. The impingers were then rinsed three times with 0.1 normal nitric acid and the rinses were added to the sample bottle. This sample was shipped to ASL for analyses of target metals.

The third impinger (empty) was rinsed three times with 0.1 normal nitric acid and the rinses collected in a clean 250-ml glass sample bottle. This sample was analyzed for mercury only, as prescribed by EPA Method 29.

The contents of impingers 4 and 5 ($KMnO_4/H_2SO_4$) were transferred to a clean 500-ml glass sample bottle, and then each impinger was rinsed with 100 ml of fresh potassium permanganate solution, followed by a deionized water rinse. These rinses were added to the permanganate impinger sample bottle for mercury analysis only. Following the deionized water rinse, these impingers were rinsed with 8.0 normal hydrochloric acid solution, followed by another deionized water rinse. This rinse was collected into a clean 250-ml glass bottle and was prepared in accordance with EPA Method 29 along with the filtered solids recovered at the laboratory from the potassium permanganate sample.

The metals train samples were shipped in compliance with the IATA regulations. At the analytical laboratory, the filter and nitric acid probe and nozzle rinse were combined together with mixed acids (nitric acid and hydrofluoric acid) in a closed microwave digestion vessel. This was classified as the "front-half" sample digestate. This digestate was split into two fractions. One fraction was analyzed for mercury by cold vapor atomic absorption spectrophotometry using EPA Method SW-7470A. The other fraction was analyzed for the remaining target metals by ICPES using EPA Method 6010B.

After removing a sample aliquot for mercury analysis, the HNO_3/H_2O_2 impinger sample was evaporated to reduce the sample volume to approximately 20 ml. The sample was then digested in nitric acid, was brought to a final volume of 150 ml, and is referred to as the "back-half" sample. The back-half digestate was analyzed for the target metals (except mercury) by ICPES using EPA Method 6010B.

The sample aliquot taken from the HNO_3/H_2O_2 impinger sample, the empty (3rd) impinger rinse sample, the $KMnO_4/H_2SO_4$ sample, and the HCl rinse sample were all analyzed for mercury by cold vapor atomic absorption spectrophotometry as described in EPA Method 29.

The mass of each target metal measured in each sample fraction analyzed was summed and divided by the volume of stack gas collected (corrected to standard conditions) to arrive at the average concentration of each target metal in the stack gas for each of the three test runs.

During the final leak check at the conclusion of the second metals run, a back-pressure incident resulted in the back-flushing of potassium permanganate impinger solution from the fourth and fifth impingers into the empty third impinger. No other transfer of impinger solution was noted. As a result, the empty impinger rinse that is normally performed with 0.1 normal HNO_3 and kept separate was recovered as a third potassium permanganate impinger. The recovered sample was combined with the sample from the other potassium permanganate impingers and analyzed for mercury without compromising the results.

2.1.7 Semivolatile Organic Compound (SVOC) Measurements

The samples for measuring SVOCs in the stack gas were collected at a fixed point in the exhaust duct using EPA SW-846 Method 0010.

The isokinetic sampling rate and appropriate sampling nozzle diameter were selected during the pre-test velocity profile for the sampling point selected in Port C. At a planned sampling rate of 0.5 dscfm and a 240-minute sampling period, a minimum gas sample volume of 120 dscf was targeted. The actual sampling rate for each of the three test runs was 0.51 dscfm. The actual sample volumes collected for Runs 1, 2 and 3 were 143.4 dscf (3.783 Nm^3), 148.8 dscf (4.215 Nm^3), and 117.6 dscf (3.330 Nm^3), respectively.

The sampling train consisted of a glass nozzle, a glass-lined probe, a chilled glass condenser, a cartridge containing Amberlite® XAD-2 resin, and a set of impingers containing organic-free (high-performance liquid chromatography [HPLC]-grade) water. The filter was eliminated so that any PM would collect either in the probe, the condenser, or on the XAD resin and be included in the recovery rinses and sample extraction. During sampling, the gas entering the XAD resin cartridge was cooled and maintained at a temperature below 68°F (20 °C).

The first, third and fourth impingers were modified Smith Greenburg design (straight tip), while the second impinger was of the Smith-Greenburg design (jet tip with impinger plate). The first two impingers each contained 100 ml of HPLC-grade, distilled, deionized water. The third impinger was empty, and the final impinger contained approximately 250 grams of silica gel for absorbing any remaining moisture in the sample gas. A pump and a dry gas meter for measuring volume completed the sampling train.

At the conclusion of the sampling run, the sampling probe and impinger train assembly were removed from the duct and leak checked to assess the integrity of the sampling

system. The end of the glass sampling nozzle was sealed with Teflon tape, and the train was taken immediately to Building 399 for sample recovery.

At the recovery location, the XAD resin cartridge was sealed with aluminum foil and placed on ice. The interior parts of the sampling nozzle, glass probe, condenser, and the connecting glassware were rinsed three times with methanol, followed by three rinses with methylene chloride. These rinses were recovered into two separate 250-ml glass sample bottles to facilitate their shipping in accordance with IATA regulations. The contents of the first two impingers were transferred to a clean 500-ml glass sample bottle, and the impingers were rinsed three times with methanol, followed by a triple rinse with methylene chloride. Again, these solvent rinses were recovered in two separate 250-ml glass sample bottles.

All samples were stored on ice and shipped in styrofoam-insulated boxes with double-bagged ice.

At the laboratory, the XAD resin was transferred to a Soxhlet extractor, spiked with surrogate compounds, and extracted with methylene chloride. This extract was also combined with the impinger sample and solvent rinse extracts, and the combined extracts were analyzed for SVOCs by GC/MS using EPA Method SW8270C.

The mass of each SVOC compound collected in the sampling train was then calculated and the resulting values divided by the volume of stack gas collected (corrected to standard conditions) to produce the average concentration for each SVOC across for each test run.

2.1.8 Dioxins/Furans Measurements

The samples for measuring PCDDs/PCDFs were collected isokinetically at a fixed sampling point using EPA SW-846 Method 0023A.

The isokinetic sampling rate and appropriate sampling nozzle diameter were selected during the pre-test velocity profile for the sampling point selected in Port B. At a planned sampling rate of 0.5 dscfm and a 240-minute sampling period, a minimum gas sample volume of 120 dscf was targeted. The actual sampling rate for each of the three test runs was between 0.50 and 0.56 dscfm. The actual sample volumes collected for Runs 1, 2 and 3 were 158.0 dscf (4.169 Nm^3), 144.9 dscf (3.824 Nm^3), and 114.8 dscf (3.030 Nm^3), respectively.

The sampling system was equipped with a glass sampling nozzle, a glass-lined probe, a glass condenser and cartridge containing Amberlite® XAD-2 resin, and a set of four ice-cooled glass impingers. There was no filter included in this sampling train because only negligible PM was expected and because all sample fractions were to be combined for a single analysis. Any entrained PM would be included in the Soxhlet extraction of the XAD resin. During sampling, the gas entering the XAD resin cartridge was cooled and maintained at a temperature below 68°F (20 °C).

The first impinger was a short-stemmed, knock-out impinger for collecting any condensate. The second impinger was a Smith-Greenburg design (jet tip with impinger plate) and the remaining impingers all had the modified Smith Greenburg design (straight tip). Impingers 2 and 3 contained 100 ml of HPLC-grade, distilled, deionized water. The final impinger contained approximately 250 grams of silica gel for absorbing any remaining moisture in the sample gas. A pump and a dry gas meter for measuring volume completed the sampling train.

At the conclusion of the sampling run, the sampling probe and impinger train assembly were removed from the duct and leak checked to assess the integrity of the sampling system. The end of the sampling nozzle sampling nozzle was sealed with Teflon tape, and the train was taken immediately to Building 399 for sample recovery.

At the recovery location, the XAD resin cartridge was sealed with aluminum foil and placed on ice. The interior parts of the sampling nozzle, probe, condenser, and the connecting glassware were rinsed three times with acetone. These rinses were recovered in a clean 250-ml glass sample bottle. After the acetone rinse, the same components were rinsed three times with methylene chloride into a separate 250-ml glass bottle. Finally, the components were rinsed two times with toluene. All samples were stored on ice.

The toluene, methylene chloride, and acetone rinse samples were stored in separate bottles to simplify their packaging and shipment in accordance with IATA regulations. Samples were shipped in styrofoam-insulated boxes with double-bagged ice.

At the laboratory, the three solvent rinse samples and the XAD resin sample were combined with internal standards. The mixture was Soxhlet-extracted together to prepare a single sample extract for analysis by high-resolution gas chromatography/high-resolution mass spectrometry in accordance with EPA Method SW8290.

The mass of each congener measured in the sample was divided by the volume of stack gas collected (corrected to standard conditions) to produce the average concentration of each PCDD/PCDF congener in the stack gas for each of the three test runs.

2.2 Solid Waste Sampling

On March 24, 2006, AST collected unused pea gravel samples from the pea gravel stockpile located outside the VCS, and ECBC collected unused lime samples from an unopened bag of lime located inside the VCS. These samples were analyzed for TCLP-metals and total metals by ASL.

Following the thermal decontamination of the chamber, operating personnel collected waste samples of the spent pea gravel and spent lime on April 10, 2006. Once collected and cleared by DSTL as free of H, the samples were packaged and shipped to ASL for analyses of TCLP-metals, TCLP-SVOCs, TCLP-VOCs, reactivity, corrosivity, total metals, and energetics. A separate sample of the spent pea gravel and spent lime were transshipped from ASL to ALTA for dioxin/furan analysis. The following EPA analytical methods were used:

- TCLP-Metals – 1311/6010B
- TCLP-SVOCs – 1311/8270C
- TCLP-VOCs – 1311/8260B
- Corrosivity (pH) – 9045C
- Reactive Sulfide – SW7.3.4.2
- Reactive Cyanide – SW 7.3.4.2

- Energetics – 3540C/8330/8332
- Dioxins/Furans – 8290
- Total Metals – 3052/6010B (pea gravel as pulverized prior to analysis)

The results from the sample analyses are discussed in Section 3.2.

SECTION 3

Environmental Sampling Results

3.1 Source Emission Test Results

Emission tests were conducted for selected inorganic and priority pollutant gases (O_2, CO, CO_2, SO_2, NO_x, and THC), plus VOCs, PM, HCl, Cl_2, metals, SVOCs, PCDDs and PCDFs. Tables 3-1, 3-2 and 3-4 summarize the test results for these parameters and list the compounds measured at detectable levels.

3.1.1 Continuous Emissions Monitoring Results (O2, CO, CO2, SO2, NOx, and THC)

Continuous monitoring results for the VCS Air Filtration Unit #2 air emissions and the air stream at the inlet to the filtration unit are summarized in Table 3-1. The average air emission concentrations from the exhaust duct (atmospheric discharge) over the three test periods were 19.25 percent O_2, 0.40 percent CO_2, 0.49 parts per million volume (ppmv) CO, 1.98 ppmv NO_x, < 0.9 ppmv SO_2, and 1.44 ppmv THC. THC measured at the inlet to Air Filtration Unit #2 had an average concentration of 2.33 ppmv.

TABLE 3-1
Emissions Test Results Summary

Test Parameter	Units	Backgroud	Run 1	Run 2	Run 3	Average	95% CI [1]
Gaseous Components							
Oxygen (O_2)	%	NA [2]	19.15	19.47	19.14	19.25	0.46
Carbon dioxide (CO_2)	%	NA	0.39	0.44	0.36	0.40	0.10
Carbon monoxide (CO)	ppmv	NA	0.657	0.392	0.433	0.494	0.35
Nitrogen oxides (NOx as NO_2)	ppmv	NA	2.00	1.74	2.20	1.98	0.56
Sulfur dioxide (SO_2)	ppmv	NA	< 0.5 [3]	< 0.9	< 0.6	< 0.9	NA
Total Hydrocarbons (THC)	ppmv	NA	1.51	1.36	1.45	1.44	0.19
Particulate Matter, Hydrogen Chloride, and Chlorine							
Particulate Matter	mg/N^3	NA	0.949	0.619	0.233	0.600	0.80
Hydrogen Chloride (HCl as Cl)	$\mu g/N^3$	NA	< 29.1	< 9.42	< 12.5	< 29.1	NA
Chlorine (Cl_2 as Cl^-)	$\mu g/N^3$	NA	< 8.72	< 6.61	< 6.87	< 8.72	NA
Metals [4]							
Antimony	$\mu g/N^3$	NA	< 24.9 J [5]	< 23.7 J	< 29.9 J	< 29.9 J	NA
Arsenic	$\mu g/N^3$	NA	< 187 J	< 179 J	< 228 J	< 228 J	NA

TABLE 3-1
Emissions Test Results Summary

Test Parameter	Units	Backgroud	Run 1	Run 2	Run 3	Average	95% CI [1]
Barium	µg/N^3	NA	< 78.7 J	< 76.2 J	< 98.7 J	< 98.7 J	NA
Beryllium	µg/N^3	NA	< 0.380 J	< 0.359 J	< 0.166 J	< 0.38 J	NA
Cadmium	µg/N^3	NA	< 0.414 J	< 0.402 J	< 0.568 J	< 0.568 J	NA
Chromium	µg/N^3	NA	< 1.50 J	< 1.75 J	< 1.83 J	< 1.83 J	NA
Cobalt	µg/N^3	NA	< 0.467 J	< 0.887 J	< 0.752 J	< 0.887 J	NA
Copper	µg/N^3	NA	< 1.98	< 2.41	< 3.37 J	< 3.37 J	NA
Iron	µg/N^3	NA	< 321	< 310 J	< 395 J	< 395 J	NA
Lead	µg/N^3	NA	< 8.05 J	< 8.00 J	< 10.2 J	< 10.2 J	NA
Mercury	µg/N^3	NA	< 0.378 J	< 0.076 J	< 0.195 J	< 0.378 J	NA
Nickel	µg/N^3	NA	< 1.23 J	< 2.64 J	< 1.67 J	< 2.64 J	NA
Selenium	µg/N^3	NA	ND (0.996)	ND(0.951)	ND (1.21)	ND (1.21)	NA
Silver	µg/N^3	NA	< 0.238 J	< 0.763 J	< 0.280 J	< 0.763 J	NA
Thallium	µg/N^3	NA	ND (0.493)	ND(0.470)	ND(0.599)	ND(0.599)	NA
Vanadium	µg/N^3	NA	< 3.72 J	< 3.59 J	< 4.64 J	< 4.64 J	NA
Zinc	µg/N^3	NA	< 19.8 J	< 20.5 J	< 25.8 J	< 25.8 J	NA
Metals (blank corrected)							
Antimony	µg/N^3	NA	< 0.334 J	< 0.319 J	< 0.406 J	< 0.406 J	NA
Arsenic	µg/N^3	NA	9.22 J	10.3 J	14.3 J	11.3 J	6.65
Barium	µg/N^3	NA	< 0.0724 J	< 0.0691J	< 0.0881J	< 0.0881J	NA
Beryllium	µg/N^3	NA	< 0.0488 J	< 0.0444	<0.0087J	< 0.0488J	NA
Cadmium	µg/N^3	NA	0.330 J	0.322 J	0.467 J	0.373 J	0.22
Chromium	µg/N^3	NA	< 0.815 J	1.11 J	1.01 J	< 0.978 J	NA
Cobalt	µg/N^3	NA	< 0.0377 J	0.360 J	0.0839 J	< 0.161 J	NA
Copper	µg/N^3	NA	< 0.258	0.246	< 0.441 J	< 0.315 J	NA
Iron	µg/N^3	NA	29.8	33.4 J	43.2 J	35.5 J	17.2
Lead	µg/N^3	NA	< 0.173 J	< 0.165 J	< 0.210 J	< 0.210 J	NA
Mercury	µg/N^3	NA	0.359 J	0.0579 J	0.172 J	0.196 J	0.38
Nickel	µg/N^3	NA	< 0.499 J	1.33 J	0.606 J	< 0.812 J	NA
Selenium	µg/N^3	NA	ND(0.998)[5]	ND(0.951)	ND (1.21)	ND (1.21)	NA
Silver	µg/Nm	NA	< 0.0885 J	< 0.0844J	< 0.107 J	< 0.107 J	NA

TABLE 3-1
Emissions Test Results Summary

Test Parameter	Units	Backgroud	Run 1	Run 2	Run 3	Average	95% CI [1]
Thallium	$\mu g/N^3$	NA	ND (0.493)	ND(0.471)	ND(0.599)	ND(0.599)	NA
Vanadium	$\mu g/N^3$	NA	0.718 J	0.742 J	1.03 J	0.830 J	0.41
Zinc	$\mu g/N^3$	NA	5.83 J	7.21 J	8.92 J	7.32 J	3.85

[1] 95% CI = 95% Confidence interval, based on the standard deviation of three results (n=3).
[2] NA = Not Applicable
[3] "Less than" symbol (<) indicates that the analyte was detected in one or more sample fractions, but the result is below the value reported.
[4] Results flagged with a "J" are "estimated" values and there is some uncertainty in the value due to detectable levels in the method or reagent blanks, poor matrix or surrogate spike recoveries, or other data validation-related findings.
[5] ND = Not Detected in any sample fraction above the detection limit in parentheses (MDL).

Peak concentrations measured by the CEMs during the detonation cycles were also identified. The peak concentrations of O_2 ranged from 19.7 to 20.1 percent, and these peak concentrations were typically observed within 1 to 2 minutes after detonation. Because oxygen was added to the detonation chamber to aid in the destruction of agent, this observation suggests that there was a surplus of oxygen available for combustion within the chamber. This excess of O_2 is observed as slight increase in concentration in the air emissions from the VCS.

The maximum CO concentration measured during the three test runs was 3.52 ppmv, and the concentration of carbon dioxide peaked at 0.79 percent. These peak concentrations were also observed during the first moments after detonation. The NOx concentration was also at its highest in the moments after detonation, with a maximum measured concentration of 5.22 ppmv.

Total hydrocarbons were measured at both the inlet and outlet of VCS Air Filtration Unit #2. Peak inlet concentrations were observed at 4.01 ppmv, and the maximum outlet concentration was 2.51 ppmv. Reduction in total hydrocarbons is likely the result of carbon-based adsorbents in the filter unit.

CEM plots illustrating the emissions profile for each test run are provided in Attachment B.

3.1.2 VOC Results

VOCs measured in each of the three VCS Air Filtration Unit #2 exhaust duct samples included methane, propane, acetone, chloromethane, dichlorodifluoromethane, methyl ethyl ketone, toluene, and trichlorofluoromethane. Butane, dichloromethane, tetrachloroethylene, and trichloroethylene were detected only once during the three tests.

VOCs measured in all three of the air samples collected from the inlet duct to Air Filtration Unit #2 were identical to those found in the exhaust duct samples (methane, propane, acetone, chloromethane, dichlorodifluoromethane, methyl ethyl ketone, toluene, and trichlorofluoromethane). The only other VOC detected in any of the inlet duct samples was benzene, and it was measured in only one sample at a concentration very near the detection limit.

An ambient air sample was collected outside the VCS near an air inlet duct to identify the presence and concentration of any VOCs in the ambient air. The VOC results for this sample indicated that the ambient air sample is likely the source of most of the VOCs measured in the air emissions duct samples. Methane, acetone, chloromethane, dichlorodifluoromethane, methyl ethyl ketone, toluene, and trichlorofluoromethane were all measured in the ambient air sample at concentrations comparable to those measured in the inlet and exhaust ducts of the air filtration unit. Propane was not detected in the single ambient air sample; however, the levels measured in the emissions samples were below the ambient air sample's detection limit.

The VOC results for each individual test run are presented in Table 3-2. Table 3-3 presents a side-by-side comparison of the average VOC concentration results for the ambient air, air filter inlet, and exhaust samples.

TABLE 3-2
VOC Test Results Summary

Volatile Organic Compounds	Units	Backgroud	Run 1	Run 2	Run 3	Average	95%CI[1]
Ambient Air Background[2] and Air Filter Inlet							
C1 (Methane)	µg/Nm^3	952 J [3]	967 J	1,360 J	1,070 J	1,130 J	506
Acetylene	µg/Nm^3	< 2,270 [4]	< 2,300	< 2,370	< 2,390	< 2,390	NA [5]
C2 (Ethane)	µg/Nm^3	< 2,620	< 2,660	< 2,740	< 2,770	< 2,770	NA
Ethene	µg/Nm^3	< 2,440	< 2,480	< 2,550	< 2,580	< 2,580	NA
C3 (Propane)	µg/Nm^3	< 3,840	1,910 J	1,730 J	1,620 J	1,750 J	364
C4 (Butane)	µg/Nm^3	< 5,060	< 5,140	< 5,290	< 5,350	< 5,350	NA
C5 (Pentane)	µg/Nm^3	< 6,280	< 6,380	< 6,570	< 6,640	< 6,640	NA
C6 (Hexane)	µg/Nm^3	< 7,500	< 7,620	< 7,850	< 7,930	< 7,930	NA
1,1,1-Trichloroethane	µg/Nm^3	< 14.5	< 11.8	< 12.1	< 12.3	< 12.3	NA
1,1,2,2-Tetrachloroethane	µg/Nm^3	< 18.3	< 14.8	< 15.3	< 15.4	< 15.4	NA
1,1,2-Trichloroethane	µg/Nm^3	< 14.5	< 11.8	< 12.1	< 12.3	< 12.3	NA
1,1-Dichloroethane	µg/Nm^3	< 10.8	< 8.75	< 9.01	< 9.10	< 9.10	NA
1,1-Dichloroethene	µg/Nm^3	< 10.6	< 8.57	< 8.83	< 8.92	< 8.92	NA
1,2,4-Trichlorobenzene	µg/Nm^3	< 19.8	< 16.0	< 16.5	< 16.7	< 16.7	NA
1,2,4-Trimethylbenzene	µg/Nm^3	< 13.1	< 10.6	< 10.9	< 11.1	< 11.1	NA
1,2-Dibromoethane	µg/Nm^3	< 20.5	< 16.6	< 17.1	< 17.3	< 17.3	NA
1,2-Dichloro,1,1,2,2-tetrafluoroethane	µg/Nm^3	< 18.6	< 15.1	< 15.6	< 15.7	< 15.7	NA
1,2-Dichlorobenzene	µg/Nm^3	< 16.0	< 13.0	< 13.4	< 13.5	< 13.5	NA
1,2-Dichloroethane	µg/Nm^3	< 10.8	< 8.75	< 9.01	< 9.10	< 9.10	NA
1,2-Dichloropropane	µg/Nm^3	< 12.3	< 9.99	< 10.3	< 10.4	< 10.4	NA
1,3,5-Trimethylbenzene	µg/Nm^3	< 13.1	< 10.6	< 10.9	< 11.1	< 11.1	NA

TABLE 3-2
VOC Test Results Summary

Volatile Organic Compounds	Units	Backgroud	Run 1	Run 2	Run 3	Average	95%CI[(1)]
1,3-Dichlorobenzene	µg/Nm^3	< 16.0	< 13.0	< 13.4	< 13.5	< 13.5	NA
1,4-Dichlorobenzene	µg/Nm^3	< 16.0	< 13.0	< 13.4	< 13.5	< 13.5	NA
Acetone	µg/Nm^3	547	44.9	31.6	38.4	38.3	16.5
Benzene	µg/Nm^3	< 8.51	< 6.91	< 7.11	0.935 J	< 7.11	8.72
Bromomethane	µg/Nm^3	< 10.3	< 8.39	< 8.65	< 8.73	< 8.73	NA
Carbon Tetrachloride	µg/Nm^3	< 16.8	< 13.6	< 14.0	< 14.1	< 14.1	NA
Chlorobenzene	µg/Nm^3	< 12.3	< 9.95	< 10.3	< 10.4	< 10.4	NA
Chloroethane	µg/Nm^3	< 7.03	< 5.70	< 5.88	< 5.93	< 5.93	NA
Chloroform	µg/Nm^3	< 13.0	< 10.6	< 10.9	< 11.0	< 11.0	NA
Chloromethane	µg/Nm^3	1.76 J	1.70 J	2.48 J	1.53 J	1.90 J	1.26
cis-1,2-Dichloroethene	µg/Nm^3	< 10.6	< 8.57	< 8.83	< 8.92	< 8.92	NA
cis-1,3-Dichloropropene	µg/Nm^3	< 12.1	< 9.81	< 10.1	< 10.2	< 10.2	NA
Dichlorodifluoromethane	µg/Nm^3	2.63 J	2.25 J	2.20 J	2.11 J	2.19 J	0.176
Dichloromethane	µg/Nm^3	< 9.25	< 7.51	< 7.73	< 7.81	< 7.81	NA
Ethylbenzene	µg/Nm^3	< 11.6	< 9.38	< 9.67	< 9.76	< 9.76	NA
Hexachlorobutadiene	µg/Nm^3	< 28.4	< 23.0	< 23.7	< 24.0	< 24.0	NA
m,p-Xylene	µg/Nm^3	< 23.1	< 18.8	< 19.3	< 19.5	< 19.5	NA
Methyl Ethyl Ketone	µg/Nm^3	14.8	6.18 J	2.76 J	1.86 J	3.60 J	5.66
Methyl Isobutyl Ketone	µg/Nm^3	< 10.9	< 8.85	< 9.12	< 9.21	< 9.21	NA
Naphthalene	µg/Nm^3	< 27.9	< 22.7	< 23.3	< 23.6	< 23.6	NA
n-Butylbenzene	µg/Nm^3	< 14.6	< 11.9	< 12.2	< 12.3	< 12.3	NA
n-Propylbenzene	µg/Nm^3	< 13.1	< 10.6	< 10.9	< 11.1	< 11.1	NA
o-Xylene	µg/Nm^3	< 11.6	< 9.38	< 9.67	< 9.76	< 9.76	NA
Styrene	µg/Nm^3	< 11.3	< 9.21	< 9.49	< 9.58	< 9.58	NA
Tetrachloroethylene	µg/Nm^3	< 18.1	< 14.7	< 15.1	< 15.3	< 15.3	NA
Toluene	µg/Nm^3	25.6	1.71 J	1.18 J	1.53 J	1.47 J	0.670
Trans-1,2-Dichloroethene	µg/Nm^3	< 10.6	< 8.57	< 8.83	< 8.92	< 8.92	NA
Trans-1,3-Dichloropropene	µg/Nm^3	< 12.1	< 9.81	< 10.1	< 10.2	< 10.2	NA
Trichloroethene	µg/Nm^3	< 14.3	< 11.6	< 12.0	< 12.1	< 12.1	NA
Trichlorofluoromethane	µg/Nm^3	1.35 J	1.09 J	1.13 J	1.13 J	1.12 J	0.0574
Trichlorotrifluoroethane	µg/Nm^3	< 20.4	< 16.6	< 17.1	< 17.2	< 17.2	NA

TABLE 3-2
VOC Test Results Summary

Volatile Organic Compounds	Units	Backgroud	Run 1	Run 2	Run 3	Average	95%CI[(1)]
Vinyl Chloride	µg/Nm^3	< 6.81	< 5.52	< 5.69	< 5.75	< 5.75	NA
Stack Emissions							
C1 (Methane)	µg/Nm^3	—	1,260 J	1,070 J	1,290 J	1,210 J	296
Acetylene	µg/Nm^3	—	< 2,300	< 2,360	< 2,360	< 2,360	NA
C2 (Ethane)	µg/Nm^3	—	< 2,660	< 2,730	< 2,750	< 2,750	NA
Ethene	µg/Nm^3	—	< 2,480	< 2,540	< 2,540	< 2,540	NA
C3 (Propane)	µg/Nm^3	—	1,750 J	1,480 J	1,580 J	1,600 J	339
C4 (Butane)	µg/Nm^3	—	< 5,140	< 5,270	480 J	< 5,270	NA
C5 (Pentane)	µg/Nm^3	—	< 6,380	< 6,540	< 6,600	< 6,600	NA
C6 (Hexane)	µg/Nm^3	—	< 7,620	< 7,810	< 7,890	< 7,890	NA
1,1,1-Trichloroethane	µg/Nm^3	—	< 11.8	< 12.1	< 12.2	< 12.2	NA
1,1,2,2-Tetrachloroethane	µg/Nm^3	—	< 14.8	< 15.2	< 15.4	< 15.4	NA
1,1,2-Trichloroethane	µg/Nm^3	—	< 11.8	< 12.1	< 12.2	< 12.2	NA
1,1-Dichloroethane	µg/Nm^3	—	< 8.75	< 8.97	< 9.06	< 9.06	NA
1,1-Dichloroethene	µg/Nm^3	—	< 8.57	< 8.79	< 8.87	< 8.87	NA
1,2,4-Trichlorobenzene	µg/Nm^3	—	< 16.0	< 16.4	< 16.6	< 16.6	NA
1,2,4-Trimethylbenzene	µg/Nm^3	—	< 10.6	< 10.9	< 11.0	< 11.0	NA
1,2-Dibromoethane	µg/Nm^3	—	< 16.6	< 17.0	< 17.2	< 17.2	NA
1,2-Dichloro,1,1,2,2-tetrafluoroethane	µg/Nm^3	—	< 15.1	< 15.5	< 15.6	< 15.6	NA
1,2-Dichlorobenzene	µg/Nm^3	—	< 13.0	< 13.3	< 13.5	< 13.5	NA
1,2-Dichloroethane	µg/Nm^3	—	< 8.75	< 8.97	< 9.06	< 9.06	NA
1,2-Dichloropropane	µg/Nm^3	—	< 9.99	< 10.2	< 10.3	< 10.3	NA
1,3,5-Trimethylbenzene	µg/Nm^3	—	< 10.6	< 10.9	< 11.0	< 11.0	NA
1,3-Dichlorobenzene	µg/Nm^3	—	< 13.0	< 13.3	< 13.5	< 13.5	NA
1,4-Dichlorobenzene	µg/Nm^3	—	< 13.0	< 13.3	< 13.5	< 13.5	NA
Acetone	µg/Nm^3	—	259	56.0	407	241	438
Benzene	µg/Nm^3	—	< 6.91	< 7.08	< 7.15	< 7.15	NA
Bromomethane	µg/Nm^3	—	< 8.39	< 8.60	< 8.69	< 8.69	NA
Carbon Tetrachloride	µg/Nm^3	—	< 13.6	< 13.9	< 14.1	< 14.1	NA
Chlorobenzene	µg/Nm^3	—	< 9.95	< 10.2	< 10.3	< 10.3	NA
Chloroethane	µg/Nm^3	—	< 5.70	< 5.85	< 5.90	< 5.90	NA

TABLE 3-2
VOC Test Results Summary

Volatile Organic Compounds	Units	Backgroud	Run 1	Run 2	Run 3	Average	95%CI[1]
Chloroform	µg/Nm^3	—	< 10.6	< 10.8	< 10.9	< 10.9	NA
Chloromethane	µg/Nm^3	—	1.74 J	2.06 J	1.62 J	1.81 J	0.565
cis-1,2-Dichloroethene	µg/Nm^3	—	< 8.57	< 8.79	< 8.87	< 8.87	NA
cis-1,3-Dichloropropene	µg/Nm^3	—	< 9.81	< 10.1	< 10.2	< 10.2	NA
Dichlorodifluoromethane	µg/Nm^3	—	2.14 J	2.08 J	2.21 J	2.14 J	0.162
Dichloromethane	µg/Nm^3	—	49.3	< 7.70	< 7.77	< 21.6	NA
Ethylbenzene	µg/Nm^3	—	< 9.38	< 9.62	< 9.72	< 9.72	NA
Hexachlorobutadiene	µg/Nm^3	—	< 23.0	< 23.6	< 23.9	< 23.9	NA
m,p-Xylene	µg/Nm^3	—	< 18.8	< 19.2	< 19.4	< 19.4	NA
Methyl Ethyl Ketone	µg/Nm^3	—	9.24	4.89 J	35.4	16.5 J	41.0
Methyl Isobutyl Ketone	µg/Nm^3	—	< 8.85	< 9.08	< 9.17	< 9.17	NA
Naphthalene	µg/Nm^3	—	< 22.7	< 23.2	< 23.5	< 23.5	NA
n-Butylbenzene	µg/Nm^3	—	< 11.9	< 12.2	< 12.3	< 12.3	NA
n-Propylbenzene	µg/Nm^3	—	< 10.6	< 10.9	< 11.0	< 11.0	NA
o-Xylene	µg/Nm^3	—	< 9.38	< 9.62	< 9.72	< 9.72	NA
Styrene	µg/Nm^3	—	< 9.21	< 9.44	< 9.53	< 9.53	NA
Tetrachloroethylene	µg/Nm^3	—	2.05 J	< 15.0	< 15.2	< 15.2	NA
Toluene	µg/Nm^3	—	14.6	2.76 J	104	40.5 J	138
Trans-1,2-Dichloroethene	µg/Nm^3	—	< 8.57	< 8.79	< 8.87	< 8.87	NA
Trans-1,3-Dichloropropene	µg/Nm^3	—	< 9.81	< 10.1	< 10.2	< 10.2	NA
Trichloroethene	µg/Nm^3	—	< 11.6	< 11.9	1.57 J	< 11.9	NA
Trichlorofluoromethane	µg/Nm^3	—	1.09 J	0.748 J	1.13 J	0.989 J	0.522
Trichlorotrifluoroethane	µg/Nm^3	—	< 16.6	< 17.0	< 17.1	< 17.1	NA
Vinyl Chloride	µg/Nm^3	—	< 5.52	< 5.66	< 5.72	< 5.72	NA

[1] 95% CI = 95% Confidence interval, based on the standard deviation of three results (n=3).
[2] An ambient air sample was collected to determine "Background" concentrations in the air entering the VCS building.
[3] Results flagged with a "J" are "estimated" values since the result is above the method detection limit, but less than the laboratory's reporting limit.
[4] "Less than" symbol (<) indicates that the analyte was not detected above the reported value.
[5] NA = Not

Table 3-3 shows the comparison of ambient air measurements, air filter inlet measurements, and stack exhaust measurements.

TABLE 3-3
Comparison of VOC Results

Volatile Organic Compounds	Units	Ambient Air	Air Filter Inlet	Stack
C1 (Methane)	µg/m^3	952 J [1]	1,130 J	1,210 J
Acetylene	µg/m^3	< 2,270 [2]	< 2,390	< 2,360
C2 (Ethane)	µg/m^3	< 2,620	< 2,770	< 2,750
Ethene	µg/m^3	< 2,440	< 2,580	< 2,540
C3 (Propane)	µg/m^3	< 3,840	1,750 J	1,210 J
C4 (Butane)	µg/m^3	< 5,060	< 5,350	< 5,270
C5 (Pentane)	µg/m^3	< 6,280	< 6,640	< 6,600
C6 (Hexane)	µg/m^3	< 7,500	< 7,930	< 7,890
1,1,1-Trichloroethane	µg/m^3	< 14.5	< 12.3	< 12.2
1,1,2,2-Tetrachloroethane	µg/m^3	< 18.3	< 15.4	< 15.4
1,1,2-Trichloroethane	µg/m^3	< 14.5	< 12.3	< 12.2
1,1-Dichloroethane	µg/m^3	< 10.8	< 9.10	< 9.06
1,1-Dichloroethene	µg/m^3	< 10.6	< 8.92	< 8.87
1,2,4-Trichlorobenzene	µg/m^3	< 19.8	< 16.7	< 16.6
1,2,4-Trimethylbenzene	µg/m^3	< 13.1	< 11.1	< 11.0
1,2-Dibromoethane	µg/m^3	< 20.5	< 17.3	< 17.2
1,2-Dichloro,1,1,2,2-tetrafluoroethane	µg/m^3	< 18.6	< 15.7	< 15.6
1,2-Dichlorobenzene	µg/m^3	< 16.0	< 13.5	< 13.5
1,2-Dichloroethane	µg/m^3	< 10.8	< 9.10	< 9.06
1,2-Dichloropropane	µg/m^3	< 12.3	< 10.4	< 10.3
1,3,5-Trimethylbenzene	µg/m^3	< 13.1	< 11.1	< 11.0
1,3-Dichlorobenzene	µg/m^3	< 16.0	< 13.5	< 13.5
1,4-Dichlorobenzene	µg/m^3	< 16.0	< 13.5	< 13.5
Acetone	µg/m^3	547	38.3	241
Benzene	µg/m^3	< 8.51	< 7.11	< 7.15
Bromomethane	µg/m^3	< 10.3	< 8.73	< 8.69
Carbon Tetrachloride	µg/m^3	< 16.8	< 14.1	< 14.1
Chlorobenzene	µg/m^3	< 12.3	< 10.4	< 10.3
Chloroethane	µg/m^3	< 7.03	< 5.93	< 5.90
Chloroform	µg/m^3	< 13.0	< 11.0	< 10.9

TABLE 3-3
Comparison of VOC Results

Volatile Organic Compounds	Units	Ambient Air	Air Filter Inlet	Stack
Chloromethane	µg/m^3	1.76 J	1.90 J	1.81 J
cis-1,2-Dichloroethene	µg/m^3	< 10.6	< 8.92	< 8.87
cis-1,3-Dichloropropene	µg/m^3	< 12.1	< 10.2	< 10.2
Dichlorodifluoromethane	µg/m^3	2.63 J	2.19 J	2.14 J
Dichloromethane	µg/m^3	< 9.25	< 7.81	< 21.6
Ethylbenzene	µg/m^3	< 11.6	< 9.76	< 9.72
Hexachlorobutadiene	µg/m^3	< 28.4	< 24.0	< 23.9
m,p-Xylene	µg/m^3	< 23.1	< 19.5	< 19.4
Methyl Ethyl Ketone	µg/m^3	14.8	3.60 J	16.5 J
Methyl Isobutyl Ketone	µg/m^3	< 10.9	< 9.21	< 9.17
Naphthalene	µg/m^3	< 27.9	< 23.6	< 23.5
n-Butylbenzene	µg/m^3	< 14.6	< 12.3	< 12.3
n-Propylbenzene	µg/m^3	< 13.1	< 11.1	< 11.0
o-Xylene	µg/m^3	< 11.6	< 9.76	< 9.72
Styrene	µg/m^3	< 11.3	< 9.58	< 9.53
Tetrachloroethylene	µg/m^3	< 18.1	< 15.3	< 15.2
Toluene	µg/m^3	25.6	1.47 J	40.5 J
trans-1,2-Dichloroethene	µg/m^3	< 10.6	< 8.92	< 8.87
trans-1,3-Dichloropropene	µg/N^3	< 12.1	< 10.2	< 10.2
Trichloroethene	µg/m^3	< 14.3	< 12.1	< 11.9
Trichlorofluoromethane	µg/m^3	1.35 J	1.12 J	0.989 J
Trichlorotrifluoroethane	µg/m^3	< 20.4	< 17.2	< 17.1
Vinyl Chloride	µg/m^3	< 6.81	< 5.75	< 5.72

[1] Results flagged with a "J" are "estimated" values because the result was above the method detection limit, but less than the laboratory's reporting limit.
[2] "Less than" symbol (<) indicates that the analyte was not detected above the reported value.

3.1.3 Particulate Matter Results

The results for PM emissions are shown in Table 3-1. These results are derived from the mass of all PM recovered on the filter and in the probe and nozzle rinse of the Method 5/26A sampling train. No discoloration or other visible evidence of PM was observed on the sample filters, and the laboratory data indicated that the weight gain associated with all of the sample filters was less than 0.1 milligram (mg). However, the acetone probe and

nozzle rinses recovered from Test Runs 1 and 2 contained a small amount of Teflon probe brush material, and this accounted for the elevated results. The probe brush bristles were scraped by a sharp edge on the end of the glass probe liner at the union between the probe liner and the nozzle. The probe liner and union were replaced before Run 3 was initiated, so the results for Run 3 are considered a better representation of the low PM emissions from the system.

The net weight differential between the tare and final filter weights was between 0.1 and 0.4 mg for all samples, including the blank. These results are below the method's 0.5- mg limit of acceptable variability between successive weight measurements. The acetone probe and nozzle rinse samples for Runs 1 and 2 (with probe brush material included) provided net recoverable weights of 3.6 and 2.7 mg, respectively. The net weight gain for the Run 3 acetone probe rinse sample was 0.7 mg. The acetone reagent blank sample reported no measurable weight gain, so no blank corrections were assessed and the results were reported as determined.

The weight gain data translate to an average particulate emission rate of 0.60 mg/Nm^3. The 95 percent confidence interval for this result is 0.89 mg/Nm^3, which reflects the variability and uncertainty introduced by the probe brush material.

3.1.4 Hydrogen Chloride and Chlorine Results

Results of hydrogen chloride and chlorine emissions are presented in Table 3-1. Laboratory results for the Method 26A impinger samples indicated that the measured chloride in the samples was indistinguishable from reagent blank values. The validated results were reported at their measured levels, but were preceded by "less than" (<) symbols to indicate that the blank contribution was significant and that the presence of HCl or chlorine would be less than the measured values. The maximum results for HCl and Cl_2 were < 29.1 µg Cl^-/Nm^3 and < 8.72 µg Cl^-/Nm^3, respectively. Combined, this translates to a total HCl/Cl_2 concentration of 0.024 ppmv (as Cl^-).

3.1.5 Metals Results

Selected metals were measured in the air emissions. Most (15) of the 17 target metals were detected in the detonation test samples, except for selenium and thallium. Table 3-1 represents the results with and without any corrections related to filter and reagent blank analysis. These results are preceded with a less than (<) symbol to indicate that the value is an estimate of the maximum levels of metals measured, and that the results would be less than the reported values if the contribution from the sampling media was taken in to account.

The contribution of metals from the inadvertent use of glass-fiber (versus quartz-fiber) filters is quite significant for many of the target metals. To detect the metals present in the glass-fiber filters, two glass-fiber filters were identified from AST's inventory and were separately digested and analyzed. The reagent blank samples from the field-prepared reagents were also analyzed to establish the proportional contaminant levels associated with the impinger and recovery solutions. The two glass-fiber filter results were very comparable and demonstrated a favorable level of consistency.

The most notable contributions of metals attributed to the glass-fiber filters included, but were not limited to, iron, arsenic, barium, antimony, lead, vanadium, and zinc. The reagent

blank and filter mass was greater than the measured emission sample mass for antimony, barium, and lead.

To arrive at a total mass of individual metals contributed from reagents and sampling media, the average mass per filter was combined with the mass contribution associated with the volume of reagents used in the sampling and recovery of the metals train samples. Table 3-4 presents the total mass measured in each of the sampling trains relative to the blank value, and the net corrected values are provided for comparison only. The levels of iron, arsenic, zinc, and vanadium were at significant concentrations in the glass-fiber filters; their presence in the air emissions was difficult to distinguish.

TABLE 3-4
Metals Sampling Train Results Summary

	Raw Uncorrected Results (µg/train) [1]				Blank Corrected Results (µg/train) [3]		
Element	**Run 1**	**Run 2**	**Run 3**	**Reagent Blank(µg) [2]**	**Run 1**	**Run 2**	**Run 3**
Antimony	70.3 J	70.6 J	70.1 J	86.8 J	< 0.944 J	< 0.948 J	< 0.951 J
Arsenic	528 J	532 J	535 J	502 J	26.0 J	30.6 J	33.6 J
Barium	222 J	227 J	232 J	332 J	< 0.205 J	< 0.206 J	< 0.207 J
Beryllium	< 1.07 J	< 1.07 J	0.389 J	< 0.936 J	< 0.138 J	< 0.132 J	< 0.0205 J
Cadmium	1.17 J	1.19 J	1.33 J	< 0.237 J	0.933 J	0.958 J	1.09 J
Chromium	< 4.23 J	5.22 J	4.29 J	1.93 J	< 2.30 J	3.29 J	2.36 J
Cobalt	1.32 J	2.64 J	1.76 J	< 1.57	< 0.107 J	1.07 J	0.197 J
Copper	< 5.60	7.18	< 7.90 J	6.86	< 0.729	0.733	< 1.03 J
Iron	908	923 J	925 J	824 J	84.4	99.4 J	101 J
Lead	22.8 J	23.8 J	24.0 J	49.0 J	< 0.488 J	< 0.490 J	< 0.492 J
Mercury	1.07 J	0.226 J	0.457 J	< 0.0537 J	1.02 J	0.172 J	0.403 J
Nickel	3.48 J	7.84 J	3.91 J	< 3.87	< 1.41 J	3.97 J	1.42 J
Selenium	ND(2.81) [4]	ND (2.83)	ND (2.84)	< 6.24	ND (2.82)	ND (2.83)	ND (2.84)
Silver	0.673 J	< 2.27 J	< 0.655 J	< 2.39 J	< 0.250 J	< 0.251 J	< 0.252 J
Thallium	ND (1.39)	ND (1.40)	ND (1.40)	< 2.36	ND (1.39)	ND (1.40)	ND (1.41)
Vanadium	10.5 J	10.7 J	10.9 J	8.47 J	2.03 J	2.21 J	2.40 J
Zinc	56.1 J	61.0 J	60.5 J	39.6 J	16.5 J	21.5 J	20.9 J

[1] The raw uncorrected result is the combination of the mass measured in the front- and back-half sample fractions of the Method 29 Sampling Train. A "J" flag indicates that at least one result in the two sample fractions was reported as an estimated value greater than the Method Detection Limit (MDL), but less than the laboratory's reporting limit.

[2] The Reagent Blank value is the mass measured in the reagent blanks that corresponding to the front- and back-half fractions of the Method 29 Sampling Train. The average result from 2 glass fiber filter blanks is included to provide a correction comparable to the glass fiber filters inadvertently used in the sampling trains.

[3] The blank corrected result is indicated as "less than" the MDL if the blank corrected value is below the MDL. All results are flagged with a "J" indicating that there is an element of uncertainty associated with the blank correction due to variability in filter weights and composition and in most of the uncorrected results.

[4] ND = Not Detected in either sample fraction. The combined MDL is shown in parentheses (MDL).

Cadmium and mercury, both volatile metals, were measured at levels slightly higher than those measured in the blanks. Cadmium appeared to be distributed primarily in the filter sample fraction and may reflect an actual presence of cadmium in the emissions, because cadmium was present in the spent pea gravel. Mercury was predominantly found in the potassium permanganate impinger fraction and is less affected by blank corrections associated with the glass-fiber filters. Chromium did not appear to have a large contaminant concentration in the glass fiber filter or reagent. In addition, chromium was detected in the spent pea gravel and lime.

3.1.6 SVOCs Results

Except for the SVOC results listed in Table 3-5,"di-N- butyl phthalate", there were no other SVOCs measured consistently in all three samples. Butyl benzyl phthalate, 1,4-dichlorobenzene, and naphthalene were detected at low levels in the sample extracts from the first run sample, but they were not measured in any samples from subsequent runs.

TABLE 3-5
SVOC Emissions Results Summary

Semi-Volatile Organic Compounds	Units	Run 1	Run 2	Run 3	Average	95%CI[1]
Acenaphthene	µg/Nm^3	< 2.64 [2]	< 2.55	< 3.22	< 3.22	NA [3]
Acenaphthylene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Anthracene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzo(a)anthracene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzo(a)pyrene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzo(b)fluoranthene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzo(g,h,i)perylene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzo(k)fluoranthene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Benzoic acid	µg/Nm^3	< 13.2	< 12.7	< 16.1	< 16.1	NA
Benzyl alcohol	µg/Nm^3	< 5.29	< 5.09	< 6.45	< 6.45	NA
4-Bromophenyl phenyl ether	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Butyl benzyl phthalate	µg/Nm^3	0.148 J[4]	< 2.55	< 3.22	< 3.22	NA
Carbazole	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
4-Chloroaniline	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
bis(2-Chloroethoxy) methane	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
bis(2-Chloroethyl) ether	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
bis(2-Ethylhexyl) phthalate	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA

TABLE 3-5
SVOC Emissions Results Summary

Semi-Volatile Organic Compounds	Units	Run 1	Run 2	Run 3	Average	95%CI[(1)]
4-Chloro-3-methyl phenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2-Chloronaphthalene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2-Chlorophenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
4-Chlorophenyl phenyl ether	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Chrysene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Dibenzo(a,h)anthracene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Dibenzofuran	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Di-n-butyl phthalate	µg/Nm^3	0.256 J	0.199 J	0.232 J	0.229 J	0.0711
1,2-Dichlorobenzene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
1,3-Dichlorobenzene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
1,4-Dichlorobenzene	µg/Nm^3	0.278 J	< 2.55	< 3.22	< 3.22	NA
3,3'-Dichlorobenzidine	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2,4-Dichlorophenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Diethyl phthalate	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2,4-Dimethylphenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Dimethyl phthalate	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
4,6-Dinitro-2-methyl phenol	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
2,4-Dinitrophenol	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
2,4-Dinitrotoluene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2,6-Dinitrotoluene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Di-n-octyl phthalate	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Fluoranthene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Fluorene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Hexachlorobenzene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Hexachlorobutadiene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Hexachloroethane	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Indeno(1,2,3-cd)pyrene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Isophorone	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2-Methylnaphthalene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2-Methylphenol (o-Cresol)	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
3,4-Methylphenol (m,p-Cresol)	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA

TABLE 3-5
SVOC Emissions Results Summary

Semi-Volatile Organic Compounds	Units	Run 1	Run 2	Run 3	Average	95%CI[1]
Naphthalene	µg/Nm^3	0.344 J	< 2.55	< 3.22	< 3.22	NA
2-Nitroaniline	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
3-Nitroaniline	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
4-Nitroaniline	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
Nitrobenzene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2-Nitrophenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
4-Nitrophenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
N-Nitrosodimethylamine	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
N-Nitrosodiphenylamine	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
N-Nitroso-di-n-propylamine	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Pentachlorophenol	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
Phenanthrene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Phenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Pyrene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
Pyridine	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
1,2,4-Trichlorobenzene	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA
2,4,5-Trichlorophenol	µg/Nm^3	< 6.61	< 6.37	< 8.06	< 8.06	NA
2,4,6-Trichlorophenol	µg/Nm^3	< 2.64	< 2.55	< 3.22	< 3.22	NA

[1] 95% CI = 95% Confidence interval, based on the standard deviation of three results (n=3).
[2] "Less than" symbol (<) indicates that the analyte was detected in one or more sample fractions, but the result is below the value reported.
[3] NA = Not Applicable
[4] Results flagged with a "J" are "estimated" values

3.1.7 PCDDs and PCDFs Results

Selected PCDD and PCDF congeners were detected in the run samples; however, none were measured consistently in every sample. These results are shown in Table 3-6. The equivalent toxicity in terms of 2,3,7,8-TCDD was calculated using the equivalent toxicity factors generated by the World Health Organization. Based on the reported concentrations for the detected congeners, the average equivalent toxicity of the emissions was determined to be 0.006 picograms (pg)/Nm^3.

TABLE 3-6
Dioxin/Furan Emissions Results Summary

Polychlorinated Dibenzo-Dioxins and Furans	Units	Run 1	Run 2	Run 3	Average	95% CI [1]
Equivalent Toxicity (as 2,3,7,8-TCDD)	pg/Nm^3	0.00591	0.0120	0.000759	0.00622	0.0140
2,3,7,8-TCDD	pg/Nm^3	ND (0.269) [2]	ND (0.324)	ND (0.383)	ND (0.383)	NA [3]
1,2,3,7,8-PeCDD	pg/Nm^3	ND (0.391)	ND (0.382)	ND (0.528)	ND (0.528)	NA
1,2,3,4,7,8-HxCDD	pg/Nm^3	ND (0.441)	ND (0.607)	ND (0.607)	ND (0.607)	NA
1,2,3,6,7,8-HxCDD	pg/Nm^3	ND (0.398)	ND (0.546)	ND (0.548)	ND (0.548)	NA
1,2,3,7,8,9-HxCDD	pg/Nm^3	ND (0.410)	ND (0.562)	ND (0.561)	ND (0.562)	NA
1,2,3,4,6,7,8-HpCDD	pg/Nm^3	0.573 J [4]	0.648 J	ND (1.24)	< 1.24 [5]	NA
OCDD	pg/Nm^3	ND (2.14)	5.49 J	7.59 J	< 5.07	NA
2,3,7,8-TCDF	pg/Nm^3	ND (0.504)	ND (0.322)	ND (0.574)	ND (0.574)	NA
1,2,3,7,8-PeCDF	pg/Nm^3	ND (1.04)	ND (0.439)	ND (0.571)	ND (1.04)	NA
2,3,4,7,8-PeCDF	pg/Nm^3	ND (0.974)	ND (0.413)	ND (0.535)	ND (0.974)	NA
1,2,3,4,7,8-HxCDF	pg/Nm^3	ND (0.131)	ND (0.213)	ND (0.204)	ND (0.213)	NA
1,2,3,6,7,8-HxCDF	pg/Nm^3	ND (0.121)	ND (0.195)	ND (0.187)	ND (0.195)	NA
2,3,4,6,7,8-HxCDF	pg/Nm^3	ND (0.133)	ND (0.216)	ND (0.207)	ND (0.216)	NA
1,2,3,7,8,9-HxCDF	pg/Nm^3	ND (0.146)	ND (0.236)	ND (0.226)	ND (0.236)	NA
1,2,3,4,6,7,8-HpCDF	pg/Nm^3	ND (0.163)	0.494 J	ND (0.802)	< 0.802	NA
1,2,3,4,7,8,9-HpCDF	pg/Nm^3	ND (0.196)	ND (0.195)	ND (0.237)	ND (0.237)	NA
OCDF	pg/Nm^3	1.78 J	ND (1.51)	ND (1.49)	< 1.59	NA
Total TCDD	pg/Nm^3	ND (0.269)	ND (0.324)	ND (0.383)	ND (0.383)	NA
Total PeCDD	pg/Nm^3	ND (0.391)	ND (0.382)	ND (0.528)	ND (0.528)	NA
Total HxCDD	pg/Nm^3	ND (0.751)	ND (0.573)	ND (0.571)	ND (0.751)	NA
Total HpCDD	pg/Nm^3	1.06	0.648	1.37	1.03	3.38
Total TCDF	pg/Nm^3	ND (0.324)	0.345	ND (1.13)	< 1.13	NA
Total PeCDF	pg/Nm^3	ND (1.00)	ND (0.424)	ND (0.551)	ND (1.00)	NA
Total HxCDF	pg/Nm^3	ND (0.132)	ND (0.280)	ND (0.239)	ND (0.280)	NA
Total HpCDF	pg/Nm^3	ND (0.178)	0.494	ND (0.875)	< 0.875	NA

[1] 95% CI = 95% Confidence interval, based on the standard deviation of three results (n=3).
[2] ND = Not Detected in any sample fraction above the detection limit in parentheses (MDL).
[3] NA = Not Applicable
[4] Results flagged with a "J" are "estimated" values since the result is above the method detection limit, but less than the laboratory's reporting limit.

[5] "Less than" symbol (<) indicates that the analyte was detected in one or more samples, but the average result is below the value reported.

3.1.8 Emission Factors

Emission factors have been calculated for PM, metals, selected gases, and VOCs and are reported in units of pounds of analyte per pounds of mustard agent destroyed (lb analyte/lb H). The emission factors were calculated using the following equation:

$$EF_i = \frac{(C_i \times Q \times t)}{H} \times 2$$

where:

EF_i = emission factor of target analyte i (lb i /lb H) for a specified test run

C_i = concentration (gm/Nm^3) of analyte i for the specified test run

Q = flow rate of the stack exhaust (Nm^3)/min) for the specified test run

t = total gas sampling period for the specified test run (minutes)

H = mass of H destroyed for the specified test run (in grams)

The factor of 2 is required to account for the assumption that the emissions from the VCS Air Filtration System were split equally between the #1 and #2 Air Filtration Units.

Because of differences in the number of detonations and variations between the sampling periods associated with the three test runs, the emission factors were calculated separately for each test run and then averaged. The emission factors are based on stack exhaust gas flow rates of 148.08, 146.87, and 146.85 Nm^3/minute for Test Runs 1, 2, and 3, respectively. These are the average stack gas air flow rates obtained from the daily pre- and post-test velocity traverses. The sampling periods for these three runs were 280 minutes, 290 minutes, and 230 minutes in duration, and the mass of agent destroyed in each test run was 18.84 pounds, 21.98 pounds, and 18.84 pounds, respectively.

Emission rates in terms of pounds per hour (lbs/hr) were calculated and reported. The calculated emission factors and mass emission rates for each test parameter are presented in Table 3-7.

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [(1) (2)] (lb/lb agent H)	Emission Rate [(1)] (lbs/hr)
Gaseous Components				
Carbon monoxide (CO)	0.494	ppmv	5.48E-03	2.41E-02
Nitrogen oxides (NOx as NO_2)	1.98	ppmv	3.54E-02	1.58E-01
Sulfur dioxide (SO_2)	< 0.9	ppmv	<2.20E-02	<1.00E-01
Total Hydrocarbons (THC)	1.44	ppmv	9.02E-03	4.03E-02

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1] (lbs/hr)
Particulate Matter, Hydrogen Chloride, and Chlorine				
Particulate Matter	0.600	mg/N^3	5.45E-03	2.34E-02
Hydrogen Chloride (HCl as Cl^-)	< 29.1	$\mu g/N^3$	<1.41E-04	<5.70E-04
Chlorine (Cl_2 as Cl^-)	< 8.72	$\mu g/N^3$	<4.23E-05	<1.71E-04
Metals				
Antimony	< 29.9 J	$\mu g/N^3$	<1.62E-05[2]	<1.16E-03
Arsenic	< 228 J	$\mu g/N^3$	<1.22E-04[2]	<8.86E-03
Barium	< 98.7 J	$\mu g/N^3$	<5.23E-05[2]	<3.83E-03
Beryllium	< 0.38 J	$\mu g/N^3$	<2.47E-07[2]	<1.49E05
Cadmium	< 0.568 J	$\mu g/N^3$	<3.01E-07[2]	<2.21E05
Chromium	< 1.83 J	$\mu g/N^3$	<1.00E-06[2]	<7.11E05
Cobalt	< 0.887 J	$\mu g/N^3$	<5.08E-07[2]	<3.45E-05
Copper	< 3.37 J	$\mu g/N^3$	<1.79E-06[2]	<1.31E-04
Iron	< 395 J	$\mu g/N^3$	<2.09E-04[2]	<1.53E-02
Lead	< 10.2 J	$\mu g/N^3$	<5.40E-06[2]	<3.96E-04
Mercury	< 0.378 J	$\mu g/N^3$	<2.46E-07[2]	<1.48E-05
Nickel	< 2.64 J	$\mu g/N^3$	<1.51E-06[2]	<1.03E-04
Selenium	ND (1.21)	$\mu g/N^3$	<6.48E-07[2]	<4.70E-05
Silver	< 0.763 J	$\mu g/N^3$	<4.37E-07[2]	<2.96E-05
Thallium	ND (0.599)	$\mu g/N^3$	<3.21E-07[2]	<2.33E-05
Vanadium	< 4.64 J	$\mu g/N^3$	<2.46E-06[2]	<1.80E-04
Zinc	< 25.8 J	$\mu g/N^3$	<1.37E-05[2]	<1.00E-03
Metals (blank corrected)				
Antimony	< 0.406 J	$\mu g/N^3$	<2.17E-07[2]	<1.58E-05
Arsenic	11.3 J	µg/Nm	5.99E-06[2]	4.39E-04
Barium	< 0.0881 J	$\mu g/N^3$	<4.71E-08[2]	<3.42E-06
Beryllium	< 0.0488 J	$\mu g/N^3$	<3.17E-08[2]	<1.91E-06
Cadmium	0.373 J	$\mu g/N^3$	2.15E-07[2]	1.45E-05
Chromium	< 0.978 J	$\mu g/N^3$	<5.30E-07[2]	<3.81E-05
Cobalt	< 0.161 J	$\mu g/N^3$	<2.45E-08[2]	<6.24E-06

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1](lbs/hr)
Copper	< 0.315 J	µg/Nm	<1.68E-07[2]	<1.23E-05
Iron	35.5 J	µg/N^3	1.94E-05[2]	1.38E-03
Lead	< 0.210 J	µg/N^3	<1.12E-07[2]	<8.16E-06
Mercury	0.196 J	µg/N^3	2.33E-07[2]	7.67E-06
Nickel	< 0.812 J	µg/N^3	<3.24E-07[2]	<3.16E-05
Selenium	ND (1.21)	µg/N^3	<6.49E-07[2]	<4.70E-05
Silver	< 0.107 J	µg/N^3	<5.75E-08[2]	<4.16E-06
Thallium	ND (0.599)	µg/Nm	<3.21E-07[2]	<2.33E-05
Vanadium	0.830 J	µg/Nm	4.67E-07[2]	3.23E-05
Zinc	7.32 J	µg/N^3	3.79E-06[2]	2.85E-04
Volatile Organic Compounds (Stack Emissions)				
C1 (Methane)	1,210 J	µg/N^3	1.05E-02	4.70E-02
Acetylene	< 2,360	µg/N^3	<2.23E-02	<9.17E-02
C2 (Ethane)	< 2,750	µg/N^3	<2.58E-02	<1.07E-01
Ethene	< 2,540	µg/N^3	<2.41E-02	<9.87E-02
C3 (Propane)	1,600 J	µg/N^3	1.05E-02	4.70E-02
C4 (Butane)	< 5,270	µg/N^3	<4.99E-02	<2.05E-01
C5 (Pentane)	< 6,600	µg/N^3	<6.19E-02	<2.56E-01
C6 (Hexane)	< 7,890	µg/N^3	<7.39E-02	<3.07E-01
1,1,1-Trichloroethane	< 12.2	µg/N^3	<1.15E-04	<4.74E-04
1,1,2,2-Tetrachloroethane	< 15.4	µg/Nm	<1.44E-04	<5.98E-04
1,1,2-Trichloroethane	< 12.2	µg/Nm	<1.15E-04	<4.74E-04
1,1-Dichloroethane	< 9.06	µg/N^3	<8.49E-05	<3.52E-04
1,1-Dichloroethene	< 8.87	µg/N^3	<8.32E-05	<3.45E-04
1,2,4-Trichlorobenzene	< 16.6	µg/N^3	<1.55E-04	<6.45E-04
1,2,4-Trimethylbenzene	< 11.0	µg/N^3	<1.03E-04	<4.27E-04
1,2-Dibromoethane	< 17.2	µg/N^3	<1.61E-04	<6.68E-04
1,2-Dichloro,1,1,2,2-tetrafluoroethane	< 15.6	µg/N^3	<1.47E-04	<6.06E-04
1,2-Dichlorobenzene	< 13.5	µg/N^3	<1.26E-04	<5.24E-04

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1](lbs/hr)
1,2-Dichloroethane	< 9.06	µg/N^3	<8.49E-05	<3.52E-04
1,2-Dichloropropane	< 10.3	µg/N^3	<9.69E-05	<4.00E-04
1,3,5-Trimethylbenzene	< 11.0	µg/N^3	<1.03E-04	<4.27E-04
1,3-Dichlorobenzene	< 13.5	µg/N^3	<1.26E-04	<5.24E-04
1,4-Dichlorobenzene	< 13.5	µg/N^3	<1.26E-04	<5.24E-04
Acetone	241	µg/N^3	2.07E-03	9.38E-03
Benzene	< 7.15	µg/N^3	<6.71E-05	<2.78E-04
Bromomethane	< 8.69	µg/N^3	<8.14E-05	<3.38E-04
Carbon Tetrachloride	< 14.1	µg/N^3	<1.32E-04	<5.48E-04
Chlorobenzene	< 10.3	µg/N^3	<9.66E-05	<4.00E-04
Chloroethane	< 5.90	µg/Nm	<5.53E-05	<2.29E-04
Chloroform	< 10.9	µg/N^3	<1.03E-04	<4.23E-04
Chloromethane	1.81 J	µg/N^3	1.58E-05	7.04E-05
cis-1,2-Dichloroethene	< 8.87	µg/N^3	<8.32E-05	<3.45E-04
cis-1,3-Dichloropropene	< 10.2	µg/N^3	<9.52E-05	<3.96E-04
Dichlorodifluoromethane	2.14 J	µg/N^3	1.87E-05	8.35E-05
Dichloromethane	< 21.6	µg/N^3	<2.02E-04	<8.44E-04
Ethylbenzene	< 9.72	µg/N^3	<9.10E-05	<3.78E-04
Hexachlorobutadiene	< 23.9	µg/N^3	<2.23E-04	<9.29E-04
m,p-Xylene	< 19.4	µg/N^3	<1.82E-04	<7.54E-04
Methyl Ethyl Ketone	16.5 J	µg/Nm	1.37E-04	6.42E-04
Methyl Isobutyl Ketone	< 9.17	µg/N^3	<8.59E-05	<3.56E-04
Naphthalene	< 23.5	µg/N^3	<2.20E-04	<9.13E-04
n-Butylbenzene	< 12.3	µg/N^3	<1.15E-04	<4.78E-04
n-Propylbenzene	< 11.0	µg/N^3	<1.03E-04	<4.27E-04
o-Xylene	< 9.72	µg/N^3	<9.10E-05	<3.78E-04
Styrene	< 9.53	µg/N^3	<8.94E-05	<3.70E-04
Tetrachloroethylene	< 15.2	µg/N^3	<1.28E-04	<5.91E-04
Toluene	40.5 J	µg/N^3	3.29E-04	1.57E-03
trans-1,2-Dichloroethene	< 8.87	µg/N^3	<8.32E-05	<3.45E-04

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1](lbs/hr)
trans-1,3-Dichloropropene	< 10.2	µg/N^3	<9.52E-05	<3.96E-04
Trichloroethene	< 11.9	µg/N^3	<1.13E-04	<4.62E-04
Trichlorofluoromethane	0.989 J	µg/N^3	8.64E-06	3.86E-05
Trichlorotrifluoroethane	< 17.1	µg/N^3	<1.61E-04	<6.64E-04
Vinyl Chloride	< 5.72	µg/N^3	<5.36E-05	<2.22E-04
Semi-Volatile Organic Compounds				
Acenaphthene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Acenaphthylene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Anthracene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzo(a)anthracene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzo(a)pyrene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzo(b)fluoranthene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzo(g,h,i)perylene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzo(k)fluoranthene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Benzoic acid	< 16.1	µg/N^3	<1.28E-04	<6.26E-04
Benzyl alcohol	< 6.45	µg/N^3	<5.13E-05	<2.51E-04
4-Bromophenyl phenyl ether	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Butyl benzyl phthalate	< 3.22	µg/N^3	<2.55E-05	<1.25E-04
Carbazole	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
4-Chloroaniline	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
bis(2-Chloroethoxy) methane	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
bis(2-Chloroethyl) ether	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
bis(2-Ethylhexyl) phthalate	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
4-Chloro-3-methyl phenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2-Chloronaphthalene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2-Chlorophenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
4-Chlorophenyl phenyl ether	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Chrysene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Dibenzo(a,h)anthracene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Dibenzofuran	< 3.22	µg/N^3	<2.56E-05	<1.25E-04

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1](lbs/hr)
Di-n-butyl phthalate	0.229 J	µg/Nm	2.00E-06	8.92E-06
1,2-Dichlorobenzene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
1,3-Dichlorobenzene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
1,4-Dichlorobenzene	< 3.22	µg/N^3	<2.55E-05	<1.25E-04
3,3'-Dichlorobenzidine	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2,4-Dichlorophenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Diethyl phthalate	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2,4-Dimethylphenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Dimethyl phthalate	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
4,6-Dinitro-2-methyl phenol	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
2,4-Dinitrophenol	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
2,4-Dinitrotoluene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2,6-Dinitrotoluene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Di-n-octyl phthalate	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Fluoranthene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Fluorene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Hexachlorobenzene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Hexachlorobutadiene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Hexachloroethane	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Indeno(1,2,3-cd)pyrene	< 3.22	µg/Nm	<2.56E-05	<1.25E-04
Isophorone	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2-Methylnaphthalene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2-Methylphenol (o-Cresol)	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
3,4-Methylphenol (m,p-Cresol)	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Naphthalene	< 3.22	µg/Nm	<2.55E-05	<1.25E-04
2-Nitroaniline	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
3-Nitroaniline	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
4-Nitroaniline	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
Nitrobenzene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2-Nitrophenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1] (lbs/hr)
4-Nitrophenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
N-Nitrosodimethylamine	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
N-Nitrosodiphenylamine	< 3.22	µg/Nm	<2.56E-05	<1.25E-04
N-Nitroso-di-n-propylamine	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Pentachlorophenol	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
Phenanthrene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Phenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Pyrene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Pyridine	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
1,2,4-Trichlorobenzene	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
2,4,5-Trichlorophenol	< 8.06	µg/N^3	<6.41E-05	<3.13E-04
2,4,6-Trichlorophenol	< 3.22	µg/N^3	<2.56E-05	<1.25E-04
Polychlorinated dibenzo-dioxins and –furans				
Equivalent Toxicity (as 2,3,7,8-TCDD)	0.00622	pg/Nm^3	5.54E-11	2.42E-10
2,3,7,8-TCDD	ND (0.383)	pg/Nm^3	<3.03E-09	<1.49E-08
1,2,3,7,8-PeCDD	ND (0.528)	pg/Nm^3	<4.17E-09	<2.05E-08
1,2,3,4,7,8-HxCDD	ND (0.607)	pg/Nm^3	<5.19E-09	<2.36E-08
1,2,3,6,7,8-HxCDD	ND (0.548)	pg/Nm^3	<4.67E-09	<2.13E-08
1,2,3,7,8,9-HxCDD	ND (0.562)	pg/Nm^3	<4.80E-09	<2.18E-08
1,2,3,4,6,7,8-HpCDD	< 1.24	pg/Nm^3	<9.80E-09	<4.82E-08
OCDD	< 5.07	pg/Nm^3	<4.26E-08	<1.97E-07
2,3,7,8-TCDF	ND (0.574)	pg/Nm^3	<4.89E-09	<2.23E-08
1,2,3,7,8-PeCDF	ND (1.04)	pg/Nm^3	<1.01E-08	<4.07E-08
2,3,4,7,8-PeCDF	ND (0.974)	pg/Nm^3	<9.45E-09	<3.82E-08
1,2,3,4,7,8-HxCDF	ND (0.213)	pg/Nm^3	<1.82E-09	<8.28E-09
1,2,3,6,7,8-HxCDF	ND (0.195)	pg/Nm^3	<1.67E-09	<7.58E-09
2,3,4,6,7,8-HxCDF	ND (0.216)	pg/Nm^3	<1.85E-09	<8.39E-09
1,2,3,7,8,9-HxCDF	ND (0.236)	pg/Nm^3	<2.02E-09	<9.17E-09
1,2,3,4,6,7,8-HpCDF	< 0.802	pg/Nm^3	<6.34E-09	<3.12E-08

TABLE 3-7
Emission Factors

Component	Average Concentration	Units	Emission Factor [1] [2] (lb/lb agent H)	Emission Rate [1](lbs/hr)
1,2,3,4,7,8,9-HpCDF	ND (0.237)	pg/Nm^3	<1.90E-09	<9.21E-09
OCDF	< 1.59	pg/Nm^3	<1.40E-08	<6.21E-08
Total TCDD	ND (0.383)	pg/Nm^3	<3.03E-09	<1.49E-08
Total PeCDD	ND (0.528)	pg/Nm^3	<4.17E-09	<2.05E-08
Total HxCDD	ND (0.751)	pg/Nm^3	<7.29E-09	<2.94E-08
Total HpCDD	1.03	pg/Nm^3	8.88E-09	4.00E-08
Total TCDF	< 1.13	pg/Nm^3	<8.93E-09	<4.39E-08
Total PeCDF	ND (1.00)	pg/Nm^3	<9.70E-09	<3.92E-08
Total HxCDF	ND (0.280)	pg/Nm^3	<2.39E-09	<1.09E-08
Total HpCDF	< 0.875	pg/Nm^3	<6.92E-09	<3.40E-08

[1] The emission factors and the emission rates were determined by doubling the emissions flow rate data collected from the outlet of the VCS Air Filtration Unit #2. It is assumed that the air filtration system exhaust fan speeds for Units #1 and #2 were the sam e and that the building exhaust air flow is split evenly between the Unit #1 and Unit #2 air filtration units.

[2] The metals emission factors are expressed in lb/lb munition, due to the shell of the munition contributing to the metals content.

3.2 Unused Pea Gravel and Lime and Waste Solids Characterization

Table 3-8 provides the results from the sample collection described earlier in Section 2.2 – Solid Waste Sampling. The following subsections discuss the results from the analyses performed.

TABLE 3-8
TCLP, Total Metals Dioxin/Furan, and Energetic Sample Results for Waste Solids

Test Parameter	Regulatory Limits	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel(from Detonation Chamber Floor)	Spent Time (from Lime Injection System)
Corrosivity (pH)	≤ 2 or ≥12.5	NA	NA	4.82	12.42
Reactive Cyanide (mg/Kg)		NA	NA	0.5 UJ	0.5 UJ
Reactive Sulfide (mg/Kg)		NA	NA	400	170

TABLE 3-8
TCLP, Total Metals Dioxin/Furan, and Energetic Sample Results for Waste Solids

Test Parameter	Regulatory Limits	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel(from Detonation Chamber Floor)	Spent Time (from Lime Injection System)
TCLP-Volatiles (ug/L)					
Benzene	5.0×10^2	NA	NA	0.23 J	1.12 R
Carbon tetrachloride	5.0×10^2	NA	NA	0.5 U	0.5 R
Chlorobenzene	1.0×10^5	NA	NA	0.13 J	0.5 R
Chloroform	6.0×10^3	NA	NA	1.14 U	0.47 R
1,2-Dichloroethane	5.0×10^2	NA	NA	0.5 U	0.5 R
1,1-Dichloroethylene	7.0×10^2	NA	NA	0.5 U	0.5 R
Methyl ethyl ketone	2.0×10^5	NA	NA	4.34 J	5 R
Tetrachloroethylene	7.0×10^2	NA	NA	6.36	0.5 R
Trichloroethylene	5.0×10^2	NA	NA	0.55	0.14 R
Vinyl chloride	2.0×10^2	NA	NA	0.5 U	0.5 R
TCLP-Semivolatiles (ug/L)					
1,4-Dichlorobenzene	7.5×10^3	NA	NA	10.5 U	10.4 U
2,4,5-Trichlorophenol	4.0×10^5	NA	NA	26.2 U	26 U
2,4,6-Trichlorophenol	2.0×10^3	NA	NA	10.5 U	10.4U
2,4-Dinitrotoluene	0.1×10^3	NA	NA	10.5 U	10.4 U
2-Methylphenol (o-Cresol)	2.0×10^5	NA	NA	10.5 U	10.4 U
cresols, m & p	2.0×10^5	NA	NA	10.5 U	10.4 U
Hexachlorobenzene	1.0×10^2	NA	NA	10.5 U	10.4 U
Hexachlorobutadiene	5.0×10^2	NA	NA	10.5 U	10.4 U
Hexachloroethane	3.0×10^3	NA	NA	10.5 U	10.4 U
Nitrobenzene	2.0×10^3	NA	NA	10.5 U	10.4 U
Pentachlorophenol	1.0×10^5	NA	NA	21 U	20.8 U
Pyridine	5.0×10^3	NA	NA	10.5 U	10.4 U
TCLP-Metals (ug/L)					
Arsenic	$5. \times 10^3$	250 U	250 U	250 U	107 J
Barium	1.0×10^5	250 U	250 U	256	136 J
Cadmium	1.0×10^3	50 U	50 U	106	50 U
Chromium	5.0×10^3	100 U	100U	12.5 J	141

TABLE 3-8
TCLP, Total Metals Dioxin/Furan, and Energetic Sample Results for Waste Solids

Test Parameter	Regulatory Limits	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel(from Detonation Chamber Floor)	Spent Time (from Lime Injection System)
Lead	5.0×10^3	50 U	50 U	6340	47000
Mercury	2.0×10^2	NA	NA	1 U	1 U
Selenium	1.0×10^3	300 U	300 U	300 U	300 U
Silver	5.0×10^3	100 U	100 U	100 U	100 U
Total Metals (mg/kg)					
Antimony	—	2 UJ	40 UJ	30.3 J	154 J
Arsenic	—	2.78 J	100 U	10 U	25.9 J
Barium	—	5 U	100	31	50 U
Beryllium	—	0.241 J	1.56 J	0.287 J	8 U
Cadmium	—	1 U	20 U	2.73	3.36 J
Calcium	—	105	554000	730	407000
Chromium (total)	—	8.81	40 U	53	23.8
Cobalt	—	5.53	3.14 J	6.26	2.49 J
Copper	—	4 U	80 U	9380	3400
Iron	—	14300	885	30100	5440
Lead	—	2.17	20 U	1840	4400
Nickel	—	5.75	80 U	84.3	24.8 J
Selenium	—	6 U	120 U	12 U	60 U
Silver	—	2 U	4.45 U	4 U	20 U
Thallium	—	2 U	40 U	1.62 J	20 U
Vanadium	—	8.39	100 U	6.06 J	50 U
Zinc	-	15.6	24.4 J	3850	1900
Polychlorinated Dibenzo-dioxins and –furans (pg/g)					
Equivalent Toxicity (as 2,3,7,8-TCDD)	—	NA	NA	5,740	7.91
2,3,7,8-TCDD	—	NA	NA	39.3	0.141 J
1,2,3,7,8-PeCDD	—	NA	NA	245	0.443 J
1,2,3,4,7,8-HxCDD	—	NA	NA	397	0.912 J
1,2,3,6,7,8-HxCDD	—	NA	NA	1570	1.6 J

TABLE 3-8
TCLP, Total Metals Dioxin/Furan, and Energetic Sample Results for Waste Solids

Test Parameter	Regulatory Limits	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel(from Detonation Chamber Floor)	Spent Time (from Lime Injection System)
1,2,3,7,8,9-HxCDD	----	NA	NA	775 J	0.967 J
1,2,3,4,6,7,8-HpCDD	----	NA	NA	20900	24.9
OCDD	----	NA	NA	67700	155
2,3,7,8-TCDF	----	NA	NA	671	0.743
1,2,3,7,8-PeCDF	----	NA	NA	1880	2.7
2,3,4,7,8-PeCDF	----	NA	NA	3570	2.51 J
1,2,3,4,7,8-HxCDF	----	NA	NA	10500	26.3
1,2,3,6,7,8-HxCDF	----	NA	NA	5380	6.88
2,3,4,6,7,8-HxCDF	----	NA	NA	5600	3.48
1,2,3,7,8,9-HxCDF	----	NA	NA	4710	5.33
1,2,3,4,6,7,8-HpCDF	----	NA	NA	29100	67.5 J
1,2,3,4,7,8,9-HpCDF	----	NA	NA	10500	33
OCDF	----	NA	NA	61300	498
Total TCDD	----	NA	NA	1060	1.94
Total PeCDD	----	NA	NA	3770	3.58
Total HxCDD	----	NA	NA	16200 J	11.8
Total HpCDD	----	NA	NA	36300	36.8
Total TCDF	----	NA	NA	13300	8.12
Total PeCDF	----	NA	NA	28100	18.5
Total HxCDF	----	NA	NA	47300	62.2 J
Total HpCDF	----	NA	NA	54400	126
Energetics (mg/kg)					
1,3,5-trinitrobenzene	----	NA	NA	0.088 U	0.088 U
1,3-dinitrobenzene	----	NA	NA	0.089 U	0.089 U
2,4,6-trinitrotoluene	----	NA	NA	0.092 U	0.092 U
2,4-Dinitrotoluene	----	NA	NA	0.059 U	0.059 U
2,6-Dinitrotoluene	----	NA	NA	0.11 U	0.11 U
2-amino-4,6-dinitrotoluene	----	NA	NA	0.099 U	0.099 U

TABLE 3-8
TCLP, Total Metals Dioxin/Furan, and Energetic Sample Results for Waste Solids

Test Parameter	Regulatory Limits	Fresh Pea Gravel	Fresh Lime	Spent Pea Gravel(from Detonation Chamber Floor)	Spent Time (from Lime Injection System)
2-nitrotoluene	----	NA	NA	0.082 U	0.082 U
3-nitrotoluene	----	NA	NA	0.081 U	0.081 U
4-amino-2,6-dinitrotoluene	----	NA	NA	0.12 U	0.12 U
4-nitrotoluene	----	NA	NA	0.11 U	0.11 U
hexahydro-1,3,5-trinitro-1,3,5,7-tetrazocine	----	NA	NA	0.15 U	0.15 U
Nitrobenzene	----	NA	NA	0.12 U	0.12 U
Nitroglycerin	----	NA	NA	0.49 U	0.49 U
octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	----	NA	NA	0.072 U	0.17 J
pentaerythritol tetranitrate	----	NA	NA	0.5 UJ	0.5 U
Tetryl	----	NA	NA	0.23 U	0.23 U

J – Either detected above the minimum detection limit and below the reporting limit, where the result is qualified and considered an estimate; or the analyte was detected above the minimum detection limit, but during validation the result was determined to be estimates due to QC issues.
B – Detected above the minimum detection limit, but below the reporting limit. The result is qualified and considered an estimate
ND = Not detected above the MDL, shown in parentheses
NA indicates analyte was either not measured or not calculate
R – Data rejected during data validation for one of the following reasons: HTA – Hold Time Alert, RE – Result Rejected.
U - Analyte was not detected above the minimum detection limit, with the detection limit and reporting limit considered accurate.

3.2.1 TCLP Metals, VOCs and SVOCs

The TCLP metals results shown in Table 3-8 indicate that of the eight RCRA metals (Ar, Ba, Cd, Cr, Pb, Hg, Se, and Ag), only lead exceeded the RCRA limit. The spent gravel result was 6,340 µg/l, while the spent lime result was 47,000 µg/l. Thus the two waste streams would be characteristically hazardous per 40 CFR 261.24 for lead.

For the spent pea gravel, only two TCLP VOC parameters (tetrachloroethylene (PCE) and trichloroethylene (TCE)) were detected above the reporting limits or minimum detection limits. These results were 6.36 µg/l for PCE and 0.55 µg/l for TCE. However, both results were below their respective RCRA limits for toxicity (40 CFR 261.24). Again, all other spent gravel VOC parameters were reported below the reporting limit or below the minimum detection limits.

All spent lime TCLP VOC laboratory results were rejected as part of the data validation. The data validation resulted in rejection of all VOC results as a consequence of extremely low surrogate recovery (bromoflurobenzene at <10 percent).

Table 3-8 demonstrates that no TCLP SVOC parameters were detected above the minimum detection limits.

3.2.2 Corrosivity and Reactivity

A shown in Table 3-8, the pH of the spent pea gravel from the chamber floor was 4.82, and the pH of the spent lime was 12.42. Neither of these results defines the wastes as being corrosive per 40 CFR 261.22. These regulatory limits are defined in this same table. Unused lime typically has a pH in the 12 range.

The results from the cyanide analysis indicate that the two waste streams would not be hazardous (per 40 CFR 261.23) for reactive cyanide. As shown in Table 3-8, the results for the spent pea gravel and lime are were not detected above the minimum reporting values and were considered estimates.

The results for the sulfide analysis indicate that sulfide was present in the spent pea gravel at 400 millgrams per kilogram (mg/kg) and present in the spent lime at 170 mg/kg.

3.2.3 Total Metals

Total metals results for both the fresh or unused pea gravel and lime, as well for the spent pea gravel and lime, are provided in Table 3-8. These results indicate the presence of metals in the unused pea gravel and lime. Calcium, chromium (total), cobalt, iron, lead, nickel, vanadium and zinc were all present in the pea gravel at naturally occurring concentrations. Of the metals analyzed for the unused lime, only barium, calcium and iron were above the detection limit or reporting limits (see table notes). Again, these concentrations are typical for lime.

Increases in specific metals concentrations in the spent pea gravel and lime were found when compared to the unused materials. The predominant concentration increases in the pea gravel were in calcium, chromium, copper, iron, lead, nickel, and zinc. The predominant metals increases in the spent lime were from copper, iron, lead and zinc.

These increases are likely to be attributed to the metal components of the munitions destroyed.

3.2.4 PCDDs and PCDFs

Table 3-8 provides the results from the dioxins (PCDDs) and furan (PCDFs) analyses for the two waste streams. All 17 of the speciated dioxin and furan congeners were detected in the recovered pea gravel and spent lime samples. The equivalent toxicity in terms of 2,3,7,8-TCDD was determined using the equivalent toxicity factors generated by the World Health Organization for each of the congeners. Based on the reported concentrations for the detected congeners, the average equivalent toxicity of the pea gravel from the floor of the detonation chamber was 5,740 pg/gm (as 2,3,7,8-TCDD). The equivalent toxicity for the spent lime was 7.91 pg/gm (as 2,3,7,8-TCDD).

3.2.5 Energetic Compounds

No energetic compounds were detected above 0.5 mg/kg, and all the data results were below the minimum detection limits for the compound list.

SECTION 4

Quality Control

Numerous quality control (QC) measures were implemented throughout the environmental testing program to ensure the representative nature of the samples and to quantify the accuracy and precision of the measurements. The quality controls used, their results, and their relevance to data quality for this test are discussed in this section. A summary of the formulae used to calculate test results and the data handling conventions are also provided.

4.1 Source Emissions Sampling

The sampling methods used during this program included collection techniques and quality control measures designed to make the samples as representative as possible of the process streams, even under the dynamic process conditions encountered.

4.1.1 Isokinetic Sampling Rates

EPA Reference Methods 1 through 5 were followed and adapted for the operation and safety requirements of the detonation chamber exclusion area. The primary deviation from the methods involved sampling isokinetically at a single point versus isokinetic sampling at multiple traverse points established by Method 1. This adaptation was necessary because test personnel were restricted to the sampling operations trailer and were unable to relocate the probes to the various ports during the test.

Another consequence of sampling at a single point was the absence of velocity measurements at each traverse point. To accomplish a full velocity profile and obtain an accurate flow rate, velocity profiles were made before and after the test. A full traverse of the air filter inlet and exhaust ducts during pre-test operations indicated a typical flow profile across 12 sampling traverse points, with no evidence of cyclonic or turbulent flow characteristics. Attachment B presents the field data sheets for the velocity profiles and cyclonic flow checks. Using the pre-test velocity profile data, isokinetic sampling rates were established at the onset of each test run. Sampling nozzle diameters were chosen to provide sampling rates of approximately 0.5 to 0.7 dscfm at isokinetic conditions. The isokinetic sampling rates for all of the PM/HCl/Cl_2, SVOCs, and PCDD/PCDF sampling trains met the method-specified range by being within 90 and 110 percent isokinetic. The isokinetic rates were 103.6 percent, 108.6 percent and 108.6 percent, respectively.

However, the metals trains were sampled at a consistent, but apparently biased, sampling rate that averaged only 75.1 percent isokinetic. In the isokinetic calculations, a nozzle size of 0.193 was used and at the end of Run 1, an isokinetic rate of 97.6 was obtained. However, the actual nozzle size was 0.219 and therefore the actual isokinetic rate was 75.8 for Run 1. Because the initial calculations showed no immediate sign of error, the same nozzle size of 0.193 was used in the preceding calculations, which resulted in the actual sampling rates being sub-isokinetic.The isokinetic sampling rate was pre-determined by the pre-test velocity profile and the average velocity of the duct. At the conclusion of the test, the measurements of difference in pressure (ΔP) across the pitot tube for the sampling trains co-located on the same side of the duct were used in place of the absent train-specific data.

Consequently, this isokinetic sampling rate determination (and the PCDD/PCDF rate determination) are merely estimates of the actual isokinetic sampling rate adherence. The absence of any significant PM in the exhaust gas stream makes the potential impact of this sampling condition negligible.

4.1.2 Sampling Train Leak Checks

With the exception of the final leak check on the SW-846 Method 0023A sampling train for PCDD/PCDFs after Run 3, all of the sampling trains passed all pre- and post test leak-checks.

The final leak check performed at the conclusion of Run 3 on the PCDD/PCDF sampling train did not meet the method requirements of 0.02 cubic feet per minute (ft^3/minute) The leak rate was 0.05 ft^3/minute. The leak was located in the union between the nozzle and the probe liner. This part of the sampling apparatus was inside of the stack wall at all times during the test run and therefore was considered an in-stack leak. The consequence of this leak is therefore minimal because the sample was taken only from within the stack itself and no ambient air was introduced.

4.1.3 Dry Gas Meter Calibration

All meter box dry gas meters were calibrated at 5 points before the test run series and were within EPA method criteria. All meter box dry gas meters passed their post-test calibrations according to EPA ALT-009 for post-test dry gas meter Y_{qa}.

4.1.4 Additional Quality Controls

Additional quality controls related to sampling included glassware, reagent, and sampling media preparation. All glassware used in the sampling trains was pre-cleaned and rinsed before use to minimize sample contamination. In addition, pre-cleaned sample bottles certified to meet EPA specifications were used to contain the recovered samples, and reagents meeting American Chemical Society reagent-grade quality or better were used to prepare all solutions. Sampling media (filters, XAD resin) were also prepared to meet method specifications.

4.2 Analytical Quality Controls

Analytical quality controls typically include instrument calibrations, calibration checks, blanks, and in some cases, matrix spikes, surrogate spikes, and duplicate sample analyses. These QC activities indicate proper instrument operation, potential for sample contamination, and the accuracy and precision of the measurements in the sample matrix. This section only describes those quality controls that were related to sample analyses performed by AST. A separate data validation report was prepared by CH2M HILL to cover the analyses performed by ASL and ALTA.

4.2.1 CEM Calibration

Before sample collection began, the CEM instruments were calibrated and a calibration error test was performed in which calibration gases were directly introduced to the analyzers. These calibration gases consisted of a zero gas, a high-level (span) gas standard, and a mid-range gas standard. The specific calibration gases and operating ranges for each

instrument were defined determined based on the expected concentrations in the exhaust gas. After each test run was completed, a final system bias check was performed, meeting the same requirements of the initial bias check. During this final system bias check, the drift of the analyzers was calculated by comparing the results of the initial and final system bias checks.

Calibration error limits of 5 percent and sample bias limits of 10 percent were chosen for these tests because of several factors. First, the lack of availability of EPA Protocol 1-certified calibration gas standards in the United Kingdom reduced the potential accuracy that could be obtained. Second, the low concentrations of the targeted analytes in the exhaust stream versus the manufacturer's specifications for drift and bias of high concentration analyzers made compliance with the 3 percent and 5 percent drift and bias criteria difficult to achieve after a 4-hour minimum test period.

All pre-test three-point calibration error checks performed were within acceptable limitations of 5 percent, and all post-test zero and mid-level bias checks were within 10 percent of the certified values of the standards, indicating good measurement accuracy.
The calibrations performed on the first day of testing were at higher spans than the subsequent two days of testing, attributable to the observation of lower concentrations than originally expected.

4.2.2 Analytical Balance Calibration

The analytical balance used to weigh the particulate filters and probe wash residues for PM were checked daily before each measurement by weighing standard weights in the appropriate range for the mass to be determined. The balance calibration was considered acceptable if the standard weight measurements were within 10 percent of the standard weights' certified value.

Filters and residue containers were stored in desiccators and were weighed at 6-hour intervals (minimum) until a stable weight was obtained. A stable weight is defined by EPA Method 5 as two successive weights that do not vary by more than 0.5 mg.

4.3 Calculations and Data Handling Conventions

4.3.1 Calculations

In general, the raw data from laboratory analytical results and field sampling measurements were used to calculate results for gas concentrations in terms of micrograms or milligrams per dry normal cubic meter (µg/Nm^3 or mg/Nm^3), with "normal" conditions being defined as a temperature of 32°F (492°Rankine [R]) and a pressure of 29.92 inches of mercury.

Most of the air sample results were reported by the laboratories in terms of their concentration in the analytical solutions (i.e., mass per unit volume). These results were converted to total mass (µg or mg) per sampling train by multiplying the laboratory-reported concentration by the appropriate impinger volume or digestate volume. The total mass per sampling train was then divided by the gas volume (Nm^3) to obtain the gas sample concentration.

4.3.2 Data Handling Conventions

Individual results for each test parameter were averaged to provide the stream concentration results summarized in Section 3 and presented in Tables 3-1 through 3-8. Several conventions are possible for averaging test results that include both measurable and undetected analyte concentrations. In general, three cases affect the calculation of average concentrations. For this project, these cases were handled as follows:

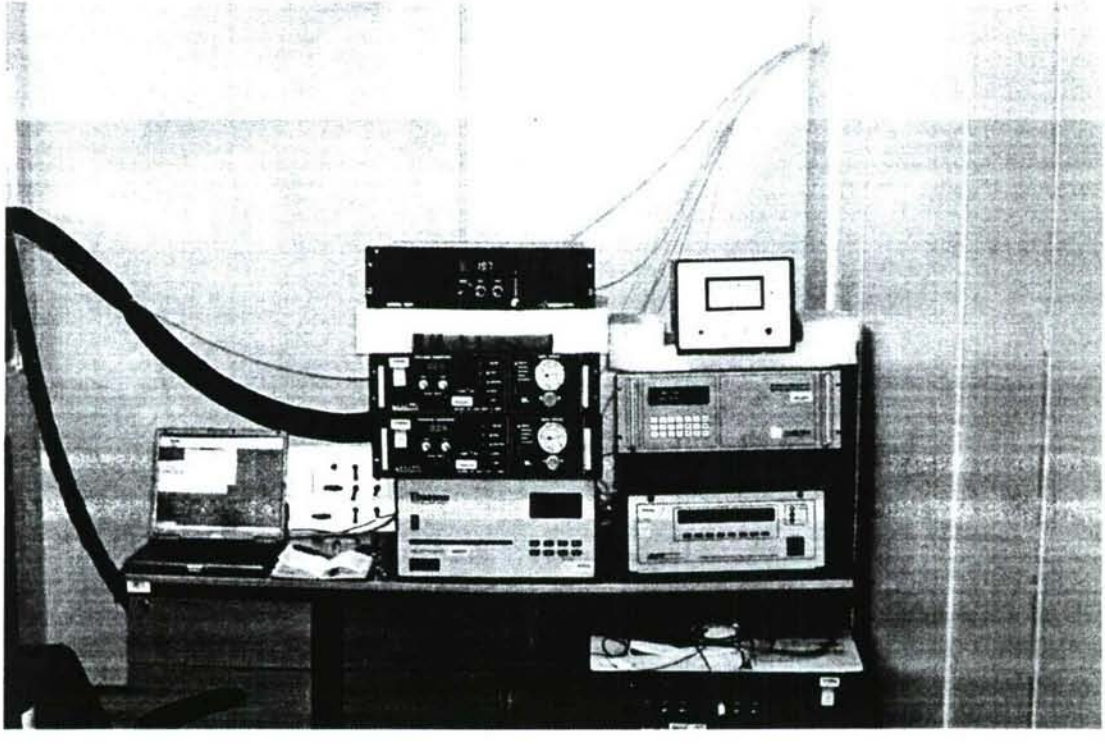
1. When all values for a given parameter were measured above the detection limit, then the average result was calculated as the true arithmetic mean value.
2. For results that included both values above and below the detection limit, a value equal to the detection limit was used in place of a measured result to calculate the mean.
3. When all results were below the detection limit, the mean result was reported as "less than" the highest detection limit value.

This approach produced the highest estimate of the average concentration and, for exhaust gas emissions, the highest emission factor.

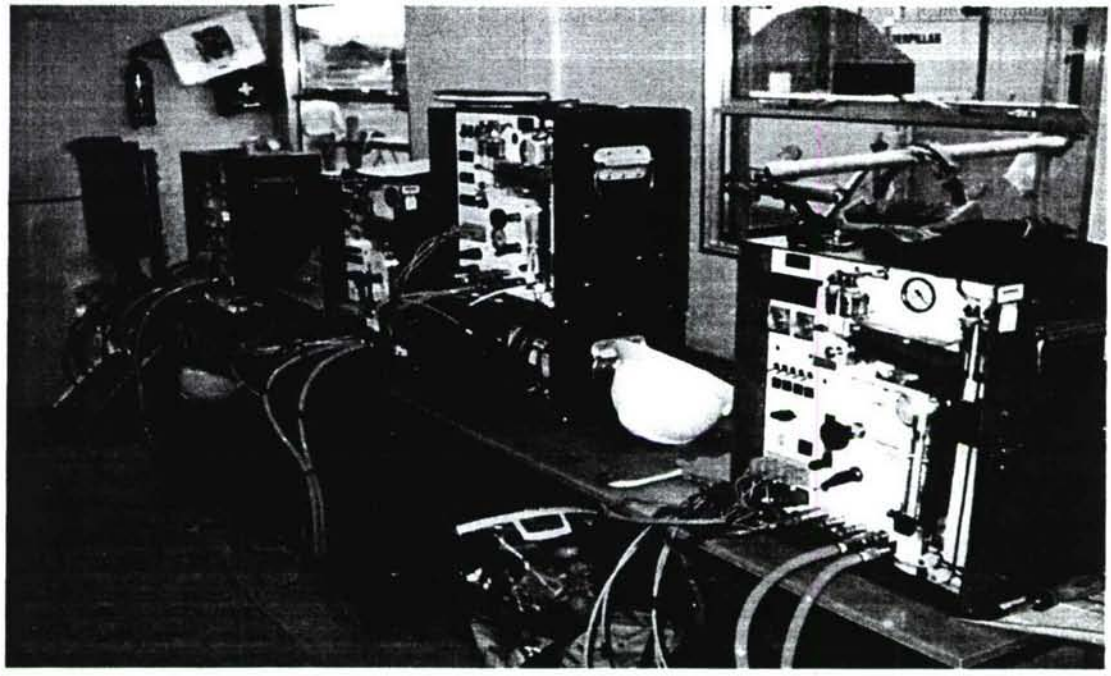
ATTACHMENT A

PHOTOGRAPHIC DOCUMENTATION

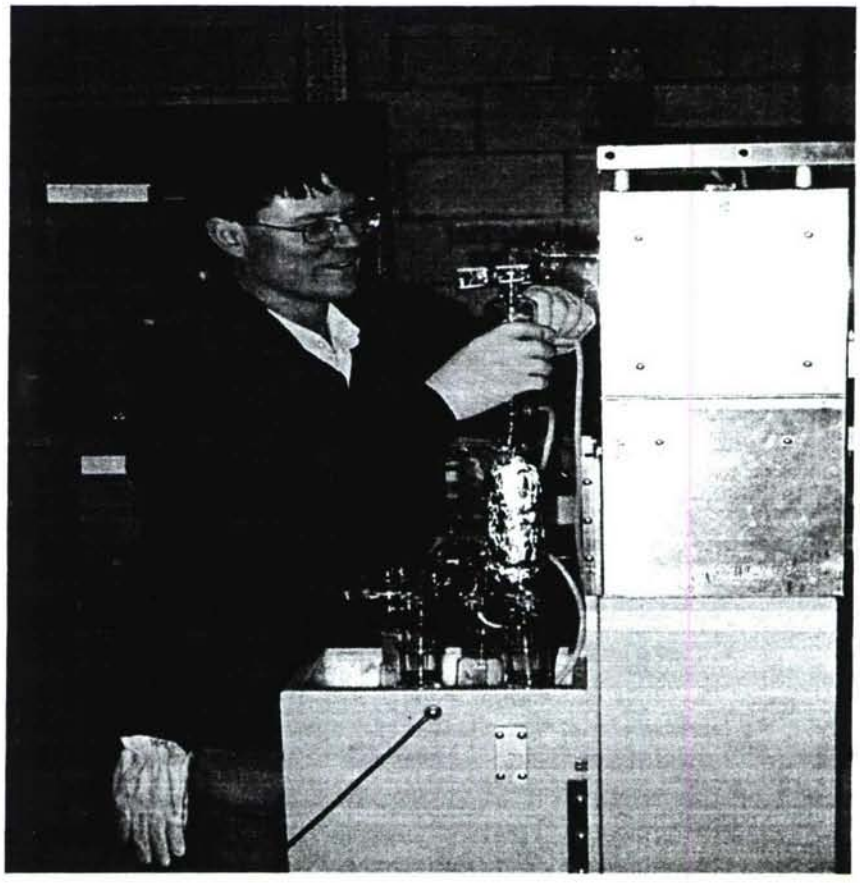
Photograph-1: Calibration Gases for Continuous Emission Monitoring Instruments



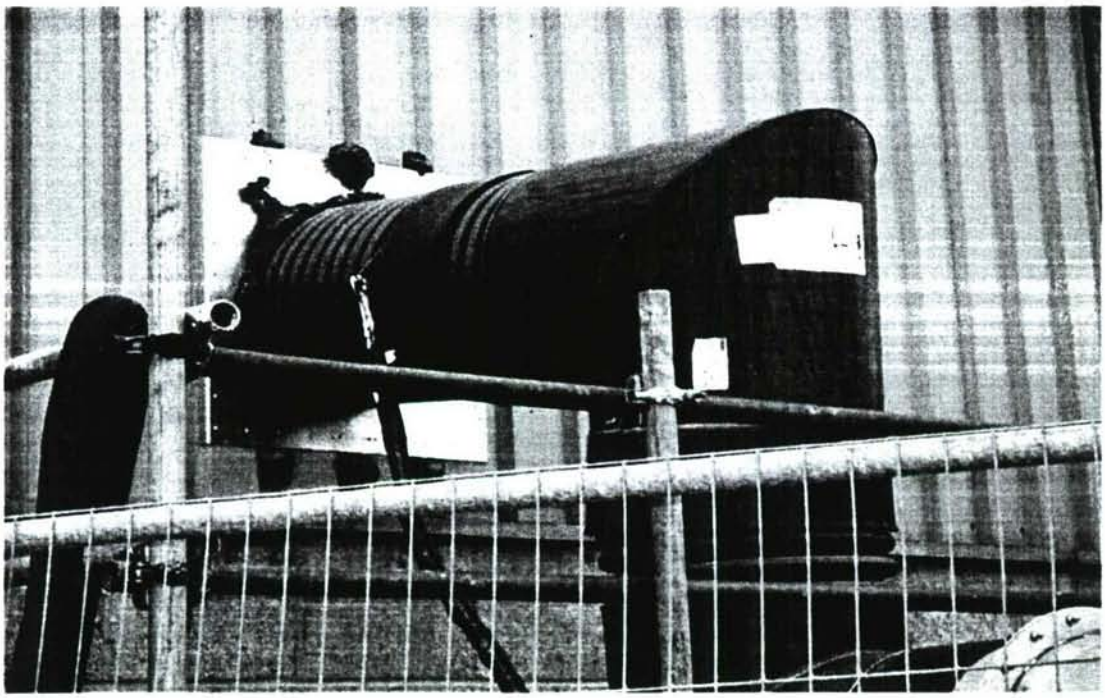
Photograph-2: Continuous Emission Monitoring Instruments



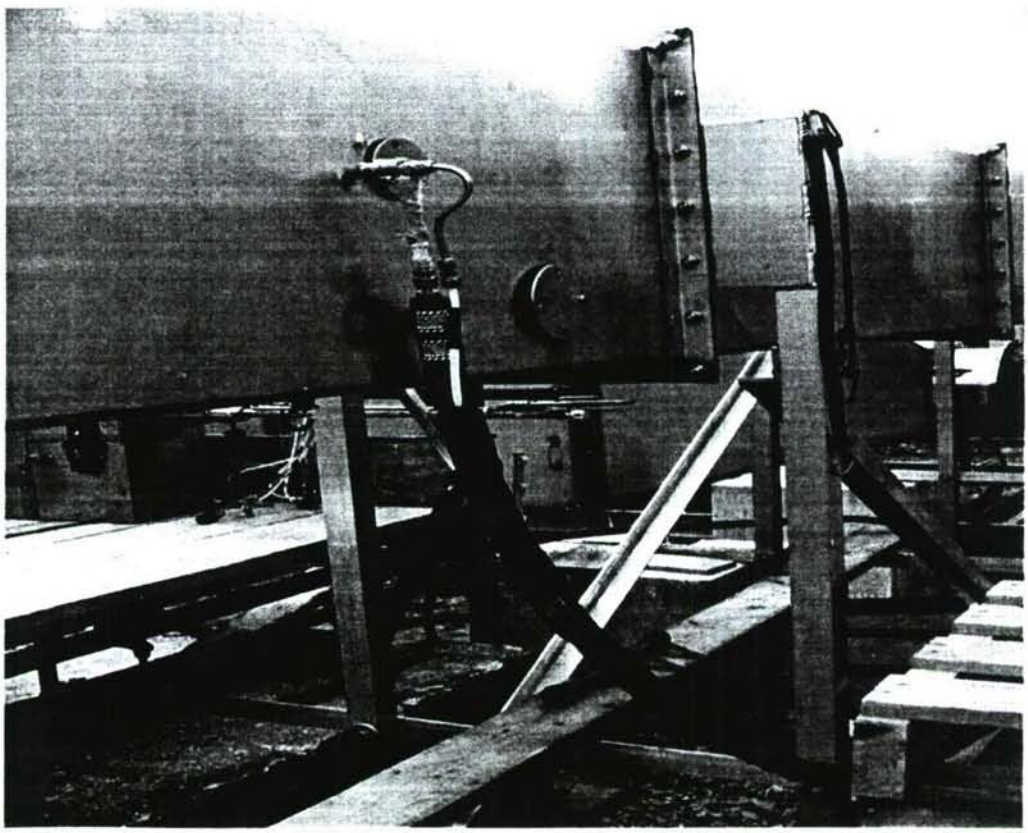
Photograh-3: Iso-kinetic, Wet Method Sampling Meter Boxes



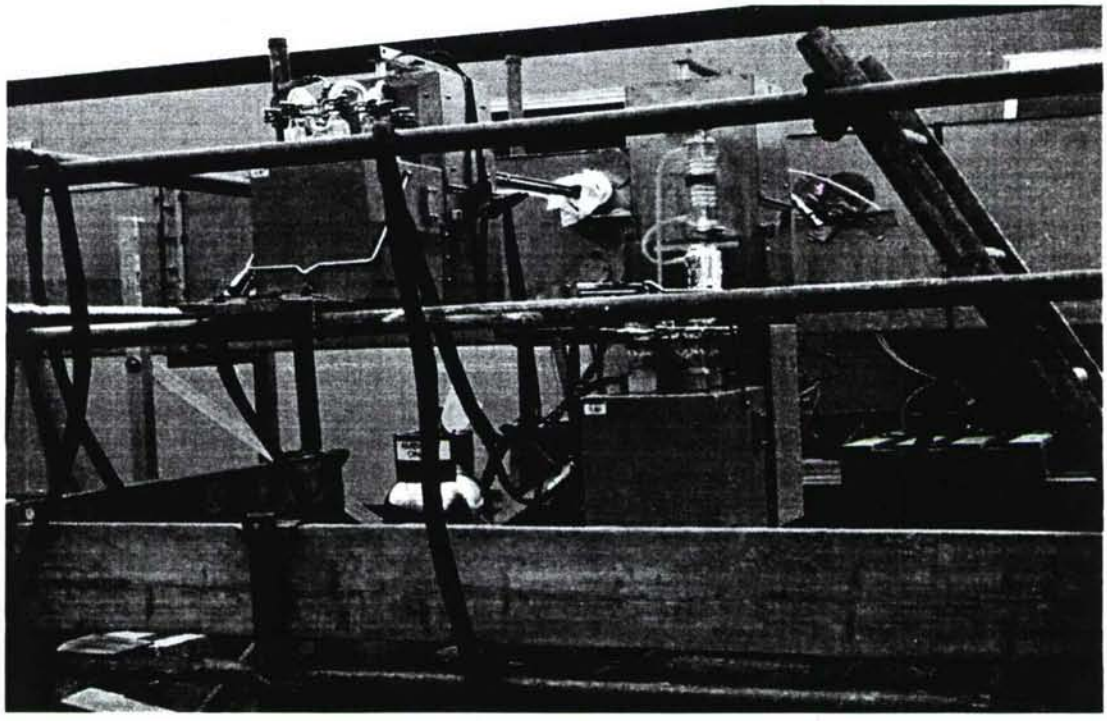
Photograph-4: Dioxins/Furans Train Assembly



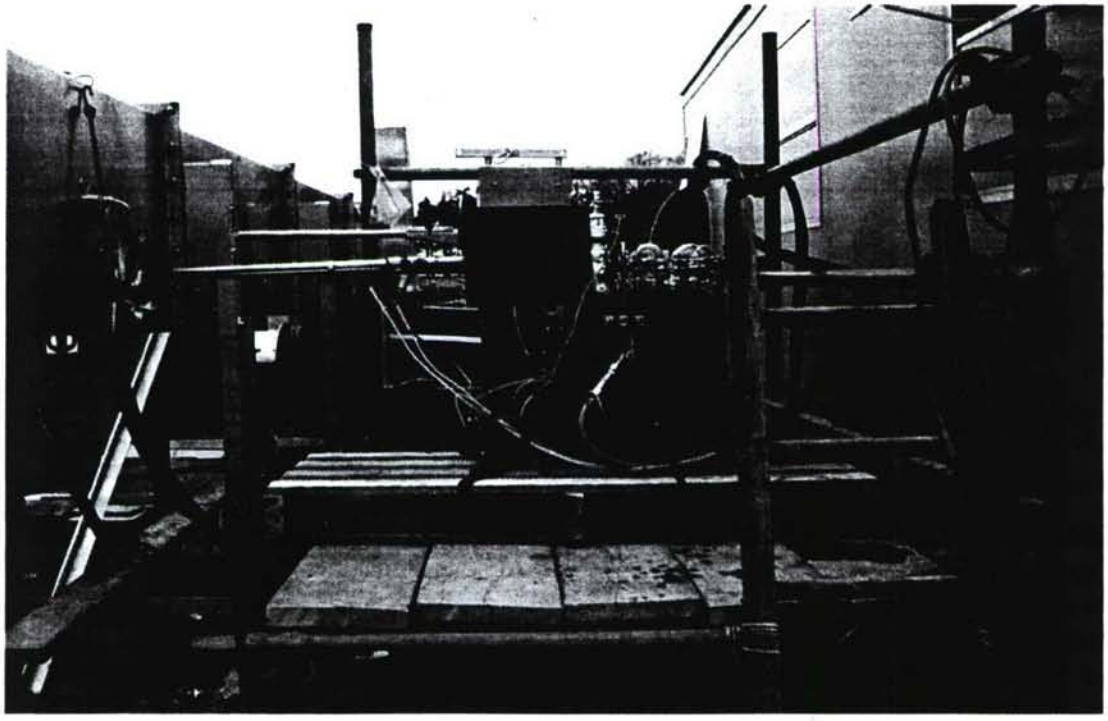
Photograph-5: Inlet Continuous Emissions Monitoring Probe



Photograph-6: Outlet Continuous Emissions Monitoring Probe



Photograph-7: PM/Method 26A, Dioxins/Furans, and VOC Canister Trains Placed in Exhaust Duct



Photograph-8: SVOC's and Metal's Trains Placed in Exhaust Duct

Photograph-9: VOC's Evacuted Sampling Canister

Photograph-10: Dioxins/Furans Train Sample Recovery from March 21, 2006

ATTACHMENT B

FIELD DATA

TC-60 CDC Demonstration Tests

Method 29 (Metals) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Reagent Blank								
TC60-RB-MET-NPR	HNO3 PNR Blank	Metals/Hg	3/23/06	0830	101.3	202.6	101.3	
TC60-RB-MET-FIL	Filter Blank	Metals/Hg	↓	↓	---	---	—	
TC60-RB-MET-NPI	HNO3/H2O2 Rgnt Blank	Metals/Hg	↓	↓	262.7	477.9	215.2	
TC60-RB-MET-EIR	HNO3 Imp. Rinse Blank	Mercury	↓	↓	100.8	202.5	101.7	
TC60-RB-MET-API	KMnO4/H2SO4 Rgnt Blank	Mercury	↓	↓	259.6	609.3	349.7	
TC60-RB-MET-HCL	HCl/Water Blank	Mercury	↓	↓	100.8	225.2	124.9	
Environmental Test - Run 1						3 DPM		
TC60-ET01-MET-NPR	PNR-HNO3	Metals/Hg	3/21/06	1503	101.7	187.3	85.6	
TC60-ET01-MET-FIL	Filter	Metals/Hg	↓	↓	---	---	—	
TC60-ET01-MET-NPI	HNO3/H2O2 Impingers	Metals/Hg	↓	↓	259.8	676.7	416.9	
TC60-ET01-MET-EIR	Empty impinger rinse	Mercury	↓	↓	100.6	184.9	84.3	
TC60-ET01-MET-API	KMnO4/H2SO4 Impingers	Mercury	↓	↓	257.5	749.9	492.4	
TC60-ET01-MET-HCL	HCl Impinger Rinse	Mercury	↓	↓	101.9	226.9	125.0	
Environmental Test - Run 2								
TC60-ET02-MET-NPR	PNR-HNO3	Metals/Hg	3/22/06	1420	101.0	162.1	61.1	
TC60-ET02-MET-FIL	Filter	Metals/Hg	↓	↓	---	---	—	
TC60-ET02-MET-NPI	HNO3/H2O2 Impingers	Metals/Hg	↓	↓	261.0	655.3	393.7	*
TC60-ET02-MET-EIR	Empty impinger rinse *	Mercury	↓	↓	102.2	215.9	113.7	Recvd as KMnO4 imp
TC60-ET02-MET-API	KMnO4/H2SO4 Impingers	Mercury	↓	↓	258.6	750.2	491.6	due to backflush.
TC60-ET02-MET-HCL	HCl Impinger Rinse	Mercury	↓	↓	101.6	226.6	125.0	DPM

C-60

TC-60 CDC Demonstration Tests

Method 29 (Metals) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Environmental Test - Run 3								
TC60-ET03-MET-NPR	PNR-HNO3	Metals/Hg	3/23/06	1338	102.0	175.5	73.5	
TC60-ET03-MET-FIL	Filter	Metals/Hg			---	---	---	
TC60-ET03-MET-NPI	HNO3/H2O2 Impingers	Metals/Hg			261.9	639.6	377.7	
TC60-ET03-MET-EIR	Empty impinger rinse	Mercury			101.6	198.4	96.8	
TC60-ET03-MET-API	KMnO4/H2SO4 Impingers	Mercury			259.2	762.7	503.5	
TC60-ET03-MET-HCL	HCl Impinger Rinse	Mercury			102.2	~~50~~ 227.3	125.1	
Environmental Test - Run 4								DAM
TC60-ET04-MET-NPR	PNR-HNO3	Metals/Hg						
TC60-ET04-MET-FIL	Filter	Metals/Hg			---	---		
TC60-ET04-MET-NPI	HNO3/H2O2 Impingers	Metals/Hg						
TC60-ET04-MET-EIR	Empty impinger rinse	Mercury						
TC60-ET04-MET-API	KMnO4/H2SO4 Impingers	Mercury						
TC60-ET04-MET-HCL	HCl Impinger Rinse	Mercury						

TC-60 CDC Demonstration Tests

Method 0010 (SVOCs) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Reagent Blank								
TC60-RB-MM5-MeOH	MeOH Rgnt Blank	SVOCs	3/23/06	1515	100.3	200.3	100.0	
TC60-RB-MM5-MeCl2	MeCl2 Rgnt Blank	SVOCs	↓	↓	101.0	252.9	151.9	
TC60-RB-MM5-XAD	XAD-2 Resin Blank	SVOCs	↓	↓	---	---	---	
TC60-RB-MM5-H2O	Water Blank	SVOCs	↓	↓	258.9	458.6	199.7	
Environmental Test - Run 1								
TC60-ET01-MM5-PNR-MeOH	MeOH PNR	SVOCs	3/21/06	1503	101.5	170.0	68.5	
TC60-ET01-MM5-PNR-MeCl2	MeCl2 PNR	SVOCs	↓	↓	101.5	252.3	150.8	
TC60-ET01-MM5-XAD	XAD-2 Resin	SVOCs	↓	↓	---	---	---	
TC60-ET01-MM5-COND	Impinger condensate	SVOCs	↓	↓	261.8	458.1	196.3	
TC60-ET01-MM5-BHR-MeOH	MeOH BHR	SVOCs	↓	↓	100.6	182.8	82.2	
TC60-ET01-MM5-BHR-MeCl2	MeCl2 BHR	SVOCs	↓	↓	101.6	180.9	79.3	
Environmental Test - Run 2								
TC60-ET02-MM5-PNR-MeOH	MeOH PNR	SVOCs	3/22/06	1420	101.5	174.5	73.0	
TC60-ET02-MM5-PNR-MeCl2	MeCl2 PNR	SVOCs	↓	↓	101.9	213.1	111.9	
TC60-ET02-MM5-XAD	XAD-2 Resin	SVOCs	↓	↓	---	---	---	
TC60-ET02-MM5-COND	Impinger condensate	SVOCs	↓	↓	263.3	458.2	194.9	
TC60-ET02-MM5-BHR-MeOH	MeOH BHR	SVOCs	↓	↓	101.8	170.0	68.2	
TC60-ET02-MM5-BHR-MeCl2	MeCl2 BHR	SVOCs	↓	↓	102.0	180.5	78.5	

TC-60 CDC Demonstration Tests

Method 0010 (SVOCs) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Environmental Test - Run 3								
TC60-ET03-MM5-PNR-MeOH	MeOH PNR	SVOCs	3/23/06	1338	101.5	169.1	67.6	
TC60-ET03-MM5-PNR-MeCl2	MeCl2 PNR	SVOCs	↓	↓	101.6	225.2	123.6	
TC60-ET03-MM5-XAD	XAD-2 Resin	SVOCs	↓	↓	---	---	—	
TC60-ET03-MM5-COND	Impinger condensate	SVOCs	↓	↓	261.8	453.6	191.8	
TC60-ET03-MM5-BHR-MeOH	MeOH BHR	SVOCs	↓	↓	100.9	183.2	82.9	
TC60-ET03-MM5-BHR-MeCl2	MeCl2 BHR	SVOCs	↓	↓	100.2	196.6	96.4	
Environmental Test - Run 4								
TC60-ET04-MM5-PNR-MeOH	MeOH PNR	SVOCs						
TC60-ET04-MM5-PNR-MeCl2	MeCl2 PNR	SVOCs						
TC60-ET04-MM5-XAD	XAD-2 Resin	SVOCs			---	---		
TC60-ET04-MM5-COND	Impinger condensate	SVOCs						
TC60-ET04-MM5-BHR-MeOH	MeOH BHR	SVOCs						
TC60-ET04-MM5-BHR-MeCl2	MeCl2 BHR	SVOCs						

TC-60 CDC Demonstration Tests

Method 0023A (PCDD/PCDF) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Reagent Blank								
TC60-RB-M23-ACE	Acetone Blank	PCDD/PCDF	3/23/06	1520	101.0	151.2	50.2	
TC60-RB-M23-MeCl2	MeCl2 Blank	PCDD/PCDF	↓	↓	100.3	200.3	100.0	
TC60-RB-M23-TOL	Toluene Blank	PCDD/PCDF	↓	↓	100.3	150.2	49.9	
TC60-RB-M23-XAD	XAD-2 Resin Blank	PCDD/PCDF	↓	↓	---	---		
Environmental Test - Run 1								
TC60-ET01-M23-ACE	Acetone Rinse	PCDD/PCDF	3/21/06	1503	101.5	152.2	50.7	
TC60-ET01-M23-MeCl2	MeCl2 Rinse	PCDD/PCDF	↓	↓	101.7	225.7	124.0	
TC60-ET01-M23-TOL	Toluene Rinse	PCDD/PCDF	↓	↓	101.7	158.0	56.3	
TC60-ET01-M23-XAD	XAD-2 Resin	PCDD/PCDF	↓	↓	---	---	—	
Environmental Test - Run 2								
TC60-ET02-M23-ACE	Acetone Rinse	PCDD/PCDF	3/22/06	1420	100.2	150.3	50.1	
TC60-ET02-M23-MeCl2	MeCl2 Rinse	PCDD/PCDF	↓	↓	100.1	207.6	107.5	
TC60-ET02-M23-TOL	Toluene Rinse	PCDD/PCDF	↓	↓	100.8	162.7	61.9	
TC60-ET02-M23-XAD	XAD-2 Resin	PCDD/PCDF	↓	↓	---	---	—	
Environmental Test - Run 3								
TC60-ET03-M23-ACE	Acetone Rinse	PCDD/PCDF	3/23/06	1338	100.9	146.0	45.1	
TC60-ET03-M23-MeCl2	MeCl2 Rinse	PCDD/PCDF	↓	↓	101.0	173.4	72.4	
TC60-ET03-M23-TOL	Toluene Rinse	PCDD/PCDF	↓	↓	100.9	141.2	40.3	
TC60-ET03-M23-XAD	XAD-2 Resin	PCDD/PCDF	↓	↓	---	---	—	

TC-60 CDC Demonstration Tests

Method 5/26A (PM-HCl/Cl2) Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Reagent Blank								
TC60-RB-M5-PNR	Acetone Blank	PM	3/23/06	1410	100.2	160.2	60.0	
TC60-RB-M5-FIL	Filter Blank	PM	↓	↓	0.3995			T1 Filter
TC60-RB-M26A-H2SO4	0.1 N H2SO4 Rgnt Blank	Chloride (HCl)			261.6	465.1	203.5	200 ml
TC60-RB-M26A-NaOH	0.1 N NaOH Rgnt Blank	Chloride (Cl2)			259.2	464.2	205.0	200 ml + 1ml $Na_2S_2O_3$
TC60-RB-M26A-H2O	Water Blank	HOLD	↓	↓	100.1	205.6	105.5	
Environmental Test - Run 1								
TC60-ET01-M5-PNR	Acetone PNR	PM	3/21/06	1503	100.8	160.2	59.4	
TC60-ET01-M5-FIL	Filter	PM	↓	↓	0.3933			T2 Filter
TC60-ET01-M26A-H2SO4	0.1 N H2SO4 Impingers	Chloride (HCl)			259.5	611.4	351.9	
TC60-ET01-M26A-NaOH	0.1 N NaOH Impingers	Chloride (Cl2)	↓	↓	263.5	661.0	397.5	+1 ml $Na_2S_2O_3$
Environmental Test - Run 2								
TC60-ET02-M5-PNR	Acetone PNR	PM	3/22/06	1420	100.3	146.8	46.5	
TC60-ET02-M5-FIL	Filter	PM	↓	↓	0.4015			T3 Filter
TC60-ET02-M26A-H2SO4	0.1 N H2SO4 Impingers	Chloride (HCl)			262.0	665.1	403.1	
TC60-ET02-M26A-NaOH	0.1 N NaOH Impingers	Chloride (Cl2)	↓	↓	254.2	615.9	356.7	+1 ml $Na_2S_2O_3$
Environmental Test - Run 3								
TC60-ET03-M5-PNR	Acetone PNR	PM	3/23/06	1338	100.7	144.1	43.2	
TC60-ET03-M5-FIL	Filter	PM	↓	↓	0.4036			T4 Filter
TC60-ET03-M26A-H2SO4	0.1 N H2SO4 Impingers	Chloride (HCl)			259.8	676.3	416.5	
TC60-ET03-M26A-NaOH	0.1 N NaOH Impingers	Chloride (Cl2)	↓	↓	240.7	629.8	368.1	+1 ml $Na_2S_2O_3$

TC-60 CDC Demonstration Tests

Canister Sample Log

Sample ID	Fraction	Analysis	Date	Start	Stop	$P_{initial}$	P_{final}	Comments
Ambient Air Background								
TC60-BG-AIR-VOC	Summa Canister	VOCs	3/23/06	0947	1320	26"	<1"	Canister # 0549
Bldg Air Filter Inlet (Location 001)								
TC60-ET01-AFI-VOC	Summa Canister	VOCs	3/21/06	1021	1421	30"	1"	Canister # 0574
TC60-ET02-AFI-VOC	Summa Canister	VOCs	3/22/06	0930	1300	27"	4"	# 0657
TC60-ET03-AFI-VOC	Summa Canister	VOCs	3/23/06	0947	1320	27"	3,5"	# 0631
Stack (Location 002)								
TC60-ET01-Stack-VOC	Summa Canister	VOCs	3/21/06	1021	1421	28"	1"	Canister # 0647
TC60-ET02-Stack-VOC	Summa Canister	VOCs	3/22/06	0930	1300	28"	4"	# 0638
TC60-ET03-Stack-VOC	Summa Canister	VOCs	3/23/06	0947	1320	26"	3"	# 0595

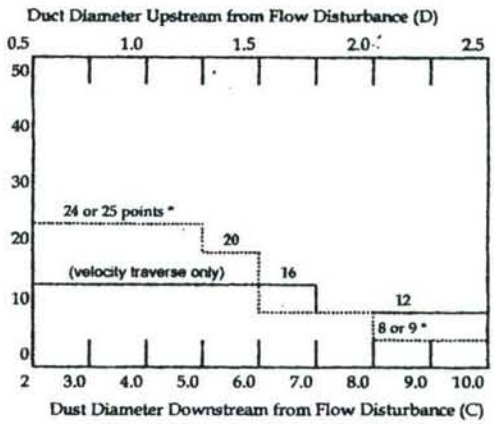
TC-60 CDC Demonstration Tests

Solids/Residue Sample Log

Sample ID	Fraction	Analysis	Date	Time	Tare	Gross	Net	Comments
Fresh Pea Gravel								
TC60-ET01-FPG-TCLP	Fresh Pea Gravel (1 of 2)	TCLP-Metals	3/24/06	1000	229.1			Collected from super sack of pea gravel outside Near entrance to ESP fence
TC60-ET01-FPG-TCLP	Fresh Pea Gravel (2 of 2)	TCLP-Metals	3/24/06	1000	229.5			
Fresh Lime								
TC60-ET01-LIME-TCLP	Fresh Lime (1 of 2)	TCLP-Metals	3/24/06	1400	228.9			
TC60-ET01-LIME-TCLP	Fresh Lime (2 of 2)	TCLP Metals	3/24/06	1400	229.0			

EPA Method 1
Traverse Point Location for Circular and Rectangular Ducts

Plant Name: TC-60 - CDC
City & State: Porton Down.
Sampling Location: 001 (Inlet)
Date: 3-18-06
Operator(s): D. Maxwell / G. Simpson
Internal Stack Diameter (b): 17.625 inches ★
Internal Stack Length: ——— inches
Internal Stack Width: ——— inches
Rectangular Equivalent Diameter (b^1): ——— inches
Nipple Length (d): 1.25 inches ▷
Nearest Upstream Disturbance (C): 36.0 inches
Nearest Downstream Disturbance (D): 18.0 inches
Number of Traverse Points: 12



Traverse Point	% Stack ID (a)	Stack ID (b)or(b^1) ★	Traverse Point (c = a x b)	Nipple Length (d) ▷	inches Traverse Point Location (c + d)
Ex	2.1	0	0.00	0	0.00
1	4.4	17.625	0.78	1.25	2.03
2	14.6	17.625	2.57	1.25	3.82
3	29.6	17.625	5.22	1.25	6.47
4	70.4	17.625	12.41	1.25	13.66
5	85.4	17.625	15.05	1.25	16.30
6	95.6	17.625	16.85	1.25	18.10
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

2" 3 1/16" 6 5/16" 13 11/16" 16 5/16" 18 7/16"

Location of Traverse Points in Circular Stacks (a)

	4	6	8	10	12
1	5.7	4.4	3.2	2.6	2.1
2	25	14.6	10.5	8.2	6.7
3	75	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.6	34.2	25
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Rectangular Duct Equivalent Diamter Determination = (b^1)	$\frac{2 \times (L \times W)}{L + W}$

Location of Traverse Points in Rectangular Stacks (a^1)

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	15.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	37.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	85.4	79.2
11										95.5	87.5
12											95.8

Generally:
Upstream distance (C) is the distance from the port to the exhaust.
Downstream distance (D) is the distance from the port to the fan.

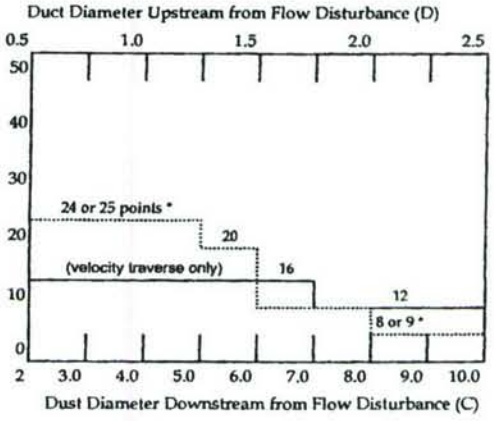
QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 1
Traverse Point Location for Circular and Rectangular Ducts

Plant Name	TC-60-CDC
City & State	Porter Down
Sampling Location	#2 (outlet)
Date	3-19-06
Operator(s)	G. Sigan / B. Gaitan
Internal Stack Diameter (b)	— inches
Internal Stack Length	22.25 inches
Internal Stack Width	14.75 inches
Rectangular Equivalent Diameter (b^1)	17.89 inches
Nipple Length (d)	1/16 inches
Nearest Upstream Disturbance (C)	122 inches
Nearest Downstream Disturbance (D)	75 inches
Number of Traverse Points	12



For 3CD

Traverse Point	% Stack ID (a)	Stack ID (b) ~~or (b¹)~~	Traverse Point (c = a x b)	Nipple Length (d)	(inches) Traverse Point Location (c + d)
Ex	2.1	0	0.00	0	0.00
1	16.7	14.75	2.463	0.063	2.526
2	50.0	14.75	7.375	0.063	7.438
3	83.3	14.75	12.287	0.063	12.350
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					

2 1/2"
7 7/16"
12 3/8"

Location of Traverse Points in Circular Stacks (a)

	4	6	8	10	12
1	5.7	4.4	3.2	2.6	2.1
2	25	14.6	10.5	8.2	6.7
3	75	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.6	34.2	25
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Rectangular Duct Equivalent Diamter Determination = (b^1)	$\frac{2 \times (L \times W)}{L + W}$

Location of Traverse Points in Rectangular Stacks (a)

	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	15.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	37.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	85.4	79.2
11										95.5	87.5
12											95.8

Generally:
Upstream distance (C) is the distance from the port to the exhaust.
Downstream distance (D) is the distance from the port to the fan.

QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date)

EPA Method 2
Gas Velocity and Cyclonic Flow Check

H1-H6 V1-V6

Plant Name	TC-60-CDC	Run Date	3-19-06 / 13 20 06
City & State	Port-Dow	Clock Time	1208
Sampling Location	PP1		
Operators	B. Gaultois / G. Snyder		
Ambient Temperature	47.0 deg. F / 42.8		nipple 1.25"
Barometric Pressure	29.54 in Hg		
Stack Pressure	0.11 in H2O		
Stack ID Inlet	Side 1 17.625 in.	Mol Wt.	
	Side 2 ____ in.	Pitot Cp.	0.84

Traverse point number	Position in.	Velocity head Delta P in H2O **	Stack Temperature °F	Angle (a) which yields a null Delta P *
V1	2.03	~~0.87~~ 0.66	~~54.0 48.6~~ 51.4	4.0°
V2	3.82	0.82	51.4	4.0°
V3	6.47	0.94	51.4	3.0°
V4	13.66	1.20	51.2	8.0°
V5	16.30	0.97	51.2	6.0°
V6	18.10	0.67	51.1	15.0°
H1	2.03	0.81	53.6	12.0°
H2	3.82	1.0	53.6	6°
H3	6.47	1.20	53.4	0°
H4	13.66	1.24	53.0	8°
H5	16.30	1.13	52.0	4°
H6	18.10	0.47	50.6	10°
Averages:		0.935	52	6

* Average angle (a) must be < 20 degrees to be acceptable.

** Average of the square root.

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ 3/27/06

Personnel (signature/Date) Team Leader (Signature/Date)

EPA Method 2
Gas Velocity and Cyclonic Flow Check

Plant Name	TC-60-CDC	Run Date	3-19-06
City & State	Porter Down	Clock Time	1230
Sampling Location	DD2		
Operators	B. Guiltoil / G. Sysgen		
Ambient Temperature	3-19-06 52.5 1.8 deg. F		
Barometric Pressure	29.57 in Hg check		
Stack Pressure	0.8 in H_2O		
Stack ID 14.75" Outlet	Side 1	in.	Mol Wt.
	Side 2	in.	Pitot Cp. 0.84

Traverse point number	Position in.	Velocity head Delta P in H2O **	Stack Temperature °F	Angle (a) which yields a null Delta P *
A1	2.526	1.1	53.0	4°
A2	7.438	0.99	52.8	2°
A3	12.350	0.73	53.4	0°
B1	2.5	0.78	53.0	0°
B2	7.4	0.75	53.0	3°
B3	12.4	0.53	53.4	3°
B C1	2.5	0.49	53.0	7°
C2	7.4	0.155	53.2	1°
C3	12.4	0.41	53.6	4°
D1	2.5	0.29	53.2	3°
D2	7.4	0.32	53.4	2°
D3	12.4	0.24	53.6	3°
Averages:	0.896	53		3

* Average angle (a) must be < 20 degrees to be acceptable.

** Average of the square root.

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ Personnel (signature/Date)

Team Leader (Signature/Date) 3/27/06

3-18-06

EPA Method 2
Gas Velocity Traverse

Plant Name: TC-6D-CDC
City & State: Porter Down
Sampling Location: #1 (Inlet)
Operators: D. Maxwell / G. Simpson
Ambient Temp: 41 deg. F
Mol Wt. 28.84

Barometric Pressure: 29.59 Decr in Hg
Stack Pressure: -1.5 in Hg
Stack ID: 17.625" Side 1 _____ in.
Side 2 _____ in.
Pitot Cp. 0.84

Run Number: Prelim 1
Start/Stop: 1515 / 1525

Traverse Point	Delta P	Stack Temp °F
V1	.53	46
2	.90	47
3	1.2	46
4	1.2	47
5	0.92	47
6	0.96	43
H1	0.95	47
2	0.97	47
3	1.3	47
4	0.90	46
5	0.63	46
6	1.3	42
Average	*0.7912	45.9

Run Number: Prelim 2
Start/Stop: 1525 / 1529

Traverse Point	Delta P	Stack Temp °F
V1	0.72	47
2	1.0	47
3	1.2	47
4	1.2	47
5	0.83	47
6	0.75	45
H1	0.95	47
2	0.92	47
3	1.3	47
4	0.96	47
5	0.65	46
6	0.73	44
Average	*0.48046	46.5

Run Number: Prelim 3
Start/Stop: 1529 / 1538

Traverse Point	Delta P	Stack Temp °F
V1	0.52	46
2	0.83	47
3	1.3	47
4	1.2	47
5	0.89	47
6	0.89	44
H1	0.77	46
2	0.90	47
3	1.3	47
4	1.1	47
5	0.63	46
6	0.65	46
Average	*0.47374	46.4

* Average of the square roots.

(Pitot Tube Leak Check ok) - GES 3/18/06

QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓
Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name	Tc-60 CDC	Barometric Pressure	29.54	in Hg	
City & State	PORTON DOWN, UK	Stack Pressure	0.02	in Hg	
Sampling Location	001 - INLET -	Stack ID	001	Side 1	17.625 in.
Operators	BG / GS / KRW			Side 2	____ in.
Ambient Temp	40° deg. F	Pitot Cp.	0.84		
Mol Wt.	____	Date	3/21/06		

Run Number	PRE 1	Run Number	Post 1	Run Number	—
Start/Stop	0816 / 0820	Start/Stop	16:05 / 16:12	Start/Stop	—

Traverse Point	Delta P	Stack Temp °F
V1	0.57	65
V2	0.72	65
V3	0.86	65
V4	1.10	65
V5	0.89	65
V6	0.76	65
H1	0.68	63
H2	0.79	64
H3	0.90	64
H4	1.20	65
H5	0.89	65
H6	0.69	65
Average	*0.755	64.7

Traverse Point	Delta P	Stack Temp °F
V 1	0.61	65
2	0.81	69
3	0.87	68
4	0.97	68
5	0.89	69
6	0.62	68
H 1	0.79	67
2	0.89	68
3	1.20	68
4	1.15	69
5	0.93	69
6	0.62	66
Average	*0.962	68.0

Traverse Point	Delta P	Stack Temp °F
Average	*	

* Average of the square roots.

* PITOT LEAK CHECKS PASSED. 3/21/06 BG GS & KRW Sc post

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

3-19-06

EPA Method 2
Gas Velocity Traverse

Plant Name: TC-60-CDC
City & State: Ponton Down
Sampling Location: PP2 Outlet
Operators: B. Guilford / G. Simpson
Ambient Temp: 48.2 deg. F
Mol Wt: 28.84

Barometric Pressure: 29.57 desk in Hg
Stack Pressure: 0.10 in Hg From CF 3-17-06 AG
Stack ID: 14.75 Side 1: 14.75 in. Side 2: 22.75 in.
Pitot Cp.: 0.84

Run Number: Prelim 1
Start/Stop: 1028 / 1037

Traverse Point	Delta P	Stack Temp °F
A1	1.05	49.4
A2	0.98	49.8
A3	0.71	50.2
B1	0.79	50.2
B2	0.82	50.4
B3	0.59	50.6
C1	0.48	50.4
C2	0.59	50.6
C3	0.43	50.8
D1	0.30	50.2
D2	0.34	50.4
D3	0.28	50.4
Average	0.383	50.2

Run Number: Prelim 2
Start/Stop: 1039 / 1046

Traverse Point	Delta P	Stack Temp °F
A1	1.1	50.0
A2	0.99	50.0
A3	0.73	50.2
B1	0.78	50.0
B2	0.82	50.0
B3	0.56	50.0
C1	0.52	50.0
C2	0.57	50.0
C3	0.42	50.2
D1	0.32	50.0
D2	0.35	49.8
D3	0.29	50.0
Average	0.336	50.0

Run Number: Prelim 3
Start/Stop: 1048 / 1054

Traverse Point	Delta P	Stack Temp °F
A1	0.99	50.0
A2	0.99	50.0
A3	0.75	50.2
B1	0.76	50.2
B2	0.79	50.0
B3	0.57	50.2
C1	0.48	50.2
C2	0.55	50.2
C3	0.42	50.4
D1	0.31	50.2
D2	0.34	50.2
D3	0.29	50.2
Average	0.380	50.0

* Average of the square roots.

* Pitot leak check ok. 3-19-06 B. Guilford

QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name	TC-60 CDC		Barometric Pressure	29.54	in Hg
City & State	PORTON DOWN, UK		Stack Pressure	2.15	in Hg
Sampling Location	OUTLET EXH - ØØ2		Stack ID	ØØ2	Side 1 14.75 in.
Operators	BG/GS/KRW				Side 2 22.75 in.
Ambient Temp	40° deg. F		Pitot Cp.	0.84	
Mol Wt.			Date	3/21/06	

Run Number	PRE 1	Run Number	Post 1	Run Number	
Start/Stop	0811/0815	Start/Stop	15:57/16:02	Start/Stop	

Traverse Point	Delta P	Stack Temp °F
A1	0.97	65
A2	0.93	65
A3	0.71	65
B1	0.73	65
B2	0.71	65
B3	0.53	65
C1	0.46	65
C2	0.50	65
C3	0.36	65
D1	0.25	64
D2	0.29	64
D3	0.26	64
Average	0.3650	64.8

Traverse Point	Delta P	Stack Temp °F
A1	0.93	66
2	0.93	67
3	0.71	67
B1	0.62	66
2	0.72	67
3	0.52	67
C1	0.48	66
2	0.50	66
3	0.37	66
D1	0.22	66
2	0.28	65
3	0.25	66
Average	0.3597	66.3

Traverse Point	Delta P	Stack Temp °F
Average	*	

* Average of the square roots.

* Pitot Leak Check Passed. 3/21/06 BG JHT eKRW for post

QA/QC Check

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Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name	Tc-60 CDC		Barometric Pressure	29.58	in Hg
City & State	PORTON DOWN, UK		Stack Pressure	-1.2	in Hg
Sampling Location	001 - INLET		Stack ID	001	Side 1 17.625 in.
Operators	BNG / KRW				Side 2 — in.
Ambient Temp	31 deg. F		Pitot Cp.	0.84	
Mol Wt.			Date	3/22/06	

Run Number	Pre 2	Run Number	Post 2	Run Number	
Start/Stop	06:08 / 06:15	Start/Stop	14:52 / 15:00	Start/Stop	

Traverse Point	Delta P	Stack Temp °F	Traverse Point	Delta P	Stack Temp °F	Traverse Point	Delta P	Stack Temp °F
V 1	0.60	62	V 1	0.61	71			
2	0.76	61	2	0.77	72			
3	0.97	63	3	0.95	73			
4	1.10	63	4	0.97	73			
5	0.91	63	5	0.86	72			
6	0.69	62	6	0.75	69			
H 1	0.78	62	H 1	0.67	71			
2	0.93	63	2	0.91	72			
3	1.05	63	3	1.10	72			
4	1.0	63	4	1.15	73			
5	0.99	62	5	0.87	74			
6	0.74	62	6	0.65	73			
Average	*0.466	62.4	Average	*0.460	72.1	Average	*	

* Average of the square roots.

* Pitot leak check performed prior to each run.

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name	TC-60 CDC	Barometric Pressure	29.58	in Hg	
City & State	PORTON DOWN, UK	Stack Pressure	-0.36	in Hg	
Sampling Location	QQ2 - OUTLET	Stack ID	002	Side 1	19.75 in.
Operators	BG/KRW			Side 2	22.75 in.
Ambient Temp	31 deg. F	Pitot Cp.	0.84		
Mol Wt.		Date	3/22/06		

Run Number	PRE 2	Run Number	POST 2 (RW)	Run Number	
Start/Stop	06:18 / 06:23	Start/Stop	15:02 / 15:06	Start/Stop	

Traverse Point	Delta P	Stack Temp °F
A1	0.94	62
A2	0.93	63
A3	0.72	63
B1	0.67	62
B2	0.72	63
B3	0.52	63
C1	0.43	62
C2	0.50	63
C3	0.42	63
D1	0.24	63
D2	0.29	63
D3	0.27	63
Average	*0.364	62.8

Traverse Point	Delta P	Stack Temp °F
A1	0.70	68
2	0.90	70
3	0.68	70
B1	0.64	69
2	0.72	70
3	0.51	70
C1	0.41	69
2	0.50	70
3	0.36	70
D1	0.23	69
2	0.29	69
3	0.23	69
Average	*0.355	69.4

Traverse Point	Delta P	Stack Temp °F
Average	*	

* Average of the square roots.

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name: dstl Porton Down
City & State: Salisbury, UK
Sampling Location: 501 Inlet
Operators: KRW / BNG
Ambient Temp: 31 deg. F
Mol Wt.:

Barometric Pressure: 29.77 in Hg
Stack Pressure: (KW) in Hg
Stack ID 001: -1.2 Side 1: 17.625 in.
-1.8 Side 2: in.
Pitot Cp.: 0.84
Date: 3/23/06

Run Number: Pre 3
Start/Stop: 06:28 / 06:34

Traverse Point		Delta P	Stack Temp °F
V	1	0.62	62
	2	0.78	63
	3	0.92	63
	4	1.05	63
	5	0.80	63
	6	0.59	61
H	1	0.70	61
	2	0.74	62
	3	1.00	62
	4	1.15	63
	5	0.89	63
	6	0.61	61
Average		0.850	62.3

Run Number: Post 3
Start/Stop: 14:[illegible] / 14:58

Traverse Point		Delta P	Stack Temp °F
V	1	0.64	75
	2	0.71	75
	3	0.90	76
	4	1.05	75
	5	0.92	75
	6	0.71	75
H	7	0.83	75
	8	0.87	75
	9	1.10	75
	10	1.10	76
	11	0.95	76
	12	0.68	75
Average		0.865	75.3

Run Number:
Start/Stop:

Traverse Point	Delta P	Stack Temp °F
Average	*	

* Average of the square roots.

* pre and post - pitot leak checks performed

QA/QC Check
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Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

EPA Method 2
Gas Velocity Traverse

Plant Name: GSK Parkan Down
City & State: Salisbury, UK
Sampling Location: 002 Exhaust
Operators: KRW / BNG
Ambient Temp: 31 deg. F
Mol Wt.:

Barometric Pressure: 29.77 in Hg
Stack Pressure: -0.49 in Hg -0.92
Stack ID rel. dia. 17.89 Side 1: 14.75 in.
Side 2: 22.75 in.
Pitot Cp.: 0.84
Date: 3/23/06

Run Number: Pre 3
Start/Stop: 06:22 / 06:27

Traverse Point		Delta P	Stack Temp °F
A	1	0.97	64
	2	0.91	65
	3	0.67	64
B	1	0.66	64
	2	0.72	64
	3	0.51	65
C	1	0.47	64
	2	0.52	64
	3	0.40	63
D	1	0.24	63
	2	0.30	64
	3	0.26	63
Average		0.3633	63.9

Run Number: Post 3
Start/Stop: 14:59 / 15:02

Traverse Point		Delta P	Stack Temp °F
A	1	0.95	74
	2	0.90	74
	3	0.66	74
B	1	0.65	72
	2	0.70	74
	3	0.52	74
C	1	0.42	73
	2	0.51	74
	3	0.38	73
D	1	0.24	73
	2	0.31	72
	3	0.25	73
Average		0.359	73.3

Run Number:
Start/Stop:

Traverse Point	Delta P	Stack Temp °F
Average	*	

* Average of the square roots.

QA/QC Check
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Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PCDD / PCDF

Plant Name			Stack Information			Run Number			K Factor Setup Data			
PORTON DOWN-TC-60 CDC			Diameter (in)		17.89	1			Stack °F		Stack °R	
Location - City/State			Depth (in)		22.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		14.75	3/21/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			$\%H_2O$		Absolute	
~~B3~~ E3			No.Traverse Points		12	1023 / 1503			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.41	Noz Est.	
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
BG	29.57	0.15	0.84	—	0.193	MAI	1.674	0.9900	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot		Sample Train Leak Checks						19.6	0.3
					Initial		Final				Actual Moisture	
Number / Tare	Pitot Number	T/C Number	Leak Check Initial	Final	in. Hg	cfm	in. Hg	cfm			Collected (grams)	
NA / —	2 BF.	—	✓	✓	11	0.001	5.0	0.002			NA	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
E3 ~~B3~~	~~0~~	483.304	N/A	1.03	N/A	65	N/A	N/A	43	25	N/A	
	10	487.657		1.03		78			38	25		
	20	492.147		1.03		79			39	25		
	30	496.721		1.03		81			39	25		
	~~40~~	1000.998		1.03		81			40	25		
	~~50~~	1012.842		1.03		84			40	25		
	60	1018.743		1.03		85			41	25		
	70	1024.931		1.03		87			43	25		
	80	1030.715		1.03		88			42	26		
	90	1036.748		1.03		88			41	25		
	100	1042.735		1.03		90			41	25		
	110	1048.931		1.03		91			41	25		
	120	1054.680		1.03		92			42	25		
	130	1060.927		1.03		95			42	25		
	140	1067.004		1.03		93			43	25		
	150	1073.032		1.03		93			43	25		
	160	1079.050		1.03		94			43	25		
	170	1085.114		1.03		94			44	25		
	180	1091.165		1.03		94			44	25		
	190	1097.195		1.03		95			44	25		
	200	1103.327		1.03		94			43	25		
	210	1109.467		1.03		94			45	25		
	220	1115.480		1.03		94			46	25		
	230	1121.562		1.03		93			47	25		
	240	1127.618		1.03		93			48	26		
	250	1133.690		1.03		93			49	25		
	260	1139.755		1.03		93			50	25		
	270	1145.806		1.03		93			52	25		
	280	1151.858		1.03		93			52	25		
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
280	168.549	0.854	1.03	66.8	88.42

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Average Iso Rate
104.6

QA/QC Check

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Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PCDD/PCDF

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 CX			Diameter (in)		17.69	2			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		22.75	3/22/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			$\%H_2O$		Absolute	
B3			No.Traverse Points		12	0930 / 14:20			Mole Wt. Dry		Wet	
	Barometric Pressure (in. Hg)	Static Pressure (in. H2O)	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.41	Noz Est.	0.57
Operators			Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
SN6	29.57	-0.16	0.84	—	0.192	MA1	1.674	0.9700	Start	Stop	O_2	CO_2
Filter(s)			Pitot			Sample Train Leak Checks					19.6	0.3
Number	Tare	Pitot Number	Flue Gas T/C Number	Leak Check Initial	Leak Check Final	Initial in. Hg	Initial cfm	Final in. Hg	Final cfm			Actual Moisture Collected (grams)
T3		2' EFF	—	30.10	0.005	10	0.005	5.0	0.005			

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
B3	0	152.097	N/A	0.80	N/A	88	N/A	N/A	40	1.5	N/A	
	10	157.368		0.80		80			38	1.5		
	20	162.657		0.80		81			39	2.0		
	30	167.965		0.80		83			39	2.0		
	40	173.321		0.80		85			40	2.0		
	50	178.613		0.80		86			39	2.0		
	60	183.963		0.80		87			39	2.0		
	70	189.280		0.80		87			39	2.0		
	80	194.632		0.80		89			39	2.0		
	90	199.975		0.80		89			40	2.0		
	100	205.325		0.80		90			40	2.0		
	110	210.684		0.80		91			40	2.0		
	120	216.022		0.80		91			40	2.0		
	130	221.375		0.80		92			41	2.0		
	140	226.728		0.80		93			41	2.0		
	150	232.100		0.80		93			42	2.0		
	160	237.416		0.80		95			43	2.0		
	170	242.788		0.80		97			43	2.0		
	180	248.152		0.80		98			44	2.0		
	190	253.521		0.80		98			44	2.0		
	200	259.978		0.80		99			44	2.0		
	210	264.265		0.80		99			44	2.0		
	220	269.665		0.80		99			44	2.0		
	230	275.063		0.80		99			45	2.0		
	240	280.451		0.80		99			45	2.0		
	250	285.857		0.80		99			46	2.0		
	260	291.255		0.80		99			47	2.0		
	270	296.653		0.80		98			47	2.0		
	280	302.042		0.80		98			44	2.0		
	290	307.454										
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
290	155.357	0.755	0.80	68.50	90.38

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Average Iso Rate

QA/QC Check

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Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PCDD/PCDF

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 C.DC			REL Diameter (in)		17.89	3			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		22.75	3/23/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft²) ID		2.33	Run Start/Stop			%H₂O		Absolute	
(10)8 E3			No.Traverse Points		12	0948 / 1338			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.41	Noz Est.	
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
BNG	29.77	-.36	0.84	—	0.192	MA1	1.674	0.9900	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot		Sample Train Leak Checks						19.6	0.3
Number / Tare	Pitot	T/C	Leak Check		Initial		Final				Actual Moisture	
— / —	Number	Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Collected (grams)	
— / —	2' EFF	—	✓	✓	10	0.008	3	0.05			—	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Calculated Isokinetic Rate
E3	0	307.667	N/A	0.80	N/A	71	N/A	N/A	44	2.5	N/A	
	10	313.015				74			40	2.5		
	20	318.201				78			42	2.5		
	30	323.526				81			42	2.5		
	40	328.850				83			43	2.5		
	50	334.176				85			43	2.5		
	60	339.520				86			44	2.5		
	70	344.878				89			44	2.5		
	80	350.236				89			44	2.5		
	90	355.546				90			45	2.5		
	100	360.920				91			44	2.5		
	110	366.282				92			44	2.5		
	120	371.652				93			44	2.5		
	130	378.034				94			44	2.5		
	140	382.394				95			45	2.5		
	150	387.816				96			45	2.5		
	160	393.225				96			45	2.5		
	170	398.613				97			45	2.5		
	180	404.015				98			46	2.5		
	190	409.418				97			47	2.5		
	200	414.807				99			51	2.5		
	210	420.196				99			51	2.5		
	220	425.589				100			52	2.5		
	230	430.960	End Run									
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
230	123.293	0.755	0.80	73.39	90.09

Average Iso Rate: —

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PM/HCl/Cl_2

Plant Name			Stack Information			Run Number			K Factor Setup Data			
Tooele CDC			Diameter (in)		17.89	1			Stack °F		Stack °R	
Location - City/State			Depth (in)		22.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		14.75	3/21/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			%H_2O		Absolute	
A3			No.Traverse Points		12	1023 / 1503			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.49	Noz Est.	0.5
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
BG	29.57	0.15	6.84		0.192	MA2	1.763	0.9648	Start	Stop	O_2	CO_2
Filter(s)											19.6	0.3
Number	Tare		Flue Gas	Pitot Leak Check		Sample Train Leak Checks						
						Initial		Final				
T2	3133	Pitot Number	T/C Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Actual Moisture
		21EFF		✓	✓	10.0	0.000	4.0	0.000			Collected (grams)
												36.8

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
A3	0	598.124	0.65	0.85	66	68	N/A	43	N/A	1.0	N/A	
	10	603.359	0.66	0.85	66	82		38		1.0		
	20	609.198	0.65	0.85	66	83		39		1.0		
	30	614.634	0.66	0.85	66	84		41		1.0		
	40	620.345	0.66	0.85	66	85		42		1.0		
	50	625.950	0.66	0.85	66	85		44		1.0		
	60	631.589	0.65	0.85	66	90		45		1.0		
	70	637.175	0.65	0.85	67	91		46		1.0		
	80	642.822	0.65	0.85	67	91		45		1.0		
	90	648.462	0.65	0.85	66	92		44		1.0		
	100	654.126	0.65	0.85	66	92		44		1.0		
	110	659.833	0.66	0.85	66	94		44		1.0		
	120	665.005	0.65	0.85	66	95		44		1.0		
	130	671.241	0.65	0.85	66	95		45		1.0		
	140	676.952	0.65	0.85	66	96		46		1.0		
	150	682.627	0.65	0.85	66	96		46		1.0		
	160	688.295	0.65	0.85	67	97		46		1.0		
	170	693.958	0.64	0.85	68	97		46		1.0		
	180	699.650	0.64	0.85	68	97		45		1.0		
	190	705.362	0.64	0.85	68	97		45		1.0		
	200	710.994	0.65	0.85	69	96		45		1.0		
	210	716.735	0.63	0.85	69	96		45		1.0		
	220	722.397	0.64	0.85	68	95		45		1.0		
	230	728.183	0.65	0.85	68	94		44		1.0		
	240	733.748	0.64	0.85	69	94		45		1.0		
	250	739.399	0.64	0.85	69	94		45		1.0		
	260	745.035	0.64	0.85	69	93		45		1.0		
	270	750.682	0.64	0.85	69	93		45		1.0		
	280	756.317	0.64	0.85	69	93		45		1.0		
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
280	158.193	0.806	0.85	66.8	91.2

Average Iso Rate
104.4

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PM/HCl/Cl_2

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 CDO			Diameter (in)		17.81	2			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		22.75	3/22/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.73	Run Start/Stop			$\%H_2O$		Absolute	
A3			No. Traverse Points		12	0930 / 1420			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.49	Noz Est.	2.73
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
BNG	29.57	-0.36	0.84	—	0.193	MA2	1.763	0.9648	Start	Stop	O_2	CO_2
Filter(s)	29.66 3/22/06	Flue Gas	Pitot Leak Check		Sample Train Leak Checks						19.6	0.3
					Initial		Final				Actual Moisture	
Number / Tare	Pitot Number	T/C Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Collected (grams)	
— / —	2'EFF	—	✓		10	0.005	4.	0.005			32.7	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
A3	0	756.488	0.63	1.09	66	86	N/A	N/A	40	2.5	N/A	
	10	762.587	0.62	1.10	66	86			43	2.5		
	20	768.935	0.62	1.10	67	86			44	2.0		
	30	775.197	0.62	1.10	67	88			45	2.0		
	40	781.490	0.62	1.10	67	89			45	2.0		
	50	787.787	0.62	1.10	67	89			44	2.0		
	60	NO 794.763	0.62	1.10	67	90			44	2.0		
	70	800.361	0.62	1.10	67	91			44	2.0		
	80	806.614	0.63	1.10	67	92			44	2.0		
	90	812.860	0.63	1.10	68	92			46	2.0		
	100	819.048	0.63	1.10	69	93			46	2.0		
	110	825.357	0.63	1.10	68	94			46	2.0		
	120	831.625	0.63	1.10	68	95			45	2.0		
	130	837.900	0.63	1.10	69	94			46	2.0		
	140	844.175	0.62	1.10	69	95			48	2.0		
	150	850.453	0.62	1.10	69	95			50	2.0		
	160	856.722	0.62	1.10	70	96			51	2.0		
	170	862.997	0.61	1.10	71	96			52	2.0		
	180	869.286	0.61	1.10	71	97			52	2.0		
	190	875.582	0.61	1.10	70	97			51	2.0		
	200	881.890	0.61	1.10	70	97			50	2.0		
	210	888.193	0.61	1.10	69	97			49	2.0		
	220	894.500	0.60	1.10	70	97			49	2.0		
	230	900.816	0.61	1.10	72	97			50	2.0		
	240	907.105	0.61	1.10	71	97			49	2.0		
	250	913.415	0.61	1.10	70	97			49	2.0		
	260	919.936	0.61	1.10	70	97			49	2.0		
	270	926.034	0.61	1.10	69	97			49	2.0		
	280	932.461	0.61	1.10	71	96			46	2.0		
	290	938.697										
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
290	182.209	0.554	1.10	68.50	92.17

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Average Iso Rate: —

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specification ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) PM/HCl/Cl_2

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 CDC			Diameter (in)		17.89	3			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		22.75	3/23/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			$\%H_2O$		Absolute	
A3			No.Traverse Points		12	0948 / 1338			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.49	Noz Est.	.73
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
BNG	24.77	-0.36	0.84	—	.193	MA2	1.763	0.9648	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot		Sample Train Leak Checks						19.6	0.3
Number / Tare		T/C	Leak Check		Initial		Final				Actual Moisture	
	Pitot Number	Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Collected (grams)	
—	21EFF	—	✓	✓	10	0.000	4	0.005			32.8	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
A3	0	938.915	0.64	1.10	69	73	N/A	N/A	50	2.0	N/A	
	10	945.140	0.64		69	78			49	2.0		
	20	951.105	0.64		71	82			46	2.0		
	30	957.345	0.64		71	85			46	2.0		
	40	963.315	0.64		71	86			46	2.0		
	50	969.465	0.64		71	88			47	2.0		
	60	975.636	0.64		73	89			47	2.0		
	70	981.876	0.64		74	92			49	2.0		
	80	988.116	0.63		74	92			49	2.0		
	90	994.316	0.62		74	93			48	2.0		
	100	1000.535	0.62		74	94			48	2.0		
	110	1006.816	0.63		73	94			49	2.0		
	120	1013.114	0.62		74	95			49	2.0		
	130	1019.392	0.61		75	95			49	2.0		
	140	1025.686	0.62		75	95			49	2.0		
	150	1031.994	0.63		74	96			49	2.0		
	160	1038.287	0.63		75	96			49	2.0		
	170	1044.587	0.62		75	96			47	2.0		
	180	1050.996	0.62		76	96			49	2.0		
	190	1057.197	0.62		75	95			49	2.0		
	200	1063.535	0.62		75	96			51	2.0		
	210	1069.872	0.62		75	96			51	2.0		
	220	1076.978	0.62		75	96			51	2.0		
	230	1082.365	End Run									
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
230	143.45	0.854	1.10	73.4	91.22

Average Iso Rate

QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓
Checked By:

Personnel (Signature/Date)

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) MM6/SVOC

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 CDC			Diameter (in)		17.89	1			Stack °F		Stack °R	
Location - City/State			Depth (in)		22.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		14.75	3/21/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			$\%H_2O$		Absolute	
F			No.Traverse Points		12	1023 / 1503			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.52	Noz Est.	
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
KRW	29.57	0.15	0.84	—	0.192	AA4	1.793	0.9693	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot		Sample Train Leak Checks						19.6	0.3
			Leak Check		Initial		Final				Actual Moisture	
Number	Tare	Pitot Number	T/C Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Collected (grams)
NA	—	2'elb	—	✓	✓	15	0.010	4	0.000			NA

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
F2	0	338.567	N/A	0.97	N/A	75	N/A	N/A	40	2	N/A	
	10	342.50				82			41	2		
	20	349.65				80			42	2		
	30	355.18				81			41	2		
	40	360.80				82			42	2		
	50	366.33				83			42	2		
	60	371.94				85			42	2		
	70	377.30				86			43	2		
	80	383.04				87			43	2		
	90	388.63				88			42	2		
	100	394.18				89			42	2		
	110	399.74				89			42	2		
	120	405.30				90			42	2		
	130	410.88				90			43	2		
	140	416.44				91			43	2		
	150	422.02				91			43	2		
	160	427.61				91			44	2		
	170	433.27				92			44	2		
	180	438.75				92			45	2		
	190	444.31				93			46	2		
	200	449.89				92			47	2		
	210	455.55				91			48	2		
	220	461.02				91			48	2		
	230	466.58				91			49	2		
	240	472.14				91			51	2		
	250	477.73				90			52	2		
	260	483.33				90			52	2		
	270	488.91				90			54	2		
	280	494.492										
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
280	155.925	0.755	0.87	67.58	87.58

Average Iso Rate
101

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By:

Personnel (Signature/Date) 3/23/06

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) MM5/SVOC

Plant Name	Stack Information		Run Number	K Factor Setup Data			
dsH Porton Down	Diameter (in)		2	Stack °F		Stack °R	
Location - City/State	Depth (in)	14.75	Test Date	Ave. Delta P		SQRT P	
Salsbury, UK	Length (in)	22.75	3/22/06	Meter °F		Meter °R	
Sampling Location ID	Area (ft²) ID	2.33	Run Start/Stop	%H_2O		Absolute	
Exhaust 002	No.Traverse Points	12	09:30 / 14:20	Mole Wt. Dry		Wet	

Operators	Barometric Pressure (in. Hg)	Static Pressure (in. H_2O)	Pitot Tube Co.	Nozzle Number	Nozzle Inside Dia.	Meter Box Number	Meter Box Delta H@	Meter Box Gamma Y	Sample Rate	0.75	Ab Stack	
									K Factor =	1.52	Noz Est.	0.57
KRW	29.57	~~0.~~	0.84	—	0.192	MA4	1.793	0.9693	Intermittent Leak Checks		Orsats/Fyrites	
									Start	Stop	O_2	CO_2
											19.6	0.3

Filter(s) Number	Filter(s) Tare	Pitot Number	Flue Gas T/C Number	Pitot Leak Check Initial	Pitot Leak Check Final	Sample Train Leak Checks Initial in. Hg	Initial cfm	Final in. Hg	Final cfm			Actual Moisture Collected (grams)	
		2'cliff	—	✓		10	0.008	4	0.01				

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
F2	0	494.668	N/A	0.87	N/A	71	N/A	N/A	40	2	N/A	
	10	500.07				80			40	2		
	20	505.49				82			40	2		
	30	510.92				83			41	2		
	40	516.38				84			41	2		
	50	521.94				84			41	2		
	60	527.51				86			40	2		
	70	533.10				85			40	2		
	80	538.78				87			41	2		
	90	544.26				87			41	2		
	100	549.85				88			41	2		
	110	555.43				88			41	2		
	120	561.01				88			42	2		
	130	566.65				88			43	2		
2.21	140	~~(HV) 291.89~~				89			44	2		
	150	577.80				90			45	2		
	160	583.32				94			46	2		
	170	589.00				94			46	2		
	180	594.64				95			46	2		
	190	600.29				95			46	2		
	200	605.95				95			46	2		
	210	611.61				95			46	2		
	220	617.28				97			46	2		
	230	622.93				97			47	2		
	240	628.88				97			48	2		
	250	634.25				97			49	2		
	260	639.88				95			50	2		
	270	645.50				95			51	2		
	280	651.20				95			52	2		
	~~290~~											
↓	290.2	656.961		↓	↓							
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
290.2	162.293	~~0.755~~	0.87	~~61.25~~	~~88.42~~

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Average Iso Rate

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: [signature] 3/23/06

Personnel (Signature/Date)

Team Leader (Signature/Date)

Isokinetic Sampling Field Data
Specific Sample Type(s) MM5/SVOC

Plant Name			Stack Information			Run Number			K Factor Setup Data			
dstl Porton Down			Diameter (in)		17.89	3			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
Salisbury, UK			Length (in)		22.75	3/23/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft²) ID		2.33	Run Start/Stop			%H₂O		Absolute	
002 Exhaust Stack			No.Traverse Points		12	09:48 / 13:38			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.52	Noz Est.	
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
KRW	29.77	-0.36	0.84	—	0.192	MA4	1.793	0.9693	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot	Sample Train Leak Checks							19.6	0.3
			Leak Check	Initial		Final						
Number	Tare	Pitot Number	T/C Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Actual Moisture Collected (grams)
—		21eff	—	✓		10	0.000	4	0.007			

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
F2	0	657.134	N/A	0.87	N/A	75	N/A	N/A	41	2	N/A	
	10	662.68				78			41	2		
	20	668.21				80			41	2		
	30	673.73				82			42	2		
	40	679.30				84			42	2		
	50	684.78				85			43	2		
	60	690.25				86			43	2		
	70	695.74				88			44	2		
	80	701.23				88			44	2		
	90	706.99				89			44	2		
	100	712.60				89			44	2		
	110	718.24				90			45	2		
	120	723.81				91			46	2		
	130	729.43				91			46	2		
	140	735.05				93			46	2		
	150	740.77				93			46	2		
	160	746.32				93			47	2		
	170	751.95				94			47	2		
	180	757.60				94			47	2		
	190	763.24				94			49	2		
	200	768.87				95			50	2		
	210	774.49				95			50	2		
	220	780.12				95			51	2		
	230	785.753	end	run								
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
230	128.619	0.755	0.87	73.70	80.78

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Average Iso Rate: —

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Team Leader (Signature/Date) 3/27/06

0.57

Isokinetic Sampling Field Data
Specific Sample Type(s) Metals

Plant Name			Stack Information			Run Number			K Factor Setup Data			
TC-60 CDC			Diameter (in)		17.89	1			Stack °F		Stack °R	
Location - City/State			Depth (in)		22.75	Test Date			Ave. Delta P		SQRT P	
PORTON DOWN, UK			Length (in)		14.95	3/21/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft²) ID		2.33	Run Start/Stop			%H₂O		Absolute	
G			No.Traverse Points		12	1023 / 1503			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.44	Noz Est.	
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
KRW	29.57	0.15	0.84	—	.219	M1	1.701	0.9951	Start	Stop	O_2	CO_2
Filter(s)											19.6	0.3
Number	Tare	Pitot	Flue Gas T/C	Pitot Leak Check		Sample Train Leak Checks					Actual Moisture	
						Initial		Final				
G	NA	Number	Number	Initial	Final	in. Hg	cfm	in. Hg	cfm		Collected (grams)	
—	—	Zefer	—	✓	✓	MH2	0.010	4.0	0.01		23.0	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
G2	0	220.997	0.38	0.49	66	75	N/A	N/A	41	2	N/A	
	10	225.15	0.38		66	77			41	2		
	20	229.35	0.37		66	80			41	2		
	30	233.30	0.37		66	81			41	2		
	40	237.31	0.37		67	83			42	2		
	50	241.33	0.37		66	84			42	2		
	60	245.34	0.37		67	85			42	2		
	70	249.35	0.37		68	87			42	2		
	80	253.40	0.37		68	88			43	2		
	90	257.43	0.37		67	89			43	2		
	100	261.98	0.36		67	90			43	2		
	110	265.58	0.37		67	90			43	2		
	120	269.54	0.37		67	90			43	2		
	130	273.60	0.37		67	90			43	2		
	140	277.66	0.37		67	90			43	2		
	150	281.71	0.38		67	92			44	2		
	160	285.77	0.37		68	92			44	2		
	170	289.84	0.37		69	93			45	2		
	180	293.91	0.37		69	93			45	2		
	190	297.97	0.38		69	93			45	2		
	200	302.06	0.37		69	92			46	2		
	210	306.12	0.37		69	91			46	2		
	220	310.19	0.37		68	89			47	2		
	230	314.25	0.37		68	90			47	2		
	240	318.31	0.37		69	90			48	2		
	250	322.35	0.37		69	88			48	2		
	260	326.41	0.37		69	87			50	2		
	270	330.46	0.37		69	87			52	2		
	280	334.489										
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
280	113.542	0.583	0.49	67.58	87.71

Average Iso Rate

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Checked By:

Personnel (Signature/Date) 3/23/06

Team Leader (Signature/Date) 3/27/06

Isokinetic Sampling Field Data
Specific Sample Type(s) Metals

Plant Name			Stack Information			Run Number			K Factor Setup Data			
66th Parton Down			rect Diameter (in)		17.89	2			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
Salisbury, UK			Length (in)		22.75	3/22/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft^2) ID		2.33	Run Start/Stop			$\%H_2O$		Absolute	
Exhaust 002			No.Traverse Points		12	09:30 / 14:20			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.44	Noz Est.	0.34
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
KRW	29.57	-1.2	0.84	—	0.219	M1	1.701	0.9951	Start	Stop	O_2	CO_2
Filter(s)		Flue Gas	Pitot			Sample Train Leak Checks					19.6	0.3
						Initial		Final			Actual Moisture	
Number	Tare	Pitot Number	T/C Number	Leak Check Initial	Leak Check Final	in. Hg	cfm	in. Hg	cfm		Collected (grams)	
—		2'00	—	✓		10	0.018	4	0.005		26.1	

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
G2	0	334.847	0.35	0.49	66	72	N/A	N/A	40	2	N/A	
	10	338.86	0.35	0.49	67	77			39	2		
	20	342.87	0.35		67	80			40	2		
	30	346.95	0.36		68	82			40	2		
	40	351.01	0.34		68	83			40	2		
	50	354.97	0.35		67	83			40	2		
	60	359.16	0.35		68	85			40	2		
	70	363.24	0.35		68	85			40	2		
	80	367.33	0.34		68	86			40	2		
	90	371.43	0.35		68	86			41	2		
	100	375.57	0.35		69	87			41	2		
	110	379.59	0.35		69	87			42	2		
	120	383.70	0.36		69	88			42	2		
	130	387.79	0.34		70	88			42	2		
	140	391.89	0.33		70	89			43	2		
	150	395.98	0.33		70	90			44	2		
	160	400.08	0.35		71	91			46	2		
	170	404.17	0.34		72	91			46	2		
	180	408.28	0.34		72	90			45	2		
	190	412.39	0.34		71	92			45	2		
	200	416.49	0.34		71	92			45	2		
	210	420.58	0.33		70	92			44	2		
	220	424.71	0.33		71	91			43	2		
	230	428.81	0.32		72	91			44	2		
	240	432.91	0.33		71	92			43	2		
	250	437.00	0.33		71	92			42	2		
	260	441.11	0.33		70	92			42	2		
	270	445.22	0.33		70	92			42	2		
	280	449.40	0.33		71	92			43	2		
	290.8	454.251	end									
Final												

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
280.8	119.404	0.563	0.49	69.25	86.58

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Average Iso Rate
97.6

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Personnel (Signature/Date) 3/23/06

Team Leader (Signature/Date)

Isokinetic Sampling Field Data
Specific Sample Type(s) Metals

Plant Name			Stack Information			Run Number			K Factor Setup Data			
dstl Porton Down			rel Diameter (in)		17.89	3			Stack °F		Stack °R	
Location - City/State			Depth (in)		14.75	Test Date			Ave. Delta P		SQRT P	
Salisbury, UK			Length (in)		22.75	3/23/06			Meter °F		Meter °R	
Sampling Location ID			Area (ft²) ID		2.33	Run Start/Stop			%H₂O		Absolute	
002 Exhaust Stack			No.Traverse Points		12	09:48 / 13:38			Mole Wt. Dry		Wet	
	Barometric Pressure	Static Pressure	Pitot Tube	Nozzle		Meter Box			Sample Rate	0.75	Ab Stack	
									K Factor =	1.44	Noz Est.	0.34
Operators	(in. Hg)	(in. H2O)	Co.	Number	Inside Dia.	Number	Delta H@	Gamma Y	Intermittent Leak Checks		Orsats/Fyrites	
KRW	29.77	-0.36	0.84	—	0.219	M1	1.701	0.9951	Start	Stop	O_2	CO_2
											19.6	0.3
Filter(s)		Flue Gas	Pitot			Sample Train Leak Checks						
			Leak Check			Initial		Final				
Number	Tare	Pitot Number	T/C Number	Initial	Final	in. Hg	cfm	in. Hg	cfm			Actual Moisture
—	—											Collected (grams)
—	—	2'elt	—	✓	✓	10	0.01	6	0.000			21.3

Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)	Pitot Reading (in. H2O)	Delta H Orifice (in.H2O)	Flue Gas Temp. (deg. F)	DGM Ave. Temp. (deg. F)	Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)	Aux. Temp. (deg. F)	Isokinetic Rate
G2	0	454.545	0.36	0.49	69	74	N/A	N/A	41	2	N/A	
	10	458.58	0.36		69	75			40	2		
	20	462.64	0.36		70	77			41	2		
	30	466.72	0.37		71	79			42	2		
	40	470.78	0.37		71	81			42	2		
	50	474.83	0.36		72	83			42	2		
	60	478.87	0.36		73	84			43	2		
	70	482.98	0.35		74	87			44	2		
	80	487.08	0.35		74	87			44	2		
	90	491.21	0.35		76	88			44	2		
	100	495.34	0.35		74	88			44	2		
	110	499.46	0.34		74	89			43	2		
	120	503.57	0.34		75	90			43	2		
	130	507.71	0.35		75	90			44	2		
	140	511.82	0.35		75	91			43	2		
	150	515.96	0.34		75	90			44	2		
	160	520.09	0.34		75	90			44	2		
	170	524.21	0.33		76	90			43	2		
	180	528.33	0.36		76	91			43	2		
	190	532.46	0.36		76	92			44	2		
	200	536.59	0.34		75	93			44	2		
	210	540.71	0.34		75	93			44	2		
	220	544.83	0.36		76	93			45	2		
	230	548.960	end	run								
Final	—											

Total Run Time	Total Volume Metered	Ave. SQRT Delta P	Ave. Delta H	Ave. Flue Gas Temp.	Ave. DGM Temp.
230	94.42	0.883	0.99	73.7	86.74

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Average Iso Rate
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Non-Isokinetic Sampling Field Data
Specific Sample Type(s) M4

Plant Name							Run Number			
TC-60 CDC							PRELIM - MOISTURE			
Location - City/State							Test Date			
PORTON DOWN, UK							3/20/06			
Sampling Location ID							Start/Stop			
EXHAUST - ΦΦ2							~~3:29:06~~ ~~0917~~ 0725 / 1025			
	Barometric	Static	Meter Box Information				Sample Train Leak Checks			
				1.674			Initial		Final	
Operators	Pressure	Pressure	Number	Delta H@	Gamma Y		in. Hg	cfm	in. Hg	cfm
GES	(in. Hg)	(in. H2O)								
BNG	29.55	0.16	MA1	~~1.647~~ BG	.990		12	0.000	13	0.000
Port and Point Number	Elapsed Test Time (min)	DGM Reading (cubic feet)		Delta H Orifice (in.H2O)	DGM Ave. Temp. (deg. F)		Probe Temp. (deg. F)	Filter Oven Temp. (deg. F)	Impinger Exit Temp. (deg. F)	Sample Train Vacuum (in. Hg)
3-20-06 BG ~~B2~~	~~0~~	937.401		1.647	61		N/A	N/A	51°	3.5
B2	5	941.102		1.650	~~45~~ 68°		N/A	N/A	45°	3.5
B2	10	944.826		1.650	71		N/A	N/A	47	3.5
B2	15	948.316		1.650	72		N/A	N/A	49	3.5
B2	20	952.255		1.650	74		N/A	N/A	52	3.5
B2	25	955.997		1.670	75		N/A	N/A	53	3.5
B2	30	~~975.237~~ 959.831		1.670	74		N/A	N/A	53	3.5
B2	35	963.625		1.670	79		N/A	N/A	54	3.5
B2	40	967.219		1.670	80		N/A	N/A	53	3.5
B2	45	971.472		1.670	80		N/A	N/A	54	3.5
B2	50	975.237		1.670	79		N/A	N/A	54	3.5
B2	55	979.093		1.670	81		N/A	N/A	54	3.5
B2	60	982.955		1.670	79		N/A	N/A	55	3.5
Final										

Total Run Time	Total Volume Metered	Ave. Delta H	Ave. DGM Temp.
60	45.55	1.66	75

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Moisture Analysis Data Sheet

Plant Name TC-60 CDC		Project Number 5037-23	
City & State PORTON DOWN, UK		Type of Sample Train	
Sampling Location #2 - OUTLET		M4 - MOISTURE	
Run Number	PRELIM - MOISTURE		
Test Date	3/20/06		
Recovery Date	3/20/06		
Recovered By	BG		
Impinger 1 100mL H_2O	-		
Final Weight	726.1		
Initial Weight	728.3		
Net Weight	-2.2		
Impinger 2 100mL H_2O			
Final Weight	699.0		
Initial Weight	699.9		
Net Weight	-0.9		
Impinger 3 EMPTY			
Final Weight	613.3		
Initial Weight	613.8		
Net Weight	-0.5		
Impinger 4 SILICA GEL			
Final Weight	849.0		
Initial Weight	840.1		
Net Weight	8.9		
Impinger 5 N/A			
Final Weight			
Initial Weight			
Net Weight			
Impinger 6 N/A			
Final Weight			
Initial Weight			
Net Weight			
Impinger 7 N/A			
Final Weight			
Initial Weight			
Net Weight			
Total Catch	5.3		

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Personnel (Signature/Date) Team Leader (Signature/Date)

Moisture Analysis Data Sheet

Plant Name TC60 CDC		Project Number 5037-23	
City & State Porton Down, UK		Type of Sample Train M29 (Metals)	
Sampling Location Stack (002)			
Run Number	ET 01	ET 02	ET 03
Test Date	3/21/06	3/22/06	3/23/06
Recovery Date	3/21/06	3/22/06	3/23/06
Recovered By	DPM	DPM	DPM
Impinger 1 Mod	100ml HNO_3/H_2O_2	→	→
Final Weight	711.3	715.6	719.7
Initial Weight	706.6	709.2	711.2
Net Weight	4.7	6.4	8.5
Impinger 2 SG	100ml HNO_3/H_2O_2	→	→
Final Weight	718.5	720.5	720.7
Initial Weight	716.8	719.2	720.3
Net Weight	1.7	1.3	0.4
Impinger 3 Mod	Empty	→	→
Final Weight	618.3	690.6	620.6
Initial Weight	617.9	619.9	621.2
Net Weight	0.4	70.7 *	-0.6
Impinger 4 Mod	100ml $KMnO_4/H_2SO_4$	→	→
Final Weight	740.0	747.1	740.5
Initial Weight	739.9	739.7	740.0
Net Weight	0.1	7.4 *	0.5
Impinger 5 Mod	100ml $KMnO_4/H_2SO_4$	→	→
Final Weight	731.6	661.3	733.1
Initial Weight	731.4	736.6	733.4
Net Weight	0.2	-75.3 *	-0.3
Impinger 6 Mod	220gm SiO_2 gel	~~845.2~~	→
Final Weight	829.6	DPM ~~661.3~~	806.0
Initial Weight	813.7	829.6	793.2
Net Weight	15.9	15.6	12.8
Impinger 7			
Final Weight			
Initial Weight			
Net Weight			
Total Catch	23.0 g	26.1 g	21.3 g

QA/QC Check

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_____ Team Leader (Signature/Date) 9/27/06

* $KMnO_4$ impingers backflushed into empty impinger (#3)

Moisture Analysis Data Sheet

Plant Name TC60 CDC		Project Number 5037-23	
City & State Porton Down, UK		Type of Sample Train M5/M26A (PM/HCl-Cl$_2$)	
Sampling Location Stack (002)			
Run Number	ET01	ET02	ET03
Test Date	3/21/06	3/22/06	3/23/06
Recovery Date	3/21/06	3/22/06	3/23/06
Recovered By	DPM/GES	DPM/GES	DPM/GES
Impinger 1 SG	100ml 0.1N H_2SO_4	→	→
Final Weight	687.9	687.6	691.1
Initial Weight	681.5	682.2	683.4
Net Weight	6.4	5.4	7.7
Impinger 2 SG	100ml 0.1N H_2SO_4	→	→
Final Weight	690.0	691.0	693.6
Initial Weight	687.9	689.1	692.3
Net Weight	2.1	1.9	1.3
Impinger 3 Mod	100ml 0.1N NaOH	→	→
Final Weight	704.8	700.9	705.7
Initial Weight	704.3	700.7	705.2
Net Weight	0.5	0.2	0.5
Impinger 4 Mod	100ml 0.1N NaOH	→	→
Final Weight	714.5	712.8	714.6
Initial Weight	711.5	712.4	714.1
Net Weight	3.0	0.4	0.5
Impinger 5 Mod	220g SiO_2 Gel	→	→
Final Weight	830.8	855.6	825.2
Initial Weight	806.0	830.8	802.4
Net Weight	24.8	24.8	22.8
Impinger 6	→	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 7	→	→	→
Final Weight			
Initial Weight			
Net Weight			
Total Catch	36.8 g	32.7 g	32.8 g

QA/QC Check

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Personnel (Signature/Date) Team Leader (Signature/Date)

Moisture Analysis Data Sheet

Plant Name TC60 CDC		Project Number 5037-23	
City & State Porton Down, UK		Type of Sample Train M23A (PCDD/PCDF)	
Sampling Location Stack (002)			
Run Number	ET01	ET02	ET03
Test Date	3/21/06	3/22/06	3/23/06
Recovery Date	3/21/06	3/22/06	3/23/06
Recovered By	DAM/GES	GES	GES
Impinger 1 SS KO	Empty	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 2 SG	100ml H_2O	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 3 Mod	100ml H_2O	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 4 Mod	220gm SiO_2 gel	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 5	→	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 6			
Final Weight			
Initial Weight			
Net Weight			
Impinger 7			
Final Weight			
Initial Weight			
Net Weight			
Total Catch	NA	NA	NA

QA/QC Check
Completeness ✓ Legibility ✓ Accuracy ✓ Specifications Reasonableness ✓
Checked By: _____ _____ 3/26/06
Personnel (Signature/Date) Team Leader (Signature/Date)

Moisture Analysis Data Sheet

Plant Name TC60 CDC		Project Number 5037-23	
City & State Pocton Down, UK		Type of Sample Train MM5 (SVOC)	
Sampling Location Stack (002)			
Run Number	ET01	ET02	ET03
Test Date	3/21/06	3/22/06	3/23/06
Recovery Date	3/21/06	3/22/06	3/23/06
Recovered By	DPM/GES	GES/DPM	GES/DPM
Impinger 1 Mod	100 ml H_2O	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 2 SG	100 ml H_2O	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 3 Mod	Empty	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 4 Mod	220 gm SiO_2 gel	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 5	→	→	→
Final Weight			
Initial Weight			
Net Weight			
Impinger 6			
Final Weight			
Initial Weight			
Net Weight			
Impinger 7			
Final Weight			
Initial Weight			
Net Weight			
Total Catch	NA	NA	NA

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ _____ 3/27/06

Personnel (Signature/Date) Team Leader (Signature/Date)

3-16-06

9-12 → Normal

14hr → 4 shots - AM

4 shots - PM

After shot: Vent 15 min

Inspect: 35 minutes

- 10,000

60' by 63" - 17" = 64,260

5.36 minutes

Proposed - Target

3-17-06

0700 Onsite at DSTL Reception

0730 Obtain Badge

0739 @ Range Control

0746 Onsite @ VZ to sign in

0749 Nigel conducts safety Meeting

0805 Released to go into Forward Area

0810 Conduct our safety/Internal AST Meeting

0828 Begin setup of Equipment

0905 Facility Personnel onsite to ~~inspect~~ inspect all electrical equipment

0200 - AST - 001135 Bad Card, facility to replace. Replaced card This day & Returned

- AST 001422 - Mode Box - Facility Replaced bad card

Repairs complete @ 12:00 hours

1100 NO_x analyzer - AST - Not operable. Had been repaired but does not work (IE). Perhaps Not the Analyzer

12:00 Return to setup

~~Kirt Griggs Back to Base~~

~~11:30~~

1305 Griggs & Dave Maxwell & John Cathey off site

3/17/06

O_2/CO_2 – RIGHT THREAD – BS-3 ✓

H_2 – BS-4 ✓

AIR (zero) – BS 3 ✓

NO_x/CO/SO_2 – BS-15

PROPANE – BS-4

ZERO AIR – BS-3 ✓

Fisher:

1. DI – Reagent Grade – BPE 2435-20L – If not available W1006/17 – A more 25L
2. 250 ml ?
3. 500 ml ?

✓ 4 HCL – Concentrated Not-in-stock scrine
Replace with 1-Liter

✓ 5. Sulfuric Concentrated 500 ml not in stock so ordered 1-liter

6 Potassium Permanganate: Sign

1320 B. Guilfoil & K. Woster onsite due to shut down

1550 B. Guilfoil, D. Maxwell, K. Woster

1620 B. Simpson onsite

1630 AST Allowed back ~~onsite~~ inside fence to secure equipment

1730 Stop work ~~here~~ for washup meeting

3/17/06

Tomorrow
Calibration
CEMs Setup + Calibration
Velocity

1745 Conduct Washup Meeting

1615 – Offsite @ VZ Area

3/17/06

3/18/06

Notes

TANK	PRES (psi)	DATE
H_2	2400	
Zero-FID	1950	
Zero	1900	
O_2/CO_2 MID	1900	
O_2/CO_2 Hi	1700	
Pro Hi-Low	2100	
Pro-Hi-Mid	1975	
Pro-Hi-Hi	2100	
Pro-Lo-Lo	2050	
Pro-Lo-Mid	2000	
Pro-Lo-Hi	2050	
Mix-Low	2050	
Mix-Mid	2100	
Mix-Hi	2000	
Mix-Highest	1900	

* Line Color Codes

Green - Zero

Red - Pro Hi

Blue - Pro Lo

Yellow - Mix

White - CO_2/O_2

Calibration Error

Notes

3/19/06

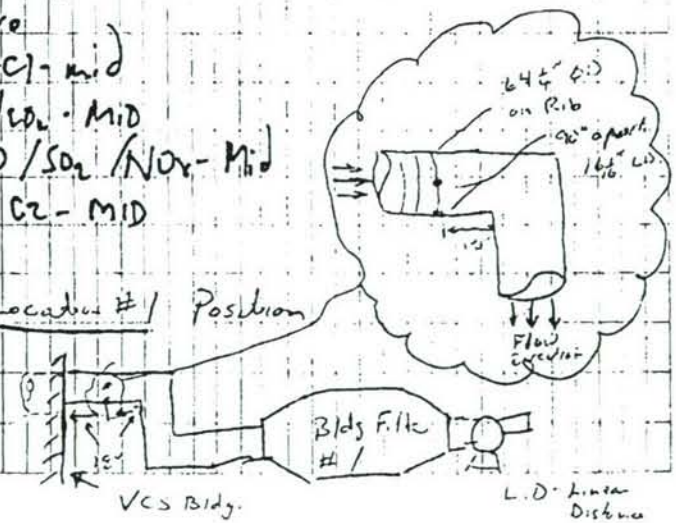
1. THC1 S2 (ZERO)
2. $CO_2/O_2/CO/SO_2/NO_x$ - ZERO
3. THC1 - HIGH - HIGH PRO
4. " - MID - " "
5. " - LOW - " "
6. O_2/CO_2 - High
7. O_2/CO_2 - Mid
8. $CO/SO_2/NO_x$ - High
9. $CO/SO_2/NO_x$ - Mid
10. THC2 - HIGH - Low Pro
11. " - MID - Low Pr
12. " - Low - " "

System Bias

- to zero all instruments : then midrange

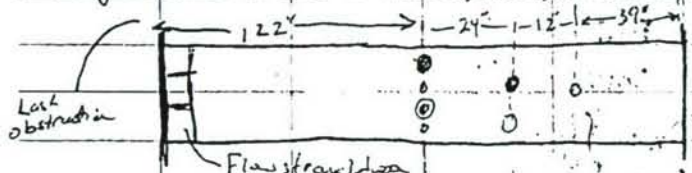
1. THC1/2 - Zero
2. Zero
3. THC1 - mid
4. O_2/CO_2 - MID
5. $CO/SO_2/NO_x$ - Mid
6. THC2 - MID

Sample Location #1 Position



3-18-06

Sample Location #2



0810 @ Main gate

0820 @ Range Control

0830 Released to go down range

0838 "Sparkie" Jim Sparkis gives DSTL Safety Brief

0850 AST (Brad) Conduct safety briefing & all discuss activities for ~~the~~ day

0905 Begin set up of equipment from previous day

B. Guilford & K Wootten ~~[illegible]~~ Install CEMs & ~~[illegible]~~ install methods in adapters on Regulators

G. Sysoe & D. Maxwell setup sample train locations & install sample Location #1 ports/holes - See drawing previous page (Sample location #1).

3-18-06

1250 Break for LUNCH

1325 Back to work

1500 D. Maxwell / K. Wootten / G. Sysoe:
- Leak check Pitot Tube
- Take Static Pressure @ Sample Location #1
- ~~Pitot~~

D. Maxwell & G. Sysoe & John Cotton perform 3 traverses for Sample Location #1

- Kirk & Brad continue CEMs install & calibration

CEMs installed & Calibrated:
- All installed
- Following calibrated: CO & SO_2
- All Calibration gases closed

1710 FID shut down to conserve H_2

1720 Secure Side ~~A~~ 2

1725 Leave ~~the~~ V.Z. Area

3/18/06

3/19/06

0915 Onsite @ VE

0920 Begin work:
- Kurt working on Calibration of CEMS
- GS & BG pull Meter box & perform Cyclonics & Velocity Traverse for Sample Location #2
- Also perform cyclonics of Location #1 →

1220 Need → Zero Air:
* N_2 - 100% Nitrogen
~~Monday~~ Zero Air
Problems with Calibration Gases:
* Propane for FIDs
* Zero Air →

1343 O_2
CO_2
CO
NOx
THC 1
THC 2
} Installed & Calibrated

SO_2 Analyzer - Problem with the lamps - Faulted - IE Issue

3/19/06

Velocity & Cyclonics complete for Sample Location #02

Monday Things to do
- Cyclonics needs to be completed 001 - Monday Tri
  + Full Calibration - SO_2, find
  + Std & Level Method Trains
  + Solvents Make up & Train Person
  + Pair Moisture on Sample Locations 001 & 002
  + Prepare Method probe liner (Nitric)
  + Rinse Dioxin Specs glassware Methylene Chloride / Methanol Rinse
- STG - Acquire Zero Air - 800 AM - N_2 H_2O CO/Hg - FID
- Solvents Coil Fisher - 8:00 AM
  Cleaned & bottles
  Talking Barry to keep checking when gas Arrive
- 2" by 10" by 51 in Length for HCL Training
- Sample Containers Delivery:
- TESCO → A36 South Hampton Road - on left
* Chemical
- Finishing Gases

1430 Offsite

3-20-06

0730 Onsite @ VZ

0835 Called David Byrans of Fisher to Contact about Delivery of Chemicals

0834 Setup for Moisture @ Sample Port #002 - Exhaust Inlet

0920 Begin Moisture Run

0945 Perform/Complete Cyclonic flow on Single Port (2)

1025 136 ppm - CO

≈ 16.1 ppm - THC

1025 End Moisture Run

Continue setup

Calibration on all instruments

1205 CO - 2.0 ppm

FID - Inlet = 18-20 ppm

1305 Back from Lunch

Per Speed → 4 hours test Run upto 4 persons on the ... (3PM)

* 9:00 AM - ... Exhaust ...

* 9:15 AM - ... Detection →

* ... with John the data to be provided.

*

3-20-06

O_2 - Sluggish & Drifting

CO_2 - ~~...~~ output Vs Huge Problem

SO_2 - Lamp is dirty / Lamp Error → Model 300

Call IE → 8:00 832-7474

Cal gas meeting → 0820 3/20/06

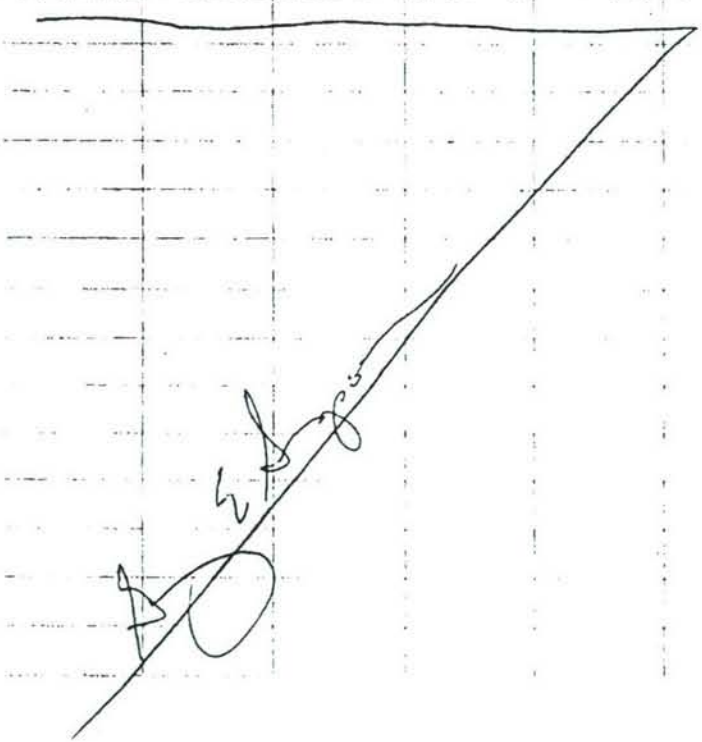
H_2 2

3/20/06

1730 Keith + Brad left site

1830 Chuck arrive onsite
- Standby & Make up?
- Solvent/Degrease cleaner
- Locked: Media Train - Partial
- Locked: HCl Drum

2000 Complete work for day
- Sign out & Leave Site



3/21/06

0710 G. Sagan & D. Maxwell onsite

0???? K. Workie & B. Guilford onsite

SUMMA CANISTERS

ID	VAC	DATE
0574	30 in Hg	3/21/06
0647	28 in Hg	3/21/06

948 : All Trains prepped & set. G. Sagan and D. Maxwell leave the forced to relocate to Visitor Trailer
K. Workie & B Guilford remain inside Trailer to operate Sampling System
+ 20.4 % O_2 - should be
+

10:30 : Debrah #1 - 6.5 lbs energetics per item
2 items - 1.5 # to Mitchell
1/4 black powder.

Shot No: 01
032106-02

on all invoices give Syed:
- P.O.
- Project #
- Contract Specialist
- Project Manager

3/21/06

* Slight Response) -

*

- Rags : Label Maker

- Heater

- Ice Chest -

- B&Q

- Home

- Find Leak Checks -

- Velocity Traverse

- Relocate Trans ~~to~~ Bldg 389 -

- Collect VOCs canisters / Record Time & Final Vacuum

• Final Vacuum :

11:00 Shot #2 → | Shot #02 032106-02 |

~~Shot~~

Notes for Shot 03

- 4200 → ~~velocity~~ dscfm → Single Location EO03 (outlet)

4200 dscfm

Results Shot # 001:

- 3 to 4 ppm CO
- <0.5 ppm THC 1 & 2 Inlet
- 3 ppm NO_2
- NR SO_2

12:48 - Shot No. 032106-03 detonation

similar response to Shot 1 & 2

3/21/06

VCS: Vapor Containment Structure

AR 385-61 - Department of the Army (DA) ~~Pamphlet~~ Pamphlet (Pam)

HD

Short Term Exposure Limit 0.003 mg/m3

Worker Population Limit : 0.0004 mg/m3

Response Limits

MINICAMS - 0.00075 mg/m3

DAAMS - 0.00008 mg/m3

General Population Limit : GPL - 24 hrs, 7 days/week, 70 years

WPL - Worker Population Limit

8 hrs / 40 week / 30 years

working NO adverse effect

13:24 Shot No. 032106-04 →

1405 Shot No. 032106-05

NOx taking 20 minutes to get back to baseline

1442 Shot No. 032106-06

1502 Stop wet metal traverse to CEM

Runs -

1700 [illegible]

3-21-06

1806 - Shift ID E101-MS-PNR - 3:Hu
sample brush - bristles
are contained in sample

2000 G. Simpson & D. Maxwell
Completed sample Recovery
& Preparation for
3/22/06 Testing

System Run Time 4.5 hours

3/22/06

0505 - K. Wootten & B. Guilford onsite @ VZ

0715 - D. Maxwell & G. Simpson onsite
@ VZ

Setup for Second Day testing
- CEMS! SO_2
CO_2/O_2
NOx
CO
THC
THC2
- VOCs - Two Methods TO-15
- Method 29
- Method 26A
- Method 23
- Method 0010

0745 - Nigel Conducts Safety Briefing

0830 - All sample trains complete
& ready for testing

0932 Shot # 032206-01
2 each - 25 lbs HD Rounds

1006 : Shot # 032206-02
2 each - 25 lb HD Rounds

1043 : Shot # 032206-03
2 each - 25 lb HD Filled

3-22-06

Solid Samples Need:

- Glass Bead
- Stainless Spacers
- Coolers
- Ziploc Baggies
-

1118 Shot ID # 032206-04

1159 Shot ID # 032206-05

1255 Shot ID # 032206-06

1355 Shot ID # 032206-07

1400 - Last shot (07) for Sampling Chapter 15 of AP Emission Factors

1416 Stop Sampling Method.

1435 Relocate to Bldg 359

1435 B. Gulstad & K. Woofter Take final velocity Traverse

1440 Begin Sample Recovery.

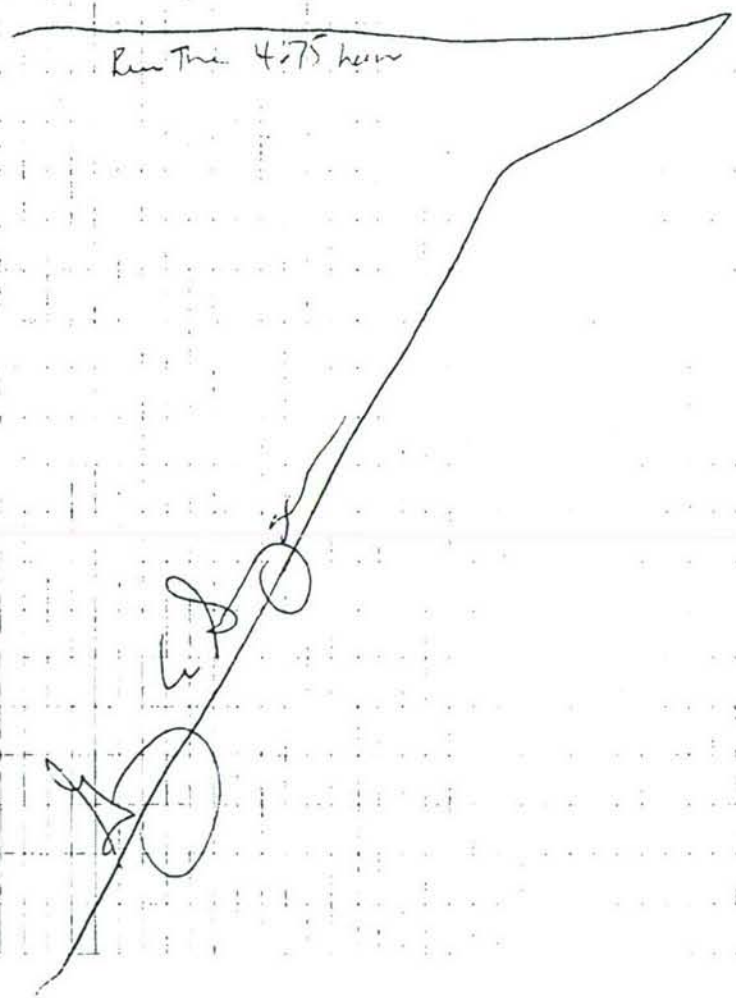
1812 Note: PM/HCl Train replaced glass probe - due to sharp edge edge cutting bristle brush Cleaned Rinse new probe liner before install

2002 G. Sysen & D. Maxwell

3/22/06

Compatible with sample train preparation.

Tell Keith They need to setup a background VOC Canister I will set



3/23/06

0715 - G. Sysson & D. Maxwell onsit

0515 B. Gonthal & K Woofter onsit

0720 Begin Setup of Wet method trains. CEM & VOC; inlet/outlet complete by 0700.

0745 Nigel Conduct safety breifing.

0947 Start VOC canister inlet (001) outlet (002) & Background sample @ intake louve to the Bldg. AST Stand Inlet/outlet oll;

0948 Wet Method trains Started.

0954 Shot # ~~0322~~ 032306-01

Takes approximately 5 minutes after shot to see increases in parameters on the CEMs; & Then another 20 minute to B

1027 No # 032306-02

1102 No# 032306-03

1137:20 No# ~~032306-04~~ 032306-04

1224:36 No # 032306-05

1320 - Stopped Background sample & Inlet & Outlet VOC canish

1320:35 No 032306-06

Start canister decrease immediately following that time

1339 Stop wet methods

1358:35 No 032306-07

1420 . Begin Train Recovery

1808: Complete with Sample recovery

3/24/06

0715 @ Range Control; D. Maxwell

K. Wootten & G. Sayers

1000 B. Gunther onsite

1000 G. Sayers Collect Pea Gravel sample

1400 Collected Fresh Lime Samples - ECBC

1100 K. Wootten offsite:

Send Syed an email regarding Mask turnin

* PICK UP PACKING TAPE

NOTES FROM BRADS LOG BOOK:

3/20/06

* CALIBRATION GAS TANK READINGS:

TANK	PRESSURE (PSI)	
H_2	2200	
ZERO-FID	1800	
ZERO	1725	
O_2/CO_2-MID	1800	
O_2/CO_2-Hi	1750	
Pro-Hi-Mid	1950	
Pro-Hi-Hi	1525	
Pro-Lo-Mid	1900	
Pro-Lo-Hi	700	* GAS LEFT ON WHEN NOT CONNECTED TO ANALYZER OR MANIFOLD BOARD
Mix-Low	2000	
Mix-Mid	1950	
Mix-Hi	1000	

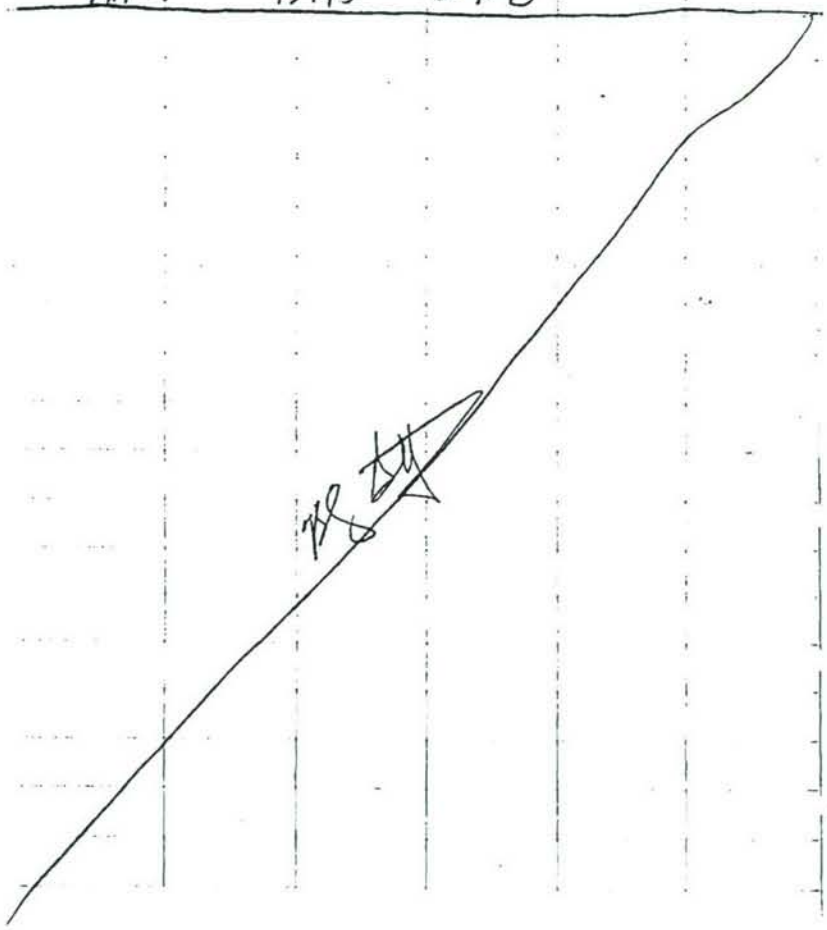
* LINES COMING INTO FLOW MANIFOLD
  - GREEN - ZERO
  - RED - PRO HIGH
  - BLUE - PRO LOW
  - YELLOW - MIX
  - FID - ZERO } CLEAR
    H_2

3/20/06

→ METERBOX CALIBRATIONS

~~MA1~~ 3/16/06 DC

BOX	ΔHe	GAMMA
MA1	1.674	0.9900
MA2	1.763	0.9648
M1	1.701	0.9951
MA4	1.793	0.9693



3/21/06

0505 ONSITE w/ K.W.

0520 - OPENING CRATE TO CHECK FOR TUBING (B.G.)
- CHECKING CYLINDER P's (B.G.)
- CHECKING CEM'S FOR OVERNIGHT (K.W.)

CYLINDER CHECK

TANK	P
H_2	2100
ZERO-FID	1600
ZERO (N_2)	2300 → NEW TANK FROM DSTL
O_2/CO_2-Hi	1500
O_2/CO_2-MD	1700
MIX-MID	1600
MIX-Hi	1200
Pro-Lo	1500
Pro-MID	1900
Pro-Hi	1400

0535 START FULL CALIBRATION
*SO_2 A LITTLE SLUGGISH

0555 START 2ND CAL

0607 CAL COMPLETE - STARTING SAMPLE BIAS

0630 CAL AND SAMPLE BIAS COMPLETE
→ START CHOSING SAMPLE NOZZLE SIZES

1021 STARTED SUMMA CANISTERS
#0574 - FC #930
0647 - FC #931

3/21/96

1023 STARTED METER BOXES

* DETONATIONS

DET #	TIME
1	≈1034
2	1111
3	(1147)- MISFIRE
	* PROBLEM W/ DET.
	* HAVE TO REDO THE ROUND
	1249
4	1325
5	1405
6	1443

* RUNNING CEM'S UNTIL 1503 DUE TO LAG IN RESPONSE AND HOW LONG IT TAKES TO GET BACK TO BACKGRAUND LEVELS.

1740 K.W. AND B6 OFF SITE

1830 FINISHED ERRANDS

3/22/96

0500 ONSITE (K.W. & B6)

0520 CHECKING GAS P

STARTING CALIBRATION

TANK	P
H_2	1950
ZERO-FID	1400
ZERO-N_2	2200
O_2/CO_2-MID	1400
O_2/CO_2-Hi	1250
Pro-MID	1450
Pro-Lo	1700
Pro-Hi	1250
MIX-MID	1250
MIX-LO	100

* MIX Hi - LEFT ON OVER NIGHT W/ VALVE SHUT; REGULATOR LEAKING BY

0605 CAL AND SYSTEM BIAS COMPLETE

0630 INIAL VELOCITY TRAVERSE AND CEM'S PROBES IN PLACE → COMPLETE

0650 SUMMA CANISTERS INSTALLED

0638 -28 in Hg (F.C #430)

0574 -27 in Hg (F.C #931)

-D.S.C. # 0585 HOS ONLY 23 in Hg VACUUM

0720 - GS & DM ON SITE

0735 - HCl TRAIN IN PLACE AND LEAK CHECKED

0745 - MORNING SAFETY MEETING

0825 - ALL TRAINS IN PLACE AND LEAK CHECKED

3/22/05

0929 STARTED SUMMACANISTERS

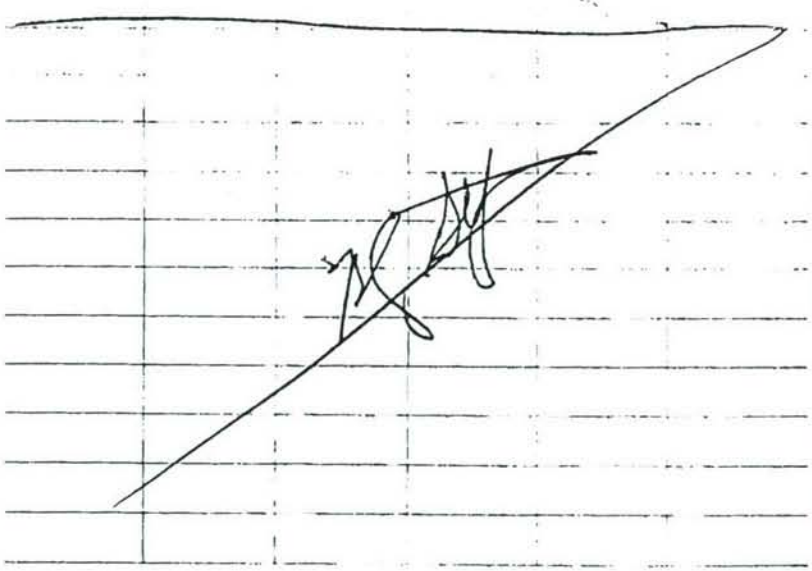
0930 STARTED METER BOXES

* DETONATIONS

#	TIME
1	0935
2	1010
3	1047
4	1122
5	1203
6	1259
7	1359

*1420 CUTTING OFF RUN

*1515 K.W. : 86 LEAVING SITE



3/23/05

0500 ONSITE (K.W. : 86)

0515 PREPARING TO CALIBRATE CEM'S

CHECKING CYLINDER PRESS'S

TANK	P
H_2	1850
ZERO-FD	1400
ZERO-N_2	2100
O_2/CO_2-Hi	1400
O_2/CO_2-MID	1100
Mix-Hi	1200
Mix-MID	1550
Pro-Lo	1300
Pro-MID	1600
Pro-Hi	1800

0600 FINISHED W/ CALIBRATIONS AND SYSTEM BIAS

0603 PREPARING SUMMA CANISTERS

#0631 - 0001 - 27 in H_g (F.C. #930)

0595 - 0002 - 26 in H_g (F.C. #931)

0549 - BACKGROUND - 26 in H_g (F.C. #906)

0620 STARTED VELOCITY TRAVERSES AND PLACEMENT OF CANISTER

0640 TRAVERSES, CEMS PROBE AND S. CANISTERS IN PLACE

0725 G.S. & DM @ VE

0740 SVOC's, PM/H_2/Cl_2 HAVE PASSED LEAK CHECK

3/25/05

0745 MORNING SAFETY MEETING

0825 METALS AND PCDD/PCDF HAVE PASSED LEAK CHECKS AND ALL OF THE PROBES HAVE BEEN INSERTED INTO THE STACK

0840 CANISTER SET UP FOR BACKGROUND DATA

0900 G.S. & KW INTO TRAILER TO MONITOR BOXES AND WATCH CEM'S

* DETONATIONS

#	Time
1	0958
2	1031
3	1106
4	1141
5	1228
6	1325
7	1402

5/1

Mark Bo
Dave > AST
Gary

* Everything looks good
Ar
Fd

Do we list of (Ca) — Cu & Barium
Arsenic Oxides

* Digest - Glass Fiber — for metals
Fe
Borosil

* Ship Filter

Ship samples — Breakers? Filters?

TC-60 CDC Air Filter #2 Exhaust Duct
CEMS Data Summary

Run averages (uncorrected)
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

These uncorrected values are used in the calculations

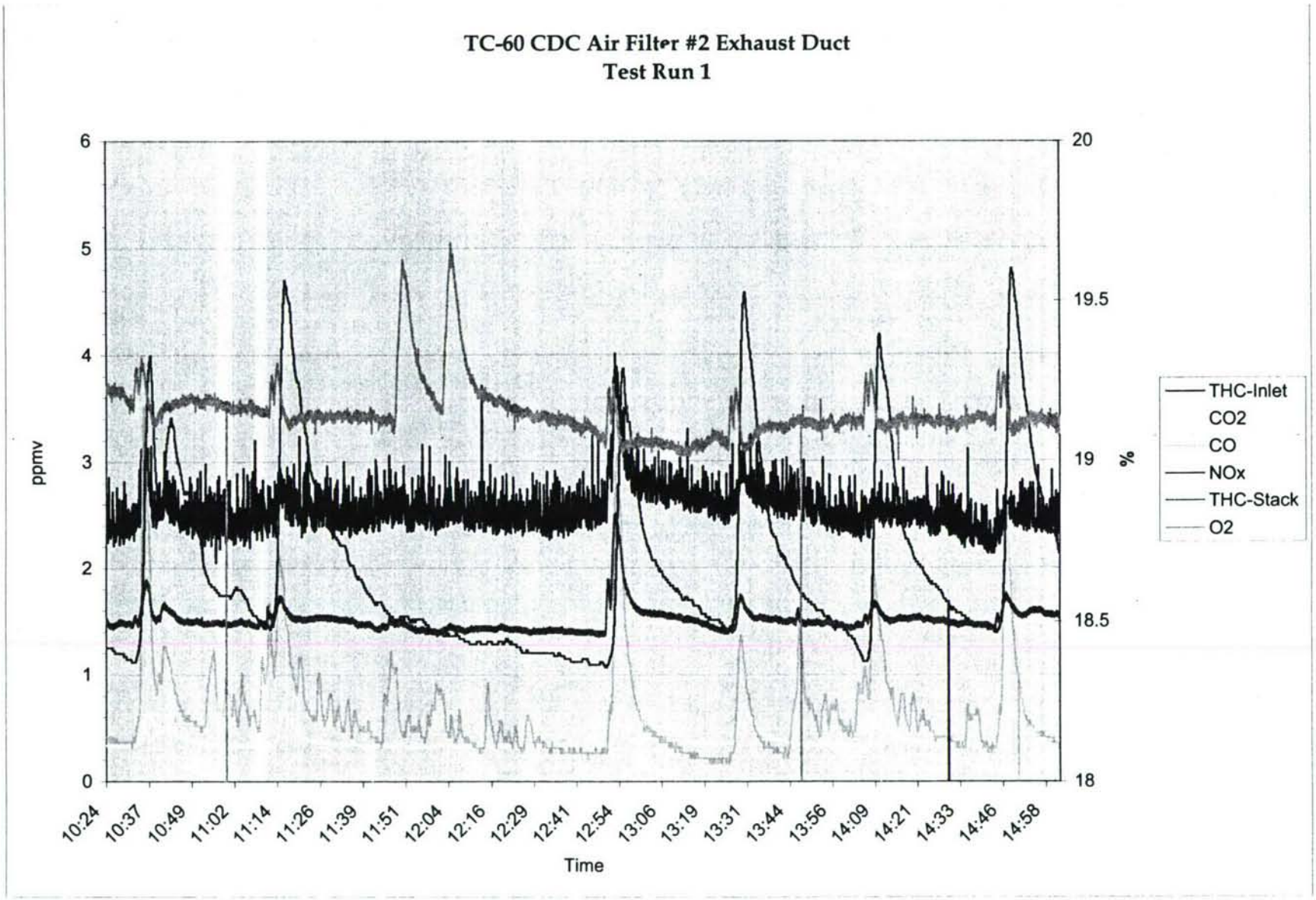
Run	Date	Start Time	Stop Time	THC1 ppm	O2 %	CO2 %	CO ppm	SO2 ppm	NOx ppm	THC2 ppm	THC DRE %
1	3/21/2006	10:24:36	15:03:00	2.56	19.152	0.3871	0.657	-0.831	2.000	1.51	40.7
2	3/22/2006	9:30:04	14:20:00	2.28	19.470	0.4397	0.392	-0.183	1.743	1.36	38.3
3	3/23/2006	9:52:38	13:38:01	2.15	19.143	0.3609	0.433	0.315	2.195	1.45	27.8
				2.33	19.25	0.40	0.49	-0.23	1.98	1.44	35.6

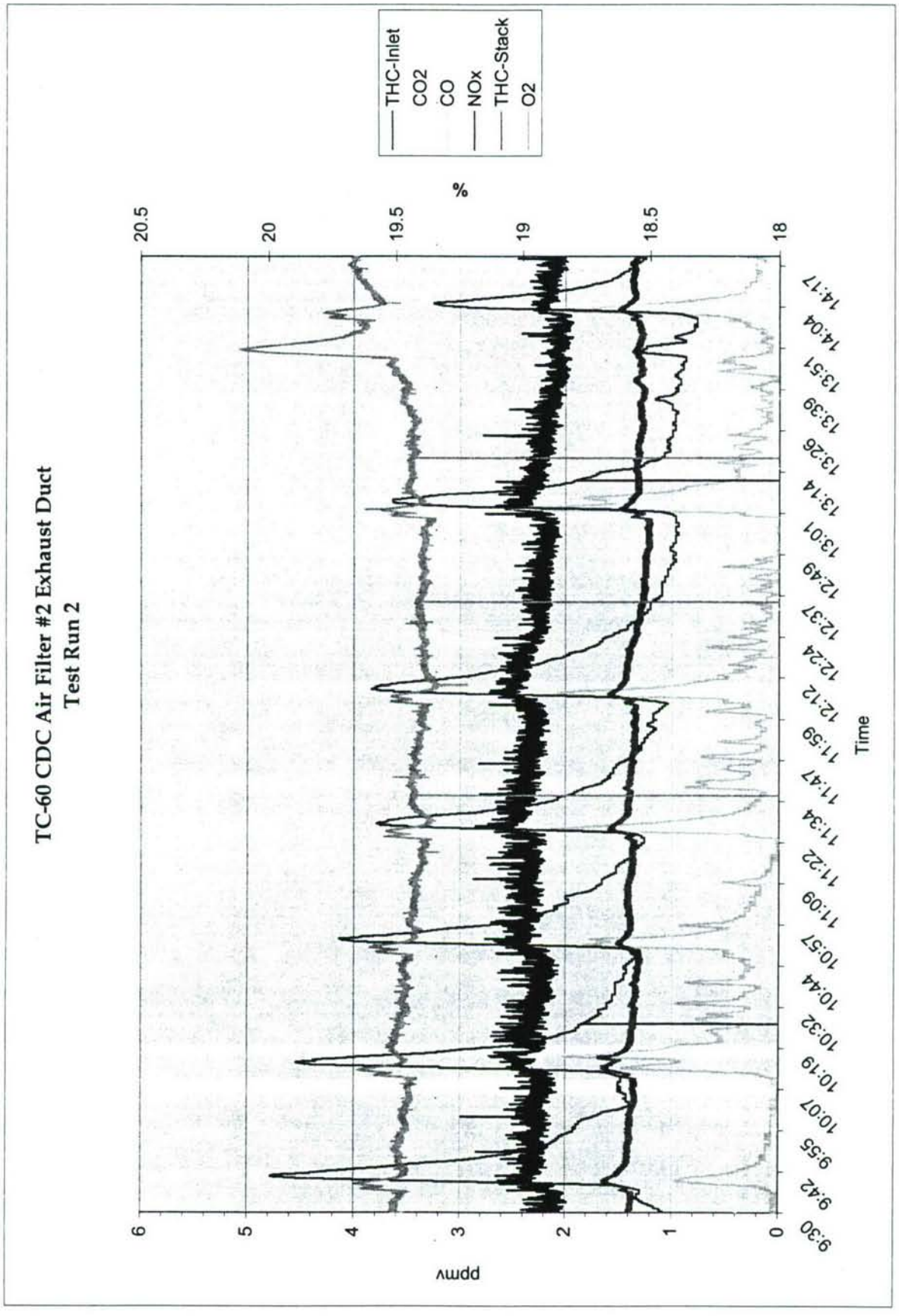
MAXIMUM VALUES

Run	Date	Start Time	Stop Time	THC1 ppm	O2 %	CO2 %	CO ppm	SO2 ppm	NOx ppm	THC2 ppm	THC DRE %
1	3/21/2006	10:24:36	15:03:00	4.01	19.683	0.7256	3.518	-0.197	4.801	2.51	61.5
2	3/22/2006	9:30:04	14:20:00	2.99	20.114	0.7900	2.573	0.893	4.778	1.69	54.7
3	3/23/2006	9:52:38	13:38:01	2.62	19.720	0.7270	3.324	0.624	5.224	1.81	48.1
				4.01	20.11	0.79	3.52	0.89	5.22	2.51	61.5

MINIMUM VALUES

Run	Date	Start Time	Stop Time	THC1 ppm	O2 %	CO2 %	CO ppm	SO2 ppm	NOx ppm	THC2 ppm	THC DRE %
1	3/21/2006	15:03:00	13:27:03	2.05	19.003	0.3124	0.169	-1.573	1.067	1.35	27.1
2	3/22/2006	9:30:04	14:20:00	1.93	19.222	0.3596	-0.080	-1.185	0.764	1.18	27.8
3	calculating run ave	13:38:01	3:42:06	1.86	19.010	0.2685	0.018	-0.142	1.128	1.27	20.9
				1.86	19.00	0.27	-0.08	-1.57	0.76	1.18	20.9


TC-60 CDC Air Filter #2 Exhaust Duct
Test Run 1
ppmv
%
Time
THC-Inlet
CO2
CO
NOx
THC-Stack
O2
0
1
2
3
4
5
6
18
18.5
19
19.5
20
10:24
10:37
10:49
11:02
11:14
11:26
11:39
11:51
12:04
12:16
12:29
12:41
12:54
13:06
13:19
13:31
13:44
13:56
14:09
14:21
14:33
14:46
14:58


TC-60 CDC Air Filter #2 Exhaust Duct
Test Run 2
THC-Inlet
CO2
CO
NOx
THC-Stack
O2
%
ppmv
Time
20.5
20
19.5
19
18.5
18
6
5
4
3
2
1
0
9:30
9:42
9:55
10:07
10:19
10:32
10:44
10:57
11:09
11:22
11:34
11:47
11:59
12:12
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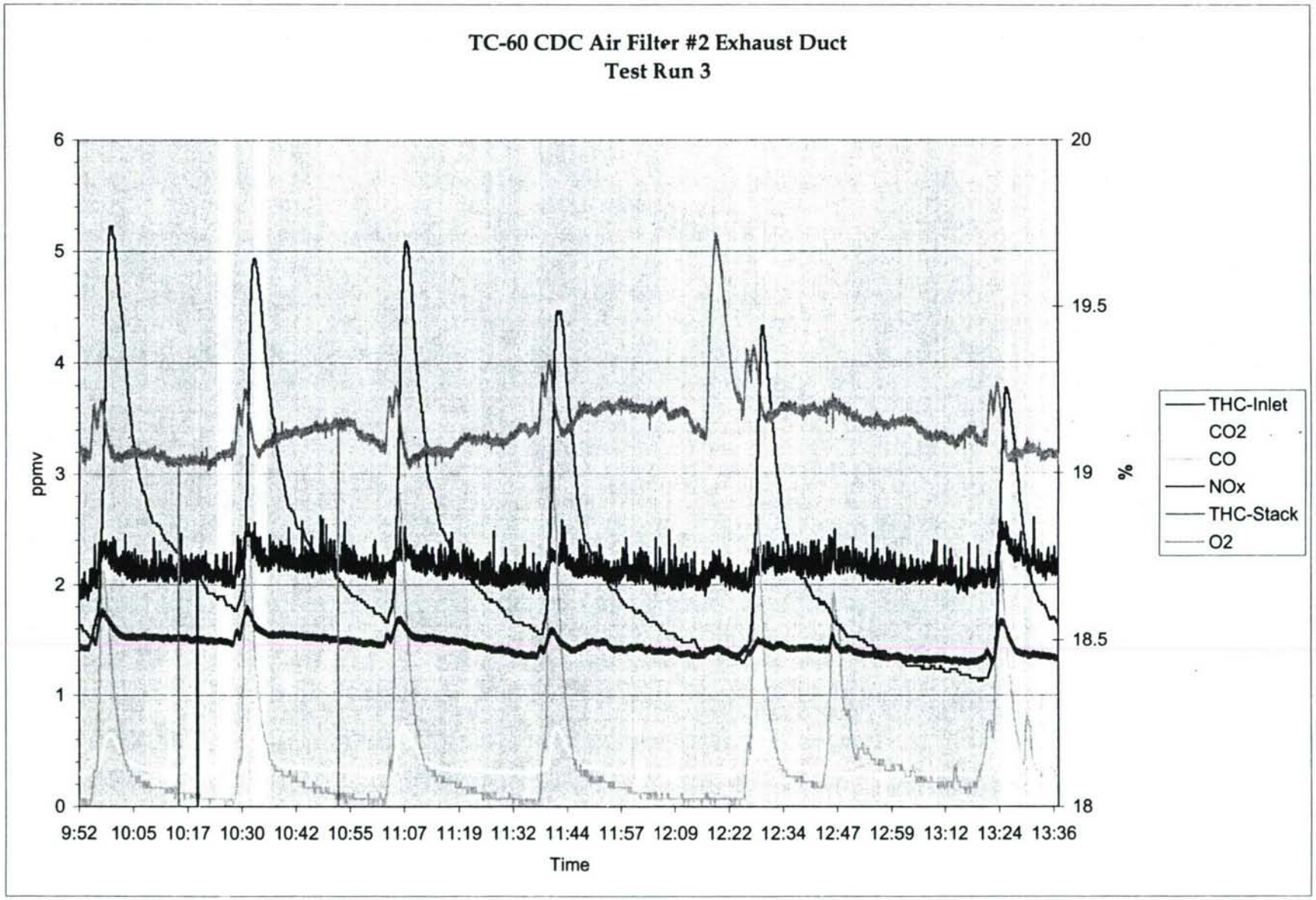
12:49
13:01
13:14
13:26
13:39
13:51
14:04
14:17


TC-60 CDC Air Filter #2 Exhaust Duct
Test Run 3
ppmv
%
Time
0
1
2
3
4
5
6
18
18.5
19
19.5
20
9:52
10:05
10:17
10:30
10:42
10:55
11:07
11:19
11:32
11:44
11:57
12:09
12:22
12:34
12:47
12:59
13:12
13:24
13:36
THC-Inlet
CO2
CO
NOx
THC-Stack
O2

ATTACHMENT C

LABORATORY RESULTS

ENVIRONMENTAL
Data Services, Inc.

June 7, 2006

Mr. Mark Stinnett
CH2M HILL, Inc
3011 SW Williston Road
Gainseville, FL 32608-3298

Re: Transmittal of Completed Data Validation Reports for Porton Down, SDGs F1474 and F1546.

Dear Mr.Stinnett:

Environmental Data Services, Inc. (EDS) is pleased to submit the data validation summary report with attached annotated Form Is for the above referenced SDGs.

Please contact me at (603) 226-0118 or via email at nweaver@env-data.com if you have any questions.

Sincerely,
Environmental Data Services, Inc.

Nancy Weaver

Nancy Weaver
Senior Chemist

Enclosed

ENVIRONMENTAL
Data Services, Inc.

VOLATILE ORGANIC COMPOUNDS
USEPA Method TO-15 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-BG-AIR-VOC	F1474-14	Air
2	TC60-ET01-AFI-VOC	F1474-15	Air
2MD	TC60-ET01-AFI-VOCMD	F1474-15MD	Air
3	TC60-ET02-AFI-VOC	F1474-16	Air
4	TC60-ET03-AFI-VOC	F1474-17	Air
5	TC60-ET01-STACK-VOC	F1474-18	Air
6	TC60-ET02-STACK-VOC	F1474-19	Air
7	TC60-ET03-STACK-VOC	F1474-20	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, in conjunction with The Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by GCMS, Method TO-15, EPA/625/R-96/010b, January 1999 was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 30 days for air samples.

GC/MS Tuning - All of the BFB tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values except the following.

ICAL Date	Compound	%RSD/RRF	Qualifier	Affected Samples
04/10/06	Hexane	30.32% RSD	None	Already Qualified

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values except the following.

CCAL Date	Compound	%D/RRF	Qualifier	Affected Samples
04/13/06	Cis-1,3-Dichloropropene	26.3% D	UJ	All Samples
	Trans-1,3-Dichloropropene	31.0% D	UJ	All Samples
	1,2-Ethylenedibromide	27.1% D	UJ	All Samples
	1,2,4-Trimethylbenzene	26.4% D	UJ	All Samples
	1,2,4-Trichlorobenzene	26.0% D	UJ	All Samples
	Hexachlorobutadiene	28.3% D	UJ	All Samples
	Naphthalene	31.7% D	UJ	All Samples

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The matrix duplicate sample exhibited acceptable RPD values.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values except the following.

LCS ID	Compound	%R	Qualifier	Affected Samples
BS1 X0413	Hexane	39%	J/R	All Samples

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ppbv	Action Level ppbv	Qualifier	Affected Samples
XB2-0413	Methylene Chloride	0.460	4.60	U	2, 3, 4, 6, 7
	Hexane	0.290	1.45	U	2, 3, 4, 5, 6

Trip, Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate samples were not analyzed.

Tentatively Identified Compounds (TICs) - All TICs were qualified as estimated (NJ).

Compound Quantitation - No discrepancies were identified.

ATTACHMENT C

LABORATORY RESULTS

ENVIRONMENTAL
Data Services, Inc.

June 7, 2006

Mr. Mark Stinnett
CH2M HILL, Inc
3011 SW Williston Road
Gainseville, FL 32608-3298

Re: Transmittal of Completed Data Validation Reports for Porton Down, SDGs F1474 and F1546.

Dear Mr.Stinnett:

Environmental Data Services, Inc. (EDS) is pleased to submit the data validation summary report with attached annotated Form Is for the above referenced SDGs.

Please contact me at (603) 226-0118 or via email at nweaver@env-data.com if you have any questions.

Sincerely,
Environmental Data Services, Inc.

Nancy Weaver

Nancy Weaver
Senior Chemist

Enclosed

ENVIRONMENTAL
Data Services, Inc.

VOLATILE ORGANIC COMPOUNDS
USEPA Method TO-15 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-BG-AIR-VOC	F1474-14	Air
2	TC60-ET01-AFI-VOC	F1474-15	Air
2MD	TC60-ET01-AFI-VOCMD	F1474-15MD	Air
3	TC60-ET02-AFI-VOC	F1474-16	Air
4	TC60-ET03-AFI-VOC	F1474-17	Air
5	TC60-ET01-STACK-VOC	F1474-18	Air
6	TC60-ET02-STACK-VOC	F1474-19	Air
7	TC60-ET03-STACK-VOC	F1474-20	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, in conjunction with The Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by GCMS, Method TO-15, EPA/625/R-96/010b, January 1999 was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 30 days for air samples.

GC/MS Tuning - All of the BFB tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values except the following.

ICAL Date	Compound	%RSD/RRF	Qualifier	Affected Samples
04/10/06	Hexane	30.32% RSD	None	Already Qualified

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values except the following.

CCAL Date	Compound	%D/RRF	Qualifier	Affected Samples
04/13/06	Cis-1,3-Dichloropropene	26.3% D	UJ	All Samples
	Trans-1,3-Dichloropropene	31.0% D	UJ	All Samples
	1,2-Ethylenedibromide	27.1% D	UJ	All Samples
	1,2,4-Trimethylbenzene	26.4% D	UJ	All Samples
	1,2,4-Trichlorobenzene	26.0% D	UJ	All Samples
	Hexachlorobutadiene	28.3% D	UJ	All Samples
	Naphthalene	31.7% D	UJ	All Samples

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The matrix duplicate sample exhibited acceptable RPD values.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values except the following.

LCS ID	Compound	%R	Qualifier	Affected Samples
BS1 X0413	Hexane	39%	J/R	All Samples

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ppbv	Action Level ppbv	Qualifier	Affected Samples
XB2-0413	Methylene Chloride	0.460	4.60	U	2, 3, 4, 6, 7
	Hexane	0.290	1.45	U	2, 3, 4, 5, 6

Trip, Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate samples were not analyzed.

Tentatively Identified Compounds (TICs) - All TICs were qualified as estimated (NJ).

Compound Quantitation - No discrepancies were identified.

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-BG-AIR-VOC**

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147414

Lab File ID: 147414.D

Date Received: 04/04/06

Date Analyzed: 04/14/06

Dilution Factor: 2.44

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.317	2.44	0.488	J	
74-87-3	Chloromethane	0.390	2.44	0.781	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.244	2.44	2.44	U	
75-01-4	Vinyl Chloride	0.244	2.44	2.44	U	
74-83-9	Bromomethane	0.220	2.44	2.44	U	
75-00-3	Chloroethane	0.195	2.44	2.44	U	
75-69-4	Trichlorofluoromethane	0.122	2.44	0.220	J	
67-64-1	Acetone	0.561	2.44	211		
75-35-4	1,1-DCE	0.122	2.44	2.44	U	
75-09-2	Methylene Chloride	0.268	2.44	2.44	U	
76-13-1	Trichlorotrifluoroethane	0.122	2.44	2.44	U	
156-60-5	trans-1,2-DCE	0.171	2.44	2.44	U	
75-34-3	1,1-DCA	0.0732	2.44	2.44	U	
110-54-3	Hexane	0.561	2.44	2.22	~~J~~	J LCSL
78-93-3	MEK (2-Butanone)	0.586	2.44	4.61		
156-59-2	cis-1,2-DCE	0.171	2.44	2.44	U	
67-66-3	Chloroform	0.0732	2.44	2.44	U	
107-06-2	1,2-DCA	0.0976	2.44	2.44	U	
71-55-6	1,1,1-TCA	0.122	2.44	2.44	U	
56-23-5	Carbon Tetrachloride	0.122	2.44	2.44	U	
71-43-2	Benzene	0.293	2.44	2.44	U	
78-87-5	1,2-Dichloropropane	0.171	2.44	2.44	U	
79-01-6	TCE	0.220	2.44	2.44	U	
10061-01-5	cis-1,3-Dichloropropene	0.195	2.44	2.44	U-	UJ CCV H
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.781	2.44	2.44	U	
10061-02-6	trans-1,3-Dichloropropene	0.317	2.44	2.44	U	UJ CCV H
79-00-5	1,1,2-TCA	0.0976	2.44	2.44	U	
108-88-3	Toluene	0.244	2.44	6.22		
106-93-4	1,2-EDB	0.122	2.44	2.44	U-	UJ CCV H
127-18-4	Tetrachloroethylene	0.122	2.44	2.44	U	
108-90-7	Chlorobenzene	0.146	2.44	2.44	U	
100-41-4	Ethylbenzene	0.317	2.44	2.44	U	
108-38-3/1	m,p-Xylene	0.659	4.88	4.88	U	
100-42-5	Styrene	0.488	2.44	2.44	U	

05/31/06

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-BG-AIR-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147414

Lab File ID: 147414.D

Date Received: 04/04/06

Date Analyzed: 04/14/06

Dilution Factor: 2.44

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
95-47-6	o-Xylene	0.317	2.44	2.44	U	
79-34-5	1,1,2,2-Tetrachloroethane	0.220	2.44	2.44	U	
103-65-1	n-Propylbenzene	0.185	2.44	2.44	U	
108-67-8	1,3,5-Trimethylbenzene	0.586	2.44	2.44	U	
95-63-6	1,2,4-Trimethylbenzene	0.610	2.44	2.44	~~U~~	LCJ CCVH
541-73-1	1,3-DCB	0.415	2.44	2.44	U	
106-46-7	1,4-DCB	0.708	2.44	2.44	U	
95-50-1	1,2-DCB	0.708	2.44	2.44	U	
104-51-8	n-Butylbenzene	0.299	2.44	2.44	U	
120-82-1	1,2,4-Trichlorobenzene	0.464	2.44	2.44	~~U~~	LCJ CCVH
87-68-3	Hexachlorobutadiene	0.683	2.44	2.44	~~U~~	LCJ
91-20-3	Naphthalene	0.849	4.88	4.88	~~U~~	LCJ

CCV3, ICC

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-BG-AIR-VOC**	**Lab ID:**	**F147414**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/13/2006
		Dilution Factor:	2.44
Sampling Date:	03/23/2006	Analysis Method:	TO-15
Sampling Time:	13:20	Report Revision No.:	0
Type:	Grab	Reported By:	B. Hayes
Matrix:	Air	Reviewed By:	
		Units:	PPBV

Compound Name	Sample Result	Qualifier
propane	13.1	J NJ T VC
isobutane	2.98	J
2-methylbutane	16.7	J
hexanal	3.76	J
alpha-pinene	30.7	J
beta-pinene	4.73	J
undecane	11.0	J

J=Estimated value
U=Not detected at specified reporting limits

05/31/06

CH2M HILL
Applied Sciences Group

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
Tel 541.752.4271 Fax 541.752.0276

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-AFI-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147415

Lab File ID: 147415.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.257	1.98	0.416	J	
74-87-3	Chloromethane	0.317	1.98	0.752	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.198	1.98	1.98	U	
75-01-4	Vinyl Chloride	0.198	1.98	1.98	U	
74-83-9	Bromomethane	0.178	1.98	1.98	U	
75-00-3	Chloroethane	0.158	1.98	1.98	U	
75-69-4	Trichlorofluoromethane	0.0990	1.98	0.178	J	
67-64-1	Acetone	0.455	1.98	17.3		
75-35-4	1,1-DCE	0.0990	1.98	1.98	U	
75-09-2	Methylene Chloride	0.218	1.98	1.98 ~~1.29~~	~~J~~	LCL
76-13-1	Trichlorotrifluoroethane	0.0990	1.98	1.98	U	
156-60-5	trans-1,2-DCE	0.139	1.98	1.98	U	
75-34-3	1,1-DCA	0.0594	1.98	1.98	U	
110-54-3	Hexane	0.455	1.98	1.98 ~~0.970~~	~~J~~	R LCSL
78-93-3	MEK (2-Butanone)	0.475	1.98	1.92	J	
156-59-2	cis-1,2-DCE	0.139	1.98	1.98	U	
67-66-3	Chloroform	0.0594	1.98	1.98	U	
107-06-2	1,2-DCA	0.0792	1.98	1.98	U	
71-55-6	1,1,1-TCA	0.0990	1.98	1.98	U	
56-23-5	Carbon Tetrachloride	0.0990	1.98	1.98	U	
71-43-2	Benzene	0.238	1.98	1.98	U	
78-87-5	1,2-Dichloropropane	0.139	1.98	1.98	U	
79-01-6	TCE	0.178	1.98	1.98	U	
10061-01-5	cis-1,3-Dichloropropene	0.158	1.98	1.98	~~U~~	LCJ CCVH
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.634	1.98	1.98	U	
10061-02-6	trans-1,3-Dichloropropene	0.257	1.98	1.98	~~U~~	LCJ CCVH
79-00-5	1,1,2-TCA	0.0792	1.98	1.98	U	
108-88-3	Toluene	0.198	1.98	0.416	J	
106-93-4	1,2-EDB	0.0990	1.98	1.98	~~U~~	LCJ CCVH
127-18-4	Tetrachloroethylene	0.0990	1.98	1.98	U	
108-90-7	Chlorobenzene	0.119	1.98	1.98	U	
100-41-4	Ethylbenzene	0.257	1.98	1.98	U	
108-38-3/1	m,p-Xylene	0.535	3.96	3.96	U	
100-42-5	Styrene	0.396	1.98	1.98	U	

4/13/06

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-AFI-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147415

Lab File ID: 147415.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
95-47-6	o-Xylene	0.257	1.98	1.98	U
79-34-5	1,1,2,2-Tetrachloroethane	0.178	1.98	1.98	U
103-65-1	n-Propylbenzene	0.150	1.98	1.98	U
108-67-8	1,3,5-Trimethylbenzene	0.475	1.98	1.98	U
95-63-6	1,2,4-Trimethylbenzene	0.495	1.98	1.98	U
541-73-1	1,3-DCB	0.337	1.98	1.98	U
106-46-7	1,4-DCB	0.574	1.98	1.98	U
95-50-1	1,2-DCB	0.574	1.98	1.98	U
104-51-8	n-Butylbenzene	0.243	1.98	1.98	U
120-82-1	1,2,4-Trichlorobenzene	0.376	1.98	1.98	U
87-68-3	Hexachlorobutadiene	0.554	1.98	1.98	U
91-20-3	Naphthalene	0.689	3.96	3.96	U

2

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET01-AFI-VOC**	**Lab ID:**	**F147415**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/13/2006
		Dilution Factor:	1.98
Sampling Date:	03/21/2006	Analysis Method:	TO-15
Sampling Time:	14:21	Report Revision No.:	0
Type:	Grab	Reported By:	B. Hayes
Matrix:	Air	Reviewed By:	
		Units:	PPBV

Compound Name	Sample Result	Qualifier
propane	61.8	J NJ TIC
isobutane	61.6	J
2-methyl-1-propene	5.50	J
butane	67.1	J
alpha-pinene	2.61	J
2-methyldecane	2.89	J
undecane	21.0	J
tridecane	2.65	J

J=Estimated value
U=Not detected at specified reporting limits

05/31/06

CH2M HILL
Applied Sciences Group

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
Tel 541.752.4271 Fax 541.752.0276

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-AFI-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147416

Lab File ID: 147416.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.04

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.265	2.04	0.408	J	
74-87-3	Chloromethane	0.326	2.04	1.10	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.204	2.04	2.04	U	
75-01-4	Vinyl Chloride	0.204	2.04	2.04	U	
74-83-9	Bromomethane	0.184	2.04	2.04	U	
75-00-3	Chloroethane	0.163	2.04	2.04	U	
75-69-4	Trichlorofluoromethane	0.102	2.04	0.184	J	
67-64-1	Acetone	0.469	2.04	12.2		
75-35-4	1,1-DCE	0.102	2.04	2.04	U	
75-09-2	Methylene Chloride	0.224	2.04	2.04 1.45	~~J~~	LCL LBL
76-13-1	Trichlorotrifluoroethane	0.102	2.04	2.04	U	
156-60-5	trans-1,2-DCE	0.143	2.04	2.04	U	
75-34-3	1,1-DCA	0.0612	2.04	2.04	U	
110-54-3	Hexane	0.469	2.04	2.04 0.816	~~J~~	R LCSL
78-93-3	MEK (2-Butanone)	0.490	2.04	0.857	J	
156-59-2	cis-1,2-DCE	0.143	2.04	2.04	U	
67-66-3	Chloroform	0.0612	2.04	2.04	U	
107-06-2	1,2-DCA	0.0816	2.04	2.04	U	
71-55-6	1,1,1-TCA	0.102	2.04	2.04	U	
56-23-5	Carbon Tetrachloride	0.102	2.04	2.04	U	
71-43-2	Benzene	0.245	2.04	2.04	U	
78-87-5	1,2-Dichloropropane	0.143	2.04	2.04	U	
79-01-6	TCE	0.184	2.04	2.04	U	
10061-01-5	cis-1,3-Dichloropropene	0.163	2.04	2.04	~~U~~	UJ CCVH
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.653	2.04	2.04	U	
10061-02-6	trans-1,3-Dichloropropene	0.265	2.04	2.04	~~U~~	UJ CCVH
79-00-5	1,1,2-TCA	0.0816	2.04	2.04	U	
108-88-3	Toluene	0.204	2.04	0.286	J	
106-93-4	1,2-EDB	0.102	2.04	2.04	~~U~~	UJ CCVH
127-18-4	Tetrachloroethylene	0.102	2.04	2.04	U	
108-90-7	Chlorobenzene	0.122	2.04	2.04	U	
100-41-4	Ethylbenzene	0.265	2.04	2.04	U	
108-38-3/1	m,p-Xylene	0.551	4.08	4.08	U	
100-42-5	Styrene	0.408	2.04	2.04	U	

05/31/06 CC

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET02-AFI-VOC**

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147416

Lab File ID: 147416.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.04

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
95-47-6	o-Xylene	0.265	2.04	2.04	U	
79-34-5	1,1,2,2-Tetrachloroethane	0.184	2.04	2.04	U	
103-65-1	n-Propylbenzene	0.155	2.04	2.04	U	
108-67-8	1,3,5-Trimethylbenzene	0.490	2.04	2.04	U	
95-63-6	1,2,4-Trimethylbenzene	0.510	2.04	2.04	U-	LJ CCVH
541-73-1	1,3-DCB	0.347	2.04	2.04	U	
106-46-7	1,4-DCB	0.592	2.04	2.04	U	
95-50-1	1,2-DCB	0.592	2.04	2.04	U	
104-51-8	n-Butylbenzene	0.250	2.04	2.04	U	
120-82-1	1,2,4-Trichlorobenzene	0.388	2.04	2.04	U	LJ CCVH
87-68-3	Hexachlorobutadiene	0.571	2.04	2.04	U	
91-20-3	Naphthalene	0.710	4.08	4.08	U	

3

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET02-AFI-VOC**	**Lab ID:**	**F147416**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/13/2006
		Dilution Factor:	2.04
Sampling Date:	03/22/2006	Analysis Method:	TO-15
Sampling Time:	13:00	Report Revision No.:	0
Type:	Grab	Reported By:	B. Hayes
Matrix:	Air	Reviewed By:	
		Units:	PPBV

Compound Name	Sample Result	Qualifier
propane	46.9	J NJ TK
isobutane	62.4	J
2-methyl-1-propene	6.83	J
butane	63.2	J
decane	3.88	J
undecane	7.96	J

J=Estimated value
U=Not detected at specified reporting limits

05731100

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET03-AFI-VOC**

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147417

Lab File ID: 147417.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.06

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.268	2.06	0.391	J	
74-87-3	Chloromethane	0.330	2.06	0.680	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.206	2.06	2.06	U	
75-01-4	Vinyl Chloride	0.206	2.06	2.06	U	
74-83-9	Bromomethane	0.185	2.06	2.06	U	
75-00-3	Chloroethane	0.165	2.06	2.06	U	
75-69-4	Trichlorofluoromethane	0.103	2.06	0.185	J	
67-64-1	Acetone	0.474	2.06	14.8		
75-35-4	1,1-DCE	0.103	2.06	2.06	U	
75-09-2	Methylene Chloride	0.227	2.06	2.06 ~~1.69~~	~~J~~	4 LBL
76-13-1	Trichlorotrifluoroethane	0.103	2.06	2.06	U	
156-60-5	trans-1,2-DCE	0.144	2.06	2.06	U	
75-34-3	1,1-DCA	0.0618	2.06	2.06	U	
110-54-3	Hexane	0.474	2.06	2.06 ~~1.13~~	~~J~~	R LCSL
78-93-3	MEK (2-Butanone)	0.494	2.06	0.577	J	
156-59-2	cis-1,2-DCE	0.144	2.06	2.06	U	
67-66-3	Chloroform	0.0618	2.06	2.06	U	
107-06-2	1,2-DCA	0.0824	2.06	2.06	U	
71-55-6	1,1,1-TCA	0.103	2.06	2.06	U	
56-23-5	Carbon Tetrachloride	0.103	2.06	2.06	U	
71-43-2	Benzene	0.247	2.06	0.268	J	
78-87-5	1,2-Dichloropropane	0.144	2.06	2.06	U	
79-01-6	TCE	0.185	2.06	2.06	U	
10061-01-5	cis-1,3-Dichloropropene	0.165	2.06	2.06	~~U~~	LJ CCV H
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.659	2.06	2.06	U	
10061-02-6	trans-1,3-Dichloropropene	0.268	2.06	2.06	~~U~~	LJ CCV H
79-00-5	1,1,2-TCA	0.0824	2.06	2.06	U	
108-88-3	Toluene	0.206	2.06	0.371	J	
106-93-4	1,2-EDB	0.103	2.06	2.06	~~U~~	LJ CCV H
127-18-4	Tetrachloroethylene	0.103	2.06	2.06	U	
108-90-7	Chlorobenzene	0.124	2.06	2.06	U	
100-41-4	Ethylbenzene	0.268	2.06	2.06	U	
108-38-3/1	m,p-Xylene	0.556	4.12	4.12	U	
100-42-5	Styrene	0.412	2.06	2.06	U	

4/13/06

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET03-AFI-VOC**

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147417

Lab File ID: 147417.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.06

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
95-47-6	o-Xylene	0.268	2.06	2.06	U
79-34-5	1,1,2,2-Tetrachloroethane	0.185	2.06	2.06	U
103-65-1	n-Propylbenzene	0.156	2.06	2.06	U
108-67-8	1,3,5-Trimethylbenzene	0.494	2.06	2.06	U
95-63-6	1,2,4-Trimethylbenzene	0.515	2.06	2.06	U
541-73-1	1,3-DCB	0.350	2.06	2.06	U
106-46-7	1,4-DCB	0.597	2.06	2.06	U
95-50-1	1,2-DCB	0.597	2.06	2.06	U
104-51-8	n-Butylbenzene	0.252	2.06	2.06	U
120-82-1	1,2,4-Trichlorobenzene	0.391	2.06	2.06	U
87-68-3	Hexachlorobutadiene	0.577	2.06	2.06	U
91-20-3	Naphthalene	0.717	4.12	4.12	U

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID: TC60-ET03-AFI-VOC		**Lab ID: F147417**	
Project Name: DeMil International		Date Received: 04/04/2006	
		Date Analyzed: 04/13/2006	
		Dilution Factor: 2.06	
Sampling Date: 03/23/2006		Analysis Method: TO-15	
Sampling Time: 13:20		Report Revision No.: 0	
Type: Grab		Reported By: B. Hayes	
Matrix: Air		Reviewed By:	
		Units: PPBV	

Compound Name	Sample Result	Qualifier
propane	41.2	J NJ TIC
isobutane	54.8	J
2-methyl-1-propene	5.77	J
butane	64.9	J
undecane	9.23	J

J=Estimated value
U=Not detected at specified reporting limits

05/3,100

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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-Stack-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147418

Lab File ID: 147418.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.257	1.98	0.396	J	
74-87-3	Chloromethane	0.317	1.98	0.772	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.198	1.98	1.98	U	
75-01-4	Vinyl Chloride	0.198	1.98	1.98	U	
74-83-9	Bromomethane	0.178	1.98	1.98	U	
75-00-3	Chloroethane	0.158	1.98	1.98	U	
75-69-4	Trichlorofluoromethane	0.0990	1.98	0.178	J	
67-64-1	Acetone	0.455	1.98	99.7		
75-35-4	1,1-DCE	0.0990	1.98	1.98	U	
75-09-2	Methylene Chloride	0.218	1.98	13.0		
76-13-1	Trichlorotrifluoroethane	0.0990	1.98	1.98	U	
156-60-5	trans-1,2-DCE	0.139	1.98	1.98	U	
75-34-3	1,1-DCA	0.0594	1.98	1.98	U	
110-54-3	Hexane	0.455	1.98	1.98 ~~1.17~~	~~J~~	R LCSL
78-93-3	MEK (2-Butanone)	0.475	1.98	2.87		
156-59-2	cis-1,2-DCE	0.139	1.98	1.98	U	
67-66-3	Chloroform	0.0594	1.98	1.98	U	
107-06-2	1,2-DCA	0.0792	1.98	1.98	U	
71-55-6	1,1,1-TCA	0.0990	1.98	1.98	U	
56-23-5	Carbon Tetrachloride	0.0990	1.98	1.98	U	
71-43-2	Benzene	0.238	1.98	1.98	U	
78-87-5	1,2-Dichloropropane	0.139	1.98	1.98	U	
79-01-6	TCE	0.178	1.98	1.98	U	
10061-01-5	cis-1,3-Dichloropropene	0.158	1.98	1.98	~~U~~	LCJ CCVH
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.634	1.98	1.98	U	
10061-02-6	trans-1,3-Dichloropropene	0.257	1.98	1.98	~~U~~	LCJ CCVH
79-00-5	1,1,2-TCA	0.0792	1.98	1.98	U	
108-88-3	Toluene	0.198	1.98	3.54		
106-93-4	1,2-EDB	0.0990	1.98	1.98	~~U~~	LCJ CCVH
127-18-4	Tetrachloroethylene	0.0990	1.98	0.277	J	
108-90-7	Chlorobenzene	0.119	1.98	1.98	U	
100-41-4	Ethylbenzene	0.257	1.98	1.98	U	
108-38-3/1	m,p-Xylene	0.535	3.96	3.96	U	
100-42-5	Styrene	0.396	1.98	1.98	U	

05/31/06

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-Stack-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147418

Lab File ID: 147418.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
95-47-6	o-Xylene	0.257	1.98	1.98	U
79-34-5	1,1,2,2-Tetrachloroethane	0.178	1.98	1.98	U
103-65-1	n-Propylbenzene	0.150	1.98	1.98	U
108-67-8	1,3,5-Trimethylbenzene	0.475	1.98	1.98	U
95-63-6	1,2,4-Trimethylbenzene	0.495	1.98	1.98	~~U~~ UJ CCVH
541-73-1	1,3-DCB	0.337	1.98	1.98	U
106-46-7	1,4-DCB	0.574	1.98	1.98	U
95-50-1	1,2-DCB	0.574	1.98	1.98	U
104-51-8	n-Butylbenzene	0.243	1.98	1.98	U
120-82-1	1,2,4-Trichlorobenzene	0.376	1.98	1.98	U UJ CCVH
87-68-3	Hexachlorobutadiene	0.554	1.98	1.98	U
91-20-3	Naphthalene	0.689	3.96	3.96	U

05/31/06

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CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information	Lab Information
Client Sample ID: TC60-ET01-STACK-VOC	**Lab ID: F147418**
Project Name: DeMil International	Date Received: 04/04/2006
	Date Analyzed: 04/13/2006
	Dilution Factor: 1.98
Sampling Date: 03/21/2006	Analysis Method: TO-15
Sampling Time: 14:21	Report Revision No.: 0
Type: Grab	Reported By: B. Hayes
Matrix: Air	Reviewed By:
	Units: PPBV

Compound Name	Sample Result	Qualifier
propane	54.1	J NJ TIC
isobutane	49.1	J
2-methyl-1-propene	5.45	J
butane	52.3	J
2-methylbutane	10.0	J
alpha-pinene	5.48	J
2-methyldecane	3.27	J
undecane	21.2	J

J=Estimated value
U=Not detected at specified reporting limits

05/3/06

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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET02-Stack-VOC**

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147419

Lab File ID: 147419.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.03

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.264	2.03	0.386	J	
74-87-3	Chloromethane	0.325	2.03	0.914	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.203	2.03	2.03	U	
75-01-4	Vinyl Chloride	0.203	2.03	2.03	U	
74-83-9	Bromomethane	0.183	2.03	2.03	U	
75-00-3	Chloroethane	0.162	2.03	2.03	U	
75-69-4	Trichlorofluoromethane	0.102	2.03	0.122	J	
67-64-1	Acetone	0.467	2.03	21.6		
75-35-4	1,1-DCE	0.102	2.03	2.03	U	
75-09-2	Methylene Chloride	0.223	2.03	2.03 1.62	J-	LBL
76-13-1	Trichlorotrifluoroethane	0.102	2.03	2.03	U	
156-60-5	trans-1,2-DCE	0.142	2.03	2.03	U	
75-34-3	1,1-DCA	0.0609	2.03	2.03	U	
110-54-3	Hexane	0.467	2.03	2.03 0.812	J-	R LCSL
78-93-3	MEK (2-Butanone)	0.487	2.03	1.52	J	
156-59-2	cis-1,2-DCE	0.142	2.03	2.03	U	
67-66-3	Chloroform	0.0609	2.03	2.03	U	
107-06-2	1,2-DCA	0.0812	2.03	2.03	U	
71-55-6	1,1,1-TCA	0.102	2.03	2.03	U	
56-23-5	Carbon Tetrachloride	0.102	2.03	2.03	U	
71-43-2	Benzene	0.244	2.03	2.03	U	
78-87-5	1,2-Dichloropropane	0.142	2.03	2.03	U	
79-01-6	TCE	0.183	2.03	2.03	U	
10061-01-5	cis-1,3-Dichloropropene	0.162	2.03	2.03	U-	LJ CCVH
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.650	2.03	2.03	U	
10061-02-6	trans-1,3-Dichloropropene	0.264	2.03	2.03	U-	LJ CCVH
79-00-5	1,1,2-TCA	0.0812	2.03	2.03	U	
108-88-3	Toluene	0.203	2.03	0.670	J	
106-93-4	1,2-EDB	0.102	2.03	2.03	U-	LJ CCVH
127-18-4	Tetrachloroethylene	0.102	2.03	2.03	U	
108-90-7	Chlorobenzene	0.122	2.03	2.03	U	
100-41-4	Ethylbenzene	0.264	2.03	2.03	U	
108-38-3/1	m,p-Xylene	0.548	4.06	4.06	U	
100-42-5	Styrene	0.406	2.03	2.03	U	

05/31/06

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-Stack-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147419

Lab File ID: 147419.D

Date Received: 04/04/06

Date Analyzed: 04/13/06

Dilution Factor: 2.03

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
95-47-6	o-Xylene	0.264	2.03	2.03	U	
79-34-5	1,1,2,2-Tetrachloroethane	0.183	2.03	2.03	U	
103-65-1	n-Propylbenzene	0.154	2.03	2.03	U	
108-67-8	1,3,5-Trimethylbenzene	0.487	2.03	2.03	U	
95-63-6	1,2,4-Trimethylbenzene	0.508	2.03	2.03	U	CCJ CCV H
541-73-1	1,3-DCB	0.345	2.03	2.03	U	
106-46-7	1,4-DCB	0.589	2.03	2.03	U	
95-50-1	1,2-DCB	0.589	2.03	2.03	U	
104-51-8	n-Butylbenzene	0.249	2.03	2.03	U	
120-82-1	1,2,4-Trichlorobenzene	0.386	2.03	2.03	U	CCJ CCV H
87-68-3	Hexachlorobutadiene	0.568	2.03	2.03	U	
91-20-3	Naphthalene	0.706	4.06	4.06	U	

04/13/06

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET02-STACK-VOC**	**Lab ID:**	**F147419**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/13/2006
		Dilution Factor:	2.03
Sampling Date:	03/22/2006	Analysis Method:	TO-15
Sampling Time:	13:00	Report Revision No.:	0
Type:	Grab	Reported By:	B. Hayes
Matrix:	Air	Reviewed By:	
		Units:	PPBV

Compound Name	Sample Result	Qualifier
propane	45.9	J
isobutane	63.5	J
2-methyl-1-propene	5.46	J
butane	56.4	J
2-methylbutane	2.74	J
2-methyldecane	4.57	J
3-methyldecane	3.37	J
undecane	27.0	J
dodecane	2.17	J

NJ TIC

J=Estimated value
U=Not detected at specified reporting limits

CH2M HILL
Applied Sciences Group

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
Tel 541.752.4271 Fax 541.752.0276

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-Stack-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147420

Lab File ID: 147420.D

Date Received: 04/04/06

Date Analyzed: 04/14/06

Dilution Factor: 2.05

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
75-71-8	Dichlorodifluoromethane	0.267	2.05	0.410	J	
74-87-3	Chloromethane	0.328	2.05	0.718	J	
76-14-2	1,2-dichloro,1,1,2,2-tetrafl	0.205	2.05	2.05	U	
75-01-4	Vinyl Chloride	0.205	2.05	2.05	U	
74-83-9	Bromomethane	0.185	2.05	2.05	U	
75-00-3	Chloroethane	0.164	2.05	2.05	U	
75-69-4	Trichlorofluoromethane	0.103	2.05	0.185	J	
67-64-1	Acetone	0.472	2.05	157		
75-35-4	1,1-DCE	0.103	2.05	2.05	U	
75-09-2	Methylene Chloride	0.226	2.05	2.71		LI LBL
76-13-1	Trichlorotrifluoroethane	0.103	2.05	2.05	U	
156-60-5	trans-1,2-DCE	0.144	2.05	2.05	U	
75-34-3	1,1-DCA	0.0615	2.05	2.05	U	
110-54-3	Hexane	0.472	2.05	8.18		J LCSL
78-93-3	MEK (2-Butanone)	0.492	2.05	11.0		
156-59-2	cis-1,2-DCE	0.144	2.05	2.05	U	
67-66-3	Chloroform	0.0615	2.05	2.05	U	
107-06-2	1,2-DCA	0.0820	2.05	2.05	U	
71-55-6	1,1,1-TCA	0.103	2.05	2.05	U	
56-23-5	Carbon Tetrachloride	0.103	2.05	2.05	U	
71-43-2	Benzene	0.246	2.05	2.05	U	
78-87-5	1,2-Dichloropropane	0.144	2.05	2.05	U	
79-01-6	TCE	0.185	2.05	0.267	J	
10061-01-5	cis-1,3-Dichloropropene	0.164	2.05	2.05	~~U~~	LCJ CCVH
108-10-1	MIBK (Methyl Isobutyl Ketone)	0.656	2.05	2.05	U	
10061-02-6	trans-1,3-Dichloropropene	0.267	2.05	2.05	~~U~~	LCJ CCVH
79-00-5	1,1,2-TCA	0.0820	2.05	2.05	U	
108-88-3	Toluene	0.205	2.05	25.2		
106-93-4	1,2-EDB	0.103	2.05	2.05	U	LCJ CCVH
127-18-4	Tetrachloroethylene	0.103	2.05	2.05	U	
108-90-7	Chlorobenzene	0.123	2.05	2.05	U	
100-41-4	Ethylbenzene	0.267	2.05	2.05	U	
108-38-3/1	m,p-Xylene	0.554	4.10	4.10	U	
100-42-5	Styrene	0.410	2.05	2.05	U	

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-Stack-VOC

SDG No.: F1474

Analysis Method: TO15

Matrix: Air

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147420

Lab File ID: 147420.D

Date Received: 04/04/06

Date Analyzed: 04/14/06

Dilution Factor: 2.05

CONCENTRATION UNITS: ppbv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
95-47-6	o-Xylene	0.267	2.05	2.05	U
79-34-5	1,1,2,2-Tetrachloroethane	0.185	2.05	2.05	U
103-65-1	n-Propylbenzene	0.156	2.05	2.05	U
108-67-8	1,3,5-Trimethylbenzene	0.492	2.05	2.05	U
95-63-6	1,2,4-Trimethylbenzene	0.513	2.05	2.05	U
541-73-1	1,3-DCB	0.349	2.05	2.05	U
106-46-7	1,4-DCB	0.595	2.05	2.05	U
95-50-1	1,2-DCB	0.595	2.05	2.05	U
104-51-8	n-Butylbenzene	0.251	2.05	2.05	U
120-82-1	1,2,4-Trichlorobenzene	0.390	2.05	2.05	U
87-68-3	Hexachlorobutadiene	0.574	2.05	2.05	U
91-20-3	Naphthalene	0.713	4.10	4.10	U

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CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET03-STACK-VOC**	**Lab ID:**	**F147420**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/13/2006
		Dilution Factor:	2.05
Sampling Date:	03/23/2006	Analysis Method:	TO-15
Sampling Time:	13:20	Report Revision No.:	0
Type:	Grab	Reported By:	B. Hayes
Matrix:	Air	Reviewed By:	
		Units:	PPBV

Compound Name	Sample Result	Qualifier
propane	48.8	J NJ TIC
isobutane	94.3	J
2-methyl-1-propene	7.73	J
butane	80.8	J
2-methylbutane	96.1	J
4-methyldecane	3.40	J
2-methyldecane	8.06	J
3-methyldecane	5.64	J
undecane	43.7	J

J=Estimated value
U=Not detected at specified reporting limits

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ENVIRONMENTAL
Data Services, Inc.

VOLATILE ORGANIC HYDROCARBONS
USEPA Method ASTM D2820 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-BG-AIR-VOC	F1474-14	Air
2	TC60-ET01-AFI-VOC	F1474-15	Air
3	TC60-ET02-AFI-VOC	F1474-16	Air
4	TC60-ET03-AFI-VOC	F1474-17	Air
5	TC60-ET01-STACK-VOC	F1474-18	Air
6	TC60-ET02-STACK-VOC	F1474-19	Air
7	TC60-ET03-STACK-VOC	F1474-20	Air
7MD	TC60-ET03-STACK-VOCMD	F1474-20MD	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 30 days for air samples.

Initial Calibration - The initial calibrations exhibited acceptable %RSD values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D values.

MS/MSD - The matrix duplicate sample exhibited acceptable RPD values.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values.

Method Blank - The method blanks were free of contamination.

Trip, Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Quantitation - No discrepancies were identified.

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-BG-AIR-VOC**

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147414

Lab File ID: 007F1701.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 1.95

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0847	1.95	1.95	U
74-86-2	Acetylene	0.0423	1.95	1.95	U
74-98-6	C3	0.110	1.95	1.95	U
106-97-8	C4	0.166	1.95	1.95	U
109-66-0	C5	0.166	1.95	1.95	U
110-54-3	C6	0.186	1.95	1.95	U
74-82-8	C1	0.653	1.95	1.33	J
74-84-0	C2	0.100	1.95	1.95	U

05/31/06

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-AFI-VOC

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147415

Lab File ID: 008F1801.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0860	1.98	1.98	U
74-86-2	Acetylene	0.0430	1.98	1.98	U
74-98-6	C3	0.112	1.98	0.970	J
106-97-8	C4	0.169	1.98	1.98	U
109-66-0	C5	0.169	1.98	1.98	U
110-54-3	C6	0.189	1.98	1.98	U
74-82-8	C1	0.663	1.98	1.35	J
74-84-0	C2	0.102	1.98	1.98	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-AFI-VOC

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147416

Lab File ID: 009F1901.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 2.04

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0886	2.04	2.04	U
74-86-2	Acetylene	0.0443	2.04	2.04	U
74-98-6	C3	0.115	2.04	0.877	J
106-97-8	C4	0.174	2.04	2.04	U
109-66-0	C5	0.174	2.04	2.04	U
110-54-3	C6	0.195	2.04	2.04	U
74-82-8	C1	0.683	2.04	1.90	J
74-84-0	C2	0.105	2.04	2.04	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-AFI-VOC

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147417

Lab File ID: 010F2001.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 2.06

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0894	2.06	2.06	U
74-86-2	Acetylene	0.0447	2.06	2.06	U
74-98-6	C3	0.117	2.06	0.824	J
106-97-8	C4	0.175	2.06	2.06	U
109-66-0	C5	0.175	2.06	2.06	U
110-54-3	C6	0.197	2.06	2.06	U
74-82-8	C1	0.690	2.06	1.50	J
74-84-0	C2	0.106	2.06	2.06	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-Stack-VOC

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147418

Lab File ID: 011F2101.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 1.98

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0860	1.98	1.98	U
74-86-2	Acetylene	0.0430	1.98	1.98	U
74-98-6	C3	0.112	1.98	0.891	J
106-97-8	C4	0.169	1.98	1.98	U
109-66-0	C5	0.169	1.98	1.98	U
110-54-3	C6	0.189	1.98	1.98	U
74-82-8	C1	0.663	1.98	1.76	J
74-84-0	C2	0.102	1.98	1.98	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-Stack-VOC

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147419

Lab File ID: 012F2201.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 2.03

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0881	2.03	2.03	U
74-86-2	Acetylene	0.0441	2.03	2.03	U
74-98-6	C3	0.115	2.03	0.751	J
106-97-8	C4	0.173	2.03	2.03	U
109-66-0	C5	0.173	2.03	2.03	U
110-54-3	C6	0.194	2.03	2.03	U
74-82-8	C1	0.680	2.03	1.50	J
74-84-0	C2	0.104	2.03	2.03	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET03-Stack-VOC**

SDG No.: F1474

Analysis Method: ASTM D2820

Matrix: Air

Sample wt/vol: (g/mL) 1 ML

Level: (low/med) LOW

GC Column: ALUMINA ID: 0.53 (mm)

Instrument Name: GCA

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147420

Lab File ID: 013F2301.D

Date Received: 04/04/06

Date Analyzed: 04/18/06

Dilution Factor: 2.03

CONCENTRATION UNITS: ppmv

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
74-85-1	Ethene	0.0881	2.03	2.03	U
74-86-2	Acetylene	0.0441	2.03	2.03	U
74-98-6	C3	0.116	2.05	0.800	J
106-97-8	C4	0.175	2.05	0.185	J
109-66-0	C5	0.175	2.05	2.05	U
110-54-3	C6	0.196	2.05	2.05	U
74-82-8	C1	0.687	2.05	1.80	J
74-84-0	C2	0.105	2.05	2.05	U

ENVIRONMENTAL
Data Services, Inc.

SEMIVOLATILE ORGANIC COMPOUNDS
USEPA SW846 Method 8270 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-RB-MM5	F1474-10	Air
2	TC60-ET01-MM5	F1474-11	Air
3	TC60-ET02-MM5	F1474-12	Air
4	TC60-ET03-MM5	F1474-13	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, was used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 14 days for air samples and analyzed within 40 days for all samples except the following.

Sample	Date Sampled	Date Extracted	# of Days	Qualifier
1	03/23/06	04/17/06	25	J/UJ
2	03/21/06	04/17/06	27	J/UJ
3	03/22/06	04/17/06	26	J/UJ
4	03/23/06	04/17/06	25	J/UJ

GC/MS Tuning - All of the DFTPP tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values except the following.

CCAL Date	Compound	%D/RRF	Qualifier	Affected Samples
04/19/06	Bis(2-Chloroisopropyl) ether	26.9% D	None	Already Qualified

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - A MS/MSD sample was not analyzed.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values except the following.

LCS ID	Compound	%R	Qualifier	Affected Samples
BS1X0417	Hexachlorocyclopentadiene	7%	R	All Samples

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ug	Action Level ug	Qualifier	Affected Samples
XB1-0417	Benzoic Acid	32.5	162.5	U	All Samples

Field, Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug	Action Level ug	Qualifier	Affected Samples
TC60-RB-MM5	Bis(2-Ethylhexyl)phthalate	1.47	14.7	U	2, 3, 4

Field Duplicates - Field duplicate samples were not analyzed.

Tentatively Identified Compounds (TICs) - All TICs were qualified as estimated (NJ).

Compound Quantitation - No discrepancies were identified.

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-RB-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147410

Lab File ID: 147410.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
62-75-9	N-Nitrosodimethylamine	0.608	10.0	10.0	U	UJ HTP
110-86-1	Pyridine	1.21	10.0	10.0	U	
108-95-2	Phenol	3.34	10.0	10.0	U	
111-44-4	bis(2-Chloroethyl)ether	0.687	10.0	10.0	U	
95-57-8	2-Chlorophenol	2.40	10.0	10.0	U	
541-73-1	1,3-DCB	0.909	10.0	10.0	U	
106-46-7	1,4-DCB	1.01	10.0	10.0	U	
100-51-6	Benzyl Alcohol	0.580	20.0	20.0	U	
95-50-1	1,2-DCB	0.890	10.0	10.0	U	
95-48-7	2-Methylphenol	3.09	10.0	10.0	U	
108-60-1	Bis(2-chloroisopropyl) Ether	0.709	10.0	10.0	~~U~~	UJ
108-39-4/1	m,p-Cresol	3.06	10.0	10.0	U	UJ
621-64-7	N-Nitroso-di-n-propylamine	0.554	10.0	10.0	U	
67-72-1	Hexachloroethane	0.902	10.0	10.0	U	
65-85-0	Benzoic Acid	1.10	50.0	SC 42.9	~~J~~	UJ LBL
98-95-3	Nitrobenzene	0.728	10.0	10.0	U	UJ HTP
78-59-1	Isophorone	0.620	10.0	10.0	U	
88-75-5	2-Nitrophenol	2.84	10.0	10.0	U	
105-67-9	2,4-Dimethylphenol	3.10	10.0	10.0	U	
111-91-1	bis(2-Chloroethoxy)methane	0.549	10.0	10.0	U	
120-83-2	2,4-Dichlorophenol	2.71	10.0	10.0	U	
120-82-1	1,2,4-Trichlorobenzene	0.812	10.0	10.0	U	
91-20-3	Naphthalene	0.643	10.0	10.0	U	
106-47-8	4-Chloroaniline	2.35	10.0	10.0	U	
87-68-3	Hexachlorobutadiene	0.874	10.0	10.0	U	
59-50-7	4-Chloro-3-Methyl Phenol	2.36	10.0	10.0	U	
91-57-6	2-Methylnaphthalene	0.702	10.0	10.0	U	
77-47-4	Hexachlorocyclopentadiene	0.524	10.0	10.0	~~U~~	R LCSL
88-06-2	2,4,6-Trichlorophenol	2.84	10.0	10.0	U	UJ HTP
95-95-4	2,4,5-Trichlorophenol	2.50	25.0	25.0	U	
91-58-7	2-Chloronaphthalene	0.633	10.0	10.0	U	
88-74-4	2-Nitroaniline	0.496	25.0	25.0	U	
131-11-3	Dimethylphthalate	0.511	10.0	10.0	U	
208-96-8	Acenaphthylene	0.654	10.0	10.0	U	

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-RB-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147410

Lab File ID: 147410.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
606-20-2	2,6-Dinitrotoluene	0.500	10.0	10.0	U	UJ HTP
83-32-9	Acenaphthene	0.529	10.0	10.0	U	
51-28-5	2,4-Dinitrophenol	2.66	25.0	25.0	U	
100-02-7	4-Nitrophenol	3.18	10.0	10.0	U	
121-14-2	2,4-Dinitrotoluene	0.643	10.0	10.0	U	
132-64-9	Dibenzofuran	0.573	10.0	10.0	U	
84-66-2	Diethylphthalate	0.534	10.0	10.0	U	
99-09-2	3-Nitroaniline	0.566	25.0	25.0	U	
86-73-7	Fluorene	0.544	10.0	10.0	U	
7005-72-3	4-Chlorophenyl phenyl ether	0.579	10.0	10.0	U	
100-01-6	4-Nitroaniline	0.569	25.0	25.0	U	
534-52-1	4,6-Dinitro-2-Methyl Phenol	2.43	25.0	25.0	U	
86-30-6	N-Nitrosodiphenylamine	0.554	10.0	10.0	U	
122-66-7	1,2-Diphenylhydrazine	0.576	10.0	10.0	U	
101-55-3	4-Bromophenyl phenyl ether	0.559	10.0	10.0	U	
118-74-1	Hexachlorobenzene	0.585	10.0	10.0	U	
87-86-5	Pentachlorophenol	2.89	25.0	25.0	U	
85-01-8	Phenanthrene	0.608	10.0	10.0	U	
120-12-7	Anthracene	0.633	10.0	10.0	U	
86-74-8	Carbazole	0.604	10.0	10.0	U	
84-74-2	Di-n-butylphthalate	0.570	10.0	10.0	U	
206-44-0	Fluoranthene	0.632	10.0	10.0	U	
129-00-0	Pyrene	0.506	10.0	10.0	U	
85-68-7	Butylbenzylphthalate	0.502	10.0	10.0	U	
56-55-3	Benzo(a)anthracene	0.511	10.0	10.0	U	
91-94-1	3,3'-Dichlorobenzidine	0.621	10.0	10.0	U	
218-01-9	Chrysene	0.586	10.0	10.0	U	
117-81-7	bis(2-Ethylhexyl)phthalate	1.02	10.0	1.47	J	J HTP
117-84-0	Di-n-octylphthalate	0.701	10.0	10.0	U	UJ HTP
205-99-2	Benzo(b)fluoroanthene	0.637	10.0	10.0	U	
207-08-9	Benzo(k)fluoranthene	0.668	10.0	10.0	U	
50-32-8	Benzo(a)pyrene	0.599	10.0	10.0	U	
193-39-5	Indeno(1,2,3-c,d)pyrene	0.678	10.0	10.0	U	
53-70-3	Dibenzo(a,h)anthracene	0.568	10.0	10.0	U	

513106

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-RB-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147410

Lab File ID: 147410.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
191-24-2	Benzo(g,h,i)perylene	0.558	10.0	10.0	U

C-161

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-RB-MM5**	**Lab ID:**	**F147410**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/19/2006
		Dilution Factor:	2.44
Sampling Date:	03/23/2006	Analysis Method:	SW8270
Sampling Time:	15:15	Report Revision No.:	0
Type:	Composite	Reported By:	JJB
Matrix:	Air	Reviewed By:	
		Units:	ug

Compound Name	Sample Result	Qualifier
1,4-Thioxane *	10.0	U
1,4-Dithane *	10.0	U
Butanoic acid, methyl ester	9.50	J
2-Hexanol	22.5	J
Methylbenzene	10.5	J
Tetrachloroetene	17.1	J
Decane	6.98	J
Ethylbenzaldehyde	6.74	J

* Forward library search performed for this compound
J=Estimated value - TIC result
U=Not detected at specified reporting limits

CH2M HILL
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SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

2

Field Sample ID: **TC60-ET01-MM5**

SDG No.: F1474
Analysis Method: SW8270
Matrix: AIR
Level: (LOW/MED) LOW
Extraction Method: SW3540
Concentrated Extract Volume: (ML) 1
Injection Volume: (UL) 2
Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO
Lab Sample ID: F147411
Lab File ID: 147411.D
Date Received: 04/04/06
Date Extracted: 04/17/06
Date Analyzed: 04/19/06
Dilution Factor: 1
CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
62-75-9	N-Nitrosodimethylamine	0.608	10.0	10.0	U	UJ HTP
110-86-1	Pyridine	1.21	10.0	10.0	U	
108-95-2	Phenol	3.34	10.0	10.0	U	
111-44-4	bis(2-Chloroethyl)ether	0.687	10.0	10.0	U	
95-57-8	2-Chlorophenol	2.40	10.0	10.0	U	
541-73-1	1,3-DCB	0.909	10.0	10.0	U	
106-46-7	1,4-DCB	1.01	10.0	1.05	J	J
100-51-6	Benzyl Alcohol	0.580	20.0	20.0	U	UJ
95 50-1	1,2-DCB	0.890	10.0	10.0	U	
95-48-7	2-Methylphenol	3.09	10.0	10.0	U	
108-60-1	Bis(2-chloroisopropyl) Ether	0.709	10.0	10.0	U	UJ
108-39-4/1	m,p-Cresol	3.06	10.0	10.0	U	
621-64-7	N-Nitroso-di-n-propylamine	0.554	10.0	10.0	U	
67-72-1	Hexachloroethane	0.902	10.0	10.0	U	
65-85-0	Benzoic Acid	1.10	50.0	50.0 26.2	J	UJ LBL
98-95-3	Nitrobenzene	0.728	10.0	10.0	U	UJ HTP
78-59-1	Isophorone	0.620	10.0	10.0	U	
88-75-5	2-Nitrophenol	2.84	10.0	10.0	U	
105-67-9	2,4-Dimethylphenol	3.10	10.0	10.0	U	
111-91-1	bis(2-Chloroethoxy)methane	0.549	10.0	10.0	U	
120-83-2	2,4-Dichlorophenol	2.71	10.0	10.0	U	
120-82-1	1,2,4-Trichlorobenzene	0.812	10.0	10.0	U	
91-20-3	Naphthalene	0.643	10.0	1.30	J	J
106-47-8	4-Chloroaniline	2.35	10.0	10.0	U	UJ
87-68-3	Hexachlorobutadiene	0.874	10.0	10.0	U	
59-50-7	4-Chloro-3-Methyl Phenol	2.36	10.0	10.0	U	
91-57-6	2-Methylnaphthalene	0.702	10.0	10.0	U	
77-47-4	Hexachlorocyclopentadiene	0.524	10.0	10.0	U	R LCSL
88-06-2	2,4,6-Trichlorophenol	2.84	10.0	10.0	U	UJ HTP
95-95-4	2,4,5-Trichlorophenol	2.50	25.0	25.0	U	
91-58-7	2-Chloronaphthalene	0.633	10.0	10.0	U	
88-74-4	2-Nitroaniline	0.496	25.0	25.0	U	
131-11-3	Dimethylphthalate	0.511	10.0	10.0	U	
208-96-8	Acenaphthylene	0.654	10.0	10.0	U	

05/31/06

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SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147411

Lab File ID: 147411.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
606-20-2	2,6-Dinitrotoluene	0.500	10.0	10.0	U
83-32-9	Acenaphthene	0.529	10.0	10.0	U
51-28-5	2,4-Dinitrophenol	2.66	25.0	25.0	U
100-02-7	4-Nitrophenol	3.18	10.0	10.0	U
121-14-2	2,4-Dinitrotoluene	0.643	10.0	10.0	U
132-64-9	Dibenzofuran	0.573	10.0	10.0	U
84-66-2	Diethylphthalate	0.534	10.0	10.0	U
99-09-2	3-Nitroaniline	0.566	25.0	25.0	U
86-73-7	Fluorene	0.544	10.0	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	0.579	10.0	10.0	U
100-01-6	4-Nitroaniline	0.569	25.0	25.0	U
534-52-1	4,6-Dinitro-2-Methyl Phenol	2.43	25.0	25.0	U
86-30-6	N-Nitrosodiphenylamine	0.554	10.0	10.0	U
122-66-7	1,2-Diphenylhydrazine	0.576	10.0	10.0	U
101-55-3	4-Bromophenyl phenyl ether	0.559	10.0	10.0	U
118-74-1	Hexachlorobenzene	0.585	10.0	10.0	U
87-86-5	Pentachlorophenol	2.89	25.0	25.0	U
85-01-8	Phenanthrene	0.608	10.0	10.0	U
120-12-7	Anthracene	0.633	10.0	10.0	U
86-74-8	Carbazole	0.604	10.0	10.0	U
84-74-2	Di-n-butylphthalate	0.570	10.0	0.970	J
206-44-0	Fluoranthene	0.632	10.0	10.0	U
129-00-0	Pyrene	0.506	10.0	10.0	U
85-68-7	Butylbenzylphthalate	0.502	10.0	0.560	J
56-55-3	Benzo(a)anthracene	0.511	10.0	10.0	U
91-94-1	3,3'-Dichlorobenzidine	0.621	10.0	10.0	U
218-01-9	Chrysene	0.586	10.0	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	1.02	10.0	2.59	J
117-84-0	Di-n-octylphthalate	0.701	10.0	10.0	U
205-99-2	Benzo(b)fluoroanthene	0.637	10.0	10.0	U
207-08-9	Benzo(k)fluoranthene	0.668	10.0	10.0	U
50-32-8	Benzo(a)pyrene	0.599	10.0	10.0	U
193-39-5	Indeno(1,2,3-c,d)pyrene	0.678	10.0	10.0	U
53-70-3	Dibenzo(a,h)anthracene	0.568	10.0	10.0	U

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

2

Field Sample ID:

TC60-ET01-MM5

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147411

Lab File ID: 147411.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
191-24-2	Benzo(g,h,i)perylene	0.558	10.0	10.0	U

UJ HTP

2

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET01-MM5**	**Lab ID:**	**F147411**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/19/2006
		Dilution Factor:	2.44
Sampling Date:	03/21/2006	Analysis Method:	SW8270
Sampling Time:	15:03	Report Revision No.:	0
Type:	Composite	Reported By:	JJB
Matrix:	Air	Reviewed By:	
		Units:	ug

Compound Name	Sample Result	Qualifier
1,4-Thioxane *	10.0	U
1,4-Dithane *	10.0	U
Butanoic acid, methyl ester	19.4	J
2-Hexanol	24.0	J
Methylbenzene	877	JE
Methyl 2-methylbutanoate	5.53	J
Tetrachloroetene	9.35	J
Decane	8.21	J
Ethylbenzaldehyde	8.35	J
Octacosane	5.09	J
Heptacosane	5.16	J
Oleamide	10.1	J

NJ TIC

* Forward library search performed for this compound
J=Estimated value - TIC result
U=Not detected at specified reporting limits
E=Estimated value - result well beyond linearity of the detector

05131CCa

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1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET02-MM5

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147412

Lab File ID: 147412.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
62-75-9	N-Nitrosodimethylamine	0.608	10.0	10.0	U	UJ HTP
110-86-1	Pyridine	1.21	10.0	10.0	U	
108-95-2	Phenol	3.34	10.0	10.0	U	
111-44-4	bis(2-Chloroethyl)ether	0.687	10.0	10.0	U	
95-57-8	2-Chlorophenol	2.40	10.0	10.0	U	
541-73-1	1,3-DCB	0.909	10.0	10.0	U	
106-46-7	1,4-DCB	1.01	10.0	10.0	U	
100-51-6	Benzyl Alcohol	0.580	20.0	20.0	U	
95 50-1	1,2-DCB	0.890	10.0	10.0	U	
95-48-7	2-Methylphenol	3.09	10.0	10.0	U	
108-60-1	Bis(2-chloroisopropyl) Ether	0.709	10.0	10.0	U	UJ
108-39-4/1	m,p-Cresol	3.06	10.0	10.0	U	
621-64-7	N-Nitroso-di-n-propylamine	0.554	10.0	10.0	U	
67-72-1	Hexachloroethane	0.902	10.0	10.0	U	
65-85-0	Benzoic Acid	1.10	50.0	SC.C 8.77	J	UJ LBL
98-95-3	Nitrobenzene	0.728	10.0	10.0	U	UJ HTP
78-59-1	Isophorone	0.620	10.0	10.0	U	
88-75-5	2-Nitrophenol	2.84	10.0	10.0	U	
105-67-9	2,4-Dimethylphenol	3.10	10.0	10.0	U	
111-91-1	bis(2-Chloroethoxy)methane	0.549	10.0	10.0	U	
120-83-2	2,4-Dichlorophenol	2.71	10.0	10.0	U	
120-82-1	1,2,4-Trichlorobenzene	0.812	10.0	10.0	U	
91-20-3	Naphthalene	0.643	10.0	10.0	U	
106-47-8	4-Chloroaniline	2.35	10.0	10.0	U	
87-68-3	Hexachlorobutadiene	0.874	10.0	10.0	U	
59-50-7	4-Chloro-3-Methyl Phenol	2.36	10.0	10.0	U	
91-57-6	2-Methylnaphthalene	0.702	10.0	10.0	U	
77-47-4	Hexachlorocyclopentadiene	0.524	10.0	10.0	U	R LCSL
88-06-2	2,4,6-Trichlorophenol	2.84	10.0	10.0	U	UJ HTP
95-95-4	2,4,5-Trichlorophenol	2.50	25.0	25.0	U	
91-58-7	2-Chloronaphthalene	0.633	10.0	10.0	U	
88-74-4	2-Nitroaniline	0.496	25.0	25.0	U	
131-11-3	Dimethylphthalate	0.511	10.0	10.0	U	
208-96-8	Acenaphthylene	0.654	10.0	10.0	U	

05/31/06

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

3

Field Sample ID:

TC60-ET02-MM5

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147412

Lab File ID: 147412.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
606-20-2	2,6-Dinitrotoluene	0.500	10.0	10.0	U
83-32-9	Acenaphthene	0.529	10.0	10.0	U
51-28-5	2,4-Dinitrophenol	2.66	25.0	25.0	U
100-02-7	4-Nitrophenol	3.18	10.0	10.0	U
121-14-2	2,4-Dinitrotoluene	0.643	10.0	10.0	U
132-64-9	Dibenzofuran	0.573	10.0	10.0	U
84-66-2	Diethylphthalate	0.534	10.0	10.0	U
99-09-2	3-Nitroaniline	0.566	25.0	25.0	U
86-73-7	Fluorene	0.544	10.0	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	0.579	10.0	10.0	U
100-01-6	4-Nitroaniline	0.569	25.0	25.0	U
534-52-1	4,6-Dinitro-2-Methyl Phenol	2.43	25.0	25.0	U
86-30-6	N-Nitrosodiphenylamine	0.554	10.0	10.0	U
122-66-7	1,2-Diphenylhydrazine	0.576	10.0	10.0	U
101-55-3	4-Bromophenyl phenyl ether	0.559	10.0	10.0	U
118-74-1	Hexachlorobenzene	0.585	10.0	10.0	U
87-86-5	Pentachlorophenol	2.89	25.0	25.0	U
85-01-8	Phenanthrene	0.608	10.0	10.0	U
120-12-7	Anthracene	0.633	10.0	10.0	U
86-74-8	Carbazole	0.604	10.0	10.0	U
84-74-2	Di-n-butylphthalate	0.570	10.0	0.780	J
206-44-0	Fluoranthene	0.632	10.0	10.0	U
129-00-0	Pyrene	0.506	10.0	10.0	U
85-68-7	Butylbenzylphthalate	0.502	10.0	10.0	U
56-55-3	Benzo(a)anthracene	0.511	10.0	10.0	U
91-94-1	3,3'-Dichlorobenzidine	0.621	10.0	10.0	U
218-01-9	Chrysene	0.586	10.0	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	1.02	10.0	~~2.23~~	~~J~~
117-84-0	Di-n-octylphthalate	0.701	10.0	10.0	U
205-99-2	Benzo(b)fluoroanthene	0.637	10.0	10.0	U
207-08-9	Benzo(k)fluoranthene	0.668	10.0	10.0	U
50-32-8	Benzo(a)pyrene	0.599	10.0	10.0	U
193-39-5	Indeno(1,2,3-c,d)pyrene	0.678	10.0	10.0	U
53-70-3	Dibenzo(a,h)anthracene	0.568	10.0	10.0	U

CFJ HTP

J

WJ

WJ FBL

WJ HTP

4/12/06 cc

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET02-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147412

Lab File ID: 147412.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
191-24-2	Benzo(g,h,i)perylene	0.558	10.0	10.0	U

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET02-MM5**	**Lab ID:**	**F147412**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/19/2006
		Dilution Factor:	2.44
Sampling Date:	03/22/2006	Analysis Method:	SW8270
Sampling Time:	14:20	Report Revision No.:	0
Type:	Composite	Reported By:	JJB
Matrix:	Air	Reviewed By:	BC
		Units:	ug

Compound Name	Sample Result	Qualifier
1,4-Thioxane *	10.0	U
1,4-Dithane *	10.0	U
Butanoic acid, methyl ester	14.3	J NJ TIC
2-Hexanol	22.4	J
Methylbenzene	546	JE
Tetrachloroetene	8.09	J
Decane	7.65	J
Ethylbenzaldehyde	6.77	J
Oleamide	6.47	J

* Forward library search performed for this compound
J=Estimated value - TIC result
U=Not detected at specified reporting limits
E=Estimated value - result well beyond linearity of the detector

05/31/06 cc

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SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

4

Field Sample ID: **TC60-ET03-MM5**

SDG No.: F1474
Analysis Method: SW8270
Matrix: AIR
Level: (LOW/MED) LOW
Extraction Method: SW3540
Concentrated Extract Volume: (ML) 1
Injection Volume: (UL) 2
Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO
Lab Sample ID: F147413
Lab File ID: 147413.D
Date Received: 04/04/06
Date Extracted: 04/17/06
Date Analyzed: 04/19/06
Dilution Factor: 1
CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q	
62-75-9	N-Nitrosodimethylamine	0.608	10.0	10.0	U	LCJ HTP
110-86-1	Pyridine	1.21	10.0	10.0	U	
108-95-2	Phenol	3.34	10.0	10.0	U	
111-44-4	bis(2-Chloroethyl)ether	0.687	10.0	10.0	U	
95-57-8	2-Chlorophenol	2.40	10.0	10.0	U	
541-73-1	1,3-DCB	0.909	10.0	10.0	U	
106-46-7	1,4-DCB	1.01	10.0	10.0	U	
100-51-6	Benzyl Alcohol	0.580	20.0	20.0	U	
95-50-1	1,2-DCB	0.890	10.0	10.0	U	
95-48-7	2-Methylphenol	3.09	10.0	10.0	U	
108-60-1	Bis(2-chloroisopropyl) Ether	0.709	10.0	10.0	U	LCJ
108-39-4/1	m,p-Cresol	3.06	10.0	10.0	U	
621-64-7	N-Nitroso-di-n-propylamine	0.554	10.0	10.0	U	
67-72-1	Hexachloroethane	0.902	10.0	10.0	U	
65-85-0	Benzoic Acid	1.10	50.0	50.0 17.8	J	LCJLBL
98-95-3	Nitrobenzene	0.728	10.0	10.0	U	LCJ HTP
78-59-1	Isophorone	0.620	10.0	10.0	U	
88-75-5	2-Nitrophenol	2.84	10.0	10.0	U	
105-67-9	2,4-Dimethylphenol	3.10	10.0	10.0	U	
111-91-1	bis(2-Chloroethoxy)methane	0.549	10.0	10.0	U	
120-83-2	2,4-Dichlorophenol	2.71	10.0	10.0	U	
120-82-1	1,2,4-Trichlorobenzene	0.812	10.0	10.0	U	
91-20-3	Naphthalene	0.643	10.0	10.0	U	
106-47-8	4-Chloroaniline	2.35	10.0	10.0	U	
87-68-3	Hexachlorobutadiene	0.874	10.0	10.0	U	
59-50-7	4-Chloro-3-Methyl Phenol	2.36	10.0	10.0	U	
91-57-6	2-Methylnaphthalene	0.702	10.0	10.0	U	
77-47-4	Hexachlorocyclopentadiene	0.524	10.0	10.0	U	R LCSL
88-06-2	2,4,6-Trichlorophenol	2.84	10.0	10.0	U	LCJ HTP
95-95-4	2,4,5-Trichlorophenol	2.50	25.0	25.0	U	
91-58-7	2-Chloronaphthalene	0.633	10.0	10.0	U	
88-74-4	2-Nitroaniline	0.496	25.0	25.0	U	
131-11-3	Dimethylphthalate	0.511	10.0	10.0	U	
208-96-8	Acenaphthylene	0.654	10.0	10.0	U	

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET03-MM5**

SDG No.: F1474
Analysis Method: SW8270
Matrix: AIR
Level: (LOW/MED) LOW
Extraction Method: SW3540
Concentrated Extract Volume: (ML) 1
Injection Volume: (UL) 2
Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO
Lab Sample ID: F147413
Lab File ID: 147413.D
Date Received: 04/04/06
Date Extracted: 04/17/06
Date Analyzed: 04/19/06
Dilution Factor: 1
CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
606-20-2	2,6-Dinitrotoluene	0.500	10.0	10.0	U
83-32-9	Acenaphthene	0.529	10.0	10.0	U
51-28-5	2,4-Dinitrophenol	2.66	25.0	25.0	U
100-02-7	4-Nitrophenol	3.18	10.0	10.0	U
121-14-2	2,4-Dinitrotoluene	0.643	10.0	10.0	U
132-64-9	Dibenzofuran	0.573	10.0	10.0	U
84-66-2	Diethylphthalate	0.534	10.0	10.0	U
99-09-2	3-Nitroaniline	0.566	25.0	25.0	U
86-73-7	Fluorene	0.544	10.0	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	0.579	10.0	10.0	U
100-01-6	4-Nitroaniline	0.569	25.0	25.0	U
534-52-1	4,6-Dinitro-2-Methyl Phenol	2.43	25.0	25.0	U
86-30-6	N-Nitrosodiphenylamine	0.554	10.0	10.0	U
122-66-7	1,2-Diphenylhydrazine	0.576	10.0	10.0	U
101-55-3	4-Bromophenyl phenyl ether	0.559	10.0	10.0	U
118-74-1	Hexachlorobenzene	0.585	10.0	10.0	U
87-86-5	Pentachlorophenol	2.89	25.0	25.0	U
85-01-8	Phenanthrene	0.608	10.0	10.0	U
120-12-7	Anthracene	0.633	10.0	10.0	U
86-74-8	Carbazole	0.604	10.0	10.0	U
84-74-2	Di-n-butylphthalate	0.570	10.0	0.720	J
206-44-0	Fluoranthene	0.632	10.0	10.0	U
129-00-0	Pyrene	0.506	10.0	10.0	U
85-68-7	Butylbenzylphthalate	0.502	10.0	10.0	U
56-55-3	Benzo(a)anthracene	0.511	10.0	10.0	U
91-94-1	3,3'-Dichlorobenzidine	0.621	10.0	10.0	U
218-01-9	Chrysene	0.586	10.0	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	1.02	10.0	1.97	J
117-84-0	Di-n-octylphthalate	0.701	10.0	10.0	U
205-99-2	Benzo(b)fluoroanthene	0.637	10.0	10.0	U
207-08-9	Benzo(k)fluoranthene	0.668	10.0	10.0	U
50-32-8	Benzo(a)pyrene	0.599	10.0	10.0	U
193-39-5	Indeno(1,2,3-c,d)pyrene	0.678	10.0	10.0	U
53-70-3	Dibenzo(a,h)anthracene	0.568	10.0	10.0	U

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

4

Field Sample ID: **TC60-ET03-MM5**

SDG No.: F1474

Analysis Method: SW8270

Matrix: AIR

Level: (LOW/MED) LOW

Extraction Method: SW3540

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 2

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147413

Lab File ID: 147413.D

Date Received: 04/04/06

Date Extracted: 04/17/06

Date Analyzed: 04/19/06

Dilution Factor: 1

CONCENTRATION UNITS: ug

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
191-24-2	Benzo(g,h,i)perylene	0.558	10.0	10.0	U

w J HTP

CH2M Hill Applied Sciences Lab

TIC REPORT

Client Information		Lab Information	
Client Sample ID:	**TC60-ET03-MM5**	**Lab ID:**	**F147413**
Project Name:	DeMil International	Date Received:	04/04/2006
		Date Analyzed:	04/19/2006
		Dilution Factor:	2.44
Sampling Date:	03/23/2006	Analysis Method:	SW8270
Sampling Time:	13:38	Report Revision No.:	0
Type:	Composite	Reported By:	JJB
Matrix:	Air	Reviewed By:	BG
		Units:	ug

Compound Name	Sample Result	Qualifier
1,4-Thioxane *	10.0	U
1,4-Dithane *	10.0	U
Butanoic acid, methyl ester	20.1	J NJ TIC
2-Hexanol	24.7	J
Methylbenzene	994	JE
Tetrachloroetene	9.02	J
Decane	7.77	J
Ethylbenzaldehyde	7.32	J
Triphenylphospine oxide	5.17	J

* Forward library search performed for this compound
J=Estimated value - TIC result

05/31/06

CH2M HILL
Applied Sciences Group

2300 NW Walnut Blvd., Corvallis, OR 97330-3538
P.O. Box 428, Corvallis, OR 97339-0428
Tel 541.752.4271 Fax 541.752.0276

ENVIRONMENTAL
Data Services, Inc.

POLYCHLORINATED DIBENZODIOXINS and POLYCHLORINATED DIBENZOFURANS (PCDD/PCDF)

USEPA Method 23 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474/27534

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: Alta Analytical Laboratory Inc, El Dorado Hills, CA Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-M23	27534-001	Air
2	TC60-ET02-M23	27534-002	Air
3	TC60-ET03-M23	27534-003	Air
4	TC60-RB-M23	27534-004	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review," September 2005, was used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 30 days of collection and analyzed 45 days after extraction.

Initial Calibration - The initial calibrations were not included in the data package.

Continuing Calibration - The continuing calibrations were not included in the data package.

Column Performance Check - Information was not provided in the data package.

Surrogates - All surrogate recovery values met QC acceptance criteria and no qualifications were required.

MS/MSD - A MS/MSD sample was not analyzed.

Laboratory Control Sample - The LCS sample exhibited results within QC criteria.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks were free of contamination.

Field, Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. pg/sample	Action Level	Qualifier	Affected Samples
TC60-RB-M23	None - ND	--	--	--	--

Field Duplicates - Field duplicate samples were not analyzed.

Compound Identification - Retention times were not provided.

Compound Quantitation - No discrepancies were noted.

ALTA

Sample ID:	TC60-ET01-M23				EPA Method 23

Client Data

Name:	CH2M Hill Laboratory
Project:	TC60 CDC Environmental Test
Date Collected:	21-Mar-06
Time Collected:	1503

Sample Data

Matrix:	MM5
Sample Size:	Sample

Laboratory Data

Lab Sample:	27534-001	Date Received:	31-Mar-06
QC Batch No.:	7898	Date Extracted:	4-Apr-06
Date Analyzed DB-5:	5-Apr-06	Date Analyzed DB-225:	NA

Analyte	Conc. (pg/Sample)	DL [a]	EMPC [b]	Qualifiers
2,3,7,8-TCDD	ND	1.12		
1,2,3,7,8-PeCDD	ND	1.63		
1,2,3,4,7,8-HxCDD	ND	1.84		
1,2,3,6,7,8-HxCDD	ND	1.66		
1,2,3,7,8,9-HxCDD	ND	1.71		
1,2,3,4,6,7,8-HpCDD	2.39			J
OCDD	ND		8.91	
2,3,7,8-TCDF	ND	2.10		
1,2,3,7,8-PeCDF	ND	4.32		
2,3,4,7,8-PeCDF	ND	4.06		
1,2,3,4,7,8-HxCDF	ND	0.548		
1,2,3,6,7,8-HxCDF	ND	0.503		
2,3,4,6,7,8-HxCDF	ND	0.556		
1,2,3,7,8,9-HxCDF	ND	0.608		
1,2,3,4,6,7,8-HpCDF	ND	0.679		
1,2,3,4,7,8,9-HpCDF	ND	0.818		
OCDF	7.41			J

	Labeled Standard	%R	LCL-UCL [d]	Qualifiers
IS	13C-2,3,7,8-TCDD	96.0	40 - 130	
	13C-1,2,3,7,8-PeCDD	103	40 - 130	
	13C-1,2,3,6,7,8-HxCDD	97.0	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDD	87.9	25 - 130	
	13C-OCDD	66.5	25 - 130	
	13C-2,3,7,8-TCDF	113	40 - 130	
	13C-1,2,3,7,8-PeCDF	119	40 - 130	
	13C-1,2,3,6,7,8-HxCDF	97.5	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDF	85.5	25 - 130	
	13C-OCDF	62.3	25 - 130	
PS	37Cl-2,3,7,8-TCDD	95.9	70 - 130	
	13C-2,3,4,7,8-PeCDF	99.8	70 - 130	
	13C-1,2,3,4,7,8-HxCDD	103	70 - 130	
	13C-1,2,3,4,7,8-HxCDF	90.1	70 - 130	
	13C-1,2,3,4,7,8,9-HpCDF	90.6	70 - 130	
AS	13C-1,2,3,7,8,9-HxCDF	88.0	40 - 130	

Totals			
Total TCDD	ND	1.12	
Total PeCDD	ND	1.63	
Total HxCDD	ND	3.13	
Total HpCDD	4.42		
Total TCDF	ND		1.35
Total PeCDF	ND	4.18	
Total HxCDF	ND	0.551	
Total HpCDF	ND	0.742	

Toxic Equivalent Quotient (TEQ) Data [c]

TEQ (Min-Max): 0.0313 - 5.19

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: MAS

Approved By: William J. Luksemburg 07-Apr-2006 11:42

C-177

Project 27534

ALTA

Sample ID: TC60-ET02-M23 **EPA Method 23**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill Laboratory	Matrix:	MM5	Lab Sample:	27534-002	Date Received:	31-Mar-06
Project:	TC60 CDC Environmental Test	Sample Size:	Sample	QC Batch No.:	7898	Date Extracted:	4-Apr-06
Date Collected:	22-Mar-03			Date Analyzed DB-5:	5-Apr-06	Date Analyzed DB-225:	NA
Time Collected:	1420						

Analyte	Conc. (pg/Sample)	DL [a]	EMPC [b]	Qualifiers
2,3,7,8-TCDD	ND	1.24		
1,2,3,7,8-PeCDD	ND	1.46		
1,2,3,4,7,8-HxCDD	ND	2.32		
1,2,3,6,7,8-HxCDD	ND	2.09		
1,2,3,7,8,9-HxCDD	ND	2.15		
1,2,3,4,6,7,8-HpCDD	2.48			J
OCDD	21.0			J
2,3,7,8-TCDF	ND	1.23		
1,2,3,7,8-PeCDF	ND	1.68		
2,3,4,7,8-PeCDF	ND	1.58		
1,2,3,4,7,8-HxCDF	ND	0.814		
1,2,3,6,7,8-HxCDF	ND	0.747		
2,3,4,6,7,8-HxCDF	ND	0.825		
1,2,3,7,8,9-HxCDF	ND	0.904		
1,2,3,4,6,7,8-HpCDF	1.89			J
1,2,3,4,7,8,9-HpCDF	ND	0.744		
OCDF	ND	5.77		

Labeled Standard		%R	LCL-UCL [d]	Qualifiers
IS	13C-2,3,7,8-TCDD	93.2	40 - 130	
	13C-1,2,3,7,8-PeCDD	97.4	40 - 130	
	13C-1,2,3,6,7,8-HxCDD	92.6	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDD	83.8	25 - 130	
	13C-OCDD	56.8	25 - 130	
	13C-2,3,7,8-TCDF	95.8	40 - 130	
	13C-1,2,3,7,8-PeCDF	104	40 - 130	
	13C-1,2,3,6,7,8-HxCDF	92.3	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDF	79.2	25 - 130	
	13C-OCDF	58.0	25 - 130	
PS	37Cl-2,3,7,8-TCDD	97.8	70 - 130	
	13C-2,3,4,7,8-PeCDF	91.5	70 - 130	
	13C-1,2,3,4,7,8-HxCDD	102	70 - 130	
	13C-1,2,3,4,7,8-HxCDF	89.2	70 - 130	
	13C-1,2,3,4,7,8,9-HpCDF	92.3	70 - 130	
AS	13C-1,2,3,7,8,9-HxCDF	83.0	40 - 130	

Totals			
Total TCDD	ND	1.24	
Total PeCDD	ND	1.46	
Total HxCDD	ND	2.19	
Total HpCDD	2.48		
Total TCDF	1.32		
Total PeCDF	ND	1.62	
Total HxCDF	ND		1.07
Total HpCDF	1.89		

Toxic Equivalent Quotient (TEQ) Data [e]

TEQ (Min-Max): 0.0647 - 4.03

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: MAS

Approved By: William J. Luksemburg 07-Apr-2006 11:42

ALTA

Sample ID:	TC60-ET03-M23							EPA Method 23
Client Data		**Sample Data**		**Laboratory Data**				
Name:	CH2M Hill Laboratory	Matrix:	MM5	Lab Sample:	27534-003	Date Received:		31-Mar-06
Project:	TC60 CDC Environmental Test	Sample Size:	Sample	QC Batch No.:	7898	Date Extracted:		4-Apr-06
Date Collected:	23-Mar-06			Date Analyzed DB-5:	5-Apr-06	Date Analyzed DB-225:		NA
Time Collected:	1338							

Analyte	Conc. (pg/Sample)	DL [a]	EMPC[b]	Qualifiers
2,3,7,8-TCDD	ND	1.16		
1,2,3,7,8-PeCDD	ND	1.60		
1,2,3,4,7,8-HxCDD	ND	1.84		
1,2,3,6,7,8-HxCDD	ND	1.66		
1,2,3,7,8,9-HxCDD	ND	1.70		
1,2,3,4,6,7,8-HpCDD	ND		3.76	
OCDD	23.0			J
2,3,7,8-TCDF	ND	1.74		
1,2,3,7,8-PeCDF	ND	1.73		
2,3,4,7,8-PeCDF	ND	1.62		
1,2,3,4,7,8-HxCDF	ND	0.618		
1,2,3,6,7,8-HxCDF	ND	0.567		
2,3,4,6,7,8-HxCDF	ND	0.626		
1,2,3,7,8,9-HxCDF	ND	0.686		
1,2,3,4,6,7,8-HpCDF	ND	2.43		
1,2,3,4,7,8,9-HpCDF	ND	0.718		
OCDF	ND	4.50		

	Labeled Standard	%R	LCL-UCL[d]	Qualifiers
IS	13C-2,3,7,8-TCDD	92.4	40 - 130	
	13C-1,2,3,7,8-PeCDD	101	40 - 130	
	13C-1,2,3,6,7,8-HxCDD	91.4	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDD	84.3	25 - 130	
	13C-OCDD	63.8	25 - 130	
	13C-2,3,7,8-TCDF	97.8	40 - 130	
	13C-1,2,3,7,8-PeCDF	99.7	40 - 130	
	13C-1,2,3,6,7,8-HxCDF	95.9	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDF	79.9	25 - 130	
	13C-OCDF	64.1	25 - 130	
PS	37Cl-2,3,7,8-TCDD	98.5	70 - 130	
	13C-2,3,4,7,8-PeCDF	103	70 - 130	
	13C-1,2,3,4,7,8-HxCDD	102	70 - 130	
	13C-1,2,3,4,7,8-HxCDF	87.6	70 - 130	
	13C-1,2,3,4,7,8,9-HpCDF	94.6	70 - 130	
AS	13C-1,2,3,7,8,9-HxCDF	83.8	40 - 130	

Totals			
Total TCDD	ND	1.16	
Total PeCDD	ND	1.60	
Total HxCDD	ND	1.73	
Total HpCDD	4.16		7.92
Total TCDF	ND	3.41	
Total PeCDF	ND	1.67	
Total HxCDF	ND		0.724
Total HpCDF	ND	2.65	

Toxic Equivalent Quotient (TEQ) Data [e]

TEQ (Min-Max): 0.0230 - 3.90

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: MAS

Approved By: William J. Luksemburg 07-Apr-2006 11:42

ALTA

Sample ID: TC60-RB-M23 **EPA Method 23**

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill Laboratory	Matrix:	MM5	Lab Sample:	27534-004	Date Received:	31-Mar-06
Project:	TC60 CDC Environmental Test	Sample Size:	Sample	QC Batch No.:	7898	Date Extracted:	4-Apr-06
Date Collected:	23-Mar-06			Date Analyzed DB-5:	5-Apr-06	Date Analyzed DB-225:	NA
Time Collected:	1520						

Analyte	Conc. (pg/Sample)	DL [a]	EMPC[b]	Qualifiers
2,3,7,8-TCDD	ND	1.51		
1,2,3,7,8-PeCDD	ND	1.93		
1,2,3,4,7,8-HxCDD	ND	2.08		
1,2,3,6,7,8-HxCDD	ND	1.88		
1,2,3,7,8,9-HxCDD	ND	1.93		
1,2,3,4,6,7,8-HpCDD	ND	2.95		
OCDD	ND		5.95	
2,3,7,8-TCDF	ND	1.17		
1,2,3,7,8-PeCDF	ND	1.29		
2,3,4,7,8-PeCDF	ND	1.21		
1,2,3,4,7,8-HxCDF	ND	0.547		
1,2,3,6,7,8-HxCDF	ND	0.502		
2,3,4,6,7,8-HxCDF	ND	0.555		
1,2,3,7,8,9-HxCDF	ND	0.607		
1,2,3,4,6,7,8-HpCDF	ND	0.989		
1,2,3,4,7,8,9-HpCDF	ND	1.19		
OCDF	ND	3.50		

Labeled Standard		%R	LCL-UCL[d]	Qualifiers
IS	13C-2,3,7,8-TCDD	65.5	40 - 130	
	13C-1,2,3,7,8-PeCDD	69.3	40 - 130	
	13C-1,2,3,6,7,8-HxCDD	67.0	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDD	61.4	25 - 130	
	13C-OCDD	46.4	25 - 130	
	13C-2,3,7,8-TCDF	68.8	40 - 130	
	13C-1,2,3,7,8-PeCDF	75.2	40 - 130	
	13C-1,2,3,6,7,8-HxCDF	68.1	40 - 130	
	13C-1,2,3,4,6,7,8-HpCDF	59.8	25 - 130	
	13C-OCDF	45.2	25 - 130	
PS	37Cl-2,3,7,8-TCDD	89.4	70 - 130	
	13C-2,3,4,7,8-PeCDF	87.6	70 - 130	
	13C-1,2,3,4,7,8-HxCDD	95.8	70 - 130	
	13C-1,2,3,4,7,8-HxCDF	83.2	70 - 130	
	13C-1,2,3,4,7,8,9-HpCDF	84.4	70 - 130	
AS	13C-1,2,3,7,8,9-HxCDF	85.2	40 - 130	

Totals			
Total TCDD	ND	1.51	
Total PeCDD	ND	1.93	
Total HxCDD	ND	1.96	
Total HpCDD	ND	2.95	
Total TCDF	ND	1.17	
Total PeCDF	ND	1.25	
Total HxCDF	ND	0.550	
Total HpCDF	ND	1.08	

Toxic Equivalent Quotient (TEQ) Data [c]

TEQ (Min-Max): 0 - 4.13

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: MAS

Approved By: William J. Luksemburg 07-Apr-2006 11:42

ENVIRONMENTAL
Data Services, Inc.

CHLORIDE
USEPA Method 300.0 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-RB-M26A-H2SO4	F1474-01	Air
2	TC60-RB-M26A-NaOH	F1474-02	Air
3	TC60-ET01-M26A-H2SO4	F1474-03	Air
4	TC60-ET01-M26A-NaOH	F1474-04	Air
5	TC60-ET02-M26A-H2SO4	F1474-05	Air
6	TC60-ET02-M26A-NaOH	F1474-06	Air
7	TC60-ET03-M26A-H2SO4	F1474-07	Air
8	TC60-ET03-M26A-NaOH	F1474-08	Air

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within the recommended holding time.

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. mg/L	Action Level mg/L	Qualifier	Affected Samples
WB1-0414	Chloride	0.0370	0.370	U	3, 5, 7

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. mg/L	Action Level mg/L	Qualifier	Affected Samples
TC60-RB-M26A-H2SO4	Chloride	0.536	0.536	None	Already Qualified due to MB
TC60-RB-M26A-NaOH	Chloride	0.152	0.152	U	4, 6, 8

Matrix Spike/Duplicate - A matrix spike/duplicate sample was not analyzed.

Sample Duplicate - A sample duplicate was not analyzed.

LCS - The LCS samples exhibited acceptable %R values.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Quantitation - No discrepancies were identified.

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-M26A-H2SO4

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147401

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.100	0.536		mg/L	1	50 ML	E300.0A	04/14/06

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-M26A-NaOH

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147402

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.200	0.152		mg/L	1	50 ML	E300.0A	04/18/06

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-M26A-H2SO4

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147404

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.100	0.314	4	mg/L	1	50 ML	E300.0A	04/14/06

05/31/06

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-M26A-NaOH

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147405

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.200	0.0830	U	mg/L	1	50 ML	E300.0A	04/18/06

FIB1

CST 3.104

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-M26A-H2SO4

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147406

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.100	0.102	U	mg/L	1	50 ML	E300.0A	04/14/06

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-M26A-NaOH

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147407

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed	
16887-00-6	Chloride	0.0122	0.200	0.0810	U	mg/L	1	50 ML	E300.0A	04/18/06	FB

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-M26A-H2SO4

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147408

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.100	0.103	U	mg/L	1	50 ML	E300.0A	04/14/06

1A-WC

GENERAL CHEMISTRY ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-M26A-NaOH

SDG No.: F1474

Matrix: AIR

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147409

Date Received: 04/04/06

CAS No.	Analyte	MDL	PQL	Result	Q	Units	DF	Sample Amount	Analysis Method	Date Analyzed
16887-00-6	Chloride	0.0122	0.200	0.0640	U	mg/L	1	50 ML	E300.0A	04/18/06

METALS & MERCURY

USEPA Methods 6010, 7470- Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1474

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-RB-MET-FH	F1474-25	Air
2	TC60-ET01-MET-FH	F1474-26	Air
3	TC60-ET02-MET-FH	F1474-27	Air
4	TC60-ET03-MET-FH	F1474-28	Air
5	TC60-RB-MET-NPI	F1474-29	Air
6	TC60-ET01-MET-NPI	F1474-30	Air
7	TC60-ET02-MET-NPI	F1474-31	Air
8	TC60-ET03-MET-NPI	F1474-32	Air
9*	TC60-RB-MET-EIR	F1474-33	Air
10*	TC60-ET01-MET-EIR	F1474-34	Air
11*	TC60-ET03-MET-EIR	F1474-36	Air
12*	TC60-RB-MET-API	F1474-37	Air
13*	TC60-ET01-MET-API	F1474-38	Air
14*	TC60-ET02-MET-API	F1474-39	Air
15*	TC60-ET03-MET-API	F1474-40	Air
15MS*	TC60-ET03-MET-APIMS	F1474-40MS	Air
15MSD*	TC60-ET03-MET-APIMSD	F1474-40MSD	Air
16*	TC60-RB-MET-HCL	F1474-41	Air
17*	TC60-ET01-MET-HCL	F1474-42	Air
18*	TC60-ET02-MET-HCL	F1474-43	Air
19*	TC60-ET03-MET-HCL	F1474-44	Air
19MS*	TC60-ET03-MET-HCLMS	F1474-44MS	Air
19MSD*	TC60-ET03-MET-HCLMSD	F1474-44MSD	Air

* - Mercury only

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 28 days for mercury and 180 days for all other metals except the following.

Sample	Date Sampled	Date Prepared	# of Days	Qualifier
1	03/23/06	04/21/06	29	J - Hg
2	03/21/06	04/21/06	31	UJ - Hg
3	03/22/06	04/21/06	30	UJ - Hg
4	03/23/06	04/21/06	29	J - Hg
6	03/21/06	04/19/06	29	UJ - Hg
10	03/21/06	04/19/06	29	UJ - Hg
13	03/21/06	04/19/06	29	UJ - Hg
15	03/23/06	04/21/06	29	J - Hg
17	03/21/06	04/19/06	29	J - Hg

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited contamination for several compounds, however, all sample results are non-detect or greater than 5X the blank concentration with the exception of the following:

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Beryllium	0.171	0.171	U	5, 6, 7
Iron	10.5	105	U	5, 7, 8
Iron	29.6	296	U	1
Silver	2.74	2.74	U	5, 7
Zinc	5.74	57.4	U	5, 6, 7, 8

Field and Equipment Blank - Field QC results are summarized below.

Blank ID	Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
TC60-RB-MET-FH	Antimony	4.03	4.03	None	All > AL
	Barium	23.0	23.0	None	All > AL
	Cadmium	2.29	2.29	None	All > AL
	Chromium	24.5	24.5	U	2
	Cobalt	0.507	0.507	None	All > AL
	Copper	21.2	21.2	U	2
	Lead	16.8	16.8	None	All > AL
	Mercury	0.056	0.0347	None	All > AL
	Silver	2.97	2.97	None	All ND or > AL
	Vanadium	4.05	4.05	None	All > AL
	Zinc	25.0	25.0	None	All > AL
TC60-RB-MET-NPI	Barium	0.910	0.910	None	All > AL
	Chromium	0.986	0.986	None	All > AL
	Copper	15.5	15.5	U	6, 8
	Lead	4.39	4.39	U	6, 7, 8
TC60-RB-MET-EIR	None - ND	--	--	--	--
TC60-RB-MET-API	None - ND	--	--	--	--
TC60-RB-MET-HCL	None - ND	--	--	--	--

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike - The matrix spike samples exhibited acceptable %R values.

Matrix Duplicate - The matrix duplicate samples exhibited acceptable RPD values.

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Quantitation - All results reported with a (B) qualifier by the laboratory were further qualified as estimated (J) except those results already qualified.

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-MET-FH

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147425

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	4.03	B		P	J 1B
7440-38-2	Arsenic	7.38	U		P	
7440-39-3	Barium	23.0	B		P	J 1B
7440-41-7	Beryllium	0.0635	U		P	
7440-43-9	Cadmium	2.29	B		P	J 1B
7440-47-3	Chromium	24.5			P	
7440-48-4	Cobalt	0.507	B		P	J 1B
7440-50-8	Copper	21.2			P	
7439-89-6	Iron	220			P	4 LBL
7439-92-1	Lead	16.8			P	
7439-97-6	Mercury	0.0560	B		CV	J HTP
7440-02-0	Nickel	4.39	U		P	
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	2.97	B		P	J 1B
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	4.05	B		P	J 1B
7440-66-6	Zinc	75.0			P	

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

C0310C2

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-MET-FH

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147426

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	465			P	
7440-38-2	Arsenic	3510			P	
7440-39-3	Barium	1480			P	
7440-41-7	Beryllium	2.60	B		P	J 1B
7440-43-9	Cadmium	6.82			P	
7440-47-3	Chromium	20.5			P	U FBH
7440-48-4	Cobalt	4.39	B		P	J 1B
7440-50-8	Copper	20.6			P	U FBH
7439-89-6	Iron	5910			P	
7439-92-1	Lead	146			P	
7439-97-6	Mercury	0.0347	U		CV	UJ HTP
7440-02-0	Nickel	4.39	U		P	
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	3.60	B		P	J 1B
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	69.2			P	
7440-66-6	Zinc	351			P	

05731C4

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET02-MET-FH

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147427

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	466			P	
7440-38-2	Arsenic	3540			P	
7440-39-3	Barium	1510			P	
7440-41-7	Beryllium	2.52	B		P	J LB
7440-43-9	Cadmium	7.45			P	
7440-47-3	Chromium	31.6			P	
7440-48-4	Cobalt	16.7			P	
7440-50-8	Copper	29.8			P	
7439-89-6	Iron	6040			P	
7439-92-1	Lead	153			P	
7439-97-6	Mercury	0.0347	U		CV	UJ HTP
7440-02-0	Nickel	45.7			P	
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	3.64	B		P	J LB
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	70.4			P	
7440-66-6	Zinc	368			P	

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-MET-FH

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147428

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	464			P	
7440-38-2	Arsenic	3560			P	
7440-39-3	Barium	1540			P	
7440-41-7	Beryllium	2.52	B		P	J FB
7440-43-9	Cadmium	7.30			P	
7440-47-3	Chromium	25.5			P	
7440-48-4	Cobalt	10.2			P	
7440-50-8	Copper	40.5			P	
7439-89-6	Iron	6050			P	
7439-92-1	Lead	154			P	
7439-97-6	Mercury	0.415			CV	J HTP
7440-02-0	Nickel	13.9	B		P	J IB
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	3.47	B		P	J IB
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	71.7			P	
7440-66-6	Zinc	376			P	

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-MET-NPI

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147429

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	2.94	U		P	
7440-38-2	Arsenic	7.38	U		P	
7440-39-3	Barium	0.910	B		P	J LB
7440-41-7	Beryllium	~~0.0728~~ 4.00	~~B~~		P	U CCBL
7440-43-9	Cadmium	0.351	U		P	
7440-47-3	Chromium	0.986	B		P	J LB
7440-48-4	Cobalt	0.332	U		P	
7440-50-8	Copper	15.5			P	
7439-89-6	Iron	~~57.6~~ 100	~~B~~		P	U LBL
7439-92-1	Lead	4.39	B		P	J LB
7439-97-6	Mercury	0.0347	U		CV	
7440-02-0	Nickel	4.39	U		P	
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	~~1.04~~ 10	~~B~~		P	U ICBL
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	0.710	U		P	
7440-66-6	Zinc	20.7			P	U LBL

03106

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-MET-NPI

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147430

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	2.94	U		P	
7440-38-2	Arsenic	7.38	U		P	
7440-39-3	Barium	2.15	B		P	J IB
7440-41-7	Beryllium	4.00 0.0865	B		P	U CCLBL
7440-43-9	Cadmium	0.862	B		P	J IB
7440-47-3	Chromium	6.77	B		P	J IB
7440-48-4	Cobalt	3.87	B		P	J IB
7440-50-8	Copper	14.7			P	U FB H
7439-89-6	Iron	127			P	
7439-92-1	Lead	5.00 2.18	B		P	U FB L
7439-97-6	Mercury	0.0347	U		CV	UJ MTP
7440-02-0	Nickel	16.5	B		P	J IB
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	0.777	U		P	
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	0.710	U		P	
7440-66-6	Zinc	20 18.9	B		P	U LBL

0.573 10G...

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-MET-NPI

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147431

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	4.23	B		P	J 1B
7440-38-2	Arsenic	7.38	U		P	
7440-39-3	Barium	1.48	B		P	J 1B
7440-41-7	Beryllium	~~0.110~~ 4.00	~~B~~		P	U (CBL
7440-43-9	Cadmium	0.448	B		P	J 1B
7440-47-3	Chromium	2.79	B		P	J 1B
7440-48-4	Cobalt	0.769	B		P	J 1B
7440-50-8	Copper	15.7			P	
7439-89-6	Iron	~~97.5~~ 100	~~B~~		P	U (BL
7439-92-1	Lead	~~1.84~~ 3.00	~~B~~		P	U FBL
7439-97-6	Mercury	0.0347	U		CV	
7440-02-0	Nickel	5.72	B		P	J 1B
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	~~1.13~~ 10	~~B~~		P	U (CBL
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	0.710	U		P	
7440-66-6	Zinc	33.9			P	U (BL

0373,100-

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-MET-NPI

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147432

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	2.94	U		P	
7440-38-2	Arsenic	7.38	U		P	
7440-39-3	Barium	2.96	B		P	J B
7440-41-7	Beryllium	0.0635	U		P	
7440-43-9	Cadmium	1.36	B		P	J B
7440-47-3	Chromium	2.68	B		P	J B
7440-48-4	Cobalt	1.34	B		P	J B
7440-50-8	Copper	10.5			P	U FB H
7439-89-6	Iron	102			P	U LBL
7439-92-1	Lead	~~2.10~~ 5.00	~~B~~		P	U FBL
7439-97-6	Mercury	0.0347	U		CV	
7440-02-0	Nickel	10.5	B		P	J B
7782-49-2	Selenium	8.77	U		P	
7440-22-4	Silver	0.777	U		P	
7440-28-0	Thallium	4.34	U		P	
7440-62-2	Vanadium	0.710	U		P	
7440-66-6	Zinc	23.6			P	U LBL

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-MET-EIR

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147433

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-MET-EIR

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147434

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

UCJ H/TP

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-MET-EIR

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147436

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-MET-API

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147437

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

073104

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-MET-API

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147438

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

LCJ HPT

(J) 3/1/04

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-MET-API

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147439

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0390	B		CV

J 1B

05131066

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-MET-API

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147440

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.108			CV

J H7P

05136166

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-RB-MET-HCL

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147441

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.0347	U		CV

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: MET 1

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-MET-HCL

SDG No.: F1474

Matrix: (soil/water) AIR

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F147442

% Moisture: 100

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	2.06			CV

J HTP

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET02-MET-HCL

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147443

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.369			CV

(3)31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET03-MET-HCL

SDG No.: F1474

Matrix: (soil/water) AIR

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F147444

Date Received: 04/04/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7439-97-6	Mercury	0.649			CV

05131106

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

ENVIRONMENTAL
Data Services, Inc.

TCLP VOLATILE ORGANIC COMPOUNDS

USEPA Method 8260 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	F1546-01	Soil
2	TC60-ET01-PGFD	F1546-02	Soil
3	TC60-ET01-SL	F1546-05	Soil
3RE	TC60-ET01-SLR1	F1546-05R1	Soil
4	TC60-ET01-SLFD	F1546-06	Soil
4RE	TC60-ET01-SLFDR1	F1546-06R1	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, was used in evaluating the data in this summary report.

Holding Times - All samples were analyzed within 28 days for soil samples.

GC/MS Tuning - All of the BFB tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values.

Surrogates - All samples exhibited acceptable surrogate recoveries except the following.

Sample ID	Surrogate	%R	Qualifier
3	Dibromofluoromethane	0%	J/R
3RE	Dibromofluoromethane	5%	J/R
4	Dibromofluoromethane	0%	J/R
4RE	Dibromofluoromethane	0%	J/R

MS/MSD - A MS/MSD sample was not analyzed.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. ppbv	Action Level ppbv	Qualifier	Affected Samples
TCLPBLK 042006	Chloroform	0.620	3.10	U	1, 2
TCLPBLK 042106	Chloroform	0.380	1.90	U	3, 3RE, 4, 4RE

Trip, Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate results are summarized below.

Compound	TC60-ET01-PG ug/L	TC60-ET01-PGFD ug/L	RPD	Qualifier
MEK (2-butanone)	4.34 J	4.68 J	8%	None
Benzene	0.230 J	0.130 J	56%	None
TCE	0.550	0.540	2%	None
Tetrachloroethylene	6.36	3.75	52%	None
Chlorobenzene	0.130 J	0.500 U	NC	None

Compound	TC60-ET01-SL ug/L	TC60-ET01-SLFD ug/L	RPD	Qualifier
MEK (2-butanone)	2.41 J	2.58 J	7%	None
Benzene	1.31 J	1.40 J	7%	None
TCE	0.150 J	0.500 R	NC	None

Tentatively Identified Compounds (TICs) - TICs were not reported.

Compound Quantitation - EDS sample ID 3 & 4 exhibited low surrogate recoveries and were reanalyzed with similar results. The reanalysis results should be used for reporting purposes.

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-PG

SDG No.: F1546

Analysis Method: SW8260

Lab Name: CH2M HILL/LAB/CVO

Matrix: Soil

Lab Sample ID: F154601

Sample wt/vol: (g/mL) 5 ML

Lab File ID: 154601.D

Level: (low/med) LOW

Date Received: 04/17/06

GC Column: DB-VRX ID: 0.25 (mm)

Date Analyzed: 04/27/06

Instrument Name: MSE

Dilution Factor: 1

Soil Extract Volume: 1 (mL)

Soil Aliquot Volume: 1 (mL)

% Moisture: 100

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	4.34	J
67-66-3	Chloroform	0.112	0.500	1.14	
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	0.230	J
79-01-6	TCE	0.0985	0.500	0.550	
127-18-4	Tetrachloroethylene	0.0841	0.500	6.36	
108-90-7	Chlorobenzene	0.0868	0.500	0.130	J

LI LB14

0573,100

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-PGFD

SDG No.: F1546

Analysis Method: SW8260

Matrix: Soil

Sample wt/vol: (g/mL) 5 ML

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSE

Soil Extract Volume: 1 (mL)

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154602

Lab File ID: 154602.D

Date Received: 04/17/06

Date Analyzed: 04/27/06

Dilution Factor: 1

Soil Aliquot Volume: 1 (mL)

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	4.68	J
67-66-3	Chloroform	0.112	0.500	1.06	
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	0.130	J
79-01-6	TCE	0.0985	0.500	0.540	
127-18-4	Tetrachloroethylene	0.0841	0.500	3.75	
108-90-7	Chlorobenzene	0.0868	0.500	0.500	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-SL**

SDG No.: F1546

Analysis Method: SW8260

Matrix: Soil

Sample wt/vol: (g/mL) 5 ML

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSE

Soil Extract Volume: 1 (mL)

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154605

Lab File ID: 154605.D

Date Received: 04/17/06

Date Analyzed: 04/27/06

Dilution Factor: 1

Soil Aliquot Volume: 1 (mL)

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	5.00	U
67-66-3	Chloroform	0.112	0.500	0.470	J
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	1.12	
79-01-6	TCE	0.0985	0.500	0.140	J
127-18-4	Tetrachloroethylene	0.0841	0.500	0.500	U
108-90-7	Chlorobenzene	0.0868	0.500	0.500	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-SLR1

SDG No.: F1546

Analysis Method: SW8260

Matrix: Soil

Sample wt/vol: (g/mL) 5 ML

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSE

Soil Extract Volume: 1 (mL)

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154605R1

Lab File ID: 154605R1.D

Date Received: 04/17/06

Date Analyzed: 04/27/06

Dilution Factor: 1

Soil Aliquot Volume: 1 (mL)

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	2.41	J
67-66-3	Chloroform	0.112	0.500	0.410	J
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	1.31	
79-01-6	TCE	0.0985	0.500	0.150	J
127-18-4	Tetrachloroethylene	0.0841	0.500	0.500	U
108-90-7	Chlorobenzene	0.0868	0.500	0.500	U

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5/31/06

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-SLFD**

SDG No.: F1546

Analysis Method: SW8260

Matrix: Soil

Sample wt/vol: (g/mL) 5 ML

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSE

Soil Extract Volume: 1 (mL)

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154606

Lab File ID: 154606.D

Date Received: 04/17/06

Date Analyzed: 04/27/06

Dilution Factor: 1

Soil Aliquot Volume: 1 (mL)

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	5.00	U
67-66-3	Chloroform	0.112	0.500	0.310	J
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	1.41	
79-01-6	TCE	0.0985	0.500	0.500	U
12, 18-4	Tetrachloroethylene	0.0841	0.500	0.500	U
108-90-7	Chlorobenzene	0.0868	0.500	0.500	U

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-SLFDR1**

SDG No.: F1546

Analysis Method: SW8260

Matrix: Soil

Sample wt/vol: (g/mL) 5 ML

Level: (low/med) LOW

GC Column: DB-VRX ID: 0.25 (mm)

Instrument Name: MSE

Soil Extract Volume: 1 (mL)

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154606R1

Lab File ID: 154606R1.D

Date Received: 04/17/06

Date Analyzed: 04/27/06

Dilution Factor: 1

Soil Aliquot Volume: 1 (mL)

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
75-01-4	Vinyl Chloride	0.0985	0.500	0.500	U
75-35-4	1,1-DCE	0.0924	0.500	0.500	U
78-93-3	MEK (2-Butanone)	0.471	5.00	2.58	J
67-66-3	Chloroform	0.112	0.500	0.300	J
107-06-2	1,2-DCA	0.112	0.500	0.500	U
56-23-5	Carbon Tetrachloride	0.0758	0.500	0.500	U
71-43-2	Benzene	0.109	0.500	1.40	
79-01-6	TCE	0.0985	0.500	0.500	U
127-18-4	Tetrachloroethylene	0.0841	0.500	0.500	U
108-90-7	Chlorobenzene	0.0868	0.500	0.500	U

ENVIRONMENTAL
Data Services, Inc.

TCLP SEMIVOLATILE ORGANIC COMPOUNDS
USEPA SW846 Method 8270 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	F1546-01	Soil
2	TC60-ET01-PGFD	F1546-02	Soil
3	TC60-ET01-SL	F1546-05	Soil
4	TC60-ET01-SLFD	F1546-06	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, was used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 14 days for soil samples and analyzed within 40 days for all samples.

GC/MS Tuning - All of the DFTPP tunes in the initial and continuing calibrations met the percent relative abundance criteria.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and mean RRF values.

Continuing Calibration - The continuing calibrations exhibited acceptable %D and RRF values.

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - A MS/MSD sample was not analyzed.

Laboratory Control Sample - The LCS sample exhibited acceptable %R values.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks were free of contamination.

Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate results are summarized below.

Compound	TC60-ET01-PG ug/L	TC60-ET01-PGFD ug/L	RPD	Qualifier
None	ND	ND	--	--

Compound	TC60-ET01-SL ug/L	TC60-ET01-SLFD ug/L	RPD	Qualifier
None	ND	ND	--	--

Tentatively Identified Compounds (TICs) - TICs were not reported.

Compound Quantitation - No discrepancies were identified.

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-PG**

SDG No.: F1546

Analysis Method: SW8270

Matrix: SOIL pH:

Sample wt/vol: (G/ML) 953.1 ML

Level: (LOW/MED) LOW

Percent Moisture: 100 Decanted: N

Extraction Method: SW3510 Cleanup - GPC: N

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 1

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154601

Lab File ID: 154601.D

Date Received: 04/17/06

Date Extracted: 04/26/06

Date Analyzed: 04/28/06

Dilution Factor: 1

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
110-86-1	Pyridine	1.27	10.5	10.5	U
106-46-7	1,4-DCB	1.06	10.5	10.5	U
95-48-7	2-Methylphenol	3.24	10.5	10.5	U
108-39-4/1	m,p-Cresol	3.21	10.5	10.5	U
67-72-1	Hexachloroethane	0.946	10.5	10.5	U
98-95-3	Nitrobenzene	0.763	10.5	10.5	U
87-68-3	Hexachlorobutadiene	0.917	10.5	10.5	U
88-06-2	2,4,6-Trichlorophenol	2.98	10.5	10.5	U
95-95-4	2,4,5-Trichlorophenol	2.63	26.2	26.2	U
121-14-2	2,4-Dinitrotoluene	0.674	10.5	10.5	U
118-74-1	Hexachlorobenzene	0.614	10.5	10.5	U
87-86-5	Pentachlorophenol	3.03	21.0	21.0	U

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-PGFD**

SDG No.: F1546

Analysis Method: SW8270

Matrix: SOIL pH:

Sample wt/vol: (G/ML) 948.8 ML

Level: (LOW/MED) LOW

Percent Moisture: 100 Decanted: N

Extraction Method: SW3510 Cleanup - GPC: N

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 1

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154602

Lab File ID: 154602.D

Date Received: 04/17/06

Date Extracted: 04/26/06

Date Analyzed: 04/28/06

Dilution Factor: 1

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
110-86-1	Pyridine	1.27	10.5	10.5	U
106-46-7	1,4-DCB	1.06	10.5	10.5	U
95-48-7	2-Methylphenol	3.25	10.5	10.5	U
108-39-4/1	m,p-Cresol	3.23	10.5	10.5	U
67-72-1	Hexachloroethane	0.950	10.5	10.5	U
98-95-3	Nitrobenzene	0.767	10.5	10.5	U
87-68-3	Hexachlorobutadiene	0.921	10.5	10.5	U
88-06-2	2,4,6-Trichlorophenol	3.00	10.5	10.5	U
95-95-4	2,4,5-Trichlorophenol	2.64	26.3	26.3	U
121-14-2	2,4-Dinitrotoluene	0.677	10.5	10.5	U
118-74-1	Hexachlorobenzene	0.617	10.5	10.5	U
87-86-5	Pentachlorophenol	3.04	21.1	21.1	U

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-SL**

SDG No.: F1546

Analysis Method: SW8270

Matrix: SOIL pH:

Sample wt/vol: (G/ML) 962.8 ML

Level: (LOW/MED) LOW

Percent Moisture: 100 Decanted: N

Extraction Method: SW3510 Cleanup - GPC: N

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 1

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154605

Lab File ID: 154605.D

Date Received: 04/17/06

Date Extracted: 04/26/06

Date Analyzed: 04/28/06

Dilution Factor: 1

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
110-86-1	Pyridine	1.26	10.4	10.4	U
106-46-7	1,4-DCB	1.05	10.4	10.4	U
95-48-7	2-Methylphenol	3.21	10.4	10.4	U
108-39-4/1	m,p-Cresol	3.18	10.4	10.4	U
67-72-1	Hexachloroethane	0.937	10.4	10.4	U
98-95-3	Nitrobenzene	0.756	10.4	10.4	U
87-68-3	Hexachlorobutadiene	0.908	10.4	10.4	U
88-06-2	2,4,6-Trichlorophenol	2.95	10.4	10.4	U
95-95-4	2,4,5-Trichlorophenol	2.60	26.0	26.0	U
121-14-2	2,4-Dinitrotoluene	0.667	10.4	10.4	U
118-74-1	Hexachlorobenzene	0.608	10.4	10.4	U
87-86-5	Pentachlorophenol	3.00	20.8	20.8	U

1C

SEMI-VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **TC60-ET01-SLFD**

SDG No.: F1546

Analysis Method: SW8270

Matrix: SOIL pH:

Sample wt/vol: (G/ML) 982.9 ML

Level: (LOW/MED) LOW

Percent Moisture: 100 Decanted: N

Extraction Method: SW3510 Cleanup - GPC: N

Concentrated Extract Volume: (ML) 1

Injection Volume: (UL) 1

Instrument: MSC

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154606

Lab File ID: 154606.D

Date Received: 04/17/06

Date Extracted: 04/26/06

Date Analyzed: 04/28/06

Dilution Factor: 1

CONCENTRATION UNITS: ug/L

CAS NO.	COMPOUND	MDL	PQL	RESULT	Q
110-86-1	Pyridine	1.23	10.2	10.2	U
106-46-7	1,4-DCB	1.03	10.2	10.2	U
95-48-7	2-Methylphenol	3.14	10.2	10.2	U
108-39-4/1	m,p-Cresol	3.12	10.2	10.2	U
67-72-1	Hexachloroethane	0.917	10.2	10.2	U
98-95-3	Nitrobenzene	0.740	10.2	10.2	U
87-68-3	Hexachlorobutadiene	0.889	10.2	10.2	U
88-06-2	2,4,6-Trichlorophenol	2.89	10.2	10.2	U
95-95-4	2,4,5-Trichlorophenol	2.55	25.4	25.4	U
121-14-2	2,4-Dinitrotoluene	0.654	10.2	10.2	U
118-74-1	Hexachlorobenzene	0.595	10.2	10.2	U
87-86-5	Pentachlorophenol	2.94	20.3	20.3	U

ENVIRONMENTAL
Data Services, Inc.

EXPLOSIVES & PETN

USEPA Method 8330 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: Columbia Analytical Services, Kelso, WA Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	K0603078-001	Soil
1MS	TC60-ET01-PGMS	K0603078-001MS	Soil
1MSD	TC60-ET01-PGMSD	K0603078-001MSD	Soil
2	TC60-ET01-SL	K0603078-002	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Organic Data Review," October 1999, was used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 14 days for soil samples and analyzed within 40 days for all samples.

Initial Calibration - The initial calibrations exhibited acceptable %RSD and/or correlation coefficients.

Continuing Calibration - The continuing calibrations exhibited acceptable %D values.

Surrogates - All samples exhibited acceptable surrogate recoveries.

MS/MSD - The MS/MSD sample exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	MS/MSD %R/RPD	Qualifier
1	PETN	Ok/75%/Ok	UJ

Laboratory Control Sample - The LCS sample exhibited acceptable %R values.

Method Blank - The method blanks were free of contamination.

Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Quantitation - No discrepancies were identified.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	CH2M Hill	**Service Request:**	K0603078
Project:	TC 60 CDC Environmental Test - DSTL / Porton Down/163160.AS.OS	**Date Collected:**	04/10/2006
Sample Matrix:	Misc. solid	**Date Received:**	04/18/2006

Nitroaromatics and Nitramines (Explosives)

Sample Name:	TC60-ET01-PG	**Units:**	mg/Kg
Lab Code:	K0603078-001	**Basis:**	Wet
Extraction Method:	METHOD	**Level:**	Low
Analysis Method:	8330		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
HMX	ND	U	2.0	0.072	1	04/24/06	05/02/06	KWG0606591	
RDX	ND	U	2.0	0.15	1	04/24/06	05/02/06	KWG0606591	
1,3,5-Trinitrobenzene	ND	U	2.0	0.088	1	04/24/06	05/02/06	KWG0606591	
1,3-Dinitrobenzene	ND	U	2.0	0.089	1	04/24/06	05/02/06	KWG0606591	
TETRYL	ND	U	2.0	0.23	1	04/24/06	05/02/06	KWG0606591	
Nitrobenzene	ND	U	2.0	0.12	1	04/24/06	05/02/06	KWG0606591	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	0.12	1	04/24/06	05/02/06	KWG0606591	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.099	1	04/24/06	05/02/06	KWG0606591	
2,4,6-Trinitrotoluene	ND	U	2.0	0.092	1	04/24/06	05/02/06	KWG0606591	
2,6-Dinitrotoluene	ND	U	2.0	0.11	1	04/24/06	05/02/06	KWG0606591	
2,4-Dinitrotoluene	ND	U	2.0	0.059	1	04/24/06	05/02/06	KWG0606591	
2-Nitrotoluene	ND	U	2.0	0.082	1	04/24/06	05/02/06	KWG0606591	
4-Nitrotoluene	ND	U	2.0	0.11	1	04/24/06	05/02/06	KWG0606591	
3-Nitrotoluene	ND	U	2.0	0.081	1	04/24/06	05/02/06	KWG0606591	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1-Chloro-3-nitrobenzene	75	67-119	05/02/06	Acceptable

05/13/06

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	CH2M Hill	**Service Request:**	K0603078
Project:	TC 60 CDC Environmental Test - DSTL / Porton Down/163160.AS.OS	**Date Collected:**	04/10/2006
Sample Matrix:	Misc. solid	**Date Received:**	04/18/2006

Nitroglycerin and PETN

Sample Name:	TC60-ET01-PG	**Units:**	mg/Kg
Lab Code:	K0603078-001	**Basis:**	Wet
Extraction Method:	METHOD	**Level:**	Low
Analysis Method:	8332		

Analyte Name	Result	Q		MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Nitroglycerin	ND	U		1.8	0.49	1	04/24/06	04/27/06	KWG0606846	
Pentaerythritol Tetranitrate	ND	U	W5	1.8	0.50	1	04/24/06	04/27/06	KWG0606846	PSTL

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1-Chloro-3-nitrobenzene	86	50-135	04/27/06	Acceptable

5/3/06

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	CH2M Hill	**Service Request:**	K0603078
Project:	TC 60 CDC Environmental Test - DSTL / Porton Down/163160.AS.OS	**Date Collected:**	04/10/2006
Sample Matrix:	Misc. solid	**Date Received:**	04/18/2006

Nitroaromatics and Nitramines (Explosives)

Sample Name:	TC60-ET01-SL	**Units:**	mg/Kg
Lab Code:	K0603078-002	**Basis:**	Wet
Extraction Method:	METHOD	**Level:**	Low
Analysis Method:	8330		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
HMX	**0.17**	JN	1.9	0.072	1	04/24/06	05/02/06	KWG0606591	
RDX	ND	U	1.9	0.15	1	04/24/06	05/02/06	KWG0606591	
1,3,5-Trinitrobenzene	ND	U	1.9	0.088	1	04/24/06	05/02/06	KWG0606591	
1,3-Dinitrobenzene	ND	U	1.9	0.089	1	04/24/06	05/02/06	KWG0606591	
TETRYL	ND	U	1.9	0.23	1	04/24/06	05/02/06	KWG0606591	
Nitrobenzene	ND	U	1.9	0.12	1	04/24/06	05/02/06	KWG0606591	
4-Amino-2,6-dinitrotoluene	ND	U	1.9	0.12	1	04/24/06	05/02/06	KWG0606591	
2-Amino-4,6-dinitrotoluene	ND	U	1.9	0.099	1	04/24/06	05/02/06	KWG0606591	
2,4,6-Trinitrotoluene	ND	U	1.9	0.092	1	04/24/06	05/02/06	KWG0606591	
2,6-Dinitrotoluene	ND	U	1.9	0.11	1	04/24/06	05/02/06	KWG0606591	
2,4-Dinitrotoluene	ND	U	1.9	0.059	1	04/24/06	05/02/06	KWG0606591	
2-Nitrotoluene	ND	U	1.9	0.082	1	04/24/06	05/02/06	KWG0606591	
4-Nitrotoluene	ND	U	1.9	0.11	1	04/24/06	05/02/06	KWG0606591	
3-Nitrotoluene	ND	U	1.9	0.081	1	04/24/06	05/02/06	KWG0606591	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1-Chloro-3-nitrobenzene	73	67-119	05/02/06	Acceptable

05/3/06

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Results

Client:	CH2M Hill	**Service Request:**	K0603078
Project:	TC 60 CDC Environmental Test - DSTL / Porton Down/163160.AS.OS	**Date Collected:**	04/10/2006
Sample Matrix:	Misc. solid	**Date Received:**	04/18/2006

Nitroglycerin and PETN

Sample Name:	TC60-ET01-SL	**Units:**	mg/Kg
Lab Code:	K0603078-002	**Basis:**	Wet
Extraction Method:	METHOD	**Level:**	Low
Analysis Method:	8332		

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Nitroglycerin	ND	U	1.9	0.49	1	04/24/06	04/27/06	KWG0606846	
Pentaerythritol Tetranitrate	ND	U	1.9	0.50	1	04/24/06	04/27/06	KWG0606846	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
1-Chloro-3-nitrobenzene	82	50-135	04/27/06	Acceptable

05/3/06

Comments:

ENVIRONMENTAL
Data Services, Inc.

POLYCHLORINATED DIBENZODIOXINS and POLYCHLORINATED DIBENZOFURANS (PCDD/PCDF)

USEPA Method 23 - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546/27603

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: Alta Analytical Laboratory, El Dorado Hills, CA Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	27603-001	Soil
1MS	TC60-ET01-PGMS	27603-001MS	Soil
1MSD	TC60-ET01-PGMSD	27603-001MSD	Soil
2	TC60-ET01-SL	27603-002	Soil
2MS	TC60-ET01-SLMS	27603-002MS	Soil
2MSD	TC60-ET01-SLMSD	27603-002MSD	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review," September 2005, was used in evaluating the data in this summary report.

Holding Times - All samples were extracted within 30 days of collection and analyzed 45 days after extraction.

Initial Calibration - The initial calibrations were not included in the data package.

Continuing Calibration - The continuing calibrations were not included in the data package.

Column Performance Check - Information was not provided in the data package.

Surrogates - All surrogate recovery values met QC acceptance criteria and no qualifications were required.

MS/MSD - The MS/MSD sample exhibited acceptable %R and RPD values except the following.

MS/MSD Sample ID	Compound	MS/MSD %R/RPD	Qualifier
1	1,2,3,7,8,9-HxCDD	19.6%/182%/161%	J
2	1,2,3,4,6,7,8-HpCDF	43.2%/48.1%/Ok	J

Laboratory Control Sample - The LCS sample exhibited results within QC criteria.

Internal Standard (IS) Area Performance - All internal standards met response and retention time (RT) criteria.

Method Blank - The method blanks exhibited the following contamination.

Blank ID	Compound	Conc. pg/g	Action Level pg/g	Qualifier	Affected Samples
MB001	OCDD	0.238	None	None	All >CRDL & >Blank
	1,2,3,6,7,8-HxCDF	0.0718	None	None	All >CRDL & >Blank
	2,3,4,6,7,8-HxCDF	0.0232	None	None	All >CRDL & >Blank
	1,2,3,4,6,7,8-HpCDF	0.238	None	None	All >CRDL & >Blank
	Total HpCDD	0.0448	None	None	All >CRDL & >Blank
	Total PeCDF	0.231	None	None	All >CRDL & >Blank
	Total HxCDF	0.398	None	None	All >CRDL & >Blank
	Total HpCDF	0.238	None	None	All >CRDL & >Blank

Field, Equipment Blank - Field QC samples were not analyzed.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Identification - Retention times were not provided.

Compound Quantitation - No discrepancies were noted.

ALTA

Sample ID:	TC60-ET01-PG			EPA Method 8290
Client Data		**Sample Data**		**Laboratory Data**
Name:	CH2M Hill Laboratory	Matrix:	Solid	Lab Sample: 27603-001
Project:	F1546	Sample Size:	9.81 g	QC Batch No.: 7970
Date Collected:	10-Apr-06	%Solids:	100	Date Analyzed DB-5: 27-Apr-06
Time Collected:	1530			Date Received: 18-Apr-06
				Date Extracted: 26-Apr-06
				Dates Analyzed DB-225: 28-Apr-06

Analyte	Conc. (pg/g)	DL [a]	EMPC[b]	Qualifiers
2,3,7,8-TCDD	39.3			
1,2,3,7,8-PeCDD	245			
1,2,3,4,7,8-HxCDD	397			
1,2,3,6,7,8-HxCDD	1570			
1,2,3,7,8,9-HxCDD	775	J MSH		
1,2,3,4,6,7,8-HpCDD	20900			
OCDD	67700			B
2,3,7,8-TCDF	671			
1,2,3,7,8-PeCDF	1880			
2,3,4,7,8-PeCDF	3570			
1,2,3,4,7,8-HxCDF	10500			
1,2,3,6,7,8-HxCDF	5380			B
2,3,4,6,7,8-HxCDF	5600			B
1,2,3,7,8,9-HxCDF	4710			
1,2,3,4,6,7,8-HpCDF	29100			B
1,2,3,4,7,8,9-HpCDF	10500			
OCDF	61300			

	Labeled Standard	%R	LCL-UCL[d]	Qualifiers
IS	13C-2,3,7,8-TCDD	93.1	40 - 135	
	13C-1,2,3,7,8-PeCDD	88.0	40 - 135	
	13C-1,2,3,4,7,8-HxCDD	86.9	40 - 135	
	13C-1,2,3,6,7,8-HxCDD	90.4	40 - 135	
	13C-1,2,3,4,6,7,8-HpCDD	98.9	40 - 135	
	13C-OCDD	92.1	40 - 135	
	13C-2,3,7,8-TCDF	96.8	40 - 135	
	13C-1,2,3,7,8-PeCDF	94.7	40 - 135	
	13C-2,3,4,7,8-PeCDF	97.0	40 - 135	
	13C-1,2,3,4,7,8-HxCDF	92.0	40 - 135	
	13C-1,2,3,6,7,8-HxCDF	84.9	40 - 135	
	13C-2,3,4,6,7,8-HxCDF	90.9	40 - 135	
	13C-1,2,3,7,8,9-HxCDF	90.8	40 - 135	
	13C-1,2,3,4,6,7,8-HpCDF	99.0	40 - 135	
	13C-1,2,3,4,7,8,9-HpCDF	100	40 - 135	
	13C-OCDF	94.8	40 - 135	
CRS	37Cl-2,3,7,8-TCDD	88.1	40 - 135	

Totals			
Total TCDD	1060		
Total PeCDD	3770		
Total HxCDD	16200	J MSH	
Total HpCDD	36300		B
Total TCDF	13300		
Total PeCDF	28100		B
Total HxCDF	47300		B
Total HpCDF	54400		B

Toxic Equivalent Quotient (TEQ) Data [e]

TEQ (Min): 5730

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: JMH

Approved By: William J. Luksemburg 01-May-2006 12:21

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Project 27603

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ALTA

Sample ID: TC60-ET01-SL

EPA Method 8290

Client Data		Sample Data		Laboratory Data			
Name:	CH2M Hill Laboratory	Matrix:	Solid	Lab Sample:	27603-002	Date Received:	18-Apr-06
Project:	F1546	Sample Size:	9.67 g	QC Batch No.:	7970	Date Extracted:	26-Apr-06
Date Collected:	10-Apr-06	%Solids:	100	Date Analyzed DB-5:	27-Apr-06	Date Analyzed DB-225:	NA
Time Collected:	1100						

Analyte	Conc. (pg/g)	DL [a]	EMPC [b]	Qualifiers
2,3,7,8-TCDD	0.141			J
1,2,3,7,8-PeCDD	0.443			J
1,2,3,4,7,8-HxCDD	0.912			J
1,2,3,6,7,8-HxCDD	1.60			J
1,2,3,7,8,9-HxCDD	0.967			J
1,2,3,4,6,7,8-HpCDD	24.9			
OCDD	155			B
2,3,7,8-TCDF	0.743			
1,2,3,7,8-PeCDF	2.70			
2,3,4,7,8-PeCDF	2.51			J
1,2,3,4,7,8-HxCDF	26.3			
1,2,3,6,7,8-HxCDF	6.88			B
2,3,4,6,7,8-HxCDF	3.48			B
1,2,3,7,8,9-HxCDF	5.33			
1,2,3,4,6,7,8-HpCDF	67.5	J MSL		B
1,2,3,4,7,8,9-HpCDF	33.0			
OCDF	498			

Totals				
Total TCDD	1.94			
Total PeCDD	3.58			
Total HxCDD	11.8			
Total HpCDD	36.8			B
Total TCDF	8.12			
Total PeCDF	18.5			B
Total HxCDF	62.2	J MSL		B
Total HpCDF	126			B

	Labeled Standard	%R	LCL-UCL [d]	Qualifiers
IS	13C-2,3,7,8-TCDD	89.6	40 - 135	
	13C-1,2,3,7,8-PeCDD	89.7	40 - 135	
	13C-1,2,3,4,7,8-HxCDD	88.8	40 - 135	
	13C-1,2,3,6,7,8-HxCDD	88.0	40 - 135	
	13C-1,2,3,4,6,7,8-HpCDD	92.1	40 - 135	
	13C-OCDD	71.3	40 - 135	
	13C-2,3,7,8-TCDF	98.2	40 - 135	
	13C-1,2,3,7,8-PeCDF	94.7	40 - 135	
	13C-2,3,4,7,8-PeCDF	92.2	40 - 135	
	13C-1,2,3,4,7,8-HxCDF	87.3	40 - 135	
	13C-1,2,3,6,7,8-HxCDF	85.1	40 - 135	
	13C-2,3,4,6,7,8-HxCDF	90.2	40 - 135	
	13C-1,2,3,7,8,9-HxCDF	87.6	40 - 135	
	13C-1,2,3,4,6,7,8-HpCDF	88.5	40 - 135	
	13C-1,2,3,4,7,8,9-HpCDF	89.6	40 - 135	
	13C-OCDF	74.6	40 - 135	
CRS	37Cl-2,3,7,8-TCDD	93.5	40 - 135	

Toxic Equivalent Quotient (TEQ) Data [e]

TEQ (Min): 8.29

a. Sample specific estimated detection limit.

b. Estimated maximum possible concentration.

c. Method detection limit.

d. Lower control limit - upper control limit.

e. TEQ based on (1989) International Toxic Equivalent Factors (ITEF).

Analyst: JMH

Approved By: William J. Luksemburg 01-May-2006 12:21

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Project 27603

ENVIRONMENTAL
Data Services, Inc.

REACTIVE CYANIDE, REACTIVE SULFIDE, pH
USEPA Methods 7.3 & 9045C - Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: Columbia Analytical Services, Kelso, WA Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	D0600273-001	Soil
2	TC60-ET01-SL	D0600273-002	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within the recommended holding time except the reactive cyanide and reactive sulfide analyses.

Reactive Cyanide				
Sample	Date Sampled	Date Analyzed	# of Days	Qualifier
1	04/10/06	04/26/06	16	UJ
2	04/10/06	04/26/06	16	UJ

Reactive Sulfide				
Sample	Date Sampled	Date Analyzed	# of Days	Qualifier
1	04/10/06	05/12/06	32	R
2	04/10/06	05/12/06	32	R

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks were free of contamination.

Field and Equipment Blank - Field QC samples were not analyzed.

Matrix Spike/Duplicate - A matrix spike/duplicate sample was not analyzed.

Sample Duplicate - A sample duplicate was not analyzed.

LCS - The LCS samples exhibited acceptable %R values.

Field Duplicates - Field duplicate samples were not analyzed.

Compound Quantitation - No discrepancies were identified.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client :	CH2M Hill	**Service Request :**	D0600273
Project Name :	DeMil International	**Date Collected :**	04/10/06
Project Number :	163160.AS.OS	**Date Received :**	04/18/06
Sample Matrix :	SOIL		

Inorganic Parameters

Sample Name : TC60-ET01-PG
Lab Code : D0600273-001
Test Notes :

Basis : Dry

Analyte	Units	Analysis Method	PQL	Dilution Factor	Date/Time Analyzed	Date Prepared	Result	Result Notes
Cyanide, Reactive	mg/Kg	SW846 Sec. 7.3	0.5	1	04/26/06 17:35	04/26/06	ND	U CCJ HTH
pH	units	SW9045C	-	1	04/20/06 14:00	NA	4.82	
Sulfide, Reactive	mg/Kg	SW846 Sec. 7.3	400	1	05/12/06 09:30	05/11/06	ND	U R HTH

Report By: C.Skillern

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client :	CH2M Hill	**Service Request :**	D0600273
Project Name :	DeMil International	**Date Collected :**	04/10/06
Project Number :	163160.AS.OS	**Date Received :**	04/18/06
Sample Matrix :	SOIL		

Inorganic Parameters

Sample Name : TC60-ET01-SL
Lab Code : D0600273-002
Test Notes :

Basis : Dry

Analyte	Units	Analysis Method	PQL	Dilution Factor	Date/Time Analyzed	Date Prepared	Result	Result Notes
Cyanide, Reactive	mg/Kg	SW846 Sec. 7.3	0.5	1	04/26/06 17:35	04/26/06	ND	U [illegible] HT A
pH	units	SW9045C	-	1	04/20/06 14:00	NA	12.42	
Sulfide, Reactive	mg/Kg	SW846 Sec. 7.3	170	1	05/12/06 09:30	05/11/06	ND	U R HT A

Report By: C.Skillern

TCLP METALS

USEPA Methods 1311/6010/7470- Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1546

Client: CH2M HILL, Inc., Herndon, Virginia Date: May 31, 2006

Laboratory: CH2M HILL Applied Sciences Lab., Corvalis, OR Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-PG	F1546-01	Soil
2	TC60-ET01-PGFD	F1546-02 FD	Soil
3	TC60-ET01-SL	F1546-05	Soil
3RE	TC60-ET01-SLRE	F1546-05RE	Soil
4	TC60-ET01-SLFD	F1546-06 FD	Soil
4RE	TC60-ET01-SLFDRE	F1546-06FDRE	Soil

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 28 days for mercury and 180 days for all other metals.

Calibration - The ICV and CCV %R values were acceptable.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited contamination for several compounds, however, all sample results are non-detect or greater than 5X the blank concentration with the exception of the following:

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Arsenic	104	1040	U	3RE, 4RE
Barium	26.3	263	U	3RE, 4RE

Field and Equipment Blank - Field QC samples were not analyzed.

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike - A matrix spike sample was not analyzed.

Matrix Duplicate - A matrix duplicate sample was not analyzed.

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values.

Field Duplicates - Field duplicate results are summarized below.

Compound	TC60-ET01-PG ug/L	TC60-ET01-PGFD ug/L	RPD	Qualifier
Barium	256	283	10%	None
Cadmium	106	93.5	13%	None
Chromium	12.5 J	11.9 J	5%	None
Silver	100 U	10.2 J	NC	None

Compound	TC60-ET01-SL ug/L	TC60-ET01-SLFD ug/L	RPD	Qualifier
Arsenic	107 J	179 J	50%	None
Barium	136 J	150 J	10%	None
Chromium	141	21.8 J	146%	None
Lead	47000	21500	74%	None

Compound Quantitation - All results reported with a (B) qualifier by the laboratory were further qualified as estimated (J) except those results already qualified.

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-PG

SDG No.: F1546

Matrix: (soil/water) SOIL

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154601

Date Received: 04/17/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	250	U		P
7440-39-3	Barium	256			P
7440-43-9	Cadmium	106			P
7440-47-3	Chromium	12.5	B		P
7439-92-1	Lead	6340			P
7439-97-6	Mercury	1.00	U		CV
7782-49-2	Selenium	300	U		P
7440-22-4	Silver	100	U		P

J 1.3

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-PGFD

SDG No.: F1546

Matrix: (soil/water) SOIL

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F154602FD

% Moisture: 100

Date Received: 04/17/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-38-2	Arsenic	250	U		P	
7440-39-3	Barium	283			P	
7440-43-9	Cadmium	93.5			P	
7440-47-3	Chromium	11.9	B		P	J 1.3
7439-92-1	Lead	5560			P	
7439-97-6	Mercury	1.00	U		CV	
7782-49-2	Selenium	300	U		P	
7440-22-4	Silver	10.2	B		P	J 1.3

05/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-SL

SDG No.: F1546

Matrix: (soil/water) SOIL

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F154605

Date Received: 04/17/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	107	B		P
7440-39-3	Barium	136	B		P
7440-43-9	Cadmium	50.0	U		P
7440-47-3	Chromium	141			P
7439-92-1	Lead	47000			P
7439-97-6	Mercury	1.00	U		CV
7782-49-2	Selenium	300	U		P
7440-22-4	Silver	100	U		P

J B

J B

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-SLRE

SDG No.: F1546

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F154605RE

Level: (low/med) LOW

Date Received: 04/17/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	~~151~~ 250	B		P
7440-39-3	Barium	~~110~~ 250	B		P
7440-43-9	Cadmium	50.0	U		P
7440-47-3	Chromium	38.6	B		P
7439-92-1	Lead	1100			P
7782-49-2	Selenium	300	U		P
7440-22-4	Silver	100	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-SLFD

SDG No.: F1546

Matrix: (soil/water) SOIL

Lab Name: CH2M HILL/LAB/CVO

Level: (low/med) LOW

Lab Sample ID: F154606FD

% Moisture: 100

Date Received: 04/17/06

CONCENTRATION UNITS: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-38-2	Arsenic	179	B		P	J UB
7440-39-3	Barium	150	B		P	J UB
7440-43-9	Cadmium	50.0	U		P	
7440-47-3	Chromium	21.8	B		P	J UB
7439-92-1	Lead	21500			P	
7439-97-6	Mercury	1.00	U		CV	
7782-49-2	Selenium	300	U		P	
7440-22-4	Silver	100	U		P	

5/31/06

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-SLFDRE

SDG No.: F1546

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F154606FDRE

Level: (low/med) LOW

Date Received: 04/17/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	250 195	B		P
7440-39-3	Barium	250 128	B		P
7440-43-9	Cadmium	50.0	U		P
7440-47-3	Chromium	64.0	B		P
7439-92-1	Lead	8700			P
7782-49-2	Selenium	300	U		P
7440-22-4	Silver	100	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

ENVIRONMENTAL
Data Services, Inc.

TOTAL & TCLP METALS
Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1765

Client: CH2M HILL, Inc., Herndon, Virginia Date: June 20, 2006

Laboratory: CH2M Hill Applied Sciences Lab,Corvallis Oregon Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-ET01-LIME	F1765-01	Soil
2	TC60-ET01-FPG	F1765-02	Soil
2MD	TC60-ET01-FPG MD	F1765-02MD	Soil
3*	TC60-ET01-LIME FD	F1765-03	Soil
4**	TC60-ET01-PG	F1765-04	Soil
5**	TC60-ET01-SL	F1765-05	Soil
6**	TC60-ET01-SL MS	F1765-05MS	Soil
7**	TC60-ET01-SL MSD	F1765-05MSD	Soil

*TCLP Only
** Total Only

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 180 days for all metals.

Calibration - The ICV and CCV %R values were acceptable.

CRDL Standard - The CRDL standards were not included in this data package.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited contamination for several compounds, however, all sample results are non-detect or greater than the CRDL concentration with the exception of the following:

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Arsenic (TCLP)	11.5	11.5	U	1,3
Barium (TCLP)	88.0	88.0	U	1,2,3
Selenium (TCLP)	19.3	19.3	None	All ND

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Silver (TCLP)	2.36	2.36	U	3
Barium (Soil)	0.0214 mg/kg	0.0214 mg/kg	U	1,2,5
Copper (Soil)	14.5	1.45 mg/kg	U	2
Silver (Soil)	0.905	0.0905 mg/kg	U	1,2,4,5

Field and Equipment Blank - Field QC samples were not included in this data package.

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike/Matrix Spike Duplicate - The MS/MSD sample exhibited acceptable %R values except the following.

MS Sample ID	Compound	%R	Qualifier	Affected Samples
5	Antimony	57%/59%/OK	J/UJ	1,2,4,5

Matrix Duplicate - The matrix duplicate sample exhibited acceptable RPD values for TCLP metals.

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values except the following.

ICP Sample ID	Compound	%D	Qualifier	Affected Samples
5	Antimony	10.4	None	Already qualified.

Field Duplicates - Field duplicate results are summarized below.

Compound	TC60-ET01-LIME ug/L	TC60-ET01-LIME FD ug/L	RPD	Qualifier
None	ND	ND	---	---

Compound Quantitation - All results reported with a (B) qualifier by the laboratory were further qualified as estimated (J) except those results already qualified.

EDS sample ID #s 1,2, and 3 for TCLP metals were analyzed at 10x dilutions.

EDS sample ID #s 1,4 and 5 for total metals were analyzed at various dilutions due to high concentrations of target analytes.

EDS soil samples # 1,2,4 and 5 were reported for total metals on a wet weight basis by the laboratory.

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-LIME

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176501

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 0

Concentration Units: mg/kg

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	40.0	U		P	UJ ADL
7440-38-2	Arsenic	100	U		P	
7440-39-3	Barium	~~11.5~~ 11.5	B		P	U LBL
7440-41-7	Beryllium	1.56	B		P	J IB
7440-43-9	Cadmium	20.0	U		P	
7440-70-2	Calcium	554000			P	
7440-47-3	Chromium	40.0	U		P	
7440-48-4	Cobalt	3.14	B		P	J IB
7440-50-8	Copper	80.0	U		P	
7439-89-6	Iron	885			P	
7439-92-1	Lead	20.0	U		P	
7440-02-0	Nickel	80.0	U		P	
7782-49-2	Selenium	120	U		P	
7440-22-4	Silver	~~4.45~~ 4.45	B		P	U ICBL
7440-28-0	Thallium	40.0	U		P	
7440-62-2	Vanadium	100	U		P	
7440-66-6	Zinc	24.4	B		P	J IB

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/20/06

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-LIME

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176501

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-38-2	Arsenic	159	B		P	U-CBL
7440-39-3	Barium	176	B		P	U CBL
7440-43-9	Cadmium	50.0	U		P	
7440-47-3	Chromium	100	U		P	
7439-92-1	Lead	50.0	U		P	
7782-49-2	Selenium	300	U		P	
7440-22-4	Silver	100	U		P	

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-FPG

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176502

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 0

Concentration Units: mg/kg

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	2.00	U		P	UJ MSL
7440-38-2	Arsenic	2.78	B		P	J LG
7440-39-3	Barium	3.83	B		P	J LBL
7440-41-7	Beryllium	0.241	B		P	J LB
7440-43-9	Cadmium	1.00	U		P	
7440-70-2	Calcium	105			P	
7440-47-3	Chromium	8.81			P	
7440-48-4	Cobalt	5.53			P	
7440-50-8	Copper	2.16	B		P	J CCBL
7439-89-6	Iron	14300			P	
7439-92-1	Lead	2.17			P	
7440-02-0	Nickel	5.75			P	
7782-49-2	Selenium	6.00	U		P	
7440-22-4	Silver	0.346	B		P	J ICBL
7440-28-0	Thallium	2.00	U		P	
7440-62-2	Vanadium	8.39			P	
7440-66-6	Zinc	15.6			P	

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/20/06

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-FPG

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176502

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	250	U		P
7440-39-3	Barium	~~116~~ 250	B		P
7440-43-9	Cadmium	50.0	U		P
7440-47-3	Chromium	100	U		P
7439-92-1	Lead	50.0	U		P
7782-49-2	Selenium	300	U		P
7440-22-4	Silver	100	U		P

LI LBL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

TC60-ET01-LIME FD

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176503

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-38-2	Arsenic	250 88.1	B		P	L, CCBL
7440-39-3	Barium	250 215	B		P	L, LBL
7440-43-9	Cadmium	50.0	U		P	
7440-47-3	Chromium	100	U		P	
7439-92-1	Lead	50.0	U		P	
7782-49-2	Selenium	300	U		P	
7440-22-4	Silver	10 7.81	B		P	L, CCBL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-PG

SDG No.: F1765

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) SOIL

Lab Sample ID: F176504

Level: (low/med) LOW

Date Received: 05/16/06

% Moisture: 0

Concentration Units: mg/kg

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	30.3			P	J MSL
7440-38-2	Arsenic	10.0	U		P	
7440-39-3	Barium	31.0			P	
7440-41-7	Beryllium	0.287	B		P	J LB
7440-43-9	Cadmium	2.73			P	
7440-70-2	Calcium	730			P	
7440-47-3	Chromium	53.0			P	
7440-48-4	Cobalt	6.26			P	
7440-50-8	Copper	9380			P	
7439-89-6	Iron	30100			P	
7439-92-1	Lead	1840			P	
7440-02-0	Nickel	84.3			P	
7782-49-2	Selenium	12.0	U		P	
7440-22-4	Silver	4.00 1.88	B		P	J LB-C
7440-28-0	Thallium	1.62	B		P	J LB
7440-62-2	Vanadium	6.06	B		P	J LB
7440-66-6	Zinc	3850			P	

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

U.S. EPA - CLP

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-SL

SDG No.: F1765

Matrix: (soil/water) SOIL

Level: (low/med) LOW

% Moisture: 0

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F176505

Date Received: 05/16/06

Concentration Units: mg/kg

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	154		N	P	J ASL
7440-38-2	Arsenic	25.9	B		P	J LB
7440-39-3	Barium	SC 14.5	B		P	U LBL
7440-41-7	Beryllium	8.00	U		P	
7440-43-9	Cadmium	3.36	B		P	J LB
7440-70-2	Calcium	407000			P	
7440-47-3	Chromium	23.8			P	
7440-48-4	Cobalt	2.49	B		P	J LB
7440-50-8	Copper	3400			P	
7439-89-6	Iron	5440			P	
7439-92-1	Lead	4400			P	
7440-02-0	Nickel	24.8	B		P	J LB
7782-49-2	Selenium	60.0	U		P	
7440-22-4	Silver	~~20.0~~ 1.66	B		P	U LBL
7440-28-0	Thallium	20.0	U		P	
7440-62-2	Vanadium	50.0	U		P	
7440-66-6	Zinc	1900			P	

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

JG060606-19:28-F1765-N

FORM I - INORG

C-258

06/20/06
LC

ENVIRONMENTAL
Data Services, Inc.

METALS
Level III Review

Site: Phase II Testing of TC-60 CDC, Porton Down, TO-60 SDG #: F1820

Client: CH2M HILL, Inc., Herndon, Virginia Date: June 20, 2006

Laboratory: CH2M Hill Applied Sciences Lab,Corvallis Oregon Reviewer: Christine Garvey

EDS ID	Client Sample ID	Laboratory Sample ID	Matrix
1	TC60-RB-M5-PRN	F1820-01	Water
2	TC60-ET01-M5-PRN	F1820-02	Water
3	TC60-ET02-M5-PRN	F1820-03	Water
4	TC60-ET03-M5-PRN	F1820-04	Water
5	Quartz Blank Filter	F1820-10	Water
6	Glass Blank Filter 1	F1820-11	Water
7	Glass Blank Filter 2	F1820-12	Water

The USEPA "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," October 2004, was used in evaluating the data in this summary report.

Holding Times - All samples were prepared and analyzed within 180 days for all metals.

Calibration - The ICV and CCV %R values were acceptable.

CRDL Standard - The CRDL standards were not included in this data package.

Method and Calibration Blanks - The method blanks and continuing calibration blanks exhibited contamination for several compounds, however, all sample results are non-detect or greater than the CRDL with the exception of the following:

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Antimony	6.25	6.25	U	1 - 4
Arsenic	11.8	11.8	U	1 - 4
Barium	5.35	5.35	U	1 - 4
Beryllium	0.268	0.268	U	1
Beryllium	0.0835	0.0835	U	6, 7
Calcium	52.0	52.0	U	2

Compound	Conc. ug/L	Action Level ug/L	Qualifier	Affected Samples
Chromium	0.964	0.964	U	1 - 5
Copper	11.4	11.4	None	> CRDL
Copper	16.4	16.4	U	5
Iron	54.5	54.5	None	> CRDL
Iron	21.4	21.4	None	> CRDL
Lead	1.95	1.95	U	5
Selenium	14.6	14.6	None	ND
Silver	0.868	0.868	U	1 - 4
Zinc	9.54	9.54	U	1,3
Zinc	4.49	4.49	None	> CRDL

Field and Equipment Blank - Field QC samples were not included in this data package.

ICP Interference Check Sample - All %R values were acceptable.

Matrix Spike - The matrix spike sample was not included in this data package.

Matrix Duplicate - The matrix duplicate sample was not included in this data package.

LCS - The LCS samples exhibited acceptable %R values.

ICP Serial Dilution - The ICP serial dilution sample exhibited acceptable %D values except the following.

ICP Sample ID	Compound	%D	Qualifier	Affected Samples
4	Calcium	15.5	J	1 - 7
	Zinc	25.3	J/UJ	1 - 7

Field Duplicates - Field duplicate samples were not included in this data package.

Compound Quantitation - All results reported with a (B) qualifier by the laboratory were further qualified as estimated (J) except those results already qualified.

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-RB-M5-PNR

SDG No.: F1820

Matrix: (soil/water) WATER

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F182001

Date Received: 05/23/06

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	5.95	B		P	4 LBL
7440-38-2	Arsenic	13.2	B		P	4 CCBL
7440-39-3	Barium	1.78	B		P	4 LBL
7440-41-7	Beryllium	0.101	B		P	4 LBL
7440-43-9	Cadmium	5.00	U		P	
7440-70-2	Calcium	519			P	J SDL
7440-47-3	Chromium	2.33	B		P	4 CCBL
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	20.9			P	
7439-89-6	Iron	120			P	
7439-92-1	Lead	4.59	B		P	J 1B
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	2.28	B		P	4 CBL
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	25.0	U		P	
7440-66-6	Zinc	13.3	B		P	4J LBL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/20/06

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET01-M5-PNR

SDG No.: F1820

Matrix: (soil/water) WATER

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F182002

Date Received: 05/23/06

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	5.23	B		P	U LBL
7440-38-2	Arsenic	12.9	B		P	U CBL
7440-39-3	Barium	1.69	B		P	U LBL
7440-41-7	Beryllium	4.00	U		P	
7440-43-9	Cadmium	5.00	U		P	
7440-70-2	Calcium	463	B		P	UJ LBL
7440-47-3	Chromium	4.86	B		P	U CBL
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	22.7			P	
7439-89-6	Iron	109			P	
7439-92-1	Lead	4.91	B		P	J LB
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	3.04	B		P	U LBL
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	25.0	U		P	
7440-66-6	Zinc	25.2			P	J SDL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET02-M5-PNR

SDG No.: F1820

Matrix: (soil/water) WATER

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F182003

Date Received: 05/23/06

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	10.0 5.46	B		P	U LBL
7440-38-2	Arsenic	25.0 9.89	B		P	U CCBL
7440-39-3	Barium	25.0 2.18	B		P	U LLIBL
7440-41-7	Beryllium	4.00	U		P	
7440-43-9	Cadmium	5.00	U		P	
7440-70-2	Calcium	519			P	J SDIL
7440-47-3	Chromium	10.0 6.42	B		P	U CCBL
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	21.2			P	
7439-89-6	Iron	147			P	
7439-92-1	Lead	6.05			P	
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	10.0 2.90	B		P	U LBL
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	25.0	U		P	
7440-66-6	Zinc	20.0 14.4	B		P	U LBL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/20/06

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INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TC60-ET03-M5-PNR

SDG No.: F1820

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) WATER

Lab Sample ID: F182004

Level: (low/med) LOW

Date Received: 05/23/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	10.0 5.83	B		P	U LBL
7440-38-2	Arsenic	35.0 8.32	B		P	U CVBL
7440-39-3	Barium	25.0 4.23	B		P	U LBL
7440-41-7	Beryllium	4.00	U		P	
7440-43-9	Cadmium	5.00	U		P	
7440-70-2	Calcium	1100			P	J SDL
7440-47-3	Chromium	10.0 7.66	B		P	U CVBL
7440-48-4	Cobalt	1.40	B		P	J LB
7440-50-8	Copper	25.2			P	
7439-89-6	Iron	274			P	
7439-92-1	Lead	22.5			P	
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	10.0 3.83	B		P	U CVBL
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	25.0	U		P	
7440-66-6	Zinc	85.4			P	J SDL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/20/06 G

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

Quartz Blank Filter

SDG No.: F1820

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) WATER

Lab Sample ID: F182010

Level: (low/med) LOW

Date Received: 05/23/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	10.0	U		P	
7440-38-2	Arsenic	25.0	U		P	
7440-39-3	Barium	21.3	B		P	J IB
7440-41-7	Beryllium	4.00	U		P	
7440-43-9	Cadmium	5.00	U		P	
7440-70-2	Calcium	258	B		P	J SDL
7440-47-3	Chromium	~~5.03~~ 10.0	~~B~~ U		P	U CBL
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	~~13.8~~ 20.0	~~B~~ U		P	U CBL
7439-89-6	Iron	140			P	
7439-92-1	Lead	~~3.73~~ 5.00	B		P	U CBL
7440-02-0	Nickel	4.47	B		P	J IB
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	0.907	B		P	J IB
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	1.17	B		P	J IB
7440-66-6	Zinc	42.0			P	J SDL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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FORM I - INORG

06/24/06

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: Glass Blank Filter 1

SDG No.: F1820

Matrix: (soil/water) WATER

Level: (low/med) LOW

% Moisture: 100

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: F182011

Date Received: 05/23/06

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	580			P	
7440-38-2	Arsenic	3380			P	
7440-39-3	Barium	2200			P	
7440-41-7	Beryllium	~~4.00~~ 0.923	B		P	U ICB
7440-43-9	Cadmium	1.11	B		P	J CB
7440-70-2	Calcium	229000			P	J SDL
7440-47-3	Chromium	11.8			P	
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	26.0			P	
7439-89-6	Iron	5380			P	
7439-92-1	Lead	324			P	
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	2.62	B		P	J CB
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	55.2			P	
7440-66-6	Zinc	232			P	J SDL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

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1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

Glass Blank Filter 2

SDG No.: F1820

Lab Name: CH2M HILL/LAB/CVO

Matrix: (soil/water) WATER

Lab Sample ID: F182012

Level: (low/med) LOW

Date Received: 05/23/06

% Moisture: 100

Concentration Units: ug/L

CAS No.	Analyte	Concentration	C	Q	M	
7440-36-0	Antimony	570			P	
7440-38-2	Arsenic	3290			P	
7440-39-3	Barium	2230			P	
7440-41-7	Beryllium	4.00 0.966	B		P	U CCBL
7440-43-9	Cadmium	1.12	B		P	J 13
7440-70-2	Calcium	229000			P	J SDL
7440-47-3	Chromium	11.3			P	
7440-48-4	Cobalt	10.0	U		P	
7440-50-8	Copper	24.5			P	
7439-89-6	Iron	5340			P	
7439-92-1	Lead	318			P	
7440-02-0	Nickel	20.0	U		P	
7782-49-2	Selenium	30.0	U		P	
7440-22-4	Silver	2.82	B		P	J 13
7440-28-0	Thallium	10.0	U		P	
7440-62-2	Vanadium	55.9			P	
7440-66-6	Zinc	241			P	J SDL

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments: _____

06/22/06

ATTACHMENT D

FIELD QC RESULTS

Dry Gas Meter 5-Point Calibration

Meter Box ID	M1
Date	1/9/2006
Calibrator	B. Guilfoil
Barometric Pressure	30.02

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	73		73-03		72-03		71-03		48	
Orifice Coefficient K'	0.8239		0.7280		0.5720		0.4240		0.3504	
Ambient Temperature	72.6	73.4	73.6	73	73	73	73.2	73.2	72.6	73.2
Meter Readings										
Vacuum (-) in. Hg	17	16.9	16.9	16.9	19.1	19	20.5	20.5	21	21
DH@ H	3.52	3.55	2.70	2.68	1.70	1.72	0.92	0.92	0.62	0.63
Initial Volume ft³	148,100	150,200	164,900	167,300	181,000	187,000	193,100	199,600	206,000	212,500
Final Volume ft³	151,500	162,800	171,300	179,400	186,200	192,300	198,100	205,600	212,100	218,500
Total (-) ft³	3.4	2.6	6.4	6.1	5.2	5.3	5	6	6.1	6
Initial DGM Temperature °F	81	83	83	83	82	81	80	78	77	76
Final DGM Temperature °F	72	74	74	75	76	76	76	76	75	75
Average Temperature °F	76.5	78.5	78.5	79.0	79.0	78.5	78.0	77.0	76.0	75.5
Time Minutes	5	6	7	7	6	6	10	13	13	12
Time Seconds	52.2	3.58	16.87	16.10	52.18	50.61	11.92	11.31	1.92	49.28
Delta H@	1.735	1.743	1.691	1.676	1.713	1.735	1.675	1.679	1.673	1.686
Gamma (Y)	0.9852	0.9842	1.0086	1.0083	0.9860	0.9938	1.0011	0.9862	0.9841	0.9829
Average Gamma (Y)	pass	0.9880	pass	1.0084	pass	0.9940	pass	0.9896	pass	0.9835

Input Temp		Temperature Reading from Individual Thermocouple Input									
		Channel Number									
Deg F	Deg R	1	"a Diff"	2	"a Diff"	3	"a Diff"	4	"a Diff"	5	"a Diff"
0	460		0.0		0.0		0.0		0.0		0.0
100	560		17.9		17.9		17.9		17.9		17.9
200	660		30.3		30.3		30.3		30.3		30.3
500	960		32.1		32.1		32.1		32.1		32.1
900	1360		99.2		99.2		99.2		99.2		99.2

Channel temperatures must agree with (+) 5 deg F

Acceptable temperature difference less than 1.5

Gamma must not deviate by more than +/- 0.02 from average

Delta H@ must not deviate by more than 0.2 inches of water from average.

Gamma (Y)	0.9951
Delta H@	1.701

Q.A./Q.C. Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: 1/9/06

Personnel (Signature/Date) Team Leader (Signature/Date)

Dry Gas Meter 5-Point Calibration

Meter Box ID	MA1	Barometric Pressure	30.51
Date	1/10/2006		
Calibrator	B. Guilfoil		

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	73		73-03		72-03		71-03		48	
Orifice Coefficient K	0.8239		0.7280		0.5720		0.4240		0.3504	
Ambient Temperature	63.6	63.6	64	63.6	64.4	64.6	63.4	63.8	63.6	63.6
Meter Readings										
Vacuum (>14" Hg)	16.4	16.4	17.5	17.6	19.1	19.4	21.2	21.2	22.1	22.2
Delta H	3.50	3.61	2.70	2.72	1.65	1.68	0.91	0.90	0.62	0.63
Initial Volume (I)	864.200	871.900	880.000	887.000	895.300	902.300	910.000	916.300	923.400	929.900
Final Volume (F)	871.100	878.500	886.500	894.100	901.900	908.900	916.000	922.300	929.400	935.900
Total (F-I)	6.9	6.9	6.5	7.1	6.6	6.6	6	6	6	6
Initial DGM Temperature (I)	64	66	71	72	72	72	72	73	70	70
Final DGM Temperature (F)	67	68	69	69	65	65	66	66	67	67
Average Temperature (T)	63.5	63.0	67.0	67.5	68.5	68.5	69.0	69.5	68.5	68.5
Time-Minutes	6	6	6	7	8	8	10	10	12	12
Time-Seconds	22.45	21.73	53.75	31.46	46.36	43.61	38.20	30.28	53.75	33.46
Delta H@	1.734	1.756	1.670	1.679	1.641	1.672	1.650	1.627	1.684	1.657
Gamma (Y)	0.9788	0.9790	1.0015	1.0017	0.9908	0.9892	0.9900	0.9883	0.9827	0.9823
Average Gamma (Y)	pass	0.9782	pass	1.0016	pass	0.9900	pass	0.9877	pass	0.9825

Input Temp		Temperature Reading from Individual Thermocouple Input									
		Channel Number									
Deg F	Deg R	1	% Diff [2]	2	% Diff [2]	3	% Diff [2]	4	% Diff [2]	5	% Diff [2]
0	460		0.0%		0.0%		0.0%		0.0%		0.0%
100	560		17.9%		17.9%		17.9%		17.9%		17.9%
200	660		30.3%		30.3%		30.3%		30.3%		30.3%
500	960		52.1%		52.1%		52.1%		52.1%		52.1%
900	1360		66.2%		66.2%		66.2%		66.2%		66.2%

[1] Channel temperatures must agree within +/- 5 F or 2C

[2] Acceptable temperature difference less than 1.5 %

Gamma must not deviate by more than +/- 0.02 from average.

Delta H@ must not deviate by more than 0.2 inches of water from average.

Gamma (Y)	0.9900
Delta H@	1.674

QA/QC Checks

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ 1/10/06

Personnel (Signature/Date) Team Leader (Signature/Date)

Dry Gas Meter 5-Point Calibration

Meter Box ID	MA2	Barometric Pressure	30.51
Date	1/10/2006		
Calibrator	B. Guilfoil		

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	73		73-03		72-03		71-03		48	
Orifice Coefficient K	0.8239		0.7280		0.5720		0.4240		0.3504	
Ambient Temperature	66	66	66	66	66.4	66.4	66.4	66.6	66.6	66.8
	Meter Readings									
Vacuum (-14" Hg)	14.4	14.5	15.9	15.9	18	18	20	20	20.9	21
Delta H	3.27	3.26	2.84	2.81	1.85	1.85	0.94	0.95	0.66	0.66
Initial Volume IT	511,700	518,200	525,800	533,500	542,000	548,400	555,600	561,400	567,700	573,800
Final Volume FT	517,700	524,200	532,900	540,600	548,000	554,700	561,100	566,900	573,600	579,900
Total (>5 FT)	6	6	7.1	7.1	6	6.3	5.5	5.5	5.9	6.1
Initial DGM Temperature °F	76	80	80	80	78	77	75	74	72	72
Final DGM Temperature °F	63	65	66	68	69	69	70	70	71	70
Average Temperature °F	69.5	72.5	73.0	74.0	73.5	73.0	72.5	72.0	71.5	71.0
Time Minutes	5	5	7	7	7	8	9	9	12	12
Time Seconds	21.23	23.48	19.07	18.01	42.82	5.02	32.53	31.81	12.72	37.73
Delta H@	1.828	1.813	1.738	1.722	1.831	1.833	1.695	1.706	1.738	1.727
Gamma (Y)	0.9624	0.9657	0.9818	0.9811	0.9651	0.9623	0.9657	0.9634	0.9508	0.9499
Average Gamma (Y)	pass	0.9641	pass	0.9816	pass	0.9637	pass	0.9645	pass	0.9504

Input Temp		Temperature Reading from Individual Thermocouple Input [1]									
		Channel Number									
Deg F	Deg R	1	% Diff [2]	2	% Diff [2]	3	% Diff [2]	4	% Diff [2]	5	% Diff [2]
0	460		0.0%		0.0%		0.0%		0.0%		0.0%
100	560		17.9%		17.9%		17.9%		17.9%		17.9%
200	660		30.3%		30.3%		30.3%		30.3%		30.3%
500	960		52.1%		52.1%		52.1%		52.1%		52.1%
900	1360		66.2%		66.2%		66.2%		66.2%		66.2%

[1] Channel temperatures must agree with +/- 5°F or 3°C

[2] Acceptable temperature difference less than 1.5 %

Gamma must not deviate by more than +/- 0.02 from average.

Delta H@ must not deviate by more than 0.2 inches of water from average.

Gamma (Y)	0.9648
Delta H@	1.763

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ Personnel (Signature/Date)

_____ 1/10/06 Team Leader (Signature/Date)

Dry Gas Meter 5-Point Calibration

Meter Box ID	**MA4**	**Barometric Pressure**	**30.50**
Date	**1/10/2006**		
Calibrator	**B. Guilfoil**		

	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2	Run #1	Run #2
Orifice ID	73		73-03		72-03		71-03		48	
Orifice Coefficient K'	0.8239		0.7280		0.5720		0.4240		0.3504	
Ambient Temperature	66.6	67	67	67	67	67.2	67.2	67.4	68.4	69
	Meter Readings									
Vacuum (>14" Hg)	14	14.2	15.5	15.5	17.1	17.5	19.5	19.7	20.5	20.5
Delta H	3.75	3.80	2.93	2.92	1.91	1.87	0.95	0.96	0.66	0.66
Initial Volume Ft³	249.500	255.900	263.300	270.000	277.700	284.400	291.900	298.200	305.000	311.200
Final Volume Ft³	255.500	261.900	269.600	276.300	284.000	290.700	297.900	304.200	311.000	317.200
Total (>5 Ft³)	6	6	6.3	6.3	6.3	6.3	6	6	6	6
Initial DGM Temperature °F	71	74	76	78	77	77	76	75	75	75
Final DGM Temperature °F	65	66	67	68	69	70	71	71	72	72
Average Temperature °F	68.0	70.0	71.5	73.0	73.0	73.5	73.5	73.0	73.5	73.5
Time Minutes	5	5	6	6	8	8	10	10	12	12
Time Seconds	23.50	23.18	30.70	30.36	9.50	7.87	30.14	30.43	33.04	33.14
Delta H@	1.826	1.845	1.809	1.798	1.896	1.855	1.713	1.719	1.725	1.740
Gamma (Y)	0.9570	0.9592	0.9807	0.9826	0.9705	0.9681	0.9753	0.9747	0.9628	0.9624
Average Gamma (Y)	pass	0.9581	pass	0.9816	pass	0.9693	pass	0.9750	pass	0.9626

Input Temp		Temperature Reading from Individual Thermocouple Input [1] Channel Number									
Deg F	Deg R	1	% Diff [2]	2	% Diff [2]	3	% Diff [2]	4	% Diff [2]	5	% Diff [2]
0	460		0.0%		0.0%		0.0%		0.0%		0.0%
100	560		17.9%		17.9%		17.9%		17.9%		17.9%
200	660		30.3%		30.3%		30.3%		30.3%		30.3%
500	960		52.1%		52.1%		52.1%		52.1%		52.1%
900	1360		66.2%		66.2%		66.2%		66.2%		66.2%

[1] Channel temperatures must agree with +/- 5°F or 3°C

[2] Acceptable temperature difference less than 1.5 %

Gamma must not deviate by more than +/- 0.02 from average.

Delta H@ must not deviate by more than 0.2 inches of water from average.

Gamma (Y)	**0.9693**
Delta H@	**1.793**

QA/QC Check

Completeness ✓ Legibility ✓ Accuracy ✓ Specifications ✓ Reasonableness ✓

Checked By: _____ _____ 1/10/06

Personnel (Signature/Date) Team Leader (Signature/Date)

APPENDIX TABLE

Meter Box Post Test Calibration Check

dstl
Porton Down
Sampling Point 002

Meter Box #: M1

Calibrated by:	B.Guilfoil	Delta H @	1.701
5-Pt Cal Date:	1/9/2006	Gamma, initial	0.9951

Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m \sqrt{\frac{0.0319\, T_m}{\Delta H_a \left(P_b + \Delta \frac{H_{avg}}{13.6} \right) M_d} \frac{29}{}} \left(\sqrt{\Delta H} \right)_{avg}}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg	average orifice meter differential, in. H20.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

	1	2	3	Average
time	280	290.8	230	266.9
Vm - total	113.542	119.404	94.415	109.1
Tm avg	87.8	87.5	86.7	87.3
Tm -R	548	548	547	547.3
Barometric	29.40	29.42	29.28	29.37
DH_{avg}	0.490	0.490	0.490	0.4900
DH@	1.7010	1.7010	1.7010	1.7010
Md stack gas	28.83	28.85	28.82	28.83
Md Air	29.00	29.00	29.00	29.00
Meter Box Gamma	0.995	0.995	0.995	0.9951
QA Gamma	1.0212	1.0076	0.9679	0.9989
Difference:	2.6%	1.3%	2.7%	0.4%
within 5%?	PASS	PASS	PASS	PASS

APPENDIX TABLE

Meter Box Post Test Calibration Check

dstl
Porton Down
Sampling Point 002

Meter Box #: MA1

Calibrated by:	B. Guilfoil	Delta H @	1.674
5-Pt Cal Date:	1/10/2006	Gamma, initial	0.99

Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m \sqrt{\frac{0.0319\, T_m}{\Delta H_@ \left(P_b + \frac{\Delta H_{avg}}{13.6} \right)} \frac{29}{M_d}}} \left(\sqrt{\Delta H} \right)_{avg}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg	average orifice meter differential, in. H2O.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

	1	2	3	Average
time	280	290	230	266.7
Vm - total	168.549	155.357	123.293	149.1
Tm avg	89.1	91.8	90.1	90.3
Tm -R	549	552	550	550.3
Barometric	29.40	29.42	29.28	29.37
DH_{avg}	1.030	0.800	0.800	0.8767
DH@	1.6740	1.6740	1.6740	1.6740
Md stack gas	28.83	28.85	28.82	28.83
Md Air	29.00	29.00	29.00	29.00
Meter Box Gamma	0.990	0.990	0.990	0.9900
QA Gamma	1.0067	0.9987	0.9577	0.9877
Difference:	1.7%	0.9%	3.3%	0.2%
within 5%?	PASS	PASS	PASS	PASS

APPENDIX TABLE

Meter Box Post Test Calibration Check

dstl
Porton Down
Sampling Point 002

Meter Box #: MA2

Calibrated by:	B.Guilfoil	Delta H@	1.763
5-Pt Cal Date:	1/10/2006	Gamma, initial	0.9648

Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m \sqrt{\frac{0.0319\, T_m \quad 29}{\Delta H_a \left(P_b + \Delta \frac{H_{avg}}{13.6} \right) M_d}}} \left(\sqrt{\Delta H} \right)_{avg}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg,	average orifice meter differential, in. H20.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

	1	2	3	Average
time	280	290	230	266.7
Vm - total	158.193	182.209	143.450	161.3
Tm avg	91.5	93.0	91.2	91.9
Tm -R	552	553	551	551.9
Barometric	29.40	29.42	29.28	29.37
DH_{avg}	0.850	1.100	1.100	1.0167
DH@	1.7630	1.7630	1.7630	1.7630
Md stack gas	28.83	28.85	28.82	28.83
Md Air	29.00	29.00	29.00	29.00
Meter Box Gamma	0.965	0.965	0.965	0.9648
QA Gamma	0.9514	0.9739	0.9414	0.9556
Difference:	1.4%	0.9%	2.4%	1.0%
within 5%?	PASS	PASS	PASS	PASS

APPENDIX TABLE

Meter Box Post Test Calibration Check

dstl
Porton Down
Sampling Point 002

Meter Box #: MA4

Calibrated by: B.Guilfoil
5-Pt Cal Date: 1/10/2006

Delta H @ 1.793
Gamma, initial 0.9693

Calculate Yqa for each test run using the following equation:

$$Y_{qa} = \frac{\theta}{V_m \sqrt{\frac{0.0319\, T_m}{\Delta H_{@}\left(P_b + \Delta \frac{H_{avg}}{13.6}\right)} \frac{29}{M_d}}} \left(\sqrt{\Delta H}\right)_{avg}$$

where:

Yqa	dry gas meter calibration check value, dimensionless.
q	total run time, min.
Vm	total sample volume measured by dry gas meter, dcf.
Tm	absolute average dry gas meter temp., °R.
Pb	barometric pressure, in. Hg.
0.0319	= (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.
DHavg	average orifice meter differential, in. H20.
DH@	orifice meter calibration coefficient, in. H2O.
Md	dry molecular weight of stack gas, lb/lb-mole.
29	dry molecular weight of air, lb/lb-mole.
13.6	specific gravity of mercury.

After each test run series, do the following:

Average the three or more Yqa's obtained from the test run series and compare this average with the dry gas meter calibration factor, Y. The average Yqa must be within 5 percent of Y.

If the average Yqa does not meet the +5 percent criterion, recalibrate the meter over the full range of orifice settings, as detailed in Section 5.3.1 of Method 5. Then follow the procedure in Section 5.3.3 of Method 5.

	1	2	3	Average
time	280	290.2	230	266.7
Vm - total	155.925	162.293	128.619	148.9
Tm avg	88.0	89.7	88.8	88.8
Tm -R	548	550	549	548.8
Barometric	29.40	29.42	29.28	29.37
DH_{avg}	0.870	0.870	0.870	0.8700
DH@	1.7930	1.7930	1.7930	1.7930
Md stack gas	28.83	28.85	28.82	28.83
Md Air	29.00	29.00	29.00	29.00
Meter Box Gamma	0.969	0.969	0.969	0.9693
QA Gamma	0.9652	0.9620	0.9238	0.9503
Difference:	0.4%	0.8%	4.7%	2.0%
within 5%?	PASS	PASS	PASS	PASS

Calibration Error Test at Run 1
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers			
	Zero	Low-range	Mid-range	High-range
THC1	05/51978UT	05/52055UT	05/52106UT	05/52102UT
O2	05/52068UT		05/51997UT	05/52090UT
CO2	05/52068UT		05/51997UT	05/52090UT
CO	05/52068UT		D903182	D889588
SO2	05/52068UT		D903182	D889588
NOx	05/52068UT		D903182	D889588
THC2	05/51978UT	05/52055UT	05/52106UT	05/52102UT

Date/Time	3/21/2006	6:07:05	PASSED				
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Avg	0.1	-0.071	-0.0272	0.115	-0.052	-0.263	0.01
Zero Error%	0.1	0.3	0.5	0.2	0.2	0.6	0
Low Ref Cyl	39						39
Low Avg	39.74						39.33
Low Error%	0.7						0.3
Mid Ref Cyl	60	15.13	2.46	19.5	12.5	26.5	60
Mid Avg	60.24	14.742	2.5174	19.981	12.207	26.813	59.71
Mid Error%	0.2	1.6	1.1	1	1	0.7	0.3
High Ref Cyl	80	20.3	3.92	39	21.5	40	80
High Avg	79.67	20.047	3.9452	39.597	21.583	40.473	79.6
High Error%	0.3	1	0.5	1.2	0.3	1.1	0.4

Initial System Bias Check for Run 1
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/Time	3/21/2006	6:29:04					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	0.1	-0.071	-0.0272	0.115	-0.052	-0.263	0.01
Zero Avg	0.08	0.408	0.0822	0.251	-0.938	0.084	0.42
Zero Bias%	0	1.9	2.2	0.3	3	0.8	0.4
Zero Drift%							
Span Ref Cyl	60	15.13	2.46	19.5	12.5	26.5	60
Span Cal	60.24	14.742	2.5174	19.981	12.207	26.813	59.71
Span Avg	59.12	14.878	2.5254	20.133	11.129	22.352	56.25
Span Bias%	1.1	0.5	0.2	0.3	3.6	9.9	3.5
Span Drift%							

Final System Bias Check for Run 1
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/Time	3/21/2006	15:38:09					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	0.1	-0.071	-0.0272	0.115	-0.052	-0.263	0.01
Zero Avg	0.1	0.641	0.088	0.182	-0.259	-0.197	0.5
Zero Bias%	0	2.8	2.3	0.1	0.7	0.1	0.5
Zero Drift%	0	0.9	0.1	-0.1	2.3	-0.6	0.1
Span Ref Cyl	60	15.13	2.46	19.5	12.5	26.5	60
Span Cal	60.24	14.742	2.5174	19.981	12.207	26.813	59.71
Span Avg	57.66	15.346	2.5726	19.791	11.673	21.846	58.02
Span Bias%	2.6	2.4	1.1	0.4	1.8	11	1.7
Span Drift%	-1.5	1.9	0.9	-0.7	1.8	-1.1	1.8
Ini Zero Avg	0.08	0.408	0.0822	0.251	-0.938	0.084	0.42
Ini Span Avg	59.12	14.878	2.5254	20.133	11.129	22.352	56.25
Run Avg	2.56	19.152	0.3868	0.655	-0.825	1.999	1.51
Co	0.09	0.525	0.0851	0.216	-0.599	-0.057	0.46
Cm	58.39	15.112	2.549	19.962	11.401	22.099	57.13
Correct Avg	2.54	19.32	0.3012	0.434	-0.236	2.458	1.12

Calibration Error Test at Run 2
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers			
	Zero	Low-range	Mid-range	High-range
THC1	05/51978UT	05/52055UT	05/52106UT	05/52102UT
O2	05/52068UT		05/51997UT	05/52090UT
CO2	05/52068UT		05/51997UT	05/52090UT
CO	05/52068UT		D903182	D889588
SO2	05/52068UT		D903182	D889588
NOx	05/52068UT		D903182	D889588
THC2	05/51978UT	05/52055UT	05/52106UT	05/52102UT

Date/Time	3/22/2006	5:57:39					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Avg	0.08	0.002	0.0098	-0.04	-0.031	-0.058	0.09
Zero Error%	0.1	0	0.2	0.1	0.1	0.1	0.1
Low Ref Cyl	39						39
Low Avg	39.58						39.34
Low Error%	0.6						0.3
Mid Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Mid Avg	60.03	14.939	2.5266	10.348	5.823	14.7	59.83
Mid Error%	0	0.8	1.3	0.3	2.3	0.7	0.2
High Ref Cyl	80	20.3	3.92	19.5	12.5	26.5	80
High Avg	80.02	20.221	3.9532	19.677	12.382	26.222	79.91
High Error%	0	0.3	0.7	0.4	0.4	0.6	0.1

Initial System Bias Check for Run 2
Operator: K.Woolter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/Time	3/22/2006	6:10:14	PASSED				
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	0.08	0.002	0.0098	-0.04	-0.031	-0.058	0.09
Zero Avg	-0.17	0.711	0.1543	0.06	0.045	-0.084	0.44
Zero Bias%	0.3	2.8	2.9	0.2	0.3	0.1	0.4
Zero Drift%							
Span Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Span Cal	60.03	14.939	2.5266	10.348	5.823	14.7	59.83
Span Avg	58.04	15.042	2.5686	9.518	6.005	13.779	56.69
Span Bias%	2	0.4	0.8	1.7	0.6	2	3.1
Span Drift%							

Final System Bias Check for Run 2
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/Time	3/22/2006	14:46:52	PASSED				
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	0.08	0.002	0.0098	-0.04	-0.031	-0.058	0.09
Zero Avg	0.29	0.809	0.205	-0.031	0.557	-0.18	0.55
Zero Bias%	0.2	3.2	3.9	0	2	0.3	0.5
Zero Drift%	0.5	0.4	1	-0.2	1.7	-0.2	0.1
Span Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Span Cal	60.03	14.939	2.5266	10.348	5.823	14.7	59.83
Span Avg	56.56	15.709	2.6571	9.457	5.378	12.85	55.82
Span Bias%	3.5	3.1	2.6	1.8	1.5	4.1	4
Span Drift%	-1.5	2.7	1.8	-0.1	-2.1	-2.1	-0.9
Ini Zero Avg	-0.17	0.711	0.1543	0.06	0.045	-0.084	0.44
Ini Span Avg	58.04	15.042	2.5686	9.518	6.005	13.779	56.69
Run Avg	2.28	19.472	0.4392	0.391	-0.175	1.737	1.36
Co	0.06	0.76	0.1797	0.014	0.301	-0.132	0.49
Cm	57.3	15.375	2.6128	9.488	5.692	13.315	56.25
Correct Avg	2.32	19.37	0.2624	0.417	-0.574	2.085	0.93

Calibration Error Test at Run 3
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers			
	Zero	Low-range	Mid-range	High-range
THC1	05/51978UT	05/52055UT	05/52106UT	05/52102UT
O2	05/52068UT		05/51997UT	05/52090UT
CO2	05/52068UT		05/51997UT	05/52090UT
CO	05/52068UT		D903182	D889588
SO2	05/52068UT		D903182	D889588
NOx	05/52068UT		D903182	D889588
THC2	05/51978UT	05/52055UT	05/52106UT	05/52102UT

Date/Time	3/23/2006	5:47:03					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Avg	-0.03	-0.003	-0.0101	0.157	-0.108	-0.073	-0.08
Zero Error%	0	0	0.2	0.3	0.4	0.2	0.1
Low Ref Cyl	39						39
Low Avg	39.34						39.75
Low Error%	0.3						0.8
Mid Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Mid Avg	59.85	15.25	2.444	10.315	4.866	14.492	60.42
Mid Error%	0.1	0.5	0.3	0.4	5.4	1.1	0.4
High Ref Cyl	80	20.3	3.92	19.5	12.5	26.5	80
High Avg	80.01	20.405	3.8647	19.257	12.282	26.435	80.21
High Error%	0	0.4	1.1	0.5	0.7	0.1	0.2

Initial System Bias Check for Run 3
Operator: K.Woofter
Plant Name: dstl Porton Down
Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/ Time	3/23/2006	5:57:53					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	-0.03	-0.003	-0.0101	0.157	-0.108	-0.073	-0.08
Zero Avg	0.01	1.045	0.1406	0.16	-0.064	-0.084	-0.2
Zero Bias%	0	4.2	3	0	0.1	0	0.1
Zero Drift%							
Span Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Span Cal	59.85	15.25	2.444	10.315	4.866	14.492	60.42
Span Avg	55.64	14.653	2.3534	9.69	6.261	13.923	55.17
Span Bias%	4.2	2.4	1.8	1.2	4.7	1.3	5.2
Span Drift%							

Final System Bias Check for Run 3

Operator: K.Wootter

Plant Name: dstl Porton Down

Location: Building Air Filter

	Reference Cylinder Numbers	
	Zero	Span
THC1	05/51978UT	05/52106UT
O2	05/52068UT	05/51997UT
CO2	05/52068UT	05/51997UT
CO	05/52068UT	D903182
SO2	05/52068UT	D903182
NOx	05/52068UT	D903182
THC2	05/51978UT	05/52106UT

Date/Time	3/23/2006	14:40:34					
Analyte	THC1	O2	CO2	CO	SO2	NOx	THC2
Units	ppm	%	%	ppm	ppm	ppm	ppm
Zero Ref Cyl	0	0	0	0	0	0	0
Zero Cal	-0.03	-0.003	-0.0101	0.157	-0.108	-0.073	-0.08
Zero Avg	0.35	1.088	0.1609	-0.081	0.597	-0.086	0.19
Zero Bias%	0.4	4.4	3.4	0.5	2.3	0	0.3
Zero Drift%	0.3	0.2	0.4	-0.5	2.2	0	0.4
Span Ref Cyl	60	15.13	2.46	10.5	6.5	15	60
Span Cal	59.85	15.25	2.444	10.315	4.866	14.492	60.42
Span Avg	55.31	15.3	2.3844	9.124	5.377	11.669	56.4
Span Bias%	4.5	0.2	1.2	2.4	1.7	6.3	4
Span Drift%	-0.3	2.6	0.6	-1.1	-2.9	-5	1.2
Ini Zero Avg	0.01	1.045	0.1406	0.16	-0.064	-0.084	-0.2
Ini Span Avg	55.64	14.653	2.3534	9.69	6.261	13.923	55.17
Run Avg	2.15	19.124	0.3583	0.431	0.334	2.123	1.43
Co	0.18	1.066	0.1508	0.04	0.267	-0.085	-0.01
Cm	55.48	14.976	2.3689	9.407	5.819	12.796	55.79
Correct Avg	2.14	19.642	0.2301	0.439	0.078	2.571	1.55

APPENDIX D
SYSTEM AVAILABILITY DETERMINATION

System Availability Determination

The Demonstration/Validation test program was conducted to prove concepts and performance in a series of short term tests. Administrative procedures for the test program were devised to support the demonstration and to match the available resources at the test site. This imposed a number of operating constraints that may not pertain to deployments for destruction operations that have resources to support extended destruction operations.

The basis of the calculation is to account for the total hours that the system was up ready to operate for each operating day in the test period. From these total hours, the time due to delays or interruptions arising from any cause were subtracted. The planned outages for maintenance days and overnight shutdowns and startup were not included in the calculation because these operating decisions were reflective of decisions made to conform to existing range practices, resource availability and operating constraints in other support organizations, particularly the magazine operations at the test site. If planned maintenance outages are included, the availability statistic will decrease. If the overnight and weekend time when the CDC system was capable of operations were to be included then the availability statistic will increase. These are typical of the operating decisions that will affect availability.

System Availability Data

Day	Total	27 Feb	28 Feb	1 Mar	2 Mar	6 Mar	7 Mar	8 Mar	9 Mar	14 Mar	15 Mar	16 Mar	21 Mar	22 Mar	23 Mar
Start time		8:42	8:42	12:15	11:30	9:45	9:10	11:27	12:00	7:55	8:05	13:05	8:00	8:00	7:54
Stop time		17:10	17:16	17:08	18:10	17:32	17:16	17:15	17:05	16:39	17:55	17:10	16:14	16:14	16:47
Total Time (A)	103:21:00	8:28	8:34	4:53	6:40	7:47	8:06	5:48	5:05	8:44	9:50	4:05	8:14	8:14	8:53
Down times															
Begin				14:52	16:54		13:36		12:54	10:02			10:38	13:28	12:14
End				17:08	18:10		13:37		12:57	10:06			10:40	13:35	12:19
Begin													11:47	13:43	
End													12:33	13:53	
Total Down time (B)	4:50:00	0:00	0:00	2:16	1:16	0:00	0:01	0:00	0:03	0:04	0:00	0:00	0:48	0:17	0:05
Available Time (A-B)	98:31:00														
Availability = (A-B)/A	95.3%														