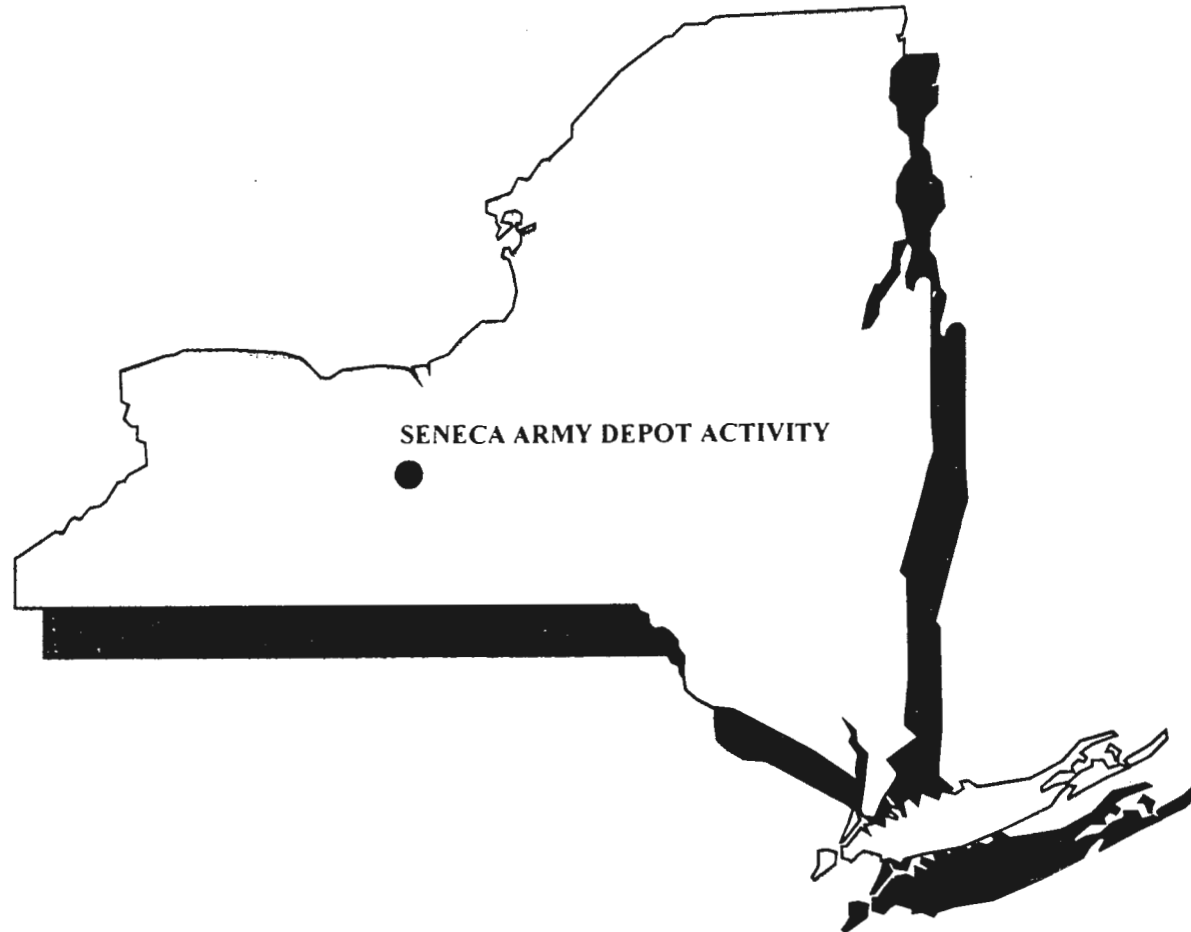


U.S. ARMY ENGINEER DIVISION
HUNTSVILLE, ALABAMA

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DRAFT

LOW TEMPERATURE THERMAL DESORPTION (LTDD)
TREATABILITY STUDY COST AND PERFORMANCE TEST REPORT
SENECA ARMY DEPOT ACTIVITY

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**LOW TEMPERATURE THERMAL DESORPTION
TREATABILITY STUDY
DRAFT COST AND PERFORMANCE TEST REPORT**

SENECA ARMY DEPOT ACTIVITY
ROMULUS, NEW YORK 14541

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EXECUTIVE SUMMARY

The US Army conducted a Treatability Study to assess the potential of using an inactive, Army Peculiar Equipment (APE) 1236 deactivation furnace as a low temperature thermal desorption (LTTD) system for treating soil contaminated with volatile and semi-volatile organic compounds. The Treatability Study was conducted using the deactivation furnace located in SEAD-17 at the Seneca Army Depot Activity (SEDA) in Romulus, New York.

The APE 1236 deactivation furnace's waste feed system was modified to allow contaminated soil to be fed into the system's rotary kiln for thermal treatment. Within the kiln, the contaminated soil was heated from ambient temperatures to a final temperature of approximately 500 to 600 degrees Fahrenheit (°F) via contact with a counter-current flow of hot combustion gases. During heating, volatile and semivolatile organic compounds contained in the contaminated soil feed were volatilized and liberated from the soil where they entered and mixed with the combustion gas stream. The combustion gases and the volatilized organics then flowed into an afterburner where they were combusted at 1,400 to 1,600 °F for a period of approximately one to two seconds before the resulting gases were channeled through a series of air pollution control devices (APCDs – i.e., High and Low Temperature Gas Coolers, a Cyclone, and a Baghouse) for exhaust gas conditioning and cooling prior to discharge to the atmosphere.

Sampling and analysis was conducted on the system's solid waste feed and residue streams to document the system's ability to thermally remove the organic contaminants from the soil via volatilization. The system's ability to remove the organic contaminants was determined by comparing the concentrations of contaminants found in the soil after treatment to those recorded for the waste feed input. Additionally, the composition of the waste gases and particulate matter liberated during the thermal treatment process (i.e., initial thermal desorption and subsequent combustion in the afterburner) and processed within the system's air pollution control device train was also documented via sampling and analysis of the waste gases and captured flyash. Finally, operational data was collected to define the economics of the treatment process.

Based on the results of the LTTD Treatability Study, the following conclusions can be made:

- The LTTD process was not entirely effective in reducing the PAH concentrations to levels below desired levels TAGMs.
- The LTTD process has no effect on metal constituent concentrations in the soils. The metal concentrations continue to exceed TAGMs following treatment, as expected.
- Fly ash will need to be disposed of in a RCRA Subtitle C or D landfill due to metals concentration far exceeding TAGMs.

- Limited stack gas sampling generally met the emissions criteria for dioxins/furans, total hydrocarbons and carbon monoxide. The results of VOST testing for VOCs were generally inconclusive.
- The treatment cost for the LTTD process is estimated at \$85 to \$108 per ton of soil treated, due mainly to the high fuel consumption. Landfilling of the soils without treatment is significantly less costly at approximately \$40 per ton.

Based on the results of the Treatability Study and the cost comparison, it is not recommended that the LTTD process be used for treatment of onsite soils. This recommendation is based mainly on the estimated high cost of the LTTD treatment process. Additionally, LTTD treated soils will still contain metals and probably some of the higher boiling PAHs at concentrations that would necessitate alternative remedial actions.

**LOW TEMPERATURE THERMAL DESORPTION
TREATABILITY STUDY
COST AND PERFORMANCE TEST REPORT
FOR THE
SENECA ARMY DEPOT ACTIVITY**

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ACRONYMS and ABBREVIATIONS

Acfm	Actual cubic feet per minute
ACGIH	American Conference of Governmental Industrial Hygenists
AGC	Annual Guideline Concentration
APC	Air Pollution Control
APCD	Air Pollution Control Device
APE	Ammunition Peculiar Equipment
ASTM	American Society of Testing Materials
AWFMS	Automatic Waste Feed Monitoring System
AWFSO	Automatic Waste Feed Shut-off
Btu	British thermal unit
CD	Calibration Drift
CEM	Continuous Emissions Monitoring
cfm	Cubic Feet Minute
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
DAS	Data Acquisition System
DF	Deactivation Furnace
DRE	Destruction and Removal Efficiency
dscf	dry standard cubic foot
dscfm	dry standard cubic foot per minute
DP	Differential Pressure
EC	Calibrator Error
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FM	Factory Mutual
FSG	Flame Safeguard Panel
GFC	Gas Filter Correlation
° C	degrees Celsius
° F	degrees Fahrenheit
hp	horsepower
hr	hour
HT	High Temperature
ID	Induced Draft
IR	Infrared
IRIS	Integrated Risk Information Service

ACRONYMS and ABBREVIATIONS

(continued)

ITRC	Interstate Technology and Regulatory Cooperation
i/o	Input/output
LDL	Lower Detectable Limit
LD ₅₀	Lethal Dose – 50
Lpm	Liters per minute
LT	Low Temperature
LTTD	Low Temperature Thermal Desorption
MM5	Modified Method 5
NDIR	Non-Dispersive Infrared
NIOSH	National Institute of Occupational Safety and Health
NYSDEC	New York State Department of Environmental Conservation
O ₂	Oxygen
PAI	Predicted Annual Impact
PC	Personnel Computer
PCDD	Polychlorinated Dibenzo-p-Dioxins
PCDF	Polychlorinated Dibenzofurans
PCOS	Personal Computer Operatives Station
PEP	Propellant/explosive/pyrotechnic
PIC	Product of Incomplete Combustion
PLC	Programmable Logic Controller
POHC	Principal Organic Hazardous Constituent
ppm	Parts per million
PSM	Point Source Method
PST	Performance Specification Test
PV	Process Variable
PVC	Polyvinyl chloride
QAC	Quality Assurance Coordinator
QA/QC	Quality Assurance/Quality Control
RA	Relative Accuracy
RAC	Reference Air Concentrators
RCRA	Resource Conservation and Recovery Act
REC	Recommended Exposure Limit
RFD	Reference Dose
RPM	Revolutions Per Minute
RSD	Risk Specific Doses
RT	Response Time

ACRONYMS and ABBREVIATIONS

(continued)

RTECS	Registry of Toxic Effects of Chemical Substances
scfm	Standard cubic feet per minute
SEAD	Seneca Army Depot
SGC	Short Term Guideline Concentration
SOP	Standing Operating Procedures
SP	Set Point
STEM	Sampling Train for Energetic Materials
TB	Trial Burn
TBP	Trial Burn Plan
TCE	Trichloro Ethylene
THC	Total Hydrocarbons
TLV	Threshold Limit Value
TSLoO ₂	Thermal Stability Low Oxygen
TSI	Thermal Stability Index
TWA	Time Weighted Average
UDRI	University of Dayton Research Institute
UHP	Ultra High Purity
USATHAMA	United States Army Toxic and Hazardous Material Agency
USGS	United States Geographic Service
VOST	Volatile Organic Sampling Train

1 INTRODUCTION

The US Army conducted a treatability study to assess the potential of using the Army Peculiar Equipment (APE) 1236 deactivation furnace as a low temperature thermal desorption (LTTD) system for treating soil contaminated with volatile and semi-volatile organic compounds. The proposed treatability study was conducted using the APE 1236 deactivation furnace located in SEAD-17 at the Seneca Army Depot Activity (SEDA). **Figure 1-1** shows the location of the deactivation furnace at SEAD-17 at SEDA.

The existing APE 1236 furnace's waste feed system was modified to allow soil contaminated with volatile organic, semi-volatile organic, and low levels of organochlorine pesticides and polychlorinated biphenyl compounds to be fed to the LTTD system for thermal treatment. Sampling and analysis was conducted on the system's solid waste feed and residue streams to document the system's ability to thermally remove the contaminants from the soil via volatilization. The system's ability to remove the organic contaminants was determined by comparing the concentration of contaminants found in the soil after treatment to those recorded for the waste feed input. Additionally, the composition of the waste gases and particulate matter liberated during the thermal treatment process (i.e., initial thermal desorption and subsequent combustion in the afterburner) and processed within the system's air pollution control device (APCD) train was documented via sampling and analysis of the waste gases and captured flyash. Operational data was collected to assess the economics of the treatment process.

The US Army's preferred management strategy for soil found at SEDA that contains volatile organic chemicals at concentrations above regulatory limits is to treat the soil and to then reuse the treated soil as fill material. A less desirable management alternative is to partially treat the soil to reduce the concentration of contaminants and to then transport (under appropriate manifests) it off-site for further treatment or disposal. This study evaluated the cost-effectiveness of these alternatives.

Specific goals of the Treatability Study included the following determinations or demonstrations:

- Organic chemical contaminated soils could be treated to a degree that reduced concentrations of volatile organic, semivolatile organic, organochlorine pesticide, and polychlorinated biphenyl constituents to levels lower than State of New York Technical and Administrative Guidance Memorandum (TAGM) levels which would allow reuse of the soil as fill or as top cover in landfills;
- Total Petroleum Hydrocarbon (TPH) contaminated soil could be treated to a degree that reduced TPH concentrations to below 100 parts per million;

- Exhaust gases released from the APE 1236 system during its operation treating soil contained less than 100 parts per million by volume (100 ppm_v) of carbon monoxide, corrected to a level of 7 percent (%) oxygen on a rolling hourly-average basis;
- Exhaust gases released from the APE 1236 system during its operation contained less than 0.05 grains per dry standard cubic foot (dscf) of particulate matter, corrected to a 7% oxygen content;
- Exhaust gases released from the APE 1236 system during its operation treating soil contained less than 0.2 nanograms per dry standard cubic meter (dscm) of Polychlorinated dibenzo-p-dioxin (dioxins) and Polychlorinated dibenzofuran (furans) compounds, corrected to a 7% oxygen level;
- Destruction and removal efficiency (DRE) achieved for volatile organic, semi-volatile organic, polychlorinated biphenyls and organo-chlorine pesticide contaminants equaled or exceeded 99.99 percent for the process or, if the DRE level could not be demonstrated, that none of the target organic compounds were present in the exhaust gases at levels above analytical detection limits;
- Operation of the APE 1236 does not result in excessive fugitive emissions from the process or from associated waste feed or waste residue handling operations;
- The APE 1236 system's Automatic Waste Feed Shutoff (AWFSO) system is fully functional and effectively works in the event of operating system upsets; and
- The APE 1236 system is shown to pose an economically viable alternative to treat soils containing TPH and semi-volatile organic compounds.

This evaluation describes the tests that were conducted to demonstrate the performance of the APE 1236 system as an LTTD unit. The work was conducted in a manner that was consistent with the technical requirements developed and recommended by the Interstate Technology and Regulatory Cooperation (ITRC) Work Group for On-Site Thermal Desorption of Solid Media Contaminated with Hazardous Chlorinated Organics.

The Cost and Performance Test Report is divided into the following sections:

Section 2 – Engineering Description of the LTTD System: Provides a detailed description of the major components and instrumentation used in the APE 1236 LTTD system. Operating procedures for soil treatment and automatic waste feed shut off (AWFSO) procedures are also included.

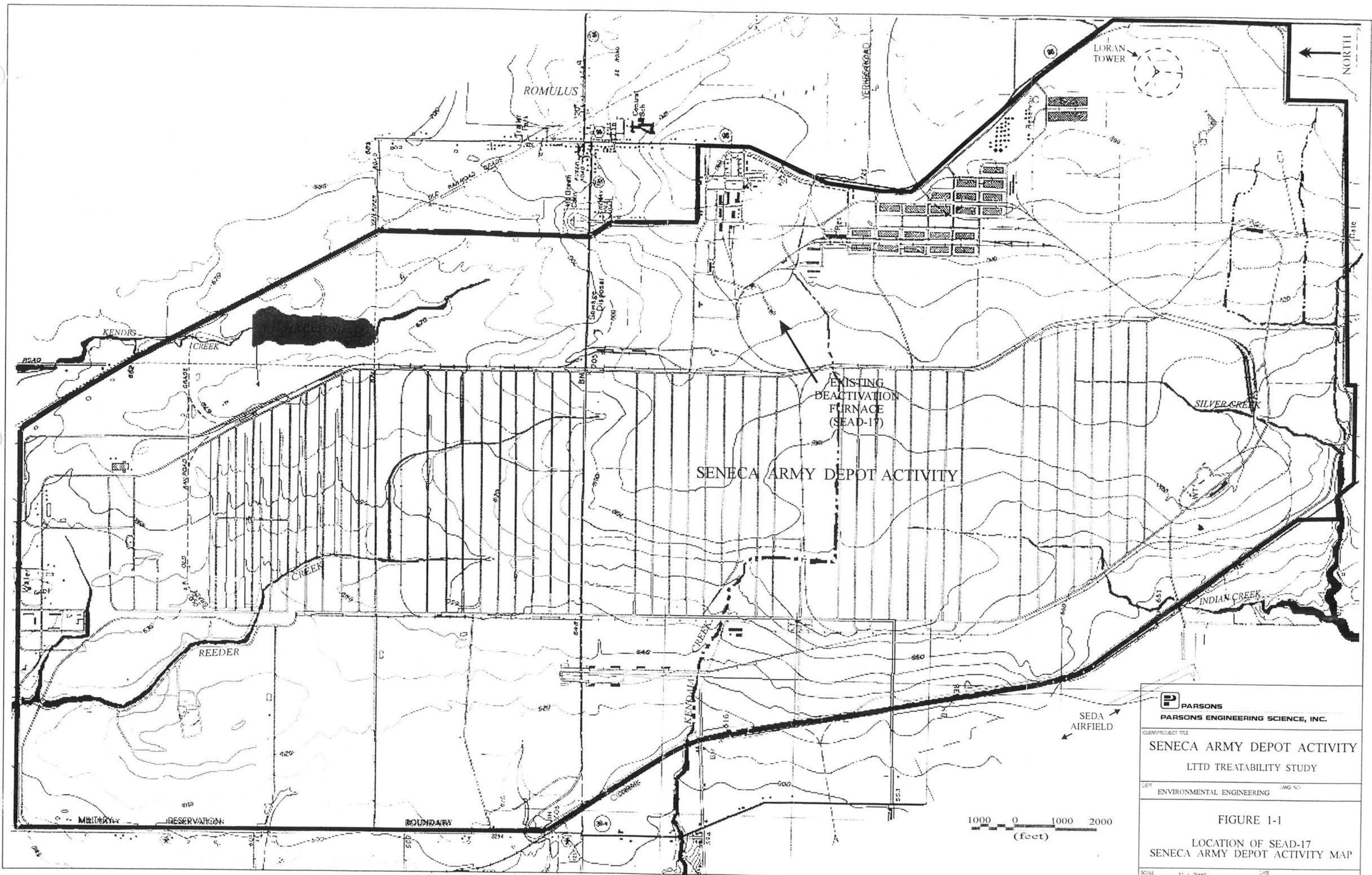
Section 3 – Waste Feed Characterization: Provides a chemical characterization of the soil that was used as the feed stock for LTTD system. Soil handling and stockpiling procedures are also included.


Section 4 – Treatment System Performance: Provides a summary of the treatability results as compared to the goals of the study. The section presents estimates of removal efficiencies, stack gas analysis, operating parameters and fugitive dust monitoring.

Section 5 – Treatment System Costs: Provides an estimate of the remediation costs associated with the LTTD treatment process. Additionally, a cost estimate was performed for remediation of SEAD-59 soils using the LTTD process.

Section 6 – Conclusions and Recommendations: Presents the general conclusions from the LTTD Treatability Study. A recommendation will be made concerning the cost-effectiveness of using this process for future treatment of site soils.

Appendices: Large Process Flow and Instrumentation Diagrams (**Appendix A**); Continuous emissions monitoring data (**Appendix B**); sample calculations (**Appendix C**); operating data logs (**Appendix D**); and detailed cost estimate (**Appendix E**).



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<small>CLIENT/PROJECT TITLE</small> SENECA ARMY DEPOT ACTIVITY LTID TREATABILITY STUDY	
<small>DEPT</small> ENVIRONMENTAL ENGINEERING	
FIGURE I-1 LOCATION OF SEAD-17 SENECA ARMY DEPOT ACTIVITY MAP	
<small>SCALE</small>	<small>DATE</small>

2 ENGINEERING DESCRIPTION

This section provides a detailed engineering description of the APE 1236 deactivation system that was converted to a Low Temperature Thermal Desorption (LTTD) unit for the LTTD Treatability Study.

The APE 1236 deactivation system was designed by the Ammunition Equipment Division (AED) at Tooele Army Depot. The APE 1236 is a rotary kiln incinerator that has been upgraded to include an afterburner and additional instrumentation. The US Army previously employed the APE 1236 at SEDA to deactivate munitions.

This section provides the following information:

- Description of major components
- Description of instrumentation
- Operating procedures

A site plan of the APE 1236 deactivation furnace is shown in Figure 2-1. An isometric of the APE 1236 system is shown in Figure 2-2. Other figures showing additional detail of the APE 1236 design are provided in Appendix A of this document.

2.1 DESCRIPTION OF MAJOR COMPONENTS

2.1.1 Fuel and Waste Feed Systems

Number (No.) 2 fuel oil is used to fire the burners in both the kiln and afterburner, and propane is used as pilot fuel for the afterburner. The propane and fuel oil piping from the storage and pumping area to the system area are installed in a concrete ditch for leak containment. The propane storage tank is a 1,000-gallon horizontal drum mounted on a concrete pad. The appropriate valves, fittings, regulators, and piping are installed for propane pressure reduction and transportation to the afterburner burner pilot train.

The fuel oil storage tank is a 4,000-gallon drum mounted on a 24 x 14-foot rectangular, 4-inch thick concrete pad. The fuel oil storage tank pad is surrounded on all side by 30-inch high walls for secondary containment. A pump with the required valves and piping is used to transport the fuel oil to

the APE 1236 area.

Modification to the APE 1236 waste feed system was necessary to adapt this unit to feed soil rather than munitions for which it was designed. The original system included an automatic waste feed monitoring system (AWFMS), and two conveyors (i.e., waste loading conveyor and the kiln feed conveyor) that were connected in series. The AWFMS consisted of a weigh scale and push-off system that were used to weigh control amounts of waste munitions that were subsequently pushed onto the waste loading conveyor. The waste loading conveyor moved the weighed amount of munitions through the APE's concrete barrier wall where they were transferred to the kiln feed conveyor that was located inside the kiln area. The kiln feed conveyor was used to feed the munitions into the kiln. The dual conveyor arrangement is shown in **Figure 2-3**.

For the Treatability Study, components comprising the AWFMS were removed and this component was replaced by other components that were needed to pre-screen and feed the soil into the rotary kiln. The replacement soil feed system was comprised of a powerscreen (i.e., an integral unit comprised of a grizzly, a hopper, a conveyor belt, the powerscreen, and size collection chutes) and an additional stacker conveyor belt that were brought to the site prior to the initiation of the test sequence. The powerscreen was used to size and sort the waste soil. Soil passing through a two-inch screen was treated, while clumps of soil and rock measuring larger than two inches in size were rejected from the feed stream and accumulated in a separate piles that were recovered and reweighed. The additional conveyor belt was used to transport the properly sized soil from the discharge side of the powerscreen to the base of the waste loading conveyor inside the control room.

Soil feed materials were initially loaded into pre-tared 55-gallon drums that were then re-weighed. The weight difference was recorded. The weighed soil was then dumped onto the top of the grizzly where large agglomerates of soil were broken or removed. Removed materials were recovered and re-weighed to allow for the subtraction of their lost weight from the soil feed total. Lost weight was recorded. Once the hopper was loaded, soil emptied out of the hopper onto the powerscreen's integral conveyor for transport to the powerscreen. Soil passing through the shaking and vibrating powerscreen (i.e., 2-inch and less in size) was captured in a drop chute and channeled to the stacker conveyor that transported the selected soil from the outside storage/processing location into the control room. The selected soil was dumped from the stacker conveyor onto the waste loading conveyor, which in turn, dumped it onto the kiln feed conveyor and then into the kiln. Material rejected by the powerscreen (i.e., material larger than 2-inches in size) were separately recovered and weighed, and this weight was

removed from the soil feed total. Soil remaining in the hopper or on the conveyors at the conclusion of each run was also weighed at the end of the test period to allow for its subtraction from the total processed weight.

2.1.2 Rotary Kiln (Deactivation Furnace)

The rotary kiln was designed to heat the waste soil feed materials to induce volatilization of volatile and semivolatile organic compounds. The heat required to promote volatilization is provided by fuel oil firing countercurrent to the direction of soil feed. Volatilized gases, aerosols, vapors and mists, and entrained ash and dusts exit the kiln adjacent to the waste material feed chute. Non-entrained residues are discharged at the burner end of the kiln. The kiln is shown on **Figure 2-4**.

The soil feed material is fed through the kiln toward the flame at the burner end by means of spiral flights that are integral components of the kiln casting. As the soil feed approaches the flame it is heated and the volatile and semivolatile organic compounds contained are vaporized (partially or fully, depending on compound, concentration, and mixing) and enter the combustion gas stream. The combination of the rotating action and the integral spiral flights located along the kiln walls provide physical separation and mixing of the soil feed as it moves through the kiln. The rotating speed of the kiln determines the residence time for the soil material in the furnace.

The kiln is 20 feet long with an average internal diameter of 30.5-inches. It is made of four, 5-foot long sections that are bolted together. The two center sections have a wall thickness of 3.25-inches and the two end sections have a wall thickness of 2.25-inches. The kiln is constructed of ASTM A217 chromium molybdenum steel for high strength and ductility at elevated temperatures. For additional personnel safety, the kiln is surrounded by concrete-block barricade walls.

The kiln is equipped with a Hauck 783 proportioning burner installed in the breaching at the residue discharge end of the kiln. This is a distillate oil fired burner with a capacity of 3 million BTU/hr and a nominal turndown ratio of 4:1. Both atomizing air and combustion air are provided by a Hauck 5-horsepower (hp) centrifugal blower.

Fuel oil and combustion air are ratioed by links and levers connecting the fuel and air control valves. The control valves are operated by an actuator that receives a signal from the kiln exit temperature controller. The controller set point ranges from 250 degrees Fahrenheit (°F) to 900°F. The input to the

controller is provided by a thermocouple located in the kiln exit duct.

The combustion control supervisory system is a Factory Mutual (FM) approved flame safety system that includes the proper safety shut-off valves, pressure switches, pressure regulators, flame detector, and burner controller. (This is shown as the Flame Safeguard Panel, FSG on the drawing.) The burner must be ignited for waste soil materials to be fed to the rotary kiln.

The kiln is operated under a slight negative pressure (vacuum) to control and limit fugitive emissions. Typically, this pressure is -0.15 to -0.25 inches of water column. The vacuum is produced by an Induced Draft (ID) fan that is located between the baghouse and the APE 1236's exhaust stack. The negative pressure in the kiln is determined by the gas flowrate and pressure drop through the air pollution control device (APCD) system and ID fan. A damper installed in the duct upstream of the ID fan is opened and closed by an electric actuator to control the gas flow rate and maintain the appropriate negative pressure within the kiln. The kiln vacuum is an input to the AWFSO system. The input to the damper actuator is provided by the kiln pressure controller. The input to the pressure controller is a pressure (draft) transmitter measuring the kiln discharge pressure.

Fugitive emissions escaping the kiln are captured and controlled by a metal shroud that covers the entire kiln assembly including the feed chute and end plates. Ducts connect the shroud to the inlet of the combustion air blower for the kiln burner. The combustion air blower creates a negative pressure inside the shroud that pulls any fugitive emissions through the blower and discharges them into the kiln via the kiln burner. The shroud is fabricated from 11 gauge, A36 carbon steel.

The kiln is trunnion driven by an electric motor. The kiln must be turning for the AWFSO interlocks to clear, allowing waste soil to be fed into the APE 1236. The drive system can vary the kiln rotation speed from 0.5 to 4.5 revolutions per minute (rpm). Varying the kiln's rotational speed changes the amount of time (i.e., kiln residence time) required for material to travel through the kiln.

Residue from the kiln is removed by the kiln residue conveyor. The kiln residue conveyor transports the waste from the kiln through the barrier wall to a collection point. The kiln residue conveyor must be operational for the AWFSO interlocks to clear, allowing waste soil to be heated. This interlock prevents the build-up soil residues within the kiln.

2.1.3 Afterburner

The kiln combustion gases are transported to the afterburner through a 24-inch diameter steel duct. Combustion gases and volatilized organic compounds previously contained in the soil feed materials enter the afterburner directly above the burner at the upstream end where they are mixed with, and heated by, gases from fuel oil combustion. The afterburner is designed to heat 4,000 standard cubic feet per minute (scfm) of combustion gas from 400-900°F to 1,200-1,800°F with a minimum gas residence time of one second. Operational experience has shown that the nominal maximum operating temperature of the afterburner is 1,600°F.

The afterburner is rectangular, with outer dimensions of 6-feet by 6-feet by 15 feet-long and with a transition cone at the discharge end. The afterburner is internally insulated with 8-inch thick, 12-pound/cubic foot (lb/ft³), ceramic fiber modules that are individually anchored to the afterburner casing. The ceramic fiber surface is coated with a rigidizer/surface coating that provides surface hardness and erosion resistance. The afterburner's skin temperature remains below 150°F during normal operation. The inside cross-section of the insulated afterburner is 4-feet 8-inches by 4-feet 8-inches with a total internal volume of 390 cubic feet. The afterburner is equipped with a Hauck WRO-164 Wide Range burner. This burner is oil-fired with a nominal capacity of 8 million Btu/hr and a 10:1 turndown ratio.

Afterburner fuel oil and combustion air are ratioed by links and levers connecting the fuel and air control valves. The control valves are operated by an actuator that receives a signal from the afterburner temperature controller. The afterburner temperature controller set point ranges from 1,200-1,800°F. The input to the controller is provided by a thermocouple located in the afterburner exit duct.

The combustion supervisor system is a Factory Mutual (FM) approved flame safety system that includes the proper safety shut-off valves, pressure switches, pressure regulator, flame detector and burner controller. (This is shown as the Flame Safeguard Panel, FSG on the drawing.) The burner must be ignited before waste feed materials can be feed to the rotary kiln. The air blower is a Cincinnati Fan #HPF-7 capable of providing 1,600 scfm of air for both atomization and combustion.

2.1.4 High Temperature Gas Cooler

High temperature combustion gases exiting the afterburner flow through a 30-inch diameter stainless

steel duct to the High Temperature (HT) gas cooler. The HT gas cooler is a gas-to-air, cross-current, forced air heat exchanger that reduces the temperature of the combustion gases to less than 850°F. The HT gas cooler is capable of cooling 4,000 scfm of combustion gas from 2200°F to 850°F. If the HT gas cooler's exit temperature exceeds 850°F, waste feed to the rotary kiln is automatically shut off. The HT gas cooler requires 25,400 cubic feet per minute (cfm) of 100°F ambient air to cool the combustion gases.

The HT gas cooler consists of two sections, each containing 65 plates. Each plate is 39-inches tall and 20.5-inches wide. The HT gas cooler is constructed of 310 stainless steel. Combustion gases enter the inlet plenum of the cooler and pass alternately downward and upward through the first and second sections and then exit the HT cooler through the outlet plenum. The heat exchanger plates are spaced so that the combustion gases pass on one side and the ambient cooling air passes on the other. There are a series of plates, a series of exhaust chambers, and a series of cooling chambers.

A 40-hp blower forces cooling air through the HT gas cooler. The blower is capable of providing 26,313 cfm of air at a static pressure of 5.2-inches of water column. The amount of air delivered by the blower is regulated by a controller that monitors the HT gas cooler's exit temperature. As the temperature changes, the output signal of the temperature controller varies the damper on the blower inlet to control air flow. A thermocouple placed in the exit duct of the HT gas cooler provides the input to the temperature controller.

The HT gas cooler is also equipped with a sonic horn to remove accumulated particles from the exchanger plates. The sonic horn emits sound pressure waves of sufficient vibrational energy to shear deposits from the surface of the plates, and it is operated by compressed air. The frequency of the sound waves and the duration of the cleaning cycle are adjustable from a local panel. Adjustments are made based on the temperature differential across the HT gas cooler. The sonic horn is an Envirocare #AH 30.

Particles and residue are removed from the HT gas cooler through a double-chamber dumping valve. The valve has two gates that are driven by an electric motor. Only one gate may be opened at any time so the vacuum within the HT gas cooler is maintained.

2.1.5 Low Temperature Gas Cooler

Combustion gases exit the HT gas cooler through a 24-inch diameter steel duct and enter the Low Temperature (LT) gas cooler. The LT gas cooler is a gas-to-air, cross-current, forced air heat exchanger that reduces the combustion gas temperature to less than 350°F. The LT gas cooler is capable of cooling 4,000 scfm of combustion gases from 900°F to 250°F. Waste feed to the rotary kiln is automatically shut off if the gas exiting the LT gas cooler exceeds 350°F. The LT gas cooler requires 16,400 cfm of 100°F ambient air to cool the combustion gases.

The LT gas cooler consists of two sections containing 75 plates each. The plates are 50-inches tall and 26-inches wide. The LT gas cooler is constructed of carbon steel. Combustion gases enter the inlet plenum of the cooler and pass alternately downward and upward through the first and second sections and then exit through the outlet plenum. Heat exchanger plates are spaced so that the combustion gases pass on one side and the ambient cooling air passes on the other. There are a series of plates, a series of exhaust chambers, and a series of cooling chambers.

A 20-hp blower forces cooling air through the LT gas cooler. The blower is capable of providing 17,054 cfm of air at a static pressure of 3.6-inches of water column. A controller that monitors the LT gas cooler's exit temperature regulates the amount of air delivered by the blower. As the temperature changes, the output signal of the temperature controller varies the damper on the blower inlet to control air flow. A thermocouple in the exit duct from the gas cooler provides the input to the LT gas cooler temperature controller.

The LT gas cooler is also equipped with a sonic horn to remove accumulated particles from the exchanger plates. The horn emits sound pressure waves with sufficient vibrational energy to shear deposits from the surface of the plates, it is operated by compressed air. The frequency of the sound waves and the duration of the cleaning cycle are adjustable from a local panel. Adjustments are made based on the temperature differential across the LT gas cooler. The sonic horn is an Envirocare #AH 30.

Particles and residue are removed from the LT gas cooler through a double-chamber dumping valve. The valve has two gates that are driven by an electric motor. Only one gate may be open at any time so the vacuum within the LT gas cooler is maintained.

2.1.6 Cyclone

Combustion gases exit the LT gas cooler and enter the cyclone through a 20-inch diameter steel duct.

The cyclone is a Ducon type VM model 700/150, size 165 with a 20-inch inlet and outlet. The cyclone is 43 inches in diameter and the inlet area is 1.65 square feet. The cyclone is fabricated from 0.1875-inch thick carbon steel.

Residue is removed from the cyclone collection hopper through an air tight slide gate valve. The slide gate valve is kept closed during operation and it is manually opened for clean-out after shutdown. The gas pressure drop across the cyclone at normal flowrates is 2- to 5-inches of water column.

2.1.7 Baghouse

Combustion gases leave the cyclone and enter the baghouse through a 20-inch diameter steel duct. The baghouse is a rectangular enclosure that measures 6-feet long by 6-feet wide and 15-feet tall. It contains 100 bags that each measure 4.5 inches in diameter and 8 feet long. This results in a total filter area of approximately 950 square feet and an air-to-cloth ratio of 5.0. The bag material is Nomex felt that is silicone treated, heat set, and flame-proofed.

The dust laden combustion gas stream enters the baghouse near the bottom of a hopper where it is dispersed evenly along the rows of bags. The combustion gas flows up through the filter bags and collects in the clean gas plenum, or exhaust manifold. As particles build up on the bags, the porosity of the bags is reduced creating a higher differential pressure between the dirty side and the clean side of the bags. This increased pressure drop across the bags reduces combustion gas flow through the baghouse.

The magnitude of baghouse pressure drop increase is limited by periodically cleaning the bags. The baghouse has a jet-pulse cleaning system that operates by inducing momentary surges of high-pressure air in the reverse direction to normal airflow. The backflow of high-pressure air flexes the bags outward and dislodges the dust particles causing them to fall into the hopper below. An automatic timing device that alternately activates one of a series of valves at preset intervals is used to clean one row of filter bags at a time.

The discharge temperature of the baghouse is measured by a thermocouple installed in the duct downstream of the baghouse. This temperature is indicated and recorded at the main control panel. Additionally, a high temperature thermocouple at the baghouse exit activates an alarm at the main control panel if the gas temperature reaches 600°F (This temperature indicates a fire situation).

The Differential Pressure (DP) is also monitored across the baghouse, and low and high DP alarms are set at 2 inches and 6 inches water column, respectively. A DP below 2 inches indicates a ruptured bag, while a DP higher than 6 inches indicates excessive fouling of the bags.

The baghouse is equipped with isolation and bypass valves. The isolation valves are located in the duct immediately upstream and downstream of the baghouse. The bypass valve is located in the baghouse bypass duct. These three valves operate in unison, i.e., when the bypass valve is closed the isolation valves are open and vice-versa. The baghouse is bypassed only under the following conditions: a) when the exit temperature measurement fails, b) during high baghouse temperature, and c) during startup to protect the bags from moisture condensation and corrosion.

2.1.8 Induced Draft Fan

Combustion gases are drafted through the entire APE 1236 system by the Induced Draft (ID) fan located downstream of the baghouse. A 20-inch diameter steel duct connects the baghouse and ID fan. Under normal operating conditions, the total system pressure drop is 25 inches of water column at 4,000 scfm.

The ID fan must be operating for the AWFSO interlocks to clear, allowing waste soil to be fed to the rotary kiln and heated.

The ID fan is belt driven by a 50-hp, 1,750-rpm electric motor. The capacity of the ID fan is 6,700 actual cubic feet per minute (acfm) at 30-inches of water column. The ID fan is designed to operate at 300°F. The upper limit for the ID fan is 500°F.

A damper is installed in the duct upstream of the ID fan. This damper controls the amount of combustion gas that the fan pulls through the APE 1236 system. The damper is operated by an electric actuator that receives a signal from the kiln pressure controller. This loop is discussed in **Section 2.2.2** of this section.

2.1.9 Exhaust Stack

Exhaust combustion gases from the ID fan are discharged to the exhaust stack and then to the atmosphere. The stack is 20 inches in diameter (outside diameter - OD) and 38-feet high.

The stack originally had four sets of sampling ports, and a fifth set was added to support the stack sampling requirements for this Treatability Study. Existing ports located at approximately 20 feet above grade are used for integral component continuous gas analyzers and gas velocity measurements. The gas analyzer port services the sampling system that supplies the continuous oxygen and carbon monoxide analyzers that are used to indicate APE 1236 system performance and are interlocked with the AWFSO. The gas velocity port accommodates probes that measure gas velocity, temperature and pressure in the stack. This information provides an indication of gas residence time in the APE 1236 system and is interlocked with AWFSO.

The stack has other existing ports at approximately 20 feet above grade that were used for the Volatile Organic Sampling Train sampling and verification continuous emission monitors. A new set of ports was added to the stack at an elevation of approximately 26.5 feet above grade to support the extractive sampling systems used for total particulate, semi-volatile organic compound, and dioxin/furan determinations.

2.2 DESCRIPTION OF INSTRUMENTATION

2.2.1 Measurement Parameters and Methods

The following paragraphs discuss the different APE 1236 process parameters that were measured during the Treatability Study. The techniques that were used to make the measurements are also discussed.

Temperature is the most common process measurement. Temperatures throughout the APE 1236 system are controlled, recorded, indicated and alarmed. Type K (Chromel-Alumel) thermocouples are used for temperature measurement. The temperature range encountered at the different measurement points depends on where the thermocouple is installed in the system. Thermocouples are installed in the duct downstream of each major system component. In addition, prior to this Treatability Study, a

thermocouple was installed in the kiln's residue discharge chute where the treated soil residue exits the rotary kiln and passes to the kiln residue conveyor. This thermocouple was used to monitor the exit temperature of the soil. Temperatures measured with this thermocouple were recorded, and the values were compared to direct measurements made using a thermometer for treated soil removed from the discharge conveyor belt at regular intervals.

Pressure and differential pressure (DP) are measured at various locations in the APE 1236 system. The pressure measurement recorded at the kiln's gaseous stream exit is actually a vacuum measurement. The scale is inches of water column and the value represents the number of inches of water column below atmospheric pressure. A pressure transmitter converts the vacuum measurement into an electronic signal that is transmitted to a remote device. DP is also measured in inches of water column. DP measurements are used to indicate the pressure drop across major components in the APE 1236 system. Differential pressure is measured with a local pressure gauge or a pressure transmitter that transmits an electronic signal that is proportional to the differential pressure being measured.

The total fuel oil flow to the two APE 1236 burner systems (i.e., kiln burner and afterburner) were measured with a flowmeter. The flowmeter is located in the fuel oil piping that is installed upstream of the piping split that is located between the storage tank and the two burners. The flowmeter is a positive displacement type that transmits an electronic signal to the main control panel for recording.

The stack gas velocity, oxygen, carbon monoxide, were monitored continuously using systems that are described in further detail in **Section 4**.

2.2.2 Panel Instrumentation

The system's panel instrumentation includes devices located in the main control panel or in local panels throughout the APE 1236 system. Instruments that control, indicate, record, and alarm process parameters are included in and are considered panel instrumentation. The following paragraphs describe the equipment that is employed to perform the various functions listed above.

The APE 1236 system is equipped with numerous process controllers to control various process parameters. A process variable (PV - e.g., temperature or system pressure/vacuum) is measured at a strategic location using a thermocouple, thermistor or pressure and the measured value is converted to an analog signal that is transmitted to the process controller. The process controller compares the

measured level of the PV to a pre-determined Set Point (SP), which represents the desired value of the process variable, and if a difference (i.e., error) between the PV and the SP exists, the process controller generates an output signal that is proportional to the error. The output signal is transmitted to a final control element (e.g., damper valve, burner control, variable speed motor) that adjusts the process to alter the PV and move it towards the pre-determined SP.

The APE 1236 system uses process controllers to control the kiln temperature (Loop # TIC-601), kiln draft (Loop # PIC-1201), afterburner temperature (Loop # TIC-701), HT gas cooler exit (Loop #TIC-801) and LT gas cooler exit temperature (Loop # TIC-901). The process controllers also communicate with the computer system that is described later. The APE 1236 system uses Honeywell UDC 3000 process controllers.

The APE 1236 system is equipped with burner control systems to monitor and control the kiln and afterburner burners. A burner controller is a sequence controller that supervises the pre-ignition air purge, ignition, main flame operation and post operation air purge. The burner controller monitors pre-ignition interlocks such as combustion air availability, fuel oil pressure, and ID fan status. A flame detector monitors the flame status. Burner controller outputs spark the flame igniter, open the pilot valve during ignition, and open the fuel oil safety shut-off valves during main flame operation. The burner controller systems are FM approved flame safety systems. Honeywell BC 7000 burner controllers are used.

A multi-point digital recorder is used to record process parameters. The recorder accepts analog signals from transmitters that measure specific process variables. The recorder is capable of recording 14 process parameters on an input value versus time scale. The Honeywell DPR 1500 recorder also communicates with the computer system. The following is a list of the process parameters that are recorded:

- Total fuel oil flow, Process Loop FR-101
- Kiln temperature, Process Loop FR-601
- Kiln draft, Process Loop PR-1201
- Afterburner temperature, Process Loop TR-701
- High temperature gas cooler exit temperature, Process Loop TR-801
- Low temperature gas cooler exit temperature, Process Loop TR-901
- Baghouse differential pressure, Process Loop PDR-1001

- Baghouse exit temperature, Process Loop TR-1002
- Stack gas velocity, Process Loop FR-1401
- Stack gas oxygen concentration, Process Loop AR-1301
- Stack gas CO concentration, Process Loop AR-1301

The baghouse status (on-line or standby) is not usually recorded; however, this information is stored internally in the computer system and can be accessed as required.

Logic control for the APE 1236 system is performed by a programmable logic controller (PLC). The PLC receives both discrete (on/off) inputs from switches and analog inputs from transmitters. The PLC operates motor starters, the AWFSO and other interlocks, and alarms by employing configurable functions of math, counter, sequence, relay, and time. The PLC is a Honeywell IPC 620 system complete with discrete and analog I/O and a data communication link so information can be shared with the computer system.

The computer system is a Personal Computer Operating Station (PCOS) that provides centralized and integrated data management, process graphics, operator interface, and report generation. Through a serial data link, the PCOS communicates with the process controllers, the PLC, and the multi-point recorder. All process parameters and information contained in these devices are available to the PCOS. The PCOS generates reports, logs data, records historical trends, displays process parameters, and alarms process parameters based on information gathered from the process controllers, PLC, and recorder. One of the primary functions of the PCOS is to record process data for internal use and regulatory compliance. The PCOS includes the following items: personal computer with keyboard and color graphics monitor, line printer and distributed automation and control software.

2.2.3 Automatic Waste Feed Shut Off (AWFSO) System

Certain process conditions are required before waste feed can be introduced into the APE 1236 system. The required conditions include minimum and maximum values of some process parameters, status of certain motors, status of burner flames, and operability of certain instruments. If waste soil is being fed and the APE 1236 deviates from any of the required conditions, waste feed is automatically shut off. When waste feed is automatically shut off, the waste loading conveyor is stopped instantly but the kiln feed conveyor continues to run so that any waste soil located in the kiln area will be loaded into the kiln. Other components of the APE-1236 continue to operate until the operator manually shuts them

down after allowing the fed waste to clear the kiln and emissions to be processed through the air pollution control train.

2.3 OPERATING PROCEDURES

This subsection outlines the procedures used to operate the APE 1236 system. The description presents a general overview of the operating procedures. The APE 1236 operational manual and the standard operating procedures (SOP) contain more detail and are the official documents used to operate the APE 1236 system.

The different operational items to be performed are listed for each of the various operating procedures. The following procedures are covered:

- Startup
- Operation
- Shutdown
- Scrap and residue handling
- Baghouse bypass

2.3.1 Startup Procedures

- Perform operational inspection and complete pre-startup check list.

The following procedures will be completed automatically upon automatic start-up but would be conducted in this manner if manual start-up were to be undertaken.

- Bypass the baghouse.
- Start the ID fan with the kiln pressure controller in manual.
- Start the gas cooler blowers with the LT gas cooler motor speed controller in manual.
- Start the air compressor.
- Start the fuel oil pump and open the hand valves to the burners.
- Start the afterburner combustion air blower.

- Place the afterburner temperature controller in manual and slightly open the control valve.
- Ignite the afterburner burner.
- Start the kiln rotation.
- Start the kiln combustion air blower.
- Place the kiln temperature controller in manual and slightly open the control valve.
- Ignite the kiln burner.
- Adjust the set points on the process controllers and place the controls in the automatic mode.
- Date and sign the recorder chart. Verify all recorded conditions are being correctly recorded.
- Enter the name of the waste feed being fed to the kiln into the computer system.
- Adjust the rotation speed of kiln to the desired level (based on desired residence time).
- Adjust the kiln temperature set point to the desired level.
- Start the waste loading, waste feed, and residue conveyors.
- Start the baghouse bag cleaning cycle.
- Open the baghouse block valves and close the baghouse bypass valve.
- Start the gas cooler sonic cleaners.
- Close the kiln barrier walls.
- Feed the soil at specified feedrate.

Note that no waste is fed to the kiln until the baghouse is on-line.

2.3.2 Operation Procedures

These procedures were performed while the APE 1236 system was processing waste soils. Necessary data and observations were recorded in the operating log that is kept for the system.

- Monitor the main control panel closely to:
 - Monitor process conditions.
 - Verify that correct recording and data logging are being performed;
 - Verify that control functions are being performed.
 - Handle alarm conditions as required.
- Inspect exhaust stack emissions hourly (minimum).
- Check all local indicators on the APE 1236 system for proper values.
- Inspect the operation of rotating equipment outside of kiln barrier walls.
- Monitor the waste feed stockpile, the kiln residue stockpile, and all components of the

deactivation furnace/LTTD for evidence of fugitive emissions.

2.3.3 Shutdown Procedures

The following procedures were performed during automatic shutdown (Note: these procedures can be initiated manually or as an automatic response from the AWFSO system):

- Stop waste feed to kiln.
- Maintain all other operating conditions, including kiln and afterburner temperature, for 15 minutes (minimum) or until kiln residue conveyor is empty, whichever is greater.
- Place process controllers in manual.
- Shut-off the kiln burner flame but keep combustion air blower on and combustion air valve open.
- Shut-off the afterburner burner flame but keep combustion air blower on and combustion air valve open.
- Shutdown fuel oil pump.
- Open ID fan damper fully.

Once kiln temperature is below 400°F and the afterburner temperature is below 600°F, the following equipment is shutdown:

- Kiln combustion air blower.
- Afterburner combustion air blower.
- ID fan.
- Gas cooler blowers.
- Baghouse residue valve.
- Gas cooler residue valves.
- Kiln rotation drive.
- Kiln residue conveyor.

Conditions that could have initiated an automatic shutdown are discussed in **Section 2.2.3**. It is important to note that kiln and afterburner conditions are maintained until all of the waste passes through the rotary kiln and the offgases are treated in the afterburner. This continues the volatilization and combustion of organic compounds contained in the feed that remains in the kiln and ensures safety

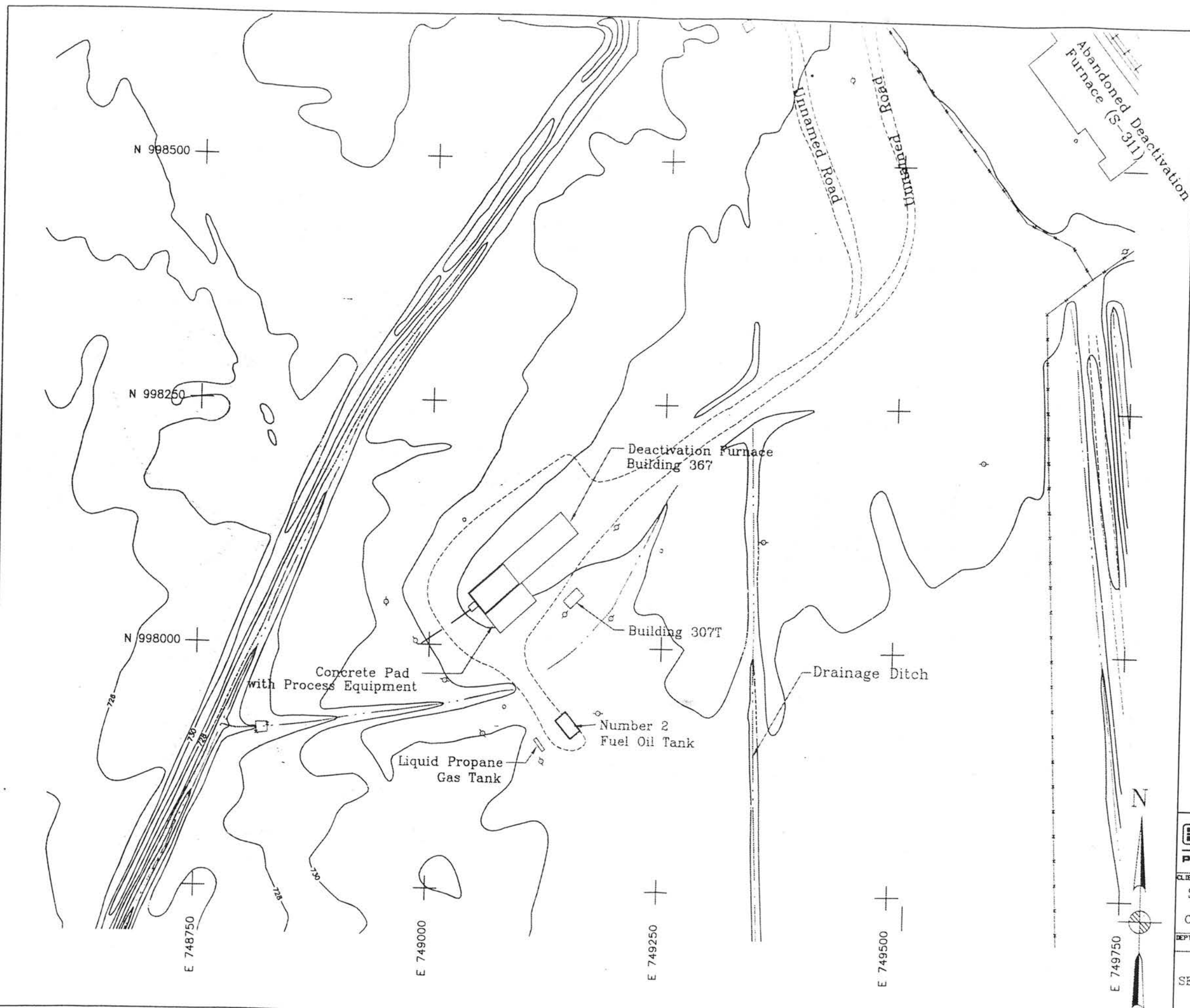
and treatment of offgases.

2.3.5 Baghouse Bypass

If the baghouse was bypassed for any reason, waste feed to the rotary kiln was stopped by the AWFSO System. Bypass of the baghouse would only occur if: 1) there was an exit temperature measurement failure; 2) the high baghouse temperature alarm sounded during a fire condition; or 3) during startup operations prior to the initiation of waste feed.

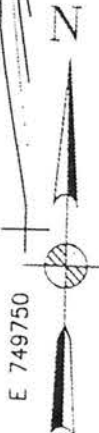
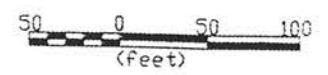
The bypass is interlocked with the AWFSO system so that waste cannot be fed if the baghouse is bypassed.

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LEGEND

	MINOR WATERWAY
	MAJOR WATERWAY
	FENCE
	UNPAVED ROAD
	BRUSH LINE
	LANDFILL EXTENT
	RAILROAD
	GROUND SURFACE ELEVATION CONTOUR
	ROAD SIGN
	DECIDUOUS TREE
	GUIDE POST
	FIRE HYDRANT
	MANHOLE
	COORDINATE GRID (250' GRID)
	POLE
	UTILITY BOX
	MAILBOX/RR SIGNAL
	OVERHEAD UTILITY POLE
	SURVEY MONUMENT



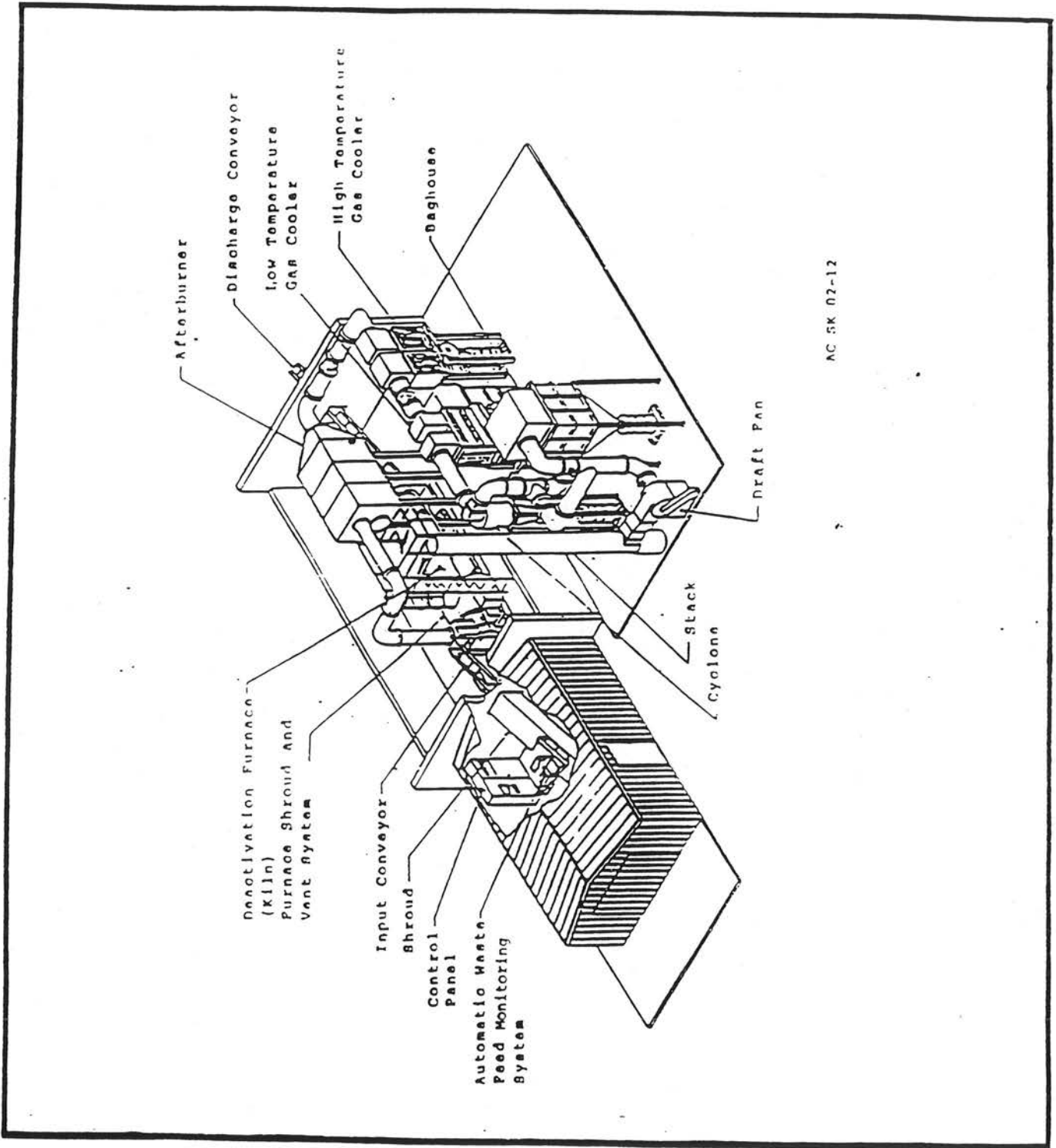
PARSONS
PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE
**SENECA ARMY DEPOT ACTIVITY
 LTD TREATABILITY STUDY
 COST AND PERFORMANCE TEST REPORT**

DEPT. ENVIRONMENTAL ENGINEERING Dwg. No. 734503-01003

**FIGURE 2-1
 SEAD-17 ACTIVE DEACTIVATION FURNACE
 SITE PLAN**

SCALE AS NOTED DATE MAY 2001 REV A



AC SK 02-12

Figure 2-2 APE 1236 - Isometric View

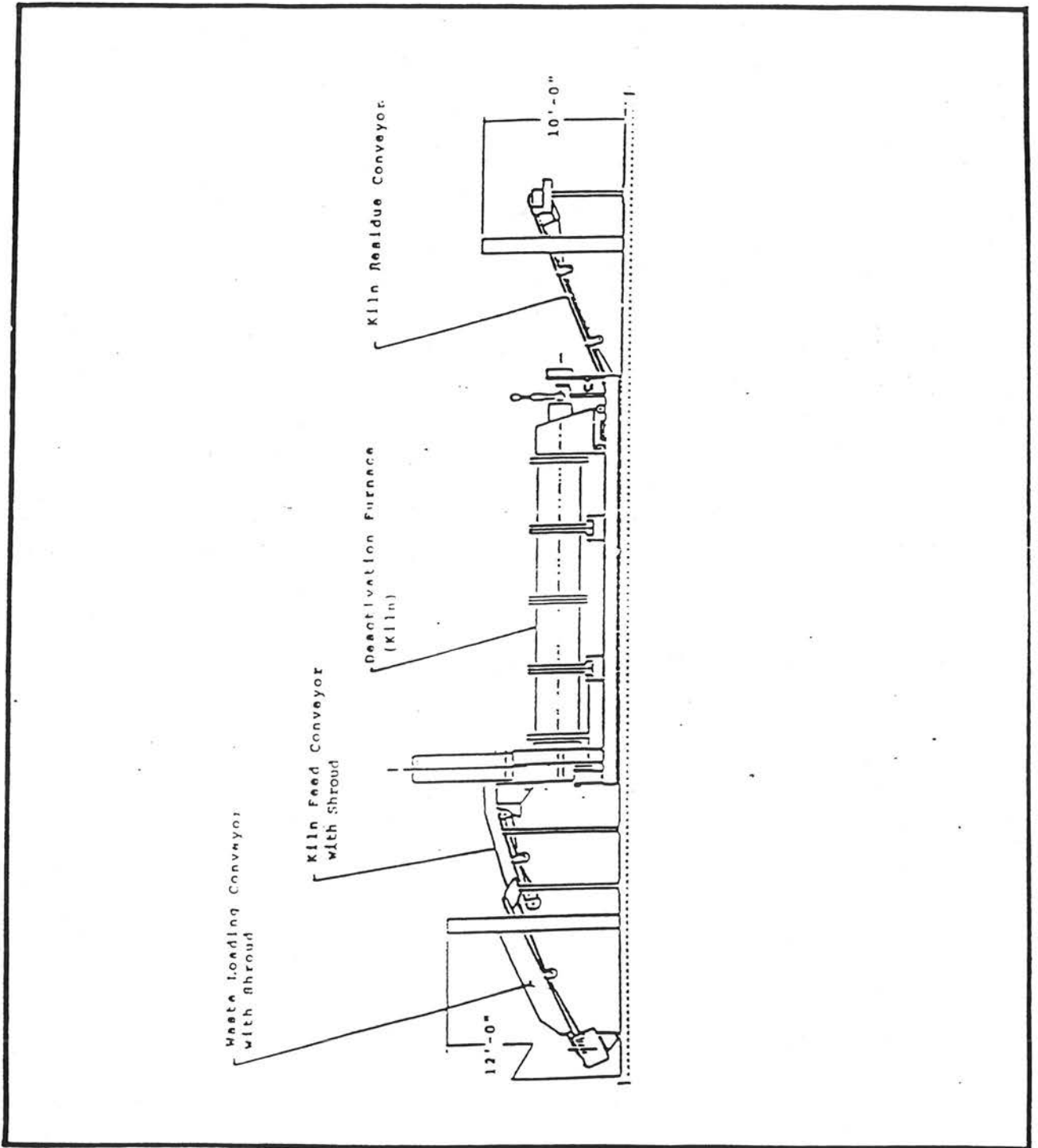


Figure 2-3 Input Conveyor Concept

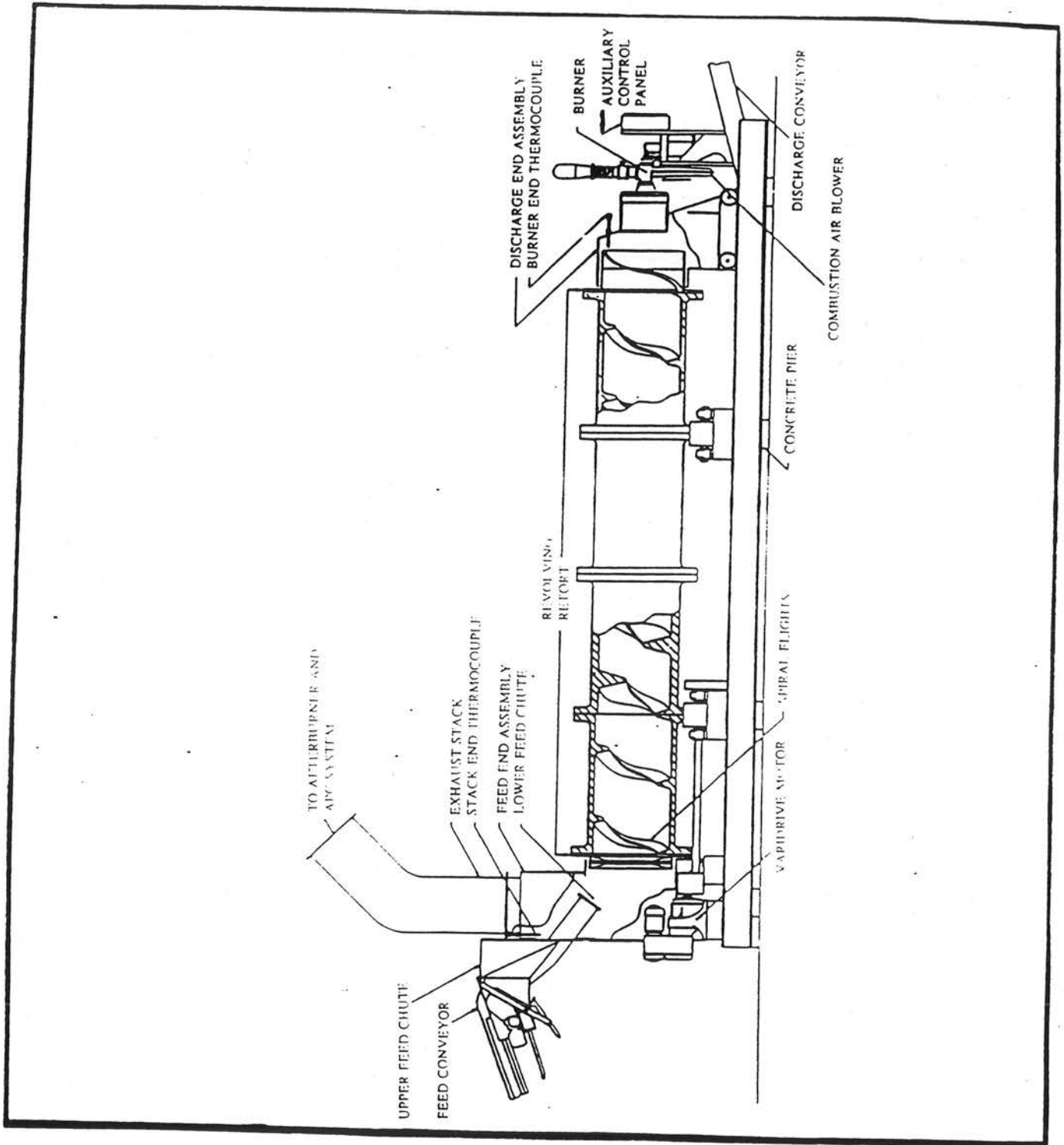


Figure 2-4 Deactivation Furnace

3 FEED CHARACTERIZATION

3.1 SOIL SELECTED FOR DEMONSTRATION STUDY

3.1.1 General

Soil selected for the LTTD Treatability Study was collected from three source areas. The source areas are as follows:

- SEAD-60, which is an oil discharge area adjacent to Building 609.
- SEAD-41, which is the boiler blowdown pit adjacent to Building 718.
- Near Building 113 where an underground storage tank was removed.

A summary of the chemical characterization of the soils from each source area is discussed below.

3.1.2 SEAD-60 Soils

Soil from SEAD-60 (Oil Discharge Area adjacent to Building 609) was used as feed material in the LTTD Treatability Study. SEAD-60 was part of an Expanded Site Inspection (ESI) that confirmed that a release of petroleum hydrocarbons had occurred (Parsons ES, 1996) at the site. On March 3 and 4, 1999, approximately 150 cubic yards of soil from this site was excavated from the area and stockpiled near the APE 1236 system (LTTD).

Based on the analysis of soil samples collected from SEAD-60 during the ESI, the surface soils in this area have been impacted primarily by total petroleum hydrocarbons (TPHs) and polynuclear aromatic hydrocarbons (PAHs) (see **Table 3-1**). TPH concentrations of 218,000 mg/Kg and 50,900 mg/Kg were found in the area of the oil-stained soil. Concentrations of PAHs (up to 18,000 mg/Kg) correlated spatially with the elevated TPH concentrations in the surface soils. TAGM exceedances for PAHs were more numerous in the surface soil samples. The concentrations of TPH and PAHs in soil were reduced at depth.

Additionally, two polychlorinated biphenyl (PCB) congeners (i.e., Aroclor®-1248 and Aroclor®-1260) were found at concentrations above their respective TAGM values, and heavy metals concentrations were also present above TAGM values.

3.1.3 SEAD-41 Soils

Soils were excavated as part of a removal action of the boiler blowdown pit in SEAD-41. Soil sampling

was conducted during a 1994 investigation and in January 2000 during the pit excavation. The results of the chemical analysis of these samples are presented in **Table 3-2 and 3-3**.

Results of the January 1994 sampling showed that the five soil samples had TPH concentrations ranging from 40 to 300 mg/Kg. No other chemical analyses were performed in January 1994. Results of the January 2000 sampling showed that one of the five samples collected contained PAH concentrations exceeding TAGM levels.

3.1.4 Building 113 Tank Excavation Soils

Soils were removed in July 2000 as part of an underground storage tank excavation near Building 113. The results of the analysis are shown on **Table 3-3**. The sampling results show that one of the two samples analyzed for PAHs contained concentrations exceeding TAGM criteria levels. PCBs were also detected in one of the two samples at a concentration below the TAGM level at 0.51 ppm. Other contaminants were not detected. TPH analyses were not performed on samples collected from the Building 113 excavation site.

3.2 FEED SOIL LIMITATIONS

The soils used for the Treatability Study also needed to meet physical criteria. According to ITRC Guidance, soils outside of the following limits needed to be pretreated prior to use in the LTTD study:

1. soil moisture > 35%
2. material > 2-inch diameter
3. soil has high plasticity
4. soil has high humus content
5. either soil TPHC > 20,000 parts per million (ppm) or greater than 25% lower explosive limit (LEL) in gas in desorption chamber

The soils from all source areas met the limits described above prior to processing in the LTTD. Percent solids data collected from the waste feed soils contained between 83.0 and 95.1% total solids (i.e., soil moisture content ranged between 4.9 – 17.0%). Waste feed soil was pretreated using a powerscreen to ensure that the waste feed soil met the 2 inches diameter size limitation recommended by the ITRC.

Soils at SEAD-60 were comprised of till that were generally gray brown and consisted of silt, with little clay, little very fine sand, and little dark gray-black shale fragments. A trace of organic material was occasionally noted in the boring logs from SEAD-60 and one log noted plastic soils (Parsons ES, 1996); however, the plasticity of the soils from SEAD-60 appeared to be low. A physical description of the

other soils excavated from SEAD-41 and near Building 113 was not provided.

Two of the four samples collected from the excavated area at SEAD-60 had TPH concentrations which exceeded 20,000 ppm (maximum concentration = 218,000 ppm). Accordingly, TPH screening of the feed soils was performed throughout the Treatability Study to demonstrate that the average feed concentration did not exceed 20,000 ppm, which is the upper limit recommended by the ITRC. A description of the TPH screening process is discussed in the following section.

Pre-testing of the soils during the work plan preparation provided evidence that low concentrations of Total Organic Halogen (TOX) content existed in the proposed waste feed material. Due to the presence of TOX in the stockpiled soil, additional testing requirements for both the waste feed and treated soil, and the stack gas emissions were implemented in accordance with the recommendations of the ITRC Work Group as defined in the document "Technical Requirements for On-site Thermal Desorption of Solid Media Contaminated with Hazardous Chlorinated Organics."

The excavated soils from SEAD-60, SEAD-41 and the tank excavation at Building 113 were selected for the LTTD demonstration study since they showed relatively high concentrations of petroleum hydrocarbons and PAHs, and met the requirements of ITRC Guidance.

3.3 SOIL HANDLING

Prior to beginning the Treatability Study, soil excavated from SEAD-60, SEAD-41 and near Building 113 was moved to the LTTD demonstration area and staged on a plastic liner. During storage, stockpiles were covered to minimize exposure to precipitation and to prevent dust generation. When necessary, water spray was used to prevent dust generation. Fugitive dust monitoring was performed during handling operations to ensure that unacceptable levels of dust that could migrate off-site or pose a hazard to workers were not generated. Monitoring is described in **Section 4.0**.

3.4 CHEMICAL CHARACTERIZATION OF FEED SOILS

Prior to treatment in the LTTD, samples of the proposed feed soils were collected for pre-screening determinations and for shipment off-site for more detailed chemical evaluation. Soil screening consisted of on-site immuno-assay TPH determinations to verify that waste feed did not exceed the 20,000 mg/Kg TPH threshold established by the ITRC. More comprehensive chemical analyses performed at an off-site laboratory included determinations for semivolatile organic compounds (via SW-846 Method 8270), PCBs (via SW-846 Method 8082), TPH (via SW-846 Method 8015) and metals (via SW-846 Method 6010B). Samples shipped off-site for chemical analyses were collected by compositing up to eight discrete samples from the feed soils during each demonstration run.

Accordingly, one composite sample was produced for each of the six test runs. The results of the comprehensive analyses are presented in **Table 3-4**.

The results of the testing on the feed soils showed that all six of the feed soil samples contained one or more PAH compound that exceeded its TAGM criteria level. Metals, particularly lead, copper, thallium and zinc, were also detected at concentrations exceeding their respective TAGM values. PCBs were detected in five of the six samples at concentrations below their respective TAGM levels, while TPH was detected in all six feed soil samples at concentrations ranging up to 770 mg/Kg.

TABLE 3-1

SENECA ARMY DEPOT ACTIVITY
 LTTD TREATABILITY STUDY
 COST AND PERFORMANCE TEST REPORT
 SEAD-60 SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE	SDG NUMBER	UNITS	TAGM (1) (ug/Kg)	NUMBER ABOVE TAGM	SOIL SEAD-60 0-0.2	SOIL SEAD-60 0-2	SOIL SEAD-60 0-0.2	SOIL SEAD-60 0-0.2
VOLATILE ORGANICS									
Methylene Chloride			ug/Kg	100	0	12 U	11 U	27 J	21
Acetone			ug/Kg	200	0	12 U	11 U	170 J	14 U
Carbon Disulfide			ug/Kg	2700	0	12 U	11 U	1 J	14 U
2-Butanone			ug/Kg	300	0	12 U	11 U	26 J	14 U
2-Hexanone			ug/Kg	NA	NA	12 U	11 U	11 U	14 U
Tetrachloroethene			ug/Kg	1400	0	12 U	11 U	11 U	14 U
Toluene			ug/Kg	1500	0	12 U	11 U	13 J	14 U
Ethylbenzene			ug/Kg	5500	0	12 U	11 U	4 J	14 U
Xylene (total)			ug/Kg	1200	0	12 U	11 U	9 J	14 U
SEMIVOLATILE ORGANICS									
Naphthalene			ug/Kg	13000	0	38 J	370 U	18000 U	2200 U
2-Methylnaphthalene			ug/Kg	36400	0	390 U	370 U	1100 J	2200 U
Acenaphthene			ug/Kg	50000 (2)	0	59 J	370 U	1400 J	2200 U
Dibenzofuran			ug/Kg	6200	0	29 J	370 U	18000 U	2200 U
Fluorene			ug/Kg	50000 (2)	0	48 J	370 U	1300 J	2200 U
Phenanthrene			ug/Kg	50000 (2)	0	570 J	25 J	8900 J	680 J
Anthracene			ug/Kg	50000 (2)	0	98 J	370 U	2000 J	2200 U
Carbazole			ug/Kg	50000 (2)	0	79 J	370 U	18000 U	2200 U
Di-n-butylphthalate			ug/Kg	8100	0	390 U	370 U	1500 J	2200 U
Fluoranthene			ug/Kg	50000 (2)	0	1100 J	370 U	14000 J	2200 U
Pyrene			ug/Kg	50000 (2)	0	700 J	31 J	27000 J	1300 J
Benzo(a)anthracene			ug/Kg	220	1	340 J	370 U	18000 U	2000 J
Chrysene			ug/Kg	400	2	400	370 U	17000 J	2200 U
bis(2-Ethylhexyl)phthalate			ug/Kg	50000 (2)	0	54 J	370 U	18000 U	1100 J
Benzo(b)fluoranthene			ug/Kg	1100	2	730 J	370 U	16000 J	2200 U
Benzo(k)fluoranthene			ug/Kg	1100	0	190 J	370 U	18000 U	1500 J
Benzo(a)pyrene			ug/Kg	61	1	350 J	370 U	18000 U	2200 U
Indeno(1,2,3-cd)pyrene			ug/Kg	3200	0	220 J	370 U	18000 U	2200 U
Dibenz(a,h)anthracene			ug/Kg	14	3	110 J	370 U	18000 U	1100 J
Benzo(g,h,i)perylene			ug/Kg	50000 (2)	0	220 J	370 U	18000 U	1100 J

TABLE 3-1

SENECA ARMY DEPOT ACTIVITY
LTTD TREATABILITY STUDY
COST AND PERFORMANCE TEST REPORT
SEAD-60 SOIL ANALYSIS RESULTS FROM THE ESI

COMPOUND	MATRIX LOCATION DEPTH (FEET) SAMPLE DATE	ES ID	LAB ID	SDG NUMBER UNITS	TAGM (1) (ug/Kg)	NUMBER ABOVE TAGM	SOIL SEAD-60		SOIL SEAD-60
							0-0.2	0-0.2	
PESTICIDES/PCB									
alpha-BHC	ug/Kg	110	0	4 UU	1.9 U				2.9 UJ
Aldrin	ug/Kg	41	0	4 UU	1.9 U				2.9 UJ
Endosulfan I	ug/Kg	900	0	3.2 J	1.9 U				6.3 J
4,4'-DDE	ug/Kg	2100	0	110 J	2.7 J				28 J
4,4'-DDD	ug/Kg	2900	0	7.8 UU	3.7 U				100 J
4,4'-DDT	ug/Kg	2100	0	84 J	3.7 U				5.6 UJ
Endrin ketone	ug/Kg	NA	NA	7.8 UU	3.7 U				5.6 UJ
alpha-Chlordane	ug/Kg	540	0	4 UU	1.9 U				3 J
gamma-Chlordane	ug/Kg	540	0	4 UU	1.9 U				3 J
Aroclor-1242	ug/Kg	1000/10000(a)	0	78 UU	37 U				2.9 UJ
Aroclor-1248	ug/Kg	1000/10000(a)	1	78 UU	37 U				56 UJ
Aroclor-1260	ug/Kg	1000/10000(a)	1	78 UU	37 U				56 UJ
									220 J
METALS									
Aluminum	mg/Kg	19300	0	10800	8440				14100
Antimony	mg/Kg	5.9	0	0.28 J	0.43 J				0.49 J
Arsenic	mg/Kg	8.2	0	5.3	4.1 J				7
Barium	mg/Kg	300	2	77.6	98.3				416
Beryllium	mg/Kg	1.1	0	0.47 J	0.43 J				0.66 J
Cadmium	mg/Kg	2.3	0	0.58 J	0.36 J				1.5 J
Calcium	mg/Kg	121000	0	65800	75100				23700 J
Chromium	mg/Kg	29.6	0	18.3	14.2				23.3
Cobalt	mg/Kg	30	0	9.6	8.3 J				13.1 J
Copper	mg/Kg	33	2	24.9	21.3				74.1
Iron	mg/Kg	36500	0	22800	18900				25700
Lead	mg/Kg	24.8	3	17.1	47.5 J				50.6
Magnesium	mg/Kg	21500	0	13300	11300				8570
Manganese	mg/Kg	1060	0	422	333				443
Mercury	mg/Kg	0.1	0	0.06 J	0.08 J				0.02 U
Nickel	mg/Kg	49	0	30.9	23.5				31.3
Potassium	mg/Kg	2380	0	1920 J	1470				1820 J
Selenium	mg/Kg	2	0	0.43 U	0.32 U				1.2 J
Sodium	mg/Kg	172	0	105 J	75 J				118 J
Vanadium	mg/Kg	150	0	18.6	14.8				26.2
Zinc	mg/Kg	110	2	85	58.6				314
OTHER ANALYSES									
Total Petroleum Hydrocarbons	mg/Kg	NA	NA	87 J	29 U				50900
Total Solids	%WW	NA	NA	85.4	88.4				59.1

(1) TAGM = NYSDEC Technical and Administrative Guidance Memorandum # 4046, "Determination of Soil Cleanup Objectives and Cleanup Levels", January 1994
 (2) Individual SVOC concentrations less than 50 ppm or 50,000 ppb.

Table 3-2
SENECA ARMY DEPOT ACTIVITY
LTTD TREATABILITY STUDY
COST AND PERFORMANCE REPORT
SEAD-41 SOIL ANALYSIS RESULTS FROM THE LIMITED SAMPLING PROGRAM

COMPOUND	TAGM (1)		Units		208407		208408		208409		208410		208402	
	Value		1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94	1/11/94
Total Petroleum Hydrocarbons	NA	mg/Kg	144	40	300	70	66							
pH	NA	Standard Units	8.74	8.57	8.49	8.19	8.64							
Total Solids	NA	%WW	88.3	86.5	84.4	84	85.1							

(1) TAGM = NYSDEC Technical and Administrative Guidance Memorandum # 4046, "Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994
 NA = None Available
 %WW = percentage by weight

Table 3-3
Initial Characterization of Feed Soils - SEAD-41 and Building 113
LTTD Treatability Study
Seneca Army Depot Activity

PARAMETER	UNITS	TAGM #4046 Value (1)	Location Sample ID: Date Sampled	SEAD-41 Blowdown Pit				Building 113 Tank Pull				
				A0046301	A0046302	A0046303	A0046304	A0046305	222425	222426	222427	
				1/21/00	01/21/00	1/21/00	1/21/00	1/21/00	7/6/00	7/6/00	7/6/00	
Benzene	ug/Kg	60		1.1	0.73	1.1	1.5	1.2	<14	<14	NA	NA
Toluene	ug/Kg	1500		1.1	0.59	0.99	1.8	1	<50	<50	NA	NA
m-Xylene	ug/Kg	NA		0.73	0.33	0.52	0.98	0.57	<50	<50	NA	NA
Total Xylenes	ug/Kg	1200		0.73	0.33	0.52	0.98	0.57	<50	<50	NA	NA
p-Cymene	ug/Kg	NA		ND	0.24	ND	ND	ND	NA	NA	NA	NA
1,2,4-Trimethylbenzene	ug/Kg	NA		0.41	ND	ND	0.34	ND	<50	<50	NA	NA
Acenaphthene	mg/Kg	50		ND	0.26 J	ND	ND	ND	<0.2	<0.2	NA	NA
Anthracene	mg/Kg	50		ND	0.29 J	ND	ND	ND	<0.2	<0.2	NA	NA
Benzo(a)anthracene	mg/Kg	0.224		0.041 J	0.84	0.063 J	0.048 J	ND	<0.2	<0.2	NA	NA
Benzo(b)fluoranthene	mg/Kg	1.1		0.061 J	1.4	0.11 J	0.099 J	ND	<0.2	<0.2	NA	NA
Benzo(ghi)perylene	mg/Kg	50		ND	0.26 J	ND	ND	ND	<0.2	<0.2	NA	NA
Benzo(a)pyrene	mg/Kg	0.061		ND	0.71	ND	ND	ND	<0.2	<0.2	NA	NA
Chrysene	mg/Kg	0.4		ND	0.66	0.059 J	0.049 J	ND	<0.2	<0.2	NA	NA
Dibenzo(a,h)anthracene	mg/Kg	0.014		ND	0.063 J	ND	ND	ND	<0.2	<0.2	NA	NA
Fluoranthene	mg/Kg	50		0.076 J	2	0.12 J	0.13 J	ND	<0.2	0.42	NA	NA
Fluorene	mg/Kg	50		ND	0.17 J	ND	ND	ND	<0.2	<0.2	NA	NA
Indeno(1,2,3-cd)pyrene	mg/Kg	3.2		ND	0.27 J	ND	ND	ND	<0.2	<0.2	NA	NA
Phenanthrene	mg/Kg	50		0.039 J	1.4	0.068 J	0.072 J	ND	NA	NA	NA	NA
Pyrene	mg/Kg	50		0.063 J	1.3	0.096 J	0.075 J	ND	<0.2	0.31	NA	NA
Naphthalene	mg/Kg	13		ND	0.060 J	ND	ND	ND	<0.2	<0.2	NA	NA
PCB-Aroclor 1254	mg/Kg	1 or 10 (2)		NA	NA	NA	NA	NA	NA	NA	<0.5	0.51

NOTES:

Only those parameters detected in one or more samples are listed

Shaded values exceed the NYSDEC guidance value

ND = Not Detected

NA = Not Analyzed

J = Indicates an estimate value

1. TAGM = NYSDEC Technical and Administrative Guidance Memorandum #4046, Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994
2. 1.0 ppm limit for surface soils and 10 ppm limit for subsurface soils.

Table 3-3
 Initial Characterization of Feed Soils - SEAD-41 and Building 113
 LTTD Treatability Study
 Seneca Army Depot Activity

PARAMETER	UNITS	#4046	A0046301	A0046302	A0046303	A0046304	A0046305	222425	222426	222427	222428
Sample ID:											

Table 3-4
Summary of Analytical Testing on Feed Soils
LTTD Treatability Study
Seneca Army Depot Activity

SAMPLE TYPE		Waste Feed	Waste Feed	Waste Feed	Waste Feed	Waste Feed	Waste Feed	Waste Feed	Waste Feed	
SAMPLE IDENTIFICATION		LT4000	LT4006	LT4012	LT4013	LT4020	LT4028	LT4029	LT4036	
RUN NO. TREATMENT RATE SAMPLE DATE		RUN 1 2 tons/hour 30-Aug-00	RUN 2 2 tons/hour 1-Sep-00	RUN 3 2 tons/hour 20-Sep-00	DUP of LT4012 RUN 3 2 tons/hour 20-Sep-00	RUN 4 5 tons/hour 21-Sep-00	RUN 5 5 tons/hour 22-Sep-00	DUP of LT4028 RUN 5 5 tons/hour 22-Sep-00	RUN 6 5 tons/hour 23-Sep-00	
PARAMETER	UNIT	TAGM Value ⁽¹⁾								
2-Methylnaphthalene	ug/kg	36,400	29 J	28 J	360 U	380 U	360 U	360 U	24 J	360 U
Acenaphthene	ug/kg	50,000	360 U	22 J	360 U	17 J	360 U	35 J	56 J	360 U
Anthracene	ug/kg	50,000	21 J	55 J	360 U	23 J	43 J	64 J	91 J	36 J
Benzo(a)anthracene	ug/kg	224	100 J	170 J	120 J	130 J	180 J	210 J	300 J	120 J
Benzo(a)pyrene	ug/kg	61	150 J	220 J	160 J	170 J	250 J	220 J	360 J	120 J
Benzo(b)fluoranthene	ug/kg	1,100	170 J	320 J	140 J	180 J	310 J	290 J	490	130 J
Benzo(ghi)perylene	ug/kg	50,000	160 J	250 J	160 J	180 J	280 J	210 J	430	110 J
Benzo(k)fluoranthene	ug/kg	1,100	140 J	270 J	190 J	230 J	270 J	210 J	440	130 J
Benzoic Acid	ug/kg	910 U	910 U	920 U	890 U	940 U	900 U	910 U	910 U	900 U
Bis(2-Ethylhexyl)phthalate	ug/kg	50,000	360 U	220 JB	36 JB	380 U	47 J	360 U	360 U	360 U
Carbazole	ug/kg	360 U	360 U	51 J	360 U	380 U	36 J	42 J	73 J	360 U
Chrysene	ug/kg	400	170 J	340 J	180 J	230 J	320 J	300 J	440	150 J
Di-n-butylphthalate	ug/kg	8,100	360 U	370 U	360 U	380 U	360 U	360 U	360 U	360 U
Di-n-octylphthalate	ug/kg	50,000	360 U	370 U	360 U	380 U	360 U	360 U	360 U	360 U
Dibenz(a,h)anthracene	ug/kg	14	60 J	89 J	55 J	48 J	85 J	45 J	140 J	39 J
Dibenzofuran	ug/kg	6,200	18 J	20 J	360 U	380 U	360 U	17 J	36 J	360 U
Diethyl phthalate	ug/kg	7,100	360 U	370 U	360 U	380 U	360 U	360 U	360 U	360 U
Fluoranthene	ug/kg	50,000	170 J	270 J	180 J	180 J	360	470	600	300 J
Fluorene	ug/kg	50,000	21 J	25 J	360 U	380 U	360 U	28 J	55 J	360 U
Indeno(1,2,3-cd)pyrene	ug/kg	3,200	120 J	200 J	120 J	160 J	230 J	180 J	380	98 J
Naphthalene	ug/kg	13,000	23 J	28 J	360 U	380 U	16 J	360 U	42 J	360 U
Phenanthrene	ug/kg	50,000	120 J	170 J	72 J	110 J	210 J	310 J	440	210 J
Phenol	ug/kg	30	360 U	370 U	360 U	380 U	360 U	360 U	360 U	360 U
Pyrene	ug/kg	50,000	210 J	330 J	250 J	310 J	420	480	680	300 J
Total SVOCs	ug/kg		1,682.	3,078.	1,627.		3,057.	3,111.		1,743.
Aroclor-1254	ug/kg	1,000	19.	18 U	18.	18 J	25.	26.	24.	18 U
Aroclor-1260	ug/kg	1,000	23.	21.	27.	24.	41.	38.	34.	18 U
Diesel Oil	mg/kg		92 Y	140 Y	43.	68.	80.	84.	81.	18.
Motor Oil	mg/kg		420 Y	630 Y	5.3	480.	680.	5.3	720.	93.
TPH (Total) ⁽²⁾	mg/kg		512.	770.	48.3		760.	89.3		111.
Aluminum	mg/kg	19,300	9,710.	10,100.	8,600 E*	12,000 E*	9,980 E*	10,400 E	11,600 E*	11,100 E*
Antimony	mg/kg	6	.93 UN	.99 UN	1.4 BN	1.1 BN	2 BN	2.7 BN	2.1 BN	.57 BN
Arsenic	mg/kg	8	4 N	4.6 N	2.9 *	3.5 *	3.4 *	3.9	3.4 *	3.9 *
Barium	mg/kg	300	85. *	79.6 *	78.6 *	113. *	99.9 *	105.	98.1 *	72.2 *
Beryllium	mg/kg	1	.73	.73	.62	.78	.68	.55	.76	.73
Cadmium	mg/kg	2	.38 B*	.47 *	.22 B	2.3	.37 B	1.5	.26 B	.03 U
Calcium	mg/kg	121,000	69,500.	75,500.	104,000. *	83,200. *	102,000. *	58,000 E*	62,600. *	61,400. *
Chromium	mg/kg	30	17 N*	18.9 N*	15.7 E*	20.9 E*	17.7 E*	18.2	20.6 E*	21.4 E*
Cobalt	mg/kg	30	10.	9.7	8.4	10.5	9.5	9.4	10.6	11.2
Copper	mg/kg	33	31.8 N	41.8 N	39.3 EN	51.1 EN	53.7 EN	77. N*	67.2 EN	32. EN
Iron	mg/kg	36,500	20,100. *	20,300. *	17,000 E*	23,800 E*	19,700 E*	22,900 E*	22,700 E*	23,800 E*
Lead	mg/kg	25	61.6 E*	105. E*	165. E	171. E	243. E	222. E	267. E	32.7 E
Magnesium	mg/kg	21,500	12,400. *	14,300. *	12,100. *	14,400. *	15,700. *	14,100 E*	16,700. *	15,300. *
Manganese	mg/kg	1,060	484. *	497. *	466.	554.	451.	428. E	506.	528.
Mercury	mg/kg	0.1	.02 U	.02 U	.03 B	.03 B	.03 B	.02 U	.03 B	.02 U
Nickel	mg/kg	49	30.5 E	30 E	25.1 *	33.4 *	29. *	31. E	32.9 *	30.5 *
Potassium	mg/kg	2,380	1,530. *	1,610. *	1,840.	1,970.	2,120.	1,950. E	2,190.	1,760.
Selenium	mg/kg	2	.23 UN	.25 UN	.22 U	.24 U	.25 U	.27 U	.28 U	.28 B
Silver	mg/kg	1	.16 UN	.18 UN	.32 BN	.25 BN	.25 BN	.36 BN	.29 BN	.17 BN
Sodium	mg/kg	172	133. B	135. B	104. B	121. B	127. B	88.3 B	97.1 B	91.3 B
Thallium	mg/kg	1	2.3	2.3	2.3	2.9	2.3	3.1	2.2	2.5
Vanadium	mg/kg	150	15.7 *	16.2 *	20.2 E*	27.7 E*	21.4 E*	16.8	21.6 E*	20.1 E*
Zinc	mg/kg	110	102. N*	98.2 N*	101. EN	175. EN	119. EN	129. EN	139. EN	67.3 EN

Notes:

- (1) Technical and Administrative Guidance Memorandum #4046, Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994.
- (2) Total TPH is approximated by the sum of the diesel and motor oil concentrations.
- (3) Only those parameters detected in one or more samples are listed.
- (4) Shaded values exceeded the TAGM guidance value.
- (5) Lab Qualifiers are defined as follows:

GC/MS Qualifiers J = Indicates an estimated value. This flag is used when the result is less than reporting limit, but greater than 1/2 reporting limit.
 U = Indicates the analyte was analyzed for but not detected above the instrument detection limit.
 B = The reported analyte was detected in the associated method blank as well as the sample.
 Y = Combined response for benzo(b)fluoranthene and benzo(k)fluoranthene.
 Y for diesel/motor oil analyses = Pattern of peaks did not match calibrated standard but fell within applicable retention time window.

Metals Qualifiers E(ICP) = The reported value is estimated because of the presence of interference.
 N = Matrix spike sample recovery not within control limits.
 * = Duplicate analysis not within control limits
 B = Entered if the report is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
 U = Entered if the analyte was analyzed for but not detected, less than IDL.

4 TREATMENT SYSTEM PERFORMANCE

4.1 INTRODUCTION AND CLEAN-UP GOALS/STANDARDS

The LTTD Treatability Study was performed to assess the feasibility of treating soils contaminated with semivolatile organic compounds and TPH in the existing APE 1236 furnace. This section assesses the effectiveness and performance of the system. Specific goals of the Treatability Study included the following determinations or demonstrations:

- Organic chemical contaminated soils could be treated to a degree that reduced concentrations of volatile organic, semivolatile organic, organochlorine pesticide, and polychlorinated biphenyl constituents to levels lower than State of New York Technical and Administrative Guidance Memorandum (TAGM) levels which would allow reuse of the soil as fill or as top cover in landfills;
- Total Petroleum Hydrocarbon (TPH) contaminated soil could be treated to a degree that reduced TPH concentrations to below 100 parts per million;
- Exhaust gases released from the APE 1236 system during its operation treating soil contained less than 100 parts per million by volume (100 ppm_v) of carbon monoxide, corrected to a level of 7 percent (%) oxygen on a rolling hourly-average basis;
- Exhaust gases released from the APE 1236 system during its operation contained less than 0.05 grains per dry standard cubic foot (dscf) of particulate matter, corrected to a 7% oxygen content;
- Exhaust gases released from the APE 1236 system during its operation treating soil contained less than 0.2 nanograms per dry standard cubic meter (dscm) of Polychlorinated dibenzo-p-dioxin (dioxins) and Polychlorinated dibenzofuran (furans) compounds, corrected to a 7% oxygen level;
- Destruction and removal efficiency (DRE) achieved for volatile organic, semi-volatile organic, polychlorinated biphenyls and organochlorine pesticide contaminants equaled or exceeded 99.99 percent for the process or, if the DRE level could not be demonstrated, that none of the target organic compounds were present in the exhaust gases at levels above analytical detection limits;
- Operation of the APE 1236 does not result in excessive fugitive emissions from the process or from associated waste feed or waste residue handling operations;
- The APE 1236 system's Automatic Waste Feed Shutoff (AWFSO) system is fully functional

- and effectively works in the event of operating system upsets; and
- The APE 1236 system is shown to pose an economically viable alternative to treat soils containing TPH and semi-volatile organic compounds.

The following sections discuss the results of the Treatability Study with respect to these performance criteria.

4.2 SUMMARY OF PERFORMANCE TEST RESULTS

4.2.1 Soil Contaminant Reduction

In order to determine the contaminant reduction accomplished by the APE 1236 furnace, the treated soils or kiln ash were sampled and analyzed and the results were compared to the results for the feed soils. The kiln ash was discharged into an accumulation pile outside of the system's confining wall where discrete samples were collected in the same manner that the waste soil feed samples were collected. The discrete sub-samples were then combined into one composite sample per test that was analyzed for each of the runs. The kiln ash samples were submitted for the analysis of TPH (SW846 Method 8015B), semi-volatiles (SW846 Method 8270), pesticides/PCBs (SW846 Method 8082), metals (SW846 Method 6010B) and dioxins/furans (SW846 Method 8290).

A comprehensive comparison of the analytical results obtained for the feed soils and kiln ash is presented as **Table 4-1**. The results of this comparison show the following:

Generally, the quantity of semivolatile organic chemicals found in the waste feed soil was reduced by the LTTD treatment process. A summary of the percent reduction achieved for semivolatile organic compounds within the Treatability Study is provided below:

Sample Identification	Concentration in Waste Feed Soil (1) (ug/Kg)	Concentration in Treated Soil – Kiln Ash (1) (ug/Kg)	Percent Reduction (%)
Run 1 – 2 ton/hour	1,682	5,965	None
Run 2 – 2 ton/hour	3,078	472 (2)	85

Sample Identification	Concentration in Waste Feed Soil (1) (ug/Kg)	Concentration in Treated Soil – Kiln Ash (1) (ug/Kg)	Percent Reduction (%)
Run 3 – 2 ton/hour	1,798 (2)	409	77
Run 4 – 5 ton/hour	3,057	629	79
Run 5 – 5 ton/hour	4,094 (2)	1,187	71
Run 6 – 5 ton/hour	1,743	ND - 165	Greater than 90

1. Only semivolatile organic compounds (SVOCs) detected in sample were included in the calculation of the sum.
2. Results from duplicate samples were combined and averaged.

Data from the first run is considered anomalous, as concentrations of semivolatile organics contained in the treated soil are found to be higher than the concentrations of semivolatile organic compounds detected in the untreated soils.

Concentrations of benzo(a)pyrene and dibenzo(a,h)anthracene exceeded NYSDEC TAGM levels in samples of waste feed collected during all six of the demonstration runs. Samples of the treated soil showed that only two samples contained residual concentrations of benzo(a)pyrene, and three samples of treated soil contained concentrations of dibenzo(a,h)anthracene above TAGM levels after treatment; however, with the exception of the first run, all concentrations of both of these PAHs were reduced by the LTTD treatment process.

Concentrations of benzo(a)anthracene and chrysene contained in samples of the waste feed soil of run five also exceeded NYSDEC TAGM levels in Run 5, and the available data indicates that the concentrations of both of these compounds were reduced to less than TAGM levels by the LTTD treatment process. The concentrations of both of these PAH compounds was found to be above TAGM levels in the samples of the treated soil collected during Run 1, even though both compounds were found at lower concentrations in samples of the waste feed collected during this same run.

Aroclor® 1254 was detected at low concentrations (i.e., less than 30 ug/Kg) in waste feed samples collected during four of the six demonstration test runs, while Aroclor® 1260 was detected at low

concentrations in waste feed samples collected during five of the demonstration runs. Neither of these compounds was detected in any sample of treated soil collected during the Treatability Study.

Diesel oil and motor oil fractions were reported and are representative of the total TPH concentration. In all samples, the TPH concentration was reduced following treatment. The TPH concentrations were reduced as follows:

	Concentration in Waste Feed Soil (1)	Concentration in Treated Soil – Kiln Ash (1)	Percent Reduction
Sample Identification	(mg/Kg)	(mg/Kg)	(%)
Run 1 – 2 ton/hour	512	149	72
Run 2 – 2 ton/hour	770	48 (2)	94
Run 3 – 2 ton/hour	298 (2)	95.7	68
Run 4 – 5 ton/hour	760	ND	Greater than 85
Run 5 – 5 ton/hour	445 (2)	379	15
Run 6 – 5 ton/hour	111	ND	Greater than 88

1. Only TPH compounds detected in sample were included in the calculation of the sum.
2. Results from duplicate samples were combined and averaged.

Data generated for two of the demonstration test runs indicate that the LTTD process was not able to meet the treatment goal of 100 mg/Kg in the kiln ash (i.e., treated soil) during two (i.e., Run 2 and Run 5) of the six tests.

Other results and conclusions that may be drawn from a review of the data collected for waste feed and treated soil samples are:

- Generally, metal concentrations measured in the feed and treated soils were similar. The single exception to this general result is lead where concentrations increased by an order of magnitude in two samples following treatment. Based on the prevalence of lead in the munitions, which were previously treated and deactivated in the APE 1236 kiln, it is assumed that the soils may have been affected by residual lead remaining within the treatment process.

- Copper, lead, potassium, sodium and zinc exceeded the TAGM clean-up goals in one or more of the treated soil samples.
- The treatment effectiveness did not appear to be affected by the rate of the incoming soil feed. Contaminant reductions appeared to be similar for the 2 tons per hour and 5 tons per hour treatment rates.

Dioxin and furan analysis was also completed on the kiln ash samples. The results of this analysis are presented in **Table 4-2**. A comparison to the feed soil concentrations could not be performed since this analysis was not performed on the feed soils. The dioxin/furan analyses showed that the concentrations were generally consistent for each of the six demonstration runs.

4.2.2 Gaseous Emissions

4.2.2.1 Introduction

Another set of goals established for the LTTD demonstration study at SEDA was to ensure collection of valid data that showed compliance with applicable air pollution regulations and standards regarding the operation of the LTTD process. Necessary data was collected based on guidance provided by USEPA, NYSDEC and the ITRC. In addition, descriptions and definitions specific to air pollution monitoring procedures and continuous emission monitoring requirements for stationary sources were derived from material provided in Title 40 Code of Federal Regulations (40 CFR) Part 60, Appendices A and B and incorporated by reference in the NYSDEC regulations. Finally, procedures associated with specialized air pollution monitoring procedures were based on protocols defined in USEPA's SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition.

The air sampling and monitoring data collected as part of the LTTD Treatability Study included the following:

- exhaust gas flow rate and moisture content;
- continuous emission monitoring for oxygen, carbon dioxide, total hydrocarbons, and carbon monoxide;
- semivolatile organic compounds in the stack gas;
- volatile organic compounds in the stack gas; and
- polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in the stack gas.

The work plan also proposed the collection of additional gas and monitoring data; however, this data was inadvertently not collected. The data that was not collected included metals concentrations, hydrochloric acid and particulate counts in the exhaust gas.

A description of the air and gas sampling techniques and testing results are summarized in the following sections.

4.2.2.2 Pre-Sampling Activities

The APE 1236 system is equipped with an unlined, 38-foot steel stack that is 20-inches in diameter (outside diameter - OD). Originally, four sets of sampling ports were installed at strategic locations on the stack to allow for the collection of exhaust gas samples and data, and a fifth set of sampling ports was installed above the previously existing four sets to support the additional sampling and monitoring required for the LTTD Treatability Study. The approximate location of all of the sampling ports is shown on **Figure 4-1**.

The newest and highest positioned ports were used for perpendicular sampling traverses for the required extractive Modified Method 5 and Method 0023 determinations. The lower sampling ports were used for the installation of sampling probes associated with the APE's integral CEM system, the independent performance evaluation CEM system, the APE's integral exhaust flow-rate pitot tube assembly, and for collection of volatile organic sampling train (VOST) samples as are shown in **Figure 4-1**.

The new set of sampling ports is located slightly more than two stack diameter equivalents downstream, and roughly 6.9 stack diameter equivalents upstream of all flow disturbances. In accordance with procedures outlined in US EPA Reference Method 1, this positioning of the sampling ports allows for the collection of stack gas samples using a 24-point (i.e., 12 points per axis) traverse. Consistent with additional stipulations of Reference Method 1, none of the 12 sampling points along any axis were placed closer than 0.5 inches to the wall of the stack. Information summarizing the location of sampling points used during exhaust gas sampling traverses is provide in **Figure 4-2**.

The required cyclonic flow check was conducted prior to each series of demonstration runs (i.e., prior to the 2 ton and 5 ton per hour sequences), with the LTTD system (i.e., both the deactivation furnace and the afterburner) operating at conditions that were representative of those that were anticipated to exist

during the proposed test sequence. Each of these determinations indicated that the overall average yaw angle was less than 20 degrees, and thus, the upper sampling ports were suitable for use during extractive sampling events.

4.2.2.3 Exhaust Gas Flow Rate and Moisture Content

Stack gas flow determinations were made in accordance with procedures identified in USEPA Reference Method 2 (RM2 – 40 CFR Part 60, Appendix A). Preliminary flow determinations were made each time the soil feed rate to the rotary kiln was adjusted, or when the operation of the rotary kiln or afterburner was altered (substantially). Additionally, flow determinations were made and recorded as part of the first two of the SW 846 Method 0023 determination. During these events, the velocity head and static pressure determinations were performed at each of the traverse points. Flow data for other extractive sample events were lost, and thus flow rates used for other runs were estimated.

Preliminary stack gas moisture determinations were completed prior to the initiation of each series of performance tests in accordance with the procedures identified in USEPA Reference Method 4 (RM4 – 40 CFR Part 60, Appendix A). The data collected from the preliminary RM4 determination was used to predict the moisture level that would be encountered during subsequent MM5 tests. Stack gas moisture determinations were also completed during Run 1 and 2 Method 0023 determinations in accordance with procedures identified in RM5 and SW846 Method 0010.

The exhaust gas flow rates and other operating data were used to calculate VOC and furan/dioxin emission rates in the exhaust gases.

4.2.2.4 Continuous Monitoring for CO, O₂, CO₂ and THC

Carbon monoxide (CO), oxygen (O₂), carbon dioxide (CO₂), and total hydrocarbon (THC) concentrations contained in the exhaust gas stream were measured continuously using continuous emission monitors (CEMs). The CEM train used to monitor gaseous constituents was brought to the site by the sampling contractor and did not include either of the CEMs that are components of the APE 1236 system. The APE CEMs have not been operated for several years, and require over-haul and upgrade before they can be used.

Each of the CEMs was operated and maintained in accordance with procedures defined in Title 40 CFR

Part 60 Appendix A and B. Logs for the continuous emission monitoring are presented in Appendix B.

Carbon Monoxide Monitoring

The concentration of carbon monoxide (CO) was measured using a Thermo Electron Model 48 non-dispersive infrared (NDIR) analyzer that could operate in the 0 to 10 parts per million (ppm), 0 to 20 ppm, 0 to 50 ppm, 0 to 100 ppm, 0 to 200 ppm, 0 to 500 ppm, or 0 to 1,000 ppm ranges. During testing, all measurements were collected in a manner that is consistent with the procedures identified in USEPA's Reference Method 10 (RM10 – 40 CFR Part 60, Appendix A).

The CEM monitoring showed that all readings of carbon monoxide in the exhaust gas remained well below the rolling hourly-average limit of 100 parts per million by volume (ppmv). The values ranged from 0.01 to 2.21 ppmv.

Oxygen Monitoring

The concentration of oxygen (O₂) in the stack gas was measured using a Servomex Model 1440 analyzer that could operate in the 0 to 25 percent range. The Servomex analyzer uses Faraday's principle that comparatively measures the magnetic susceptibility of a gas volume by the force acting upon a non-magnetic test body suspended in a disproportionate magnetic field. This analyzer was operated in a manner that is consistent with the procedures identified in USEPA's Reference Method 13A (RM3A – 40 CFR Part 60, Appendix A). The analyzer located in the control room is an integral component of the APE 1236 system and is monitored by the system's computer.

The CEM monitoring showed that the oxygen values ranged from 12.51 to 14.21 percent. The oxygen data was used for to correct stack gas CO and dioxin concentrations to 7 percent oxygen content.

Carbon Dioxide Monitoring

The concentration of carbon dioxide (CO₂) in the stack gas was measured using a Servomex Model 1440, non-dispersive infrared (NDIR) monitor. The carbon dioxide analyzer could operate in the 0 to 25 percent range. The system was operated in a manner that is consistent with the procedures identified in USEPA's Reference Method 3A (RM3A – 40 CFR Part 60, Appendix A).

The CEM monitoring showed that the stack gases' carbon dioxide content ranged from 5.12 to 6.55 percent.

Total Hydrocarbon Emissions Monitoring

Total hydrocarbon (THC) emissions were measured in accordance with the procedures identified in USEPA Reference Method 25A. The THC analyzer was a J.U.M. Engineering Model 3 – 300 flame ionization detector (FID) analyzer with multiple operating ranges: 0 to 10 ppm, 0 to 100 ppm, 0 to 1,000 ppm, 0 to 10,000 ppm, and 0 to 100,000 ppm.

The CEM monitoring showed that the THC values ranged from 2.23 to 4.54 ppm. The THC emissions decreased significantly after the first run to a range of 0.06 to 1.58 ppm. The THC emissions are well below NYSDEC's standard of 20 ppm as listed in 6 NYCRR 374-1.8 for Hazardous Waste Burned in Boiler and Industrial Furnaces.

4.2.2.5 Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans Determinations

Polychlorinated Dibenzo-*p*-dioxins (dioxin) and Polychlorinated Dibenzofuran (furan) concentrations emitted from the APE 1236 system were determined using USEPA's SW846 Method 0023. The Method 0023 system was operated in accordance with USEPA Reference Method 5 (RM5 – 40 CFR, Part 60, Appendix A, Reference Method 5) and SW846 Method 0023 procedures. A diagram of the USEPA Method 0023 sampling train is shown in **Figure 4-3**.

Dioxin/furan compounds contained in the sampled gas stream were collected in the Method 0023 system via their adsorption onto captured particulate, their adsorption onto the porous polymeric resin, and their condensation onto the sampling nozzle, the probe liner, the filter or filter housing. All front-half and sorbent module components were recovered in accordance with SW846 Method 0023 procedures after the completion of each sample run and the recovered materials were sent to an analytical laboratory for the determination of captured organic compounds via SW846 Method 8290.

During each series of the proposed LTTD system performance testing, triplicate determinations of the system's dioxin/furan and hydrochloric acid emission rates were completed for each waste feed/system operating condition tested. Each Method 0023 determination included the traverse of the stack along two perpendicular axes at a sampling location that is approximately 26.5 feet above grade. Each

Method 0023 determination encompassed a period of no less than 360 minutes of sampling time and the collection of no less than 106 dry, standard cubic feet (dscf) of gas. As is discussed above (i.e., **Section 4.2.2.2**), each Method 0023 determination required collection of stack gas from a 24-point traverse. The resulting dioxin/furan loading contained in the APE 1236 system's exhaust gas was determined in accordance with procedures defined in EPA Reference Method 23.

The results of the dioxin/furan sampling for the six demonstration runs are presented on **Table 4-3**. NYSDEC's air pollution regulations require that the exhaust gases contain less than 0.2 nanograms per dry standard cubic meter (dscm) of combined dioxin/furan. To compare the generated analytical results with NYSDEC's standard, results provided for individual dioxin/furan species (e.g., heptachloro dibenzo-p-dioxin or octachloro dibenzofuran) were converted using TCDD equivalency factors, as well as the oxygen content, exhaust gas flow rate and stack gas moisture content. The resulting TCDD equivalent concentrations, expressed in nanograms per dry standard cubic meter (ng/dscm), for each test runs are also presented in **Table 4-3**. An example calculation is provided in **Appendix C**.

As is shown on **Table 4-3**, all dioxin/furan stack gas concentrations are less than NYSDEC's standard of 0.2 ng/dscm. The dioxin/furan concentrations ranged from 0.049 to 0.16 ng/dscm. Note that the concentrations for Runs 3 (2 tons/hour feed rate) and Runs 4, 5, and 6 (5 tons/hour feed rate) are based on estimated APE 1236 exhaust gas flow data since data needed for these determinations were not recorded during the actual sampling event.

4.2.2.6 Volatile Organic Sampling Train (VOST)

Volatile organic compound (VOC) emissions discharged from the APE 1236 system were determined in accordance with the USEPA's SW846 Method 0030 "Volatile Organic Sampling Train – VOST" methodology. The VOST sampling system is shown in **Figure 4-4**.

Each VOST determination included the exposure, field collection, and analysis of six replicate pairs of sorbent traps and any associated moisture condensate that resulted from the conditioning of the sampled gas. Each sampling run, during which time one pair of clean sorbent traps arranged in series were exposed to a conditioned (i.e., cooled) sample gas stream, lasted twenty minutes with the sample gas flowrate set at approximately one liter per minute, resulting in a total stack gas sample volume of roughly 20 liters. The stack gas was collected from a point located at the center of the stack at the 17.5-foot above grade level (See **Figure 4-1**).

VOCs captured in the VOST system via their adsorption onto collection media (i.e., Tenax® GC and activated charcoal) loaded within the resin traps, or due to condensation in stack gas moisture, were analyzed via EPA's SW846 Method 5040 at Research Triangle Park Laboratories, Inc. in Raleigh, North Carolina.

VOST sampling was performed for Run 1 and Run 2 for a waste soil feed rate of 2 tons per hour. Sampling was not completed for the remaining four demonstration test runs. The results of the VOST sampling and analyses are presented in **Table 4-4**.

Available VOST results indicate that low concentrations of VOCs were contained in the exhaust gas of the APE 1236 LTTD system. Total mass loadings found in collected samples ranged from 752 to 6,146 nanograms (per 20 liter sample volume). The observed mass loading equate to approximately 0.00047 to 0.004 pounds of VOC emissions per day. Detected VOCs included 1,3-butadiene, 1,1-dichloroethene, methylene chloride, benzene, toluene and styrene. For most sampling trap pairs, methylene chloride, a common laboratory contaminant, comprised the largest component of the observed VOC loading.

The field blank collected during the VOST sampling also showed 1,1-dichloroethene, methylene chloride and benzene content. Levels of benzene found in the exhaust gas were generally consistent with the concentrations detected for this compound in the blank. Measured concentrations of methylene chloride in the exhaust gas were significantly higher than those found in the blank sample. The source of the methylene chloride is uncertain. Available results indicate that this species is not present at significant levels in the waste soil feed material. Methylene chloride is a common laboratory contaminant; thus, the reported concentrations of this species may be partially attributable to this cause. Alternatively, since methylene chloride was used to recover dioxin/furan samples from the Method 0023 sampling system, it is possible that some of the VOST traps could have been exposed to this solvent during sample recovery operations in the field.

Some of the VOCs detected in VOST samples do not appear to be attributable to blank or lab contamination. For example, toluene and styrene were not detected in the blank samples analyzed, but they were frequently detected in the exhaust gas samples. Therefore, it is assumed that these compounds were either liberated or generated in the LTTD process. Accordingly, the performance criteria that no detectable concentrations of VOCs are found in the exhaust gases from the LTTD

process was not achieved.

The work plan indicated that the amount of individual VOCs emitted from the LTTD process would be compared to the amount of the same compound contained in the waste feed to allow for the computation of a destruction and removal efficiency (DRE) value for each compound. This determination could not be made however, because analyses conducted for soil and stack gas samples submitted to the two different laboratories were completed via different methods, and reported data for different sets of analytes. Soil samples were analyzed via SW846 Method 8015 that reported data for VOCs as either Motor Oil or Diesel Oil, while VOST samples were reported as individual VOC species (e.g., benzene, toluene, styrene, methylene chloride, etc.).

4.2.3 Fugitive Dust Monitoring

A MINIRAM (Miniature Real-time Aerosol Monitor manufactured by Monitoring Instruments for the Environment, Inc.) personal monitor Model PDM-3 was used during each of the six demonstration runs to monitor fugitive particulate emissions. Two different sampling stations were used. One station was located near the discharge conveyor of the rotary kiln where treated soil fell out of the kiln. The second station was located upwind of the discharge conveyor to represent background conditions. The actual location of the monitors was changed periodically to adjust to variable wind directions.

Frequently, the dust monitor located near the discharge conveyor became clogged due to excessive dust release. It is presumed that in these instances, the national primary and secondary 24-hour ambient air quality standard of 150 ug/m³ was exceeded.

4.2.4 Fly Ash Sampling

Fly ash was collected from four components of the APE 1236's air pollution control device system (i.e., high temperature and low temperature gas coolers, cyclone and baghouse). The fly ash is captured in these locations prior to the exhaust gases release to the atmosphere.

Fly ash samples were collected from all six runs from the low and high temperature gas coolers. Samples were collected from the baghouse during Runs 3 and 6. Previously, there was insufficient fly ash to collect a sample. Only one sample, containing fly ash from all six runs was collected from the cyclone since the gate valve at the bottom of this device was stuck closed until the last day of testing.

Each of the samples was analyzed for semivolatile organic compounds, TPH, and metals. The results are shown on **Table 4-5**. Two samples for the high and low temperature gas cooler and one sample from the baghouse and cyclone were analyzed for dioxins/furans. The results of the sampling were compared TCLP trigger values in order to assess disposal options. The TCLP trigger values were estimated using the "20 times rule" which approximates the soil concentrations that could theoretically leach contaminants which would classify the soils as hazardous waste due to toxicity.

The results of the fly ash sampling show that individual TCLP criterion were exceeded for one or more metals in all six of the low temperature gas cooler samples, four of the high temperature gas cooler samples, and all of the baghouse and cyclone samples. Since this evaluation is based on use of the "20 times rule" additional TCLP testing (Method 1311) must be performed to determine if the TCLP criteria are met.

Dioxin/furan testing of the fly ash was also performed and the results are shown on **Table 4-6**. There are no TCLP criteria for dioxins/furans. The testing showed that the baghouse and cyclone samples contained concentrations for dioxin/furans at least one order of magnitude higher than the gas cooler samples.

4.2.5 LTTD Systems Operations and Operating Parameters

Operating parameters were continuously recorded during each of the six demonstration runs to provide a basis for estimating operating costs associated with the use of the LTTD process. The operating parameters recorded during the program included rotary kiln temperature, afterburner temperature, high temperature gas cooler exit temperature, low temperature gas cooler exit temperature, kiln draft, burner end temperature, fuel usage, and rotary kiln speed. The operating data log sheets are presented in **Appendix D**.

The following list provides a summary of the range of operational conditions that were recorded during the Treatability Study.

<u>Parameter</u>	<u>Operating Range</u>
Rotary Kiln Temperature	274 to 585°F

Afterburner Temperature	1,425 to 1,703°F
High Temperature Cooler Exit Temperature	627 to 732°F
Low Temperature Cooler Exit Temperature	192 to 256°F
Kiln Draft	31 to 52%
Burner End Temperature	1,158 to 1,560°F
Rotary Kiln Speed	1.0 to 1.5 rpm

The operating conditions were generally steady throughout each of the six demonstration runs.

The residence time of the soil within the kiln was 12 minutes during the first run and then reduced to 10 minutes for each subsequent run. Since the removal efficiency reported for TPH concentration in soil after treatment is slightly lower in Run 1, with higher residence time, then in subsequent runs, it does not appear that this change significantly impacted the treatment process.

4.3 OPERATIONAL CONCERNS

There were a few factors that temporarily impacted the operations of the LTTD system. These factors are as follows:

- The start of the demonstration test series was delayed initially due to the inability to start the burner. The electric eye was replaced and the burner was lit. There were no additional delays due to the operations of the burner.
- The feed system for the APE 1236 furnace consisting of the conveyor and hopper are impacted by wet or sticky soils. The first run was hampered by wet soil that caused clogging of the hopper. As the soil feed dried, clogging of the hopper became a less frequent occurrence.
- The furnace had to be shut down for one day due to a sheared feed belt gear. The cause of this condition was unknown.
- The treated soil discharge conveyor was shut down for a day due to a stretched belt. The original rubber belt overheated due to contact with the hot treated soil. A new belt with higher heat tolerance was used.

Although minor operational modifications were necessary, future operations would not be greatly impacted.

Table 4-1
Comparison of Waste Feed Soils and Kiln Ash to Soil Cleanup Standards
LTTD Treatability Study
Seneca Army Depot Activity

PARAMETER	UNIT	SAMPLE DESIGNATION	TAGM TAGM Value (1)	Waste Feed	Kiln Ash	Waste Feed	Kiln Ash	Kiln Ash	Waste Feed	Waste Feed	Kiln Ash
				LT4000	LT4001	LT4006	LT4007	LT0000 DUP of LT4007	LT4012	LT4013 DUP of LT4012	LT4014
RUN NO.	TREATMENT RATE	SAMPLE DATE		RUN 1 2 tons/hour 30-Aug-00	RUN 1 2 tons/hour 30-Aug-00	RUN 2 2 tons/hour 1-Sep-00	RUN 2 2 tons/hour 1-Sep-00	RUN 2 2 tons/hour 1-Sep-00	RUN 3 2 tons/hour 20-Sep-00	RUN 3 2 tons/hour 20-Sep-00	RUN 3 2 tons/hour 20-Sep-00
2-Methylnaphthalene	ug/kg	36,400		29. J	18. J	28. J	330. U	390. U	360. U	380. U	330. U
Acenaphthene	ug/kg	50,000		360. U	330. U	22. J	330. U	390. U	360. U	17. J	330. U
Anthracene	ug/kg	50,000		21. J	65. J	55. J	330. U	25. J	360. U	23. J	330. U
Benzo(a)anthracene	ug/kg	224		100. J	480.	170. J	330. U	40. J	120. J	130. J	16. J
Benzo(a)pyrene	ug/kg	61		150. J	560.	220. J	330. U	32. J	160. J	170. J	17. J
Benzo(b)fluoranthene	ug/kg	1,100		170. J	660.	320. J	330. U	36. J	140. J	180. J	55. JY
Benzo(ghi)perylene	ug/kg	50,000		160. J	380.	250. J	330. U	27. J	160. J	180. J	32. J
Benzo(k)fluoranthene	ug/kg	1,100		140. J	650.	270. J	330. U	48. J	190. J	230. J	330. U
Benzoic Acid	ug/kg	--		910. U	320. J	920. U	830. U	310. J	890. U	940. U	120. J
Bis(2-Ethylhexyl)phthalate	ug/kg	50,000		360. U	330. U	220. JB	330. U	44. JB	36. JB	380. U	330. U
Carbazole	ug/kg	--		360. U	35. J	51. J	330. U	32. J	360. U	380. U	330. U
Chrysene	ug/kg	400		170. J	660.	340. J	330. U	47. J	180. J	230. J	36. J
Di-n-butylphthalate	ug/kg	8,100		360. U	330. U	370. U	330. U	43. J	360. U	380. U	330. U
Di-n-octylphthalate	ug/kg	50,000		360. U	330. U	370. U	330. U	38. J	360. U	380. U	330. U
Dibenz(a,h)anthracene	ug/kg	14		60. J	130. J	89. J	330. U	28. J	55. J	48. J	330. U
Dibenzofuran	ug/kg	6,200		18. J	17. J	20. J	330. U	390. U	360. U	380. U	330. U
Diethyl phthalate	ug/kg	7,100		360. U	330. U	370. U	330. U	26. J	360. U	380. U	330. U
Fluoranthene	ug/kg	50,000		170. J	640.	270. J	330. U	41. J	180. J	180. J	50. J
Fluorene	ug/kg	50,000		21. J	330. U	25. J	330. U	390. U	360. U	380. U	330. U
Indeno(1,2,3-cd)pyrene	ug/kg	3,200		120. J	370.	200. J	330. U	29. J	120. J	160. J	24. J
Naphthalene	ug/kg	13,000		23. J	330. U	28. J	330. U	390. U	360. U	380. U	330. U
Phenanthrene	ug/kg	50,000		120. J	410.	170. J	330. U	33. J	72. J	110. J	28. J
Phenol	ug/kg	30		360. U	330. U	370. U	330. U	25. J	360. U	380. U	330. U
Pyrene	ug/kg	50,000		210. J	570.	330. J	330. U	39. J	250. J	310. J	31. J
Total SVOCs	ug/kg	--		1,682.	5,965.	3,078.	0	943.	1,627.	1,968.	409.
Aroclor-1254	ug/kg	1,000		19.	17. U	18. U	17. U	20. U	18.	18. J	16. U
Aroclor-1260	ug/kg	1,000		23.	17. U	21.	17. U	20. U	27.	24.	16. U
Diesel Oil	mg/kg	--		92. Y	29. Y	140. Y	14. Y	7.8 U	43.	68.	5.7 J
Motor Oil	mg/kg	--		420. Y	120. Y	630. Y	60. Y	22. Y	5.3	480.	90.
TPH (Total) (2)	mg/kg	--		512.	149.	770.	74.	22.	48.3	548.	95.7
Aluminum	mg/kg	19,300		9,710.	8,370.	10,100.	9,630.	12,200.	8,600. E*	12,000. E*	11,700. E*
Antimony	mg/kg	5.9		.93 UN	1.2 BN	.99 UN	2.4 BN	4.1 BN	1.4 BN	1.1 BN	4.8 BN
Arsenic	mg/kg	8.2		4. N	4.3 N	4.6 N	4.1 N	5.7 N	2.9 *	3.5 *	3.7 *
Barium	mg/kg	300		85. *	75.8 *	79.6 *	87.2 *	103. *	78.6 *	113. *	98.5 *
Beryllium	mg/kg	1.1		.73	.66	.73	.73	.9	.62	.78	.77
Cadmium	mg/kg	2.3		.38 B*	1.5 *	.47 *	.69 *	1.3 *	.22 B	2.3	.38 B
Calcium	mg/kg	121,000		69,500.	116,000.	75,500.	78,300.	9,190.	104,000. *	83,200. *	69,900. *
Chromium	mg/kg	29.6		17. N*	15.6 N*	18.9 N*	19.8 N*	24.8 N*	15.7 E*	20.9 E*	10.3
Cobalt	mg/kg	30		10.	7.9	9.7	9.2	11.5	8.4	10.5	22.9 E*
Copper	mg/kg	33		31.8 N	37.3 N	41.8 N	53.3 N	53.4 N	39.3 EN	51.1 EN	60.6 EN
Iron	mg/kg	36,500		20,100. *	18,300. *	20,300. *	20,400. *	26,500. *	17,000. E*	23,800. E*	22,900. E*
Lead	mg/kg	24.8		61.6 E*	152. E*	105. E*	185. E*	315. E*	165. E	171. E	1,120. E
Magnesium	mg/kg	21,500		12,400. *	14,100. *	14,300. *	12,200. *	15,100. *	12,100. *	14,400. *	16,900. *
Manganese	mg/kg	1,060		484. *	396. *	497. *	443. *	573. *	466.	554.	500.
Mercury	mg/kg	0.1		.02 U	.01 U	.02 U	.01 U	.02 U	.03 B	.03 B	.02 U
Nickel	mg/kg	49		30.5 E	27.7 E	30. E	31.8 E	39.6 E	25.1 *	33.4 *	33.4 *
Potassium	mg/kg	2,380		1,530. *	1,280. *	1,610. *	1,540. *	2,030. *	1,840.	1,970.	2,250.
Selenium	mg/kg	2		.23 UN	.2 UN	.25 UN	.21 UN	.29 UN	.22 U	.24 U	.26 U
Silver	mg/kg	0.75		.16 UN	.34 BN	.18 UN	.15 UN	.36 BN	.32 BN	.25 BN	.33 BN
Sodium	mg/kg	172		133. B	140. B	135. B	135. B	166. B	104. B	121. B	93.1 B
Thallium	mg/kg	0.7		2.3	1.9	2.3	2.3	2.4	2.3	2.9	2.2
Vanadium	mg/kg	150		15.7 *	12.9 *	16.2 *	15.7 *	21.1 *	20.2 E*	27.7 E*	25. E*
Zinc	mg/kg	110		102. N*	93.7 N*	98.2 N*	105. N*	135. N*	101. EN	175. EN	130. EN

Notes:

- (1) Technical and Administrative Guidance Memorandum #4046, Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994.
- (2) Total TPH is approximated by the sum of the diesel and motor oil concentrations.
- (3) Only those parameters detected in one or more samples are listed.
- (4) Shaded values exceeded the TAGM or soil background values.
- (5) Lab Qualifiers are defined as follows:

GCMS Qualifiers J = Indicates and estimated value. This flag is used when the result is less than reporting limit, but greater than 1/2 reporting limit.
 U = Indicates the analyte was analyzed for but not detected above the instrument detection limit.
 B = The reported analyte was detected in the associated method blank as well as the sample.
 Y = Combined response for benzo[b]fluoranthene and benzo[k]fluoranthene.
 Y for diesel/motor oil analyses = Pattern of peaks did not match calibrated standard but fell within applicable retention time window.
 Metals Qualifiers E(ICP) = The reported value is estimated because of the presence of interference.
 N = Matrix spiked sample recovery not within control limits.
 * = Duplicate analysis not within control limits
 B = Entered if the report is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
 U = Entered if the analyte was analyzed for but not detected, less than IDL.

Table 4-1
Comparison of Waste Feed Soils and Kiln Ash to Soil Cleanup Standards
LTTD Treatability Study
Seneca Army Depot Activity

PARAMETER	UNIT	E DESIGNATION	Waste Feed	Kiln Ash	Waste Feed	Waste Feed	Kiln Ash	Waste Feed	Kiln Ash
			LT4020	LT4021	LT4028	LT4029 DUP of LT4028	LT4030	LT4036	LT4037
RUN NO. TREATMENT RATE SAMPLE DATE	TAGM TAGM Value (1)	RUN 4 5 tons/hour 21-Sep-00	RUN 4 5 tons/hour 21-Sep-00	RUN 5 5 tons/hour 22-Sep-00	RUN 5 5 tons/hour 22-Sep-00	RUN 5 5 tons/hour 22-Sep-00	RUN 5 5 tons/hour 22-Sep-00	RUN 6 5 tons/hour 23-Sep-00	RUN 6 5 tons/hour 23-Sep-00
2-Methylnaphthalene	ug/kg	36,400	360. U	15. J	360. U	24. J	330. U	360. U	330. U
Acenaphthene	ug/kg	50,000	360. U	330. U	35. J	56. J	330. U	360. U	330. U
Anthracene	ug/kg	50,000	43. J	330. U	64. J	91. J	330. U	36. J	330. U
Benzo(a)anthracene	ug/kg	224	180. J	25. J	210. J	300. J	66. J	120. J	330. U
Benzo(a)pyrene	ug/kg	61	250. J	25. J	220. J	360. J	73. J	120. J	330. U
Benzo(b)fluoranthene	ug/kg	1,100	310. J	77. JY	290. J	490.	200. JY	130. J	330. U
Benzo(ghi)perylene	ug/kg	50,000	280. J	41. J	210. J	430.	120. J	110. J	330. U
Benzo(k)fluoranthene	ug/kg	1,100	270. J	330. U	210. J	440.	330. U	130. J	330. U
Benzoic Acid	ug/kg	--	900. U	190. J	910. U	910. U	230. J	900. U	830. U
Bis(2-Ethylhexyl)phthalate	ug/kg	50,000	47. J	330. U	360. U	360. U	330. U	360. U	330. U
Carbazole	ug/kg	--	36. J	330. U	42. J	73. J	330. U	360. U	330. U
Chrysene	ug/kg	400	320. J	51. J	300. J	440.	110. J	150. J	330. U
Di-n-butylphthalate	ug/kg	8,100	360. U	330. U	360. U	360. U	330. U	360. U	330. U
Di-n-octylphthalate	ug/kg	50,000	360. U	330. U	360. U	360. U	330. U	360. U	330. U
Dibenz(a,h)anthracene	ug/kg	14	85. J	330. U	45. J	140. J	50. J	39. J	330. U
Dibenzofuran	ug/kg	6,200	360. U	330. U	17. J	36. J	330. U	360. U	330. U
Diethyl phthalate	ug/kg	7,100	360. U	330. U	360. U	360. U	330. U	360. U	330. U
Fluoranthene	ug/kg	50,000	360.	73. J	470.	600.	140. J	300. J	330. U
Fluorene	ug/kg	50,000	360. U	330. U	28. J	55. J	330. U	360. U	330. U
Indeno(1,2,3-cd)pyrene	ug/kg	3,200	230. J	34. J	180. J	380.	100. J	98. J	330. U
Naphthalene	ug/kg	13,000	16. J	330. U	360. U	42. J	330. U	360. U	330. U
Phenanthrene	ug/kg	50,000	210. J	46. J	310. J	440.	88. J	210. J	330. U
Phenol	ug/kg	30	360. U	330. U	360. U	360. U	330. U	360. U	330. U
Pyrene	ug/kg	50,000	420.	52. J	480.	680.	120. J	300. J	330. U
Total SVOCs	ug/kg	--	3,057.	629.	3,111.	5,077.	1,187.	1,743.	0
Aroclor-1254	ug/kg	1,000	25.	17. U	26.	24.	16. U	18. U	17. U
Aroclor-1260	ug/kg	1,000	41.	17. U	38.	34.	16. U	18. U	17. U
Diesel Oil	mg/kg	--	80.	13. U	84.	81.	19. J	18.	6.6 U
Motor Oil	mg/kg	--	680.	100. U	5.3	720.	360.	93.	6.6 U
TPH (Total) (2)	mg/kg	--	760.	0	89.3	801.	379.	111.	0
Aluminum	mg/kg	19,300	9,980. E*	10,600. E*	10,400. E	11,600. E*	10,800. E*	11,100. E*	11,500. E*
Antimony	mg/kg	5.9	2. BN	1.8 BN	2.7 BN	2.1 BN	3.7 BN	.57 BN	2.4 BN
Arsenic	mg/kg	8.2	3.4 *	3.3 *	3.9	3.4 *	3.6 *	3.9 *	3.5 *
Barium	mg/kg	300	99.9 *	93.9 *	105.	98.1 *	109. *	72.2 *	76.4 *
Beryllium	mg/kg	1.1	.68	.73 J	.55	.76	.71	.73	.73
Cadmium	mg/kg	2.3	.37 B	.16 B	1.5	.26 B	.39	.03 U	5.9
Calcium	mg/kg	121,000	102,000. *	92,500. *	58,000. E*	62,600. *	65,200. *	61,400. *	68,000. *
Chromium	mg/kg	29.6	17.7 E*	19.1 E*	18.2	20.6 E*	24.3 E*	21.4 E*	22.1 E*
Cobalt	mg/kg	30	9.5	9.7 U	9.4	10.6	9.7	11.2	11.2
Copper	mg/kg	33	53.7 EN	49.7 EN	77. N*	67.2 EN	72.3 EN	32. EN	42.9 EN
Iron	mg/kg	36,500	19,700. E*	20,700. E*	22,900. E	22,700. E*	20,900. E*	23,800. E*	21,500. E*
Lead	mg/kg	24.8	243. E	227. E	222. E	257. E	320. E	32.7 E	270. E
Magnesium	mg/kg	21,500	15,700. *	13,800. *	14,100. E*	16,700. *	18,700. *	15,300. *	14,200. *
Manganese	mg/kg	1,060	451.	471. U	428. E	506.	468.	528.	466.
Mercury	mg/kg	0.1	.03 B	.02 U	.02 U	.03 B	.02 U	.02 U	.02 U
Nickel	mg/kg	49	29. *	30.2 *	31. E	32.9 *	29.4 *	30.5 *	29.5 *
Potassium	mg/kg	2,380	2,120.	2,350. U	1,950. E	2,190.	2,200.	1,760.	2,600.
Selenium	mg/kg	2	.25 U	.27 U	.27 U	.28 U	.2 U	.28 B	.22 U
Silver	mg/kg	0.75	.25 BN	.38 BN	.36 BN	.29 BN	.32 BN	.17 BN	1.3 N
Sodium	mg/kg	172	127. B	181. B	88.3 B	97.1 B	163. B	91.3 B	185. B
Thallium	mg/kg	0.7	2.3	2.5 U	3.1	2.2	2.3	2.5	2.3
Vanadium	mg/kg	150	21.4 E*	21.8 E*	16.8	21.6 E*	21.6 E*	20.1 E*	20.5 E*
Zinc	mg/kg	110	119. EN	122. EN	129. EN	139. EN	125. EN	67.3 EN	71.3 EN

Notes:

- (1) Technical and Administrative Guidance Memorandum #4046, Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994.
- (2) Total TPH is approximated by the sum of the diesel and motor oil concentrations.
- (3) Only those parameters detected in one or more samples are listed.
- (4) Shaded values exceeded the TAGM or soil background values.
- (5) Lab Qualifiers are defined as follows:
 - GC/MS Qualifiers J = Indicates an estimated value. This flag is used when the result is less than reporting limit, but greater than 1/2 reporting limit.
 - U = Indicates the analyte was analyzed for but not detected above the instrument detection limit.
 - B = The reported analyte was detected in the associated method blank as well as the sample.
 - Y = Combined response for benzo(b)fluoranthene and benzo(k)fluoranthene.
 - Y for diesel/motor oil analyses = Pattern of peaks did not match calibrated standard but fell within applicable retention time window.
 - Metals Qualifiers E(ICP) = The reported value is estimated because of the presence of interference.
 - N = Matrix spiked sample recovery not within control limits.
 - * = Duplicate analysis not within control limits.
 - B = Entered if the report is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
 - U = Entered if the analyte was analyzed for but not detected, less than IDL.

Table 4-2
Summary of Dioxin and Furan Testing of Kiln Ash
LTDD Treatability Study
Seneca Army Depot Activity

Parameter	Sample Type:	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	Kiln Ash	
	Sample Number: Run Number: Treatment Rate: Sampling Date: Sample Designation:	LT4001 RUN 1 2 tons/hour 30-Aug-00	LT4007 RUN 2 2 tons/hour 1-Sep-00	LT0000 RUN 3 2 tons/hour 1-Sep-00 DUP of LT4007	LT4014 RUN 3 2 tons/hour 20-Sep-00	LT4021 RUN 4 5 tons/hour 21-Sep-00	LT4030 RUN 5 5 tons/hour 22-Sep-00	LT4031 RUN 5 5 tons/hour 22-Sep-00 DUP of LT4030	LT4037 RUN 6 5 tons/hour 23-Sep-00			
	Units											
2,3,7,8-TCDD	pg/g	0.188 A	0.094 U	0.114 U	0.125 U	0.141 A	0 A	0 A	0.049 U			
1,2,3,7,8-PeCDD	pg/g	0.531 A	0.214 U	0.187 A	0.361 U	0 A	0.362 A	0.412 A	0.12 U			
1,2,3,4,7,8-HxCDD	pg/g	0.622 A	0.31 U	0.238 A	0.204 U	0.304 A	0.438 A	0.494 A	0.144 U			
1,2,3,6,7,8-HxCDD	pg/g	1.72 A	0.378 U	0.453 A	0.636	0.645 A	1.03 A	0.913 A	0.162 U			
1,2,3,7,8,9-HxCDD	pg/g	1.44 A	0.322 U	0.429 A	0.536	0.625 A	0.999 A	0.861 A	0.144 U			
1,2,3,4,6,7,8-HpCDD	pg/g	28.1	3.16	5.2	7.27 B	8.74 B	16.6 B	14.9 B	0.704 A,B			
OCDD	pg/g	144 B	15.1 B	24.1 B	38.3 B	50.3 B	110 B	99.4 B	3.21 A,B			
2,3,7,8-TCDF	pg/g	2.42	0.447	0.487 A	0.544	0.952	0.976	1.21	0.134 A			
1,2,3,7,8-PeCDF	pg/g	0.742 A	0.19	0.239 A	0.294 A	0.308 A	0.373 A	0.402 A	0.112 A			
2,3,4,7,8-PeCDF	pg/g	1.89 A	0.376	0.456 A	0.986 A	0.957 A	1.26 A	1.17 A	0 A			
1,2,3,4,7,8-HxCDF	pg/g	0.75 A	0.224	0.274 A	0.378 A	0.369 A	0.443 A	0.447 A	0.0999 A			
1,2,3,6,7,8-HxCDF	pg/g	0.66 A	0.135	0.218 A	0.347 A	0.333 A	0.448 A	0.389 A	0.0586 A			
2,3,4,6,7,8-HxCDF	pg/g	0.861 A	0.163	0.253 A	0.46 A	0.401 A	0.609 A	0.512 A	0.0409 U			
1,2,3,7,8,9-HxCDF	pg/g	0.168 A	0.0313 U	0.0988 A	0.0606 U	0.0865 U	0.0868 U	0.0914 A	0.0564 U			
1,2,3,4,6,7,8-HpCDF	pg/g	3.38	0.446	0.838 A	1.06 A	1.3 A	2.38 A	1.88 A	0 A			
1,2,3,4,7,8,9-HpCDF	pg/g	0.349 A	0.0484 U	0.148 A	0.122 U	0.0861 U	0.0843 U	0.136 U	0.0729 U			
OCDF	pg/g	5.96 B	0.175	1.36 A,B	2.24 A,B	2.42 A,B	4.99 A,B	3.77 A,B	0 A,B			
Total TCDD	pg/g	2.47	0.214 U	0.174	0.125 U	1.61	2.18	1.87	8.14			
Total PeCDD	pg/g	4.51	0.214 U	1.03	1.34	2.5	3.32	3.41	0.19			
Total HxCDD	pg/g	16	1.96	5.17	6.48	7.72	10.9	10.5	0.629			
Total HpCDD	pg/g	52.5	6.64	11	14.5 B	18.1	33.5	30.3 B	1.34 B			
Total TCDF	pg/g	16.3	3.14	3.63	6.62	9.93	12.4	10.6	6.98			
Total PeCDF	pg/g	16.6	3.49	4.31	9.12	7.77	12.6	12.6	0.66			
Total HxCDF	pg/g	9.71	1.6	2.57	5.9	5.16	8.03	6.54	0.38			
Total HpCDF	pg/g	8.11	0.95	1.7	2.25	2.87	5.49	4.5	0.133 U*			

Notes:
(1) Lab qualifiers:
A = The amount detected is below the Method Calibration Limit.
B = This compound was also detected in the blank.
U = The compound was not detected above the sample specific estimated detection limit.
U* = The compound was not detected. Value is estimated maximum possible concentration.
(2) Soil Cleanup goals are not available for dioxins/furans.

Table 4-3
 Summary of Method 0023 Testing for Dioxins and Furans
 LTTD Treatability Study
 Seneca Army Depot Activity

Parameter	Toxicity Equivalency Factors ⁽¹⁾	Method 0023 Test Results for Dioxins ⁽⁶⁾											
		Run 1 2 tons/hour		Run 2 2 tons/hour		Run 3 2 tons/hour		Run 4 5 tons/hour		Run 5 5 tons/hour		Run 6 5 tons/hour	
		Result (pg)	TCDD Equivalents (pg) ⁽²⁾	Result (pg)	TCDD Equivalents (pg) ⁽²⁾	Result (pg)	TCDD Equivalents (pg) ⁽²⁾	Result (pg)	TCDD Equivalents (pg) ⁽²⁾	Result (pg)	TCDD Equivalents (pg) ⁽²⁾	Result (pg)	TCDD Equivalents (pg) ⁽²⁾
2,3,7,8-TCDD	1	69	28.3	21.4	21.4	52.8	21.4	52.8	50.1	50.1	20.1	20.1	
1,2,3,7,8-PeCDD	1	160	55.5	38	38	157	157	140	140	70.2	70.2	70.2	
1,2,3,4,7,8-HxCDD	0.03	81.4	2.442	23.6	0.708	27.9	0.837	109	3.09	3.09	50.5	1.515	
1,2,3,6,7,8-HxCDD	0.03	150	4.5	44.2	1.326	57.3	1.719	218	6.54	6.54	97.4	2.922	
1,2,3,7,8,9-HxCDD	0.03	86.7	2.601	30.5	0.915	26.7	0.801	145	4.35	4.35	64.5	1.935	
1,2,3,4,6,7,8-HpCDD	0.001	411	0.411	111	0.111	160	0.16	740	0.74	0.69	330	0.33	
OCDD	0	895	0	236	0	329	0	1230	0	1400	0	523	
2,3,7,8-TCDF	0.33	194	64.02	102	33.66	64.8	21.384	141	46.53	138	45.54	17.325	
1,2,3,7,8-PeCDF	0.33	100	33	51.7	17.061	29.5	9.735	90.4	29.832	87	28.71	37.5	
2,3,4,7,8-PeCDF	0.33	199	65.67	99.3	32.769	60	19.8	228	75.24	205	67.65	96.6	
1,2,3,4,7,9-HxCDF	0.01	110	1.1	42.4	0.424	37.5	0.375	144	1.44	127	1.27	66.1	
1,2,3,6,7,8-HxCDF	0.01	106	1.06	48.5	0.485	37.4	0.374	141	1.41	123	1.23	61.2	
2,3,4,6,7,8-HxCDF	0.01	165	1.65	57.9	0.579	60.1	0.601	259	2.59	224	2.24	110	
1,2,3,7,8,9-HxCDF	0.01	32.9	0.329	11.4	0.114	14.8	0.148	54.5	0.545	44.2	0.442	23.3	
1,2,3,4,6,7,8-HpCDF	0.001	257	0.257	98	0.098	113	0.113	518	0.518	448	0.448	225	
1,2,3,4,7,8,9-HpCDF	0.001	22.5	0.0225	4.69	0	13.1	0	48.3	0	42	0	21.1	
OCDF	0	75.4	0	26.4	0	40	0	184	0	189	0	85	
Total TCDD	0.01	8470	3580	2790	5490	5490	5490	5437.2	54.372	5779.9	57.799	2129.9	
Adjusted TCDD ⁽³⁾	0.01	8401	3551.7	2768.6	5437.2	27686	27686	5437.2	54.372	5779.9	57.799	2129.9	
Total PeCDD	0.01	5740	2120	1600	1600	1600	1600	1600	1600	1600	1600	1600	
Adjusted PeCDD ⁽³⁾	0.01	5580	2064.5	1562	1562	1562	1562	1562	1562	1562	1562	1562	
Total HxCDD	0.0003	2780	861	946	946	946	946	946	946	946	946	946	
Adjusted HxCDD ⁽³⁾	0.0003	2461.9	762.7	834.1	834.1	834.1	834.1	834.1	834.1	834.1	834.1	834.1	
Total HpCDD	0.00001	833	232	327	327	327	327	327	327	327	327	327	
Adjusted HpCDD ⁽³⁾	0.00001	422	121	167	167	167	167	167	167	167	167	167	
Total TCDF	0.003	12000	5940	4440	4440	4440	4440	4440	4440	4440	4440	4440	
Adjusted TCDF ⁽³⁾	0.003	11806	5838	4375.2	4375.2	4375.2	4375.2	4375.2	4375.2	4375.2	4375.2	4375.2	
Total PeCDF	0.003	3970	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	
Adjusted PeCDF ⁽³⁾	0.003	3671	1899	1899	1899	1899	1899	1899	1899	1899	1899	1899	
Total HxCDF	0.00001	1530	662	662	662	662	662	662	662	662	662	662	
Adjusted HxCDF ⁽³⁾	0.00001	1116.1	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	507.8	
Total HpCDF	0.00001	378	137	178	178	178	178	178	178	178	178	178	
Adjusted HpCDF ⁽³⁾	0.00001	98.5	34.31	34.31	34.31	34.31	34.31	34.31	34.31	34.31	34.31	34.31	
Total TCDD Equivalents		593.1	251.7	175.6	526.2	175.6	526.2	175.6	526.2	175.6	526.2	175.6	
Sample Volume (dscm)		7.36 (6)	7.12 (6)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	7.24 (7)	
Total (ng/dscm) ⁽⁴⁾		0.162	0.071	0.049	0.146	0.049	0.146	0.049	0.139	0.049	0.127	0.127	

Notes:
 (1) Toxicity Equivalency Factors (TEF) - Factors used to express furan and dioxin isomers as an equivalent concentration of 2,3,7,8-tetrachlorinated dibenzo-para-dioxin. (Reference: 6NYCRR 219.1-1)
 (2) TCDD Equivalents - Any combination or mix of polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans containing from 4 to 8 chlorine atoms which are expressed as 2,3,7,8-tetrachlorinated dibenzo-para-dioxin.
 (3) Individual Total Dioxin/Furan Isomer values (e.g., Total TCDD or Total HxCDF) are adjusted by subtracting component, individual isomers listed above.
 (4) The total TCDD is expressed in ng/dscm corrected to 7% Oxygen for comparison to the standard of 0.2 ng/dscm. An example conversion calculation is provided in Appendix C.
 (5) USEPA's SW846 Method 0023 was used to determine Polychlorinated Dibenzofuran concentrations and Polychlorinated Dibenzofuran concentrations emitted from the APE 1236 system.
 (6) Volume data based on field measurements.

Table 4-4
Summary of VOST Train Analyses
LTTD Treatability Study
Seneca Army Depot Activity

August 30, 2000

Compound	Field Blank		Pair #1		Pair #2		Pair #3		Pair #4		Pair #5		Pair #6	
	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day
Chloromethane	--	NA	--	--	--	--	--	--	--	--	260	0.00017	--	--
1,3 Butadiene	--	NA	--	52	0.00003	--	51	0.00003	70	0.00005	--	--	--	--
1,1-Dichloroethene	66	NA	--	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	93	NA	1,762	863	0.00056	944	0.00062	926	0.0006	0.0006	5,465	0.00357	3,542	0.00231
Benzene	285	NA	231	627	0.00041	384	0.00025	364	0.00024	0.00024	421	0.00027	78	0.00005
Toluene	--	NA	--	--	--	57	0.00004	--	--	--	--	--	--	--
Styrene	--	NA	--	77	0.0005	--	--	--	--	--	--	--	--	--
Total VOCs	444		1,993	1,619	0.0015	1,436	0.00094	1,360	0.00089	0.00089	6,146	0.00401	3,620	0.00236

September 1, 2000

Compound	Field Blank		Pair #1		Pair #2		Pair #3		Pair #4		Pair #5		Pair #6	
	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day	ng	lbs/day
Chloromethane	--	NA	--	--	--	--	--	--	--	--	260	0.00017	--	--
1,3 Butadiene	--	NA	--	97	0.00006	--	63	0.00004	70	0.00004	69	0.00004	56	0.00004
1,1-Dichloroethene	69	NA	--	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	87	NA	1,110	1,440	0.00092	185	0.00012	467	0.0003	0.0003	374	0.00024	752	0.00048
Benzene	295	NA	299	428	0.00027	532	0.00034	163	0.0001	0.0001	439	0.00028	467	0.0003
Toluene	--	NA	109	60	0.00007	57	0.00004	52	0.00003	0.00003	88	0.00006	89	0.00006
Styrene	--	NA	--	77	0.00005	75	0.00005	--	--	--	51	0.00003	54	0.00003
Total VOCs	451		1,518	2,102	0.00134	912	0.00059	752	0.00047	0.00047	1,281	0.00082	1,418	0.00091

Notes:

- (1) Only those parameters detected in one or more of the sampling pairs are listed.
- (2) NA = Not Applicable

Table 4-6
Summary of Dioxin/Furan Testing on Fly Ash
LTTD Treatability Study
Seneca Army Depot Activity

Sample Location: Sample Number: Run Number: Treatment Rate: Sampling Date: Parameter: Units	Fly Ash Samples					
	Low Temperature Gas Cooler		High Temperature Gas Cooler		Baghouse	Cyclone
	LT4004 RUN 1 2 tons/hr 8/30/00	LT4010 RUN 2 2 tons/hr 9/1/00	LT4005 RUN 1 2 tons/hr 8/30/00	LT4011 RUN 2 2 tons/hr 9/1/00	LT4016 RUN 3 2 tons/hr 9/20/00	LT4039 RUN 6 5 tons/hr 9/23/00
2,3,7,8-TCDD	0.0827 U	0.182 U	0.103 U	0.0797 U	1.67	0.543
1,2,3,7,8-PeCDD	0.102 U	0.137 U	0.113 U	0.0917 U	4.11	0.911 A
1,2,3,4,7,8-HxCDD	0.208 U	0.196 U	0.144 U	0.0957 U	3.33	0.687 A
1,2,3,6,7,8-HxCDD	0.352 A	0.273 A	0.171 U	0.114 U	8.73	1.58 A
1,2,3,7,8,9-HxCDD	0.221 U	0.198 U	0.148 U	0.0982 U	6.43	1.13 A
1,2,3,4,6,7,8-HpCDD	5.59	2.23 A	0.621 A	1.72 A	38.3 B	11.9 B
OCDD	33.6 B	12.8 B	2.97 A,B	7.63 B	114 B	54.6 B
2,3,7,8-TCDF	0.585	1.24	0.32 A	0.437 A	8.6	4.68
1,2,3,7,8-PeCDF	0.355 A	0.655 A	0.134 A	0.176 A	4.79	1.85 A
2,3,4,7,8-PeCDF	0.605 A	1.17 A	0.406 A	0.415 A	14.6	3.53
1,2,3,4,7,8-HxCDF	0.394 A	0.682 A	0.206 A	0.202 A	8.57	1.56 A
1,2,3,6,7,8-HxCDF	0.386 A	0.649 A	0.137 A	0.121 A	7.84	2.46 A
2,3,4,6,7,8-HxCDF	0.426 A	0.683 A	0.169 A	0.155 A	16	2.33 A
1,2,3,7,8,9-HxCDF	0.135 U	0.173 A	0.0361 U	0.0422 U	2.94	0.636 A
1,2,3,4,6,7,8-HpCDF	1.79 A	1.67 A	0.365 A	0.295 A	36.9	4.96
1,2,3,4,7,8,9-HpCDF	0.144 A	0.157 A	0.0372 U	0.0703 U	3.01	0.509 A
OCDF	3.8 A,B	1.6 A,B	0.469 A,B	0.602 A,B	23.3 B	3.02 A,B
Total TCDD	0.428	0.335	0.103 U	0.0797 U	147	18.1
Total PeCDD	0.364	0.581	0.113 U	0.151 U*	151	20
Total HxCDD	1.66	1.9	0.154 U	0.585	133	20
Total HpCDD	8.69	3.99	1.12	2.91	76.9 B	21.5 B
Total TCDF	12.7	20.7	3.61	1.54	250	59.7
Total PeCDF	5.86	11.5	2.44	2.09	152	32.3
Total HxCDF	3.47	5.29	1.21	1.01	98.5	17.1
Total HpCDF	4.48	2.74	0.365	0.295	54	8.25

Notes:

(1) Lab qualifiers:

A = The amount detected is below the Method Calibration Limit.

B = This compound was also detected in the blank.

U = The compound was not detected above the sample specific estimated detection limit.

U* = The compound was not detected. Value is estimated maximum possible concentration.

(2) There are no TCLP criteria or TAGM cleanup goals for dioxins/furans.

FIGURE 4-1
Deactivation Furnace Stack
Configuration

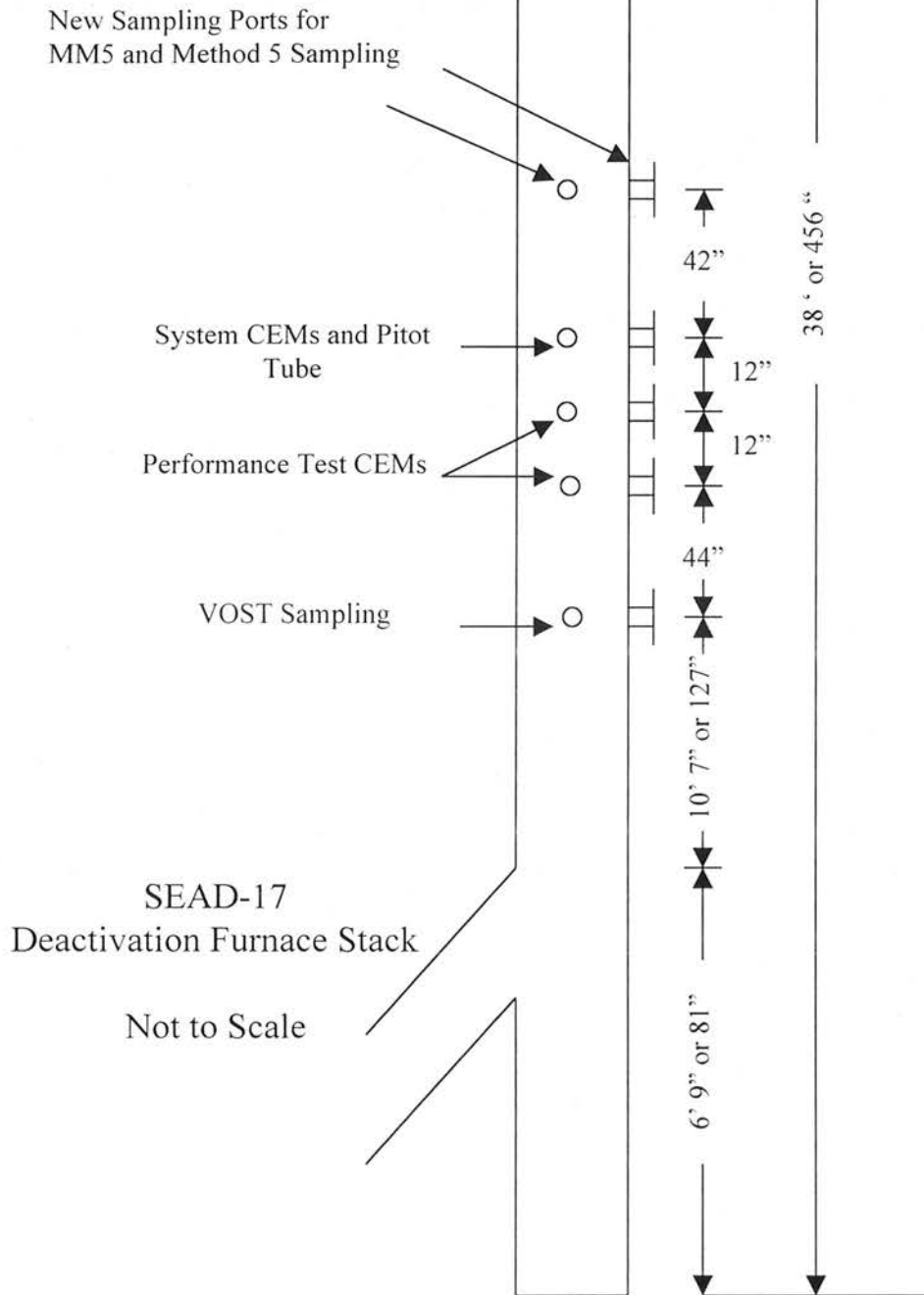
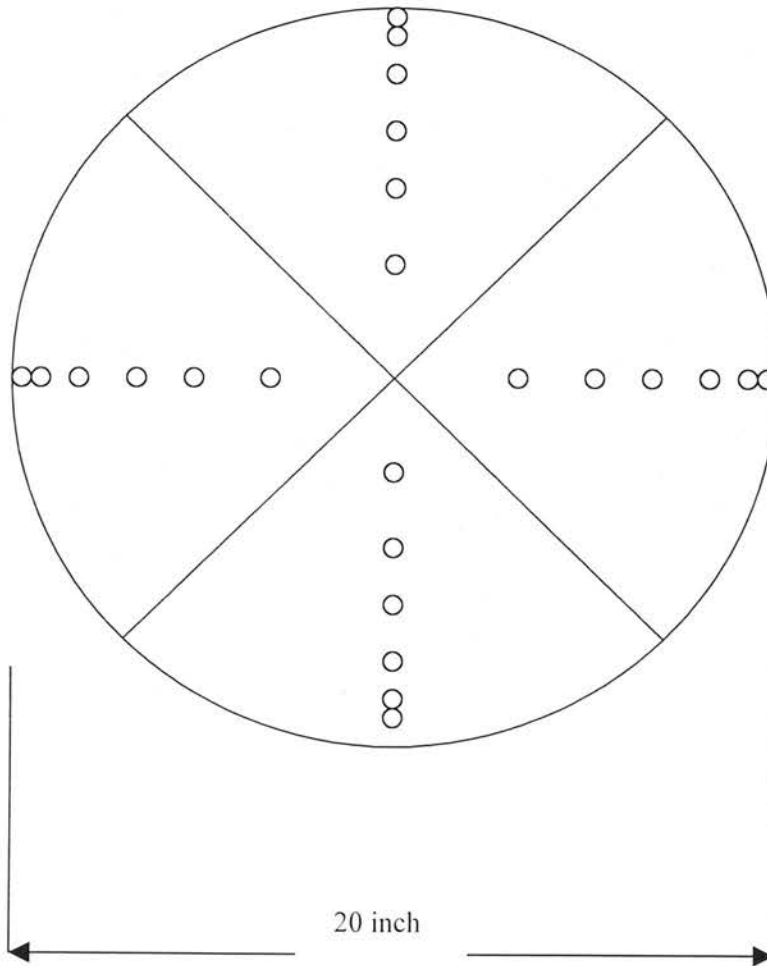


Figure 4-2 Traverse Points

Traverse Point	Percentage of Diameter	Calculated (1)	Repositioned
1	2.1	0.42	0.5
2	6.7	1.34	1.34
3	11.8	2.36	2.36
4	17.7	3.54	3.54
5	25	5	5
6	35.6	7.12	7.12
7	64.4	12.88	12.88
8	75	15	15
9	82.3	16.46	16.46
10	88.2	17.46	17.46
11	93.3	18.66	18.66
12	97.9	19.58	19.5

(1) Assumes inside diameter of 20 inches; actual measurement to be field verified.



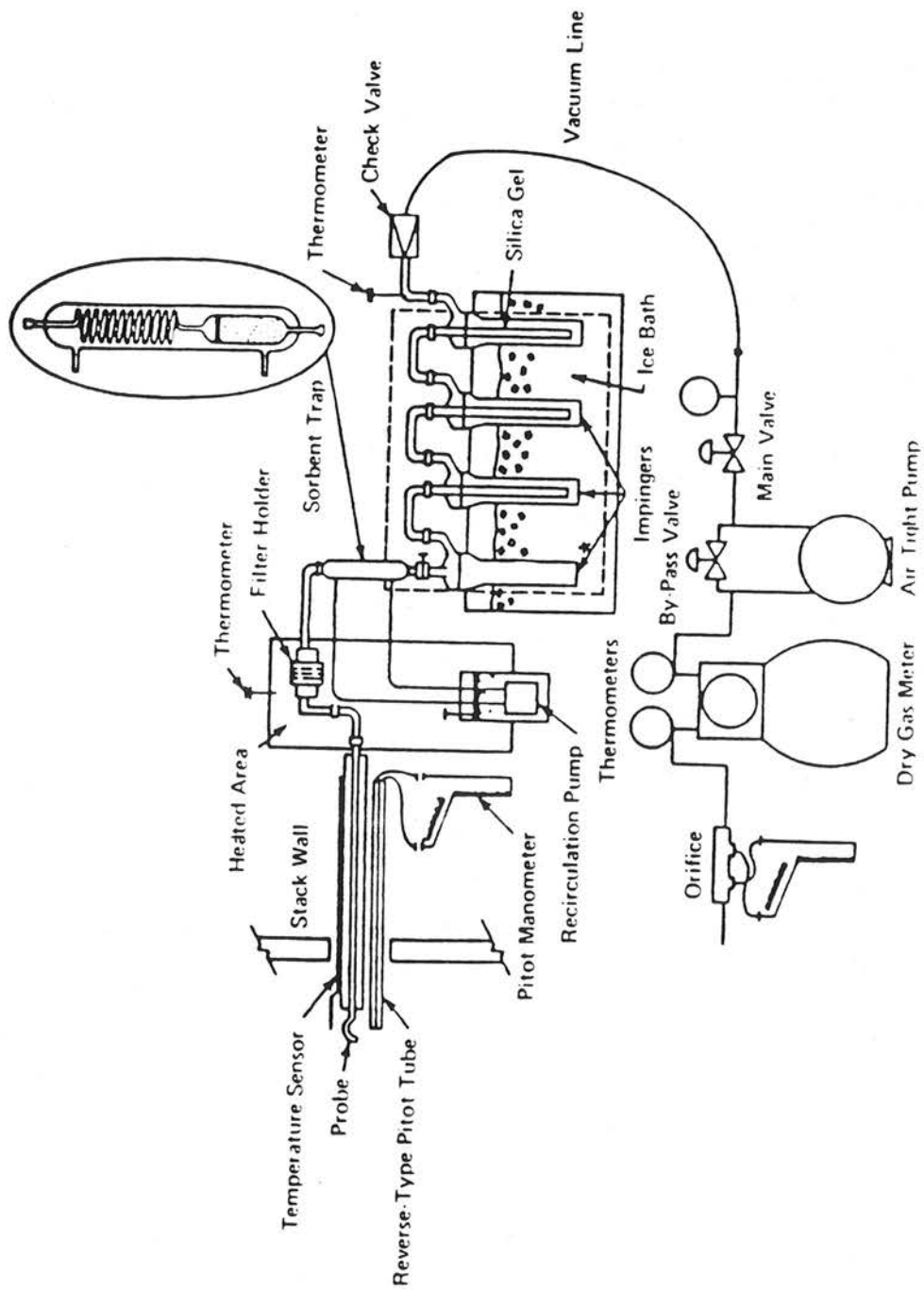


Figure 4-3: Typical Modified Method 5 (MM5) Train Set-up

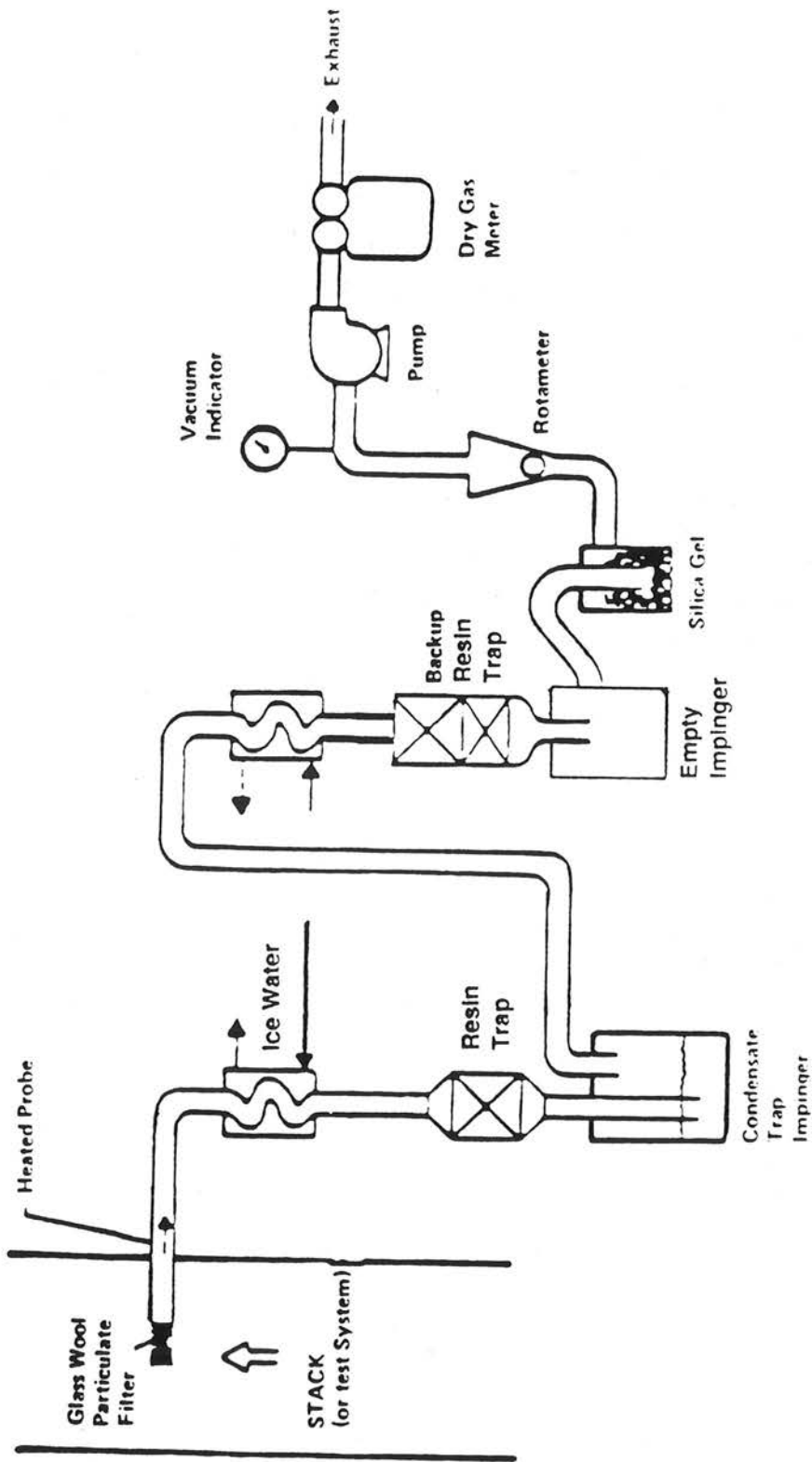


Figure 4-4: Typical Volatile Organic Sampling Train (VOST) Set-up

5 TREATMENT SYSTEM COSTS

5.1 LTTD TREATMENT COSTS

Remediation of contaminated soils from SEAD-59 may involve treatment using the LTTD process. For this reason, a cost estimate for remediation of SEAD-59 assuming LTTD treatment was developed. The cost was developed based on site data and the operational data presented in this report. Additionally, a cost for the LTTD treatment process alone was developed. The remediation costs for SEAD-59 are presented in **Table 5-1**. The complete cost analysis including assumptions is presented in **Appendix E**.

As shown in **Table 5-1**, the total cost for remediating soils contaminated with volatile and semivolatile organic compounds found in SEAD-59 using the LTTD process is \$5,640,000. A cost for the LTTD treatment process was also developed. The cost included purchase of additional soil handling equipment, labor (three operators), fuel for the treatment unit, controls and fees associated with the performance of a trial burn. Based on a treatment volume of 25,650 tons of soil and a LTTD treatment cost of \$2,773,000, the cost per ton for LTTD treatment is approximately \$108 per ton. Since the capital costs of purchasing processing equipment and the trial burn would be reduced as more soil is treated, the cost for treatment would reduce to approximately \$85 per ton by apportioning these costs over a longer period of time.

5.2 LANDFILL DISPOSAL COSTS

The alternative to treating organic compound contaminated soils with concentrations exceeding TAGMs is to dispose of them in a RCRA Subtitle D landfill. Therefore, landfill disposal costs were developed for comparison to the costs of treating the soils onsite using the LTTD process. The landfill disposal costs included tipping fees at a non-hazardous waste landfill, transportation costs and the costs of purchasing and placing clean fill in the excavations. All other costs are common between the LTTD soil treatment and landfilling alternative. The landfill disposal costs are estimated as follows:

<u>Item</u>	<u>Cost</u>
Transport and Disposal at Non-Hazardous Landfill	\$31.50/ton
Furnish and Install Common Backfill	<u>\$6.00/ton</u>
Total	\$37.50/ton

5.3 COMPARISON OF COSTS

The alternative to treating soils with concentrations exceeding TAGMs is to dispose of them in a RCRA Subtitle D landfill. Clearly, if the cost of treating and backfilling the treated soils exceeds the costs of disposal in a landfill with backfilling excavations with clean fill, LTTD treatment is not cost-effective. Therefore this comparison was performed.

Based on the unit rates presented and described above, the landfilling cost of approximately \$40/ton is significantly less expensive than LTTD treatment at between \$85 and \$108 per ton. LTTD treatment costs will only be competitive if fuel prices drop, landfill capacity is reduced or landfill disposal costs increase significantly.

Table 5-1
Summary of SEAD-59 Remediation Costs Using the LTTD Treatment Process
LTTD Treatability Study
Seneca Army Depot Activity

Remediation Task	Total Cost
Mobilization	\$5,290
Sampling and Testing	\$502,410
Site Work	\$244,120
Fencing	\$63,630
Wastewater Handling and Treatment	\$41,540
Soils Handling	\$1,116,520
Drum Removal and Disposal	\$222,850
Vegetative Cover (Area 1)	\$135,700
LTTD Process	\$2,773,710
Demobilization	\$37,040
Remedial Design	\$492,120
Well Installation	\$5,240
Total Remediation Cost	\$5,640,170

Notes:

See Appendix E for detailed cost-estimate and assumptions.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the results of the LTTD Treatability Study, the following conclusions can be made:

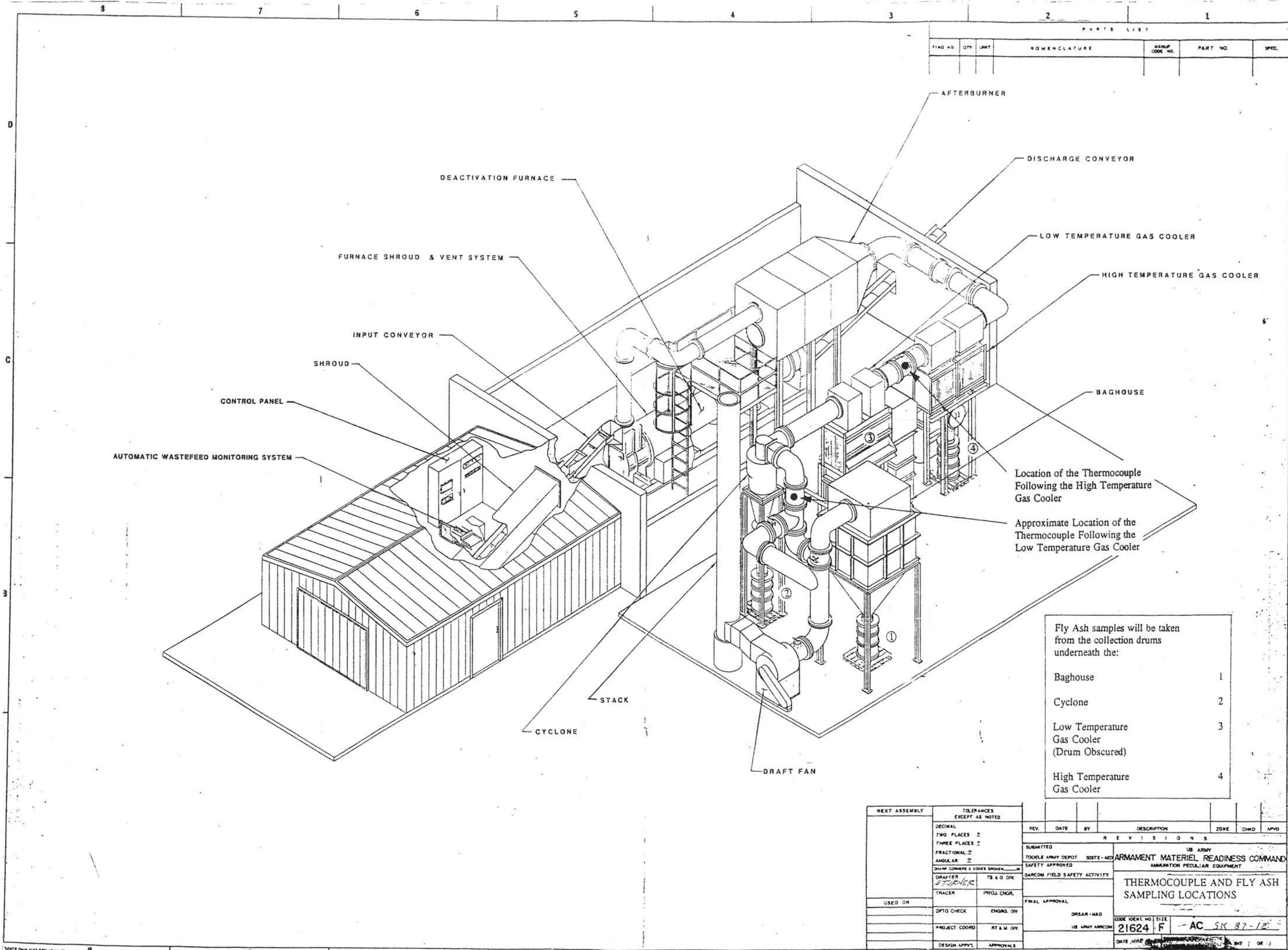
- The LTTD process was not entirely effective in reducing the PAH concentrations to levels below desired levels TAGMs.
- The LTTD process has no effect on metal constituent concentrations in the soils. The metal concentrations continue to exceed TAGMs following treatment, as expected.
- Fly ash will need to be disposed of in a RCRA Subtitle C or D landfill due to metals concentration far exceeding TAGMs.
- Limited stack gas sampling generally met the emissions criteria for dioxins/furans, total hydrocarbons and carbon monoxide. The results of VOST testing for VOCs were generally inconclusive.
- The treatment cost for the LTTD process is estimated at \$85 to \$108 per ton of soil treated, due mainly to the high fuel consumption. Landfilling of the soils without treatment is significantly less costly at approximately \$40 per ton.

6.2 RECOMMENDATIONS

Based on the results of the Treatability Study and the cost comparison, it is not recommended that the LTTD process be used for treatment of onsite soils. This recommendation is based mainly on the estimated high cost of the LTTD treatment process. Additionally, LTTD treated soils will still contain metals and probably some of the higher boiling PAHs at concentrations that would necessitate alternative remedial actions.

Appendix A

Large Process Flow and Instrumentation Diagrams



PARTS LIST						
FIG. NO.	QTY.	UNIT	NOMENCLATURE	MANUF. CODE NO.	PART NO.	SPEC.

Location of the Thermocouple Following the High Temperature Gas Cooler

Approximate Location of the Thermocouple Following the Low Temperature Gas Cooler

Fly Ash samples will be taken from the collection drums underneath the:	
Baghouse	1
Cyclone	2
Low Temperature Gas Cooler (Drum Obscured)	3
High Temperature Gas Cooler	4

REV.	DATE	BY	DESCRIPTION	ZONE	CHWD	APVD
SUBMITTED						
TOOLE ARMY DEPOT			US ARMY			
SAFETY APPROVED			ARMAMENT MATERIEL READINESS COMMAND			
DARCOM FIELD SAFETY ACTIVITY			AMMUNITION PECULIAR EQUIPMENT			
FINAL APPROVAL						
DRSAR-MAD			CODE IDENT NO SIZE			
US ARMY ARMCOM			21624 F -- AC SK 87-12			
DATE / /						

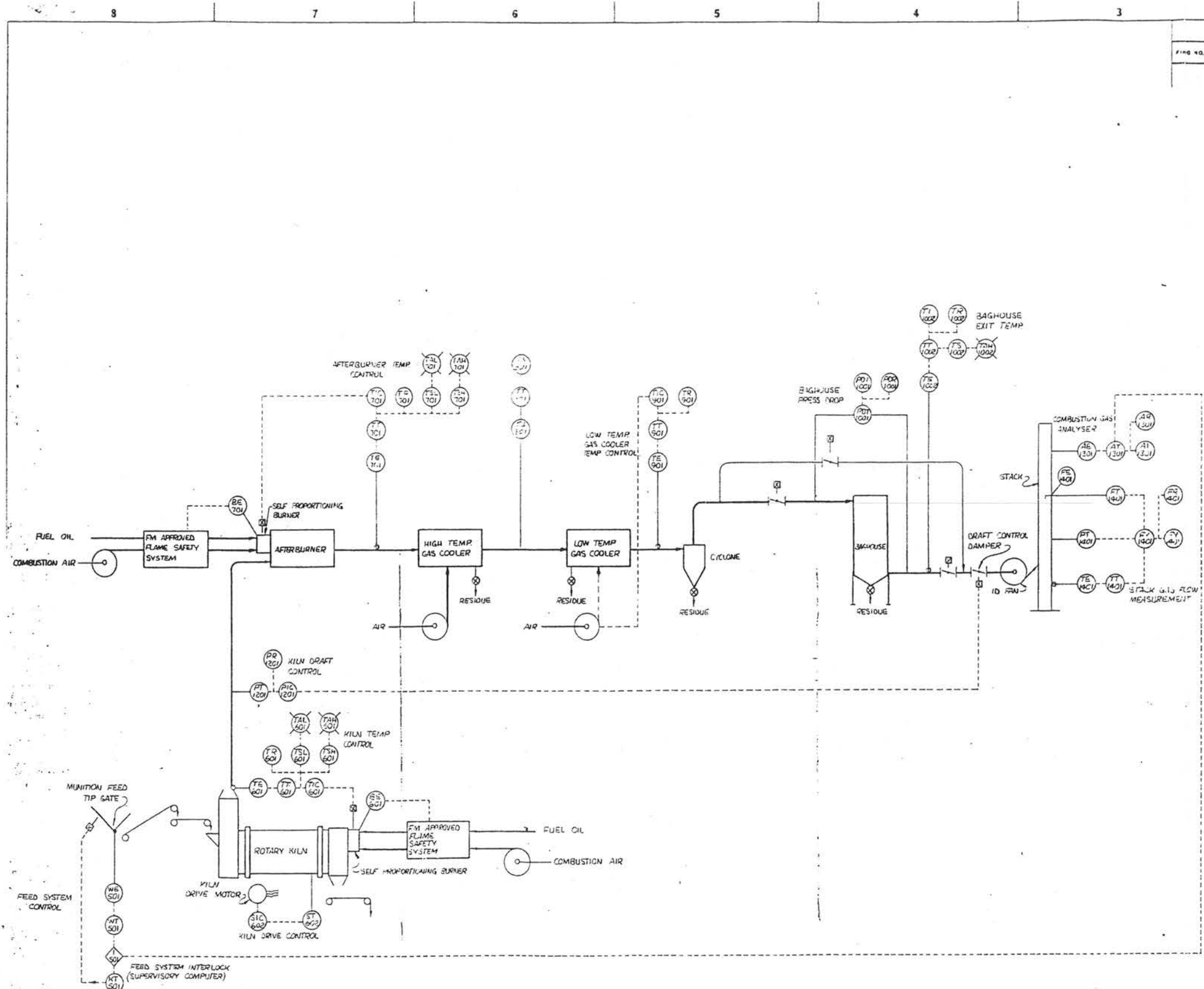
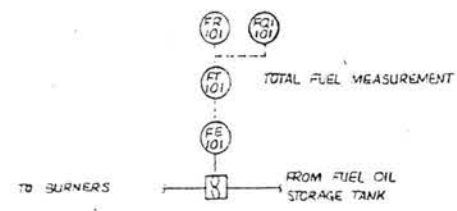


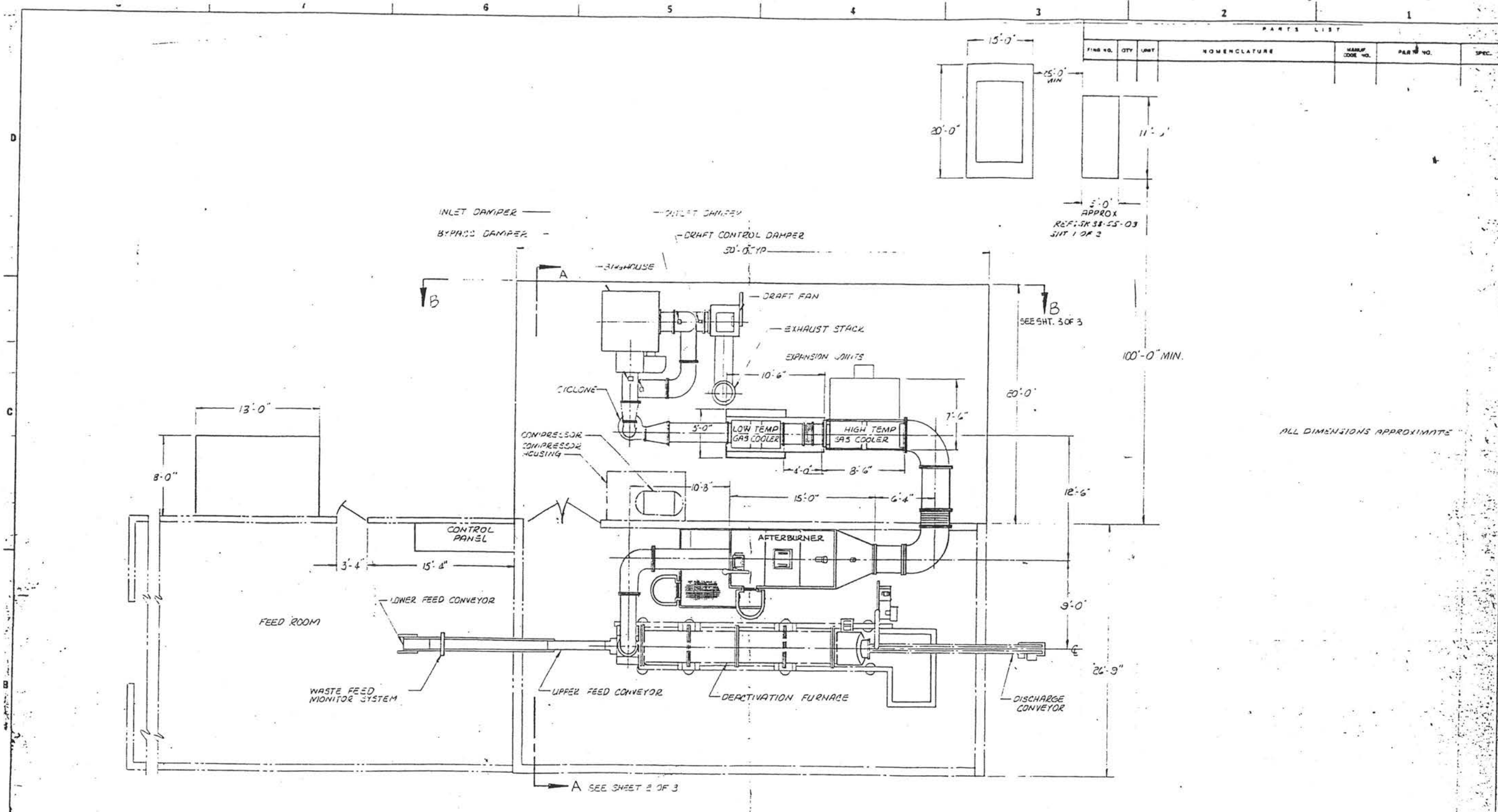
FIG NO.	QTY	UNIT	NOMENCLATURE	WARRANT CODE NO.	PART NO.	SPEC.
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LEGEND FOR INSTRUMENT SYMBOLS

FIRST LETTER	SECOND LETTER	THIRD LETTER
A	ANALYSIS	ALARM
B	BURNER FLAME	
C	CONDUCTIVITY	CONTROL
D	DENSITY	DIFFERENTIAL
E	VOLTAGE (EMF)	PRIMARY ELEMENT
F	FLOW RATE	RATIO (FRACTION)
G	GAGING	GLASS
H	HAND	HIGH
I	CURRENT	INDICATE
J	POWER	SCAN
K	TIME	
L	LEVEL	LIGHT (PILOT) LOW
M	MOISTURE	
O		ORIFICE
P	PRESSURE OR VACUUM	POINT
Q	QUANTITY OR EVENT	INTEGRATE OR TOTALIZE
R		RECORD OR PRINT
S	SPEED OR FREQUENCY	SAFETY SWITCH
T	TEMPERATURE	TRANSMIT
U	MULTIVARIABLE	MULTIFUNCTION MULTIFUNCTION
V	VISCOSITY	VALVE
W	WEIGHT OR FORCE	WELL
Y	USER'S CHOICE	RELAY OR COMPUTER
Z	POSITION	DRIVE



REV	DATE	BY	DESCRIPTION	ZONE	CHKD	APVD
TOLERANCES EXCEPT AS NOTED DECIMAL TWO PLACES ± THREE PLACES ± FRACTIONAL ± ANGULAR ±						
SUBMITTED TOOLE ARMY DEPOT - SOSTE-ACD SAFETY APPROVED			US ARMY ARMAMENT MATERIEL READINESS COMMAND AMMUNITION PECULIAR EQUIPMENT			
DRAFTED BY TRACER			FUNCTIONAL PROCESS CONTROL DIAGRAM APE 1236 UPGRADE			
USED ON DTG CHECK PROJECT COORD DESIGN APPL			FINAL APPROVAL DRSR - 440 US ARMY AMCOM CODE IDENT. NO. SIZE 21624 F DATE 21 MAY 88 SCALE: 1/8" = 1'-0" SHEET 11 OF 12			



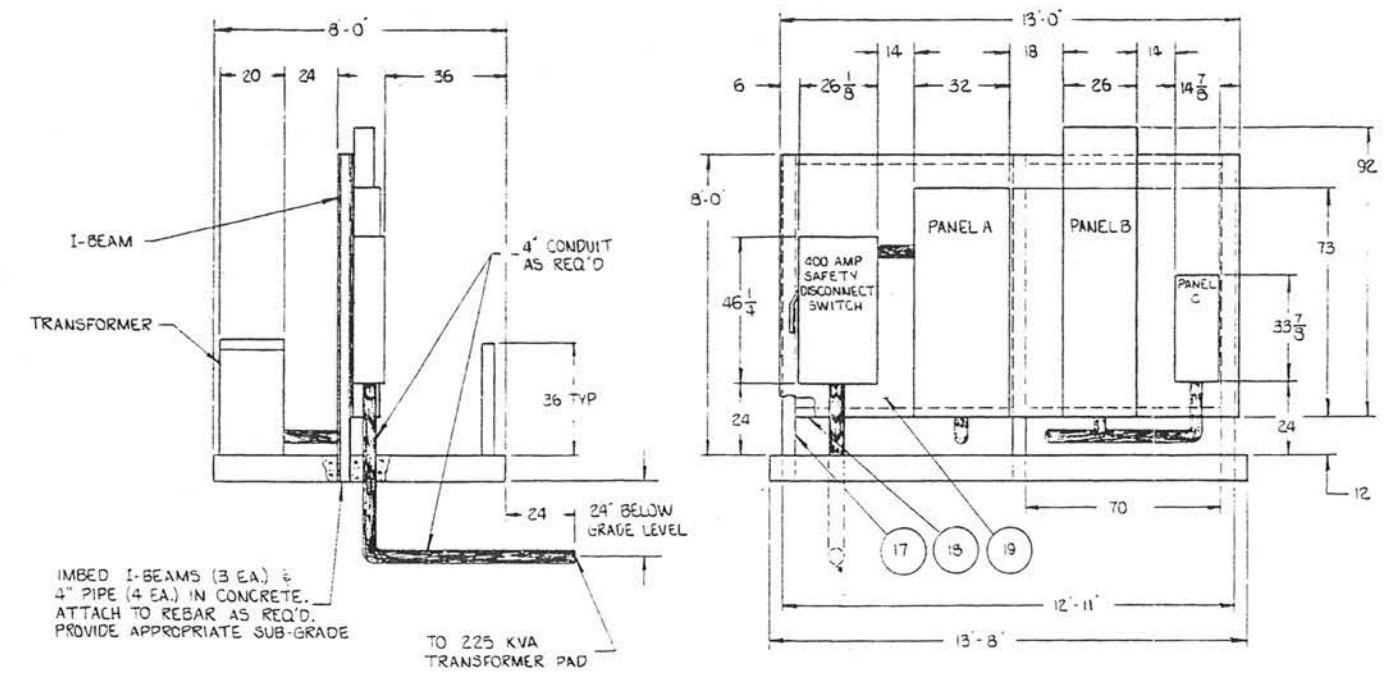
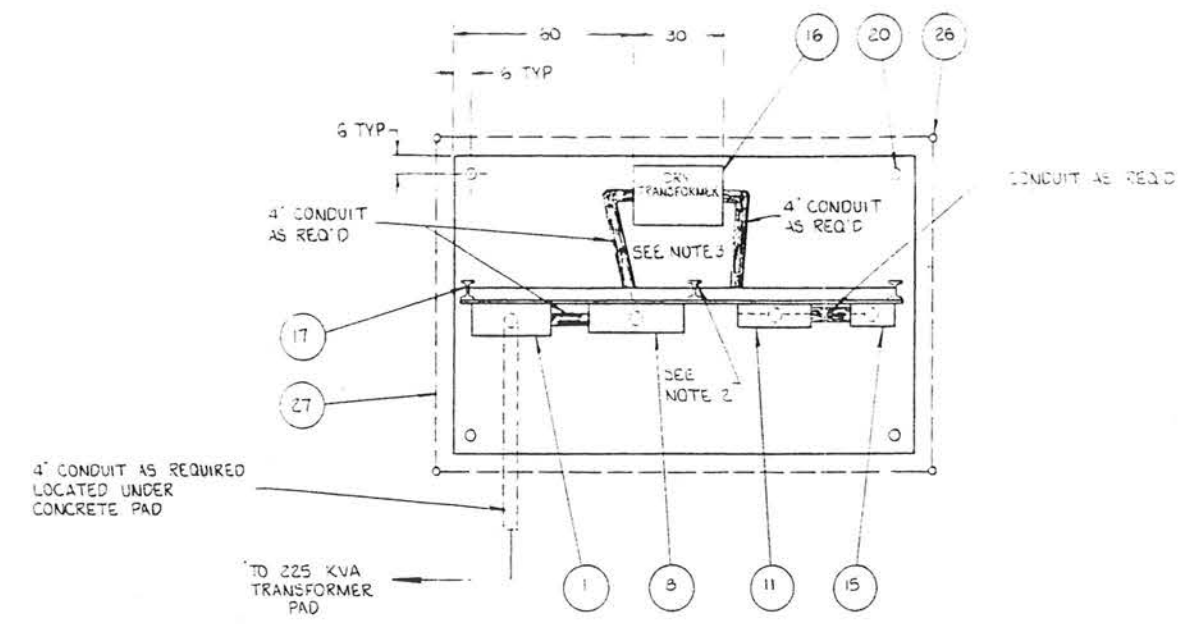
SITE LAYOUT

PARTS LIST					
FIG. NO.	QTY	UNIT	NOMENCLATURE	MANUF. CODE NO.	PART NO.

ALL DIMENSIONS APPROXIMATE

REV.	DATE	BY	DESCRIPTION	ZONE	CHKD	APVD
SUBMITTED TO: US ARMY TO: ARMY DEPOT (SISTE-AED) SAFETY APPROVED BY: DARCUM FIELD SAFETY ACTIVITY FINAL APPROVAL BY: DRSAR-MAG US ARMY ARMCOM DATE: 27 OCT 88						
NEXT ASSEMBLY DECIMAL ± TWO PLACES FRACTIONAL ± THREE PLACES ANGULAR ±			TOLERANCES EXCEPT AS NOTED			
USED ON DFTG CHECK PROJECT COORD DESIGN APPL			EXCEPT AS NOTED			
DRAFTER: R. SPEER TRACER:			TS & D DIV. PROJ. ENGR.			
CODE IDENT. NO.: 21624 F SCALE:			ARMAMENT MATERIEL READINESS COMMAND SENECA ARMY DEPOT FURNACE SITE LAYOUT AC SK-88-55-02 SHEET 1 OF 3			

FIG. NO.	QTY.	UNIT	NOMENCLATURE	MANUFACTURE CODE NO.	PART NUMBER



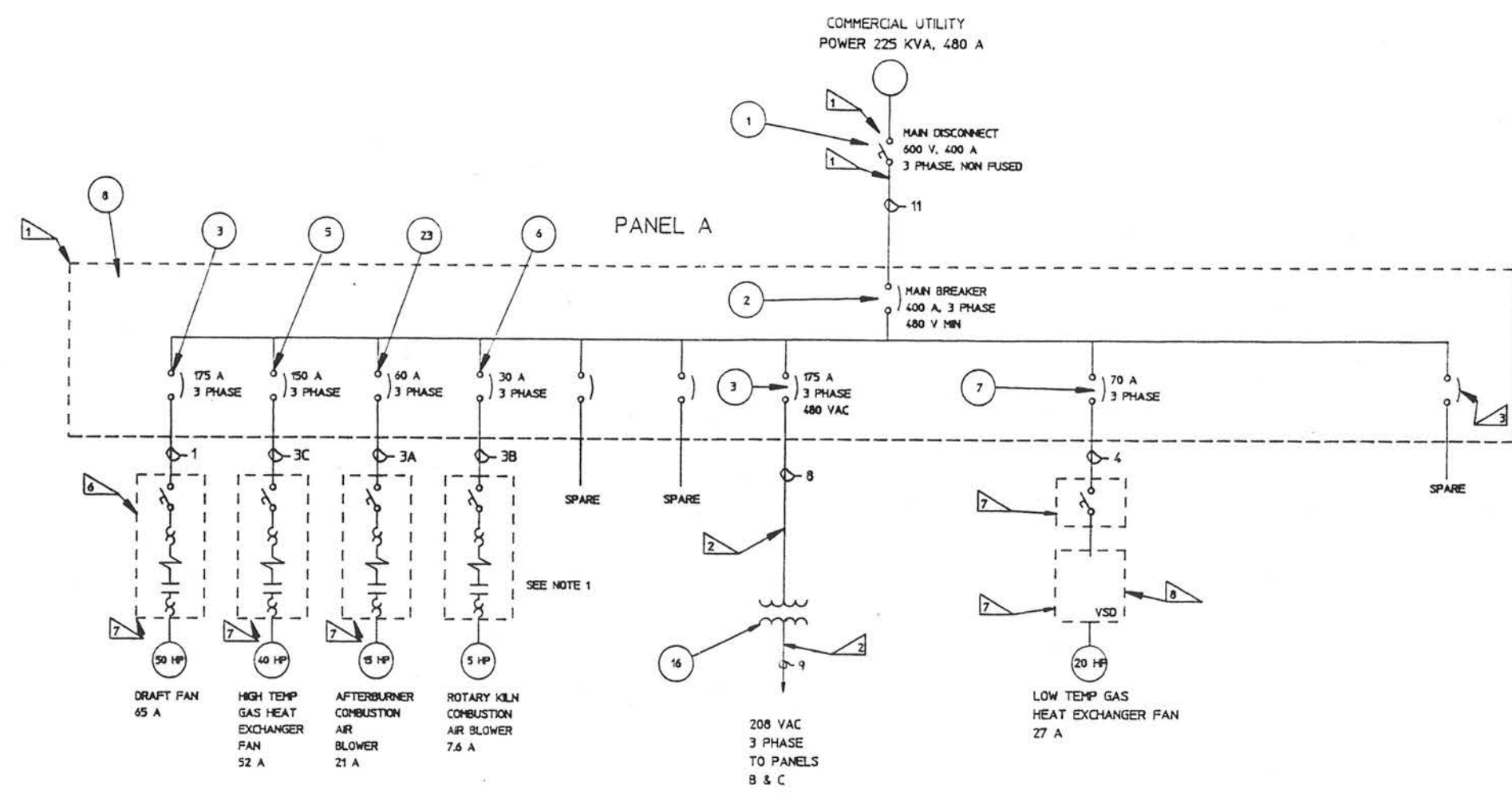
NOTES:

1. DIMENSIONS SHOWN FOR CIRCUIT BREAKER ENCLOSURES AND DRY TYPE TRANSFORMER ARE FOR GENERAL REFERENCE ONLY.
2. THE CONCRETE PAD AND STEEL SUPPORT STRUCTURE SHALL BE SIZED ACCORDING TO THE COMPONENTS CHOSEN.
3. MAY BE LOCATED UNDER THE CONCRETE PAD.

VIEW A-A

NEXT ASSEMBLY	TOLERANCES EXCEPT AS NOTED	2	5/1/89	TT	UPDATED CONFIGURATION			KDH
	DIGITAL	REV	DATE	BY	DESCRIPTION	ZONE	CHKD	APVD
	TWO PLACES ±	SUBMITTED						
	THREE PLACES ±	US ARMY						
	FRACTIONAL ±	TOOLE & ARMY DEPOT - 105TC-ASD						
	ANGULAR ±	ARMAMENT, MUNITIONS & CHEMICAL COMMAND						
	SHARP CORNERS & EDGES SHOWN	SAFETY APPROVED						
	DRAWN	DARCOM FIELD SAFETY ACTIVITY						
	DATE	FINAL APPROVAL						
	THICKEN	US ARMY AMCCOM						
USED ON	DFTS CHECK	APE 1236 UPGRADE						
	ENGRG. DIV	POWER DISTRIBUTION						
	PROJECT COORD	EQUIPMENT LOCATION & DETAILS						
	DESIGN APPL	SENECA ARMY DEPOT						
	APPROVALS	CODE IDENT. NO. SIZE						
		21624 F SK88-55-04						
		DATE 5/2/89 SCALE: 1/2" = 1'-0"						
		SHEET 3 OF 9						

PARTS LIST				
FIG. NO.	QTY	UNIT	NOMENCLATURE	PART NUMBER

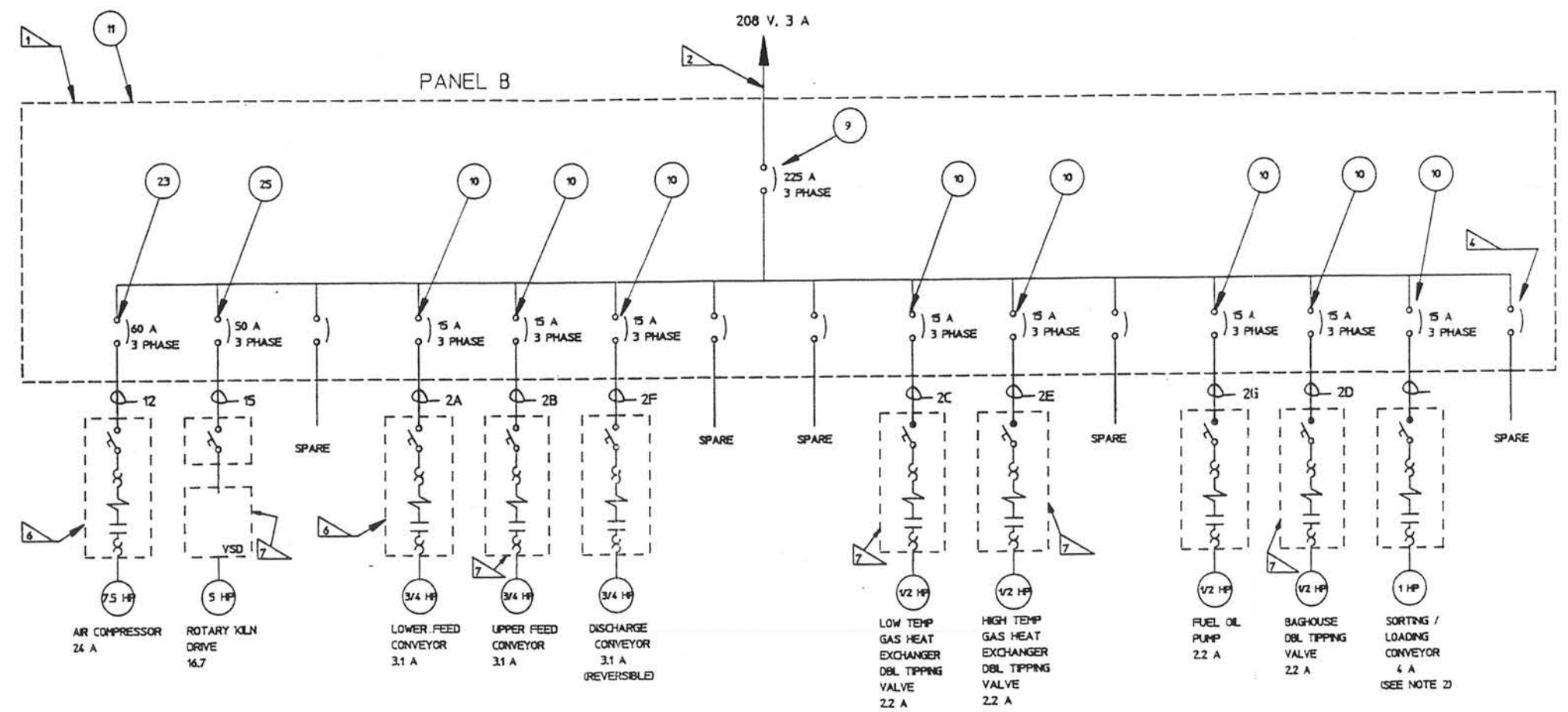


NOTE:

1. FOR FLAG NOTES SEE DRAWING NO. SK88-55-04 SHT. 1 OF 9.

REV	DATE	BY	DESCRIPTION	ZONE	CHKD	APVD
2	5/1/89	KDH	UPDATED CONFIGURATION	ALL		KDH
SUBMITTED BY: R VIGIL TITLE: ARMAMENT, MUNITIONS & CHEMICAL COMMAND SAFETY APPROVED BY: DARCOM FIELD SAFETY ACTIVITY FINAL APPROVAL BY: US ARMY AMCCOM						
PROJECT COORD: RT & M DIV DESIGN APPL: APPROVALS						
CODE IDENT. NO. SIZE: 21624 F SK88-55-04 DATE: _____ SCALE: _____ SHT 4 of 9						

FIG. NO.	QTY	UNIT	DESCRIPTION	MANUFACTURE CODE NO.	PART NUMBER



NOTE:

- FOR FLAG NOTES SEE DRAWING NO. SK88-55-04 SH. 1 OF 9.
- THIS IS AN EXISTING PIECE OF EQUIPMENT. RUN CONDUIT AND WIRE AS REQUIRED.

REV	DATE	BY	DESCRIPTION	ZONE	CHKD	APVD
2	5/1/89	KDH	UPDATED CONFIGURATION	ALL		KDH

DECIMAL TWO PLACES ± THREE PLACES ± FRACTIONAL ± ANGULAR ±	TOLERANCES EXCEPT AS NOTED
DRAWN BY: R. VIGEL TRACER: PROJ. ENGR. DFTG CHECK: ENGR. J.V. PROJECT COORD: RT & M DIV. DESIGN APPL: APPROVALS	SUBMITTED TO: TOOLS & ARMY DEPOT-1051C-A&E SAFETY APPROVED DARCOM FIELD SAFETY ACTIVITY FINAL APPROVAL U.S. ARMY AMCCOM
USED ON:	U.S. ARMY ARMAMENT, MUNITIONS & CHEMICAL COMMAND AMMUNITION PECULIAR EQUIPMENT APE 1236 UPGRADE POWER DISTRIBUTION 208V SINGLE LINE DIAGRAM SENECA ARMY DEPOT
CODE IDENT. NO.: 21624 SIZE: F	SK88-55-04 SCALE: EXCEPT AS NOTED SHEET: 5 OF 9

Appendix B

Continuous Emissions Monitoring Data

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 30-Aug-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5
Oxygen (%)	14.16	14.19	14.18	14.21	14.15
Carbon Dioxide (%)	5.12	5.12	5.13	5.18	5.22
Qs(std) dscfm					
Calculations					
HC as Propane (THC)					
ppm, dry	1.71	1.44	0.93	0.84	0.84
ppm @ 3% O ₂	4.54	3.84	2.47	2.24	2.23
lb/hr	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)					
ppm, dry	0.26	0.22	0.17	0.20	0.20
ppm @ 3% O ₂	0.70	0.60	0.46	0.54	0.54
lb/hr	0.00	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): 68
Oxygen Correction: 3

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 1-Sep-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5	RUN 6
Oxygen (%)	13.03	13.25	13.40	13.36	13.25	13.21
Carbon Dioxide (%)	6.22	5.76	5.67	5.71	5.84	5.75
Qs(std) dscfm						
Calculations						
HC as Propane (THC)						
ppm, dry	0.63	0.80	0.59	0.69	0.79	0.38
ppm @ 3% O ₂	1.11	1.46	1.10	1.28	1.43	0.69
lb/hr	0.00	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)						
ppm, dry	0.16	0.17	0.16	0.19	0.14	0.14
ppm @ 3% O ₂	0.29	0.31	0.30	0.36	0.26	0.26
lb/hr	0.00	0.00	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): $\frac{68}{7}$
 Oxygen Correction: $\frac{7}{7}$

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 21-Sep-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5
Oxygen (%)	13.25	12.87	12.65	12.51	12.54
Carbon Dioxide (%)	5.71	6.07	6.20	6.39	6.38
Qs(std) dscfm					
Calculations					
HC as Propane (THC)					
ppm, dry	0.87	0.52	0.57	0.45	0.24
ppm @ 3% O ₂	1.58	0.91	0.97	0.75	0.40
lb/hr	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)					
ppm, dry	0.90	0.13	0.03	0.04	0.01
ppm @ 3% O ₂	1.64	0.22	0.06	0.06	0.01
lb/hr	0.00	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): 68
 Oxygen Correction: 7

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 21-Sep-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5
Oxygen (%)	13.37	13.24	13.43	14.07	14.04
Carbon Dioxide (%)	5.87	5.87	5.83	5.24	5.27
Qs(std) dscfm					
Calculations					
HC as Propane (THC)					
ppm, dry	0.61	0.48	0.55	0.33	0.22
ppm @ 3% O ₂	1.12	0.86	1.02	0.67	0.45
lb/hr	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)					
ppm, dry	0.25	0.10	0.73	0.87	1.09
ppm @ 3% O ₂	0.47	0.18	1.36	1.76	2.21
lb/hr	0.00	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): 68
 Oxygen Correction: 7

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 22-Sep-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5
Oxygen (%)	13.65	13.53	13.27	13.19	13.17
Carbon Dioxide (%)	5.63	5.52	5.69	5.78	6.55
Qs(std) dscfm					
Calculations					
HC as Propane (THC)					
ppm, dry	0.08	0.45	0.46	0.39	0.54
ppm @ 3% O ₂	0.15	0.84	0.84	0.69	0.98
lb/hr	0.00	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)					
ppm, dry	0.33	0.28	0.20	0.21	0.36
ppm @ 3% O ₂	0.63	0.53	0.37	0.38	0.64
lb/hr	0.00	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): 68

Oxygen Correction: 7

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

**Emission Calculations
Gas Components**

**SENECA ARMY DEPOT
LTTD**

Date: 23-Sep-00

EMISSIONS DATA

Parameter	RUN 1	RUN 2	RUN 3	RUN 4
Oxygen (%)	13.71	13.60	13.33	13.75
Carbon Dioxide (%)	5.63	5.49	5.69	5.64
Qs(std) dscfm				
Calculations				
HC as Propane (THC)				
ppm, dry	0.08	0.44	0.46	0.03
ppm @ 3% O ₂	0.15	0.85	0.84	0.06
lb/hr	0.00	0.00	0.00	0.00
Carbon Monoxide (CO)				
ppm, dry	0.33	0.28	0.20	0.33
ppm @ 3% O ₂	0.64	0.53	0.37	0.65
lb/hr	0.00	0.00	0.00	0.00

Equations:

$$\text{lb/hr} = (1.3711 \cdot 6 \text{ lb-Mole } ^\circ\text{R} / \text{ft}^3) \times 60 \text{ min/hr} \times \text{Qs(std)} \times \text{MW} \times \text{ppm} / (\text{T(std)} + 460)$$

$$\text{ppm @ \%O}_2 \text{ Correction} = \text{ppm measured} \times ((20.9 - \text{O}_2 \text{ Correction}) / (20.9 - \% \text{O}_2 \text{ measured}))$$

Constants:

Standar Temp. T(std): 68
Oxygen Correction: 7

CO, MW = 28.010 lb/lb-mole

HC Propane, MW = 44.09 lb/lb-mole

Appendix C
Sample Calculations

Reference Method 1 - Cyclonic Flow Check Calculations

Nomenclature

- R = Average "yaw" angle, degree.
Y(i) = yaw angle measured at traverse point i, degree.
n = Total number of traverse points.

Calculate the average "yaw" angle found in the stack:

$$\bar{R} = \sum \frac{Y(i)}{n}$$

The measurement location is acceptable if $\bar{R} \leq 20^\circ$.

Reference Method 2 - Determination of Stack Gas Velocity

Nomenclature

- A Cross-sectional area of stack, m² (ft²)
B(ws) Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.
C(p) Pitot tube coefficient, dimensionless.
K(p) Pitot tube constant

$$34.97 \text{ (m /sec)} \left[\frac{(\text{g/g-mole})(\text{mm Hg})}{(^{\circ}\text{K})(\text{mm H}_2\text{O})} \right]^{\frac{1}{2}}$$

for the metric system and

$$85.49 \text{ (ft / sec)} \left[\frac{(\text{lb/lb-mole})(\text{in Hg})}{(^{\circ}\text{R})(\text{in. H}_2\text{O})} \right]^{\frac{1}{2}}$$

for the English system.

- M(d) Molecular weight of stack gas, dry basis (see section 3.6) g/g-mole (lb/lb-mole).
M(s) Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole)

$$= M(d) (1 - B(ws)) + 18.0 B(ws)$$

- P(bar) Barometric pressure at measurement site, mm Hg (in. Hg).
P(g) stack static pressure, mm Hg (in. Hg).
P(s) Absolute stack gas pressure, mm Hg (in. Hg) = P(bar)+ P(g)
P(std) Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Q(sd) Dry volumetric stack gas flow rate corrected to standard conditions, dcsm/hr (dscf/hr).
t(s) Stack temperature, °C (°F).
T(s) Absolute stack temperature, °K, (°R).

$$= 273 + t(s) \text{ for metric.}$$

$$= 460 + t(s) \text{ for English.}$$

- T(std) Standard absolute temperature, 293°K (528°R).
v(s) Average stack gas velocity, m/sec (ft/sec).
p Velocity head of stack gas, mm H₂O (in. H₂O).
3,600 Conversion factor, sec/hr.
18.0 Molecular weight of water, g/g-mole (lb/lb-mole).

Reference Method 2 - Determination of Stack Gas Velocity (continued)

Average Stack Gas Velocity.

$$\sqrt{T(s)_{avg}}$$

$$v(s) = K(p) * C(p) * (\Delta p_{avg}) * \frac{\text{-----}}{P(s) * M(s)}$$

Average Stack Gas Dry Volumetric Flow Rate.

$$Q(sd) = 3,600 (1 - B(ws)) * V(s) * A * \frac{[T(std)] * [P(s)]}{[T(s)_{avg}] [P(std)]}$$

To convert Q(sd) from dscm/hr (dscf/hr) to dscm/min (dscf/min), divide Q(sd) by 60.

Reference Method 4 – Moisture Content

Nomenclature

B(ws)	= Proportion of water vapor, by volume, in the gas stream.
M(w)	= Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).
P(m)	= Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).
P(std)	= Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
R	= Ideal gas constant, 0.06236 (mm Hg) (m ³)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft ³)/(lb-mole) (°R) for English units.
T(m)	= Absolute temperature at meter, °K (°R).
T(std)	= Standard absolute temperature, 293°K (528°R).
V(m)	= Dry gas volume measured by dry gas meter, dcm (dcf).
ΔV(m)	= Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).
V(m(std))	= Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
V(wc(std))	= Volume of water vapor condensed corrected to standard conditions, scm (scf).
V(wsg(std))	= Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).
V(f)	= Final volume of condenser water, ml.
V(i)	= Initial volume, if any, of condenser water, ml.
W(f)	= Final weight of silica gel or silica gel plus impinger, g.
W(i)	= Initial weight of silica gel or silica gel plus impinger, g.
Y	= Dry gas meter calibration factor.
ρ(w)	= Density of water, 0.9982 g/ml (0.002201 lb/ml).

Volume of Water Vapor Condensed

$$V(wc(std)) = \frac{(V(f) - V(i)) * \rho(w) * R * T(std)}{P(std) * M(w)} = K_{(1)} * (V(f) - V(i))$$

Where:

$$K_{(1)} = 0.001333 \text{ m}^3/\text{ml} \text{ for metric units} \\ = 0.04707 \text{ ft}^3/\text{ml} \text{ for English units}$$

Volume of Water Vapor Collected in Silica Gel.

$$V(wsg(std)) = \frac{(W(f) - W(i)) * R * T(std)}{P(std) * M(w)} = K_{(2)} * (W(f) - W(i))$$

Where:

$$K_{(2)} = 0.001335 \text{ m}^3/\text{g} \text{ for metric units} \\ = 0.04715 \text{ ft}^3/\text{g} \text{ for English units}$$

Reference Method 4 – Moisture Content (continued)

Sample Gas Volume

$$V(m(std)) = V(m) * Y * \frac{(P(m)) * (T(std))}{(P(std)) * (T(m))} = K_{(3)} * Y * \frac{V(m) * P(m)}{T(m)}$$

Where:

$$\begin{aligned} K_{(3)} &= 0.3858 \text{ } ^\circ\text{K/mm Hg for metric units} \\ &= 17.64 \text{ } ^\circ\text{R/in. Hg for English units} \end{aligned}$$

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of $V(m)$ per guidance in Method 5

Moisture Content

$$B(ws) = \frac{V(wc(std)) + V(wsg(std))}{V(wc(std)) + V(wsg(std)) + V(m(std))}$$

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of $B(ws)$, shall be considered correct.

Verification of Constant Sampling Rate. For each time increment, determine the $V(m)$. Calculate the average. If the value for any time increment differs from the average by more than 10 percent, reject the results and repeat the run.

Reference Method 5 – Determination of Particulate Emissions from Stationary Sources

Nomenclature

A(n)	Cross-sectional area of nozzle, m ² (ft ²).
B(ws)	Water vapor in the gas stream, proportion by volume.
C(a)	Acetone blank residue concentration, mg/mg.
C(s)	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
I	Percent of isokinetic sampling.
L(a)	Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.00057 m ³ /min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.
L(i)	Individual leakage rate observed during the leak check conducted prior to the "i[th]" component change (i = 1, 2, 3 ... n), m ³ /min (cfm).
L(p)	Leakage rate observed during the post-test leak check, m ³ /min (cfm).
m(a)	Mass of residue of acetone after evaporation, mg.
m(n)	Total amount of particulate matter collected, mg.
M(w)	Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).
P(bar)	Barometric pressure at the sampling site, mm Hg (in. Hg).
P(s)	Absolute stack gas pressure, mm Hg (in. Hg).
P(std)	Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
R	Ideal gas constant, 0.06236 mm Hg-m ³ /°K-g-mole (21.85 in. Hg-ft ³ /°R-lb-mole).
T(m)	Absolute average dry gas meter temperature, °K (°R).
T(s)	Absolute average stack gas temperature, °K (°R).
T(std)	Standard absolute temperature, 293°K (528°R).
V(a)	Volume of acetone blank, ml.
V(aw)	Volume of acetone used in wash, ml.
V(lc)	Total volume of liquid collected in impingers and silica gel, ml.
V(m)	Volume of gas sample as measured by dry gas meter, dcm (dscf).
V(m(std))	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
V(w(std))	Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
v(s)	Stack gas velocity, calculated by Method 2, using data obtained from Method 5, m/sec (ft/sec).
W(a)	Weight of residue in acetone wash, mg.
Y	Dry gas meter calibration factor.
ΔH	Average pressure differential across the orifice meter, mm H ₂ O (in. H ₂ O).
l(a)	Density of acetone, mg/ml (see label on bottle).
l(w)	Density of water, 0.9982 g/ml (0.002201 lb/ml).
φ	Total sampling time, min. - (1) = Sampling time interval, from the beginning of a run until the first component change, min. - (i) = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min. - (p) = Sampling time interval, from the final (n[th]) component change until the end of the sampling run, min.
13.6	Specific gravity of mercury.
60	Seconds / minute
100	Conversion to percent.

Reference Method 5 – Determination of Particulate Emissions from Stationary Sources
(continued)

Dry Gas Volume.

Correct the sample volume measured by the dry gas meter to standard conditions (20°C, 760 mm Hg or 68°F, 29.92 in. Hg) using:

$$V(m(std)) = \frac{V(m) * Y * \left[\frac{\Delta H}{T(m)} \right] * \left[\frac{P(bar) + (13.6)}{P(std)} \right]}{K(1) * V(m) * Y * \left[\frac{\Delta H}{T(m)} \right] * \left[\frac{P(bar) + (13.6)}{P(std)} \right]}$$

Where
 $K(1) = 0.3858 \text{ } ^\circ\text{K/mm Hg}$ for metric units
 $= 17.64 \text{ } ^\circ\text{R/in. Hg}$ for English units

NOTE: Equation can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds L(a). If L(p), or (i) exceeds L(a), Equation must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace V(m) in Equation with the expression:

$$V(m) - \{(L(p) - L(a)) * \phi\}$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace V(m) by the expression:

$$\left[V(m) - [(L(i) - L(a)) * \phi(1)] - \sum_{i=2}^n [(L(i) - L(a)) * \phi(i)] - [(L(p) - L(a)) * \phi(p)] \right]$$

and substitute only for those leakage rates (L(i), or L(p)) which exceed L(a).

Reference Method 5 – Determination of Particulate Emissions from Stationary Sources (continued)

Volume of Water Vapor

$$V(w(\text{std})) = \frac{V(lc) * \{ \rho(w) \} * \{ RT(\text{std}) \}}{(M(w)) * (P(\text{std}))} = K_{(2)} * V(lc)$$

Where:

$$\begin{aligned} K_{(2)} &= 0.001333 \text{ m}^3/\text{ml} \text{ for metric units} \\ &= 0.04707 \text{ ft}^3/\text{ml} \text{ for English units.} \end{aligned}$$

Moisture Content.

$$B(ws) = \frac{V(w)((\text{std}))}{V(m)((\text{std})) + V(w)((\text{std}))}$$

NOTE: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis, and a second from the assumption of saturated conditions. The lower of the two values of B(w) shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is $\pm 1^\circ\text{C}$ (2°F).

Acetone Blank Concentration

$$C(a) = \frac{M(a)}{V(a) * \rho(a)}$$

Acetone Wash Blank

$$W(a) = C(a) * V(aw) * \rho(a)$$

Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from Containers 1 and 2 less the acetone blank (see Figure 5-3).

Particulate Concentration.

$$c(s) = 0.001 \text{ g/mg} * \frac{m(n)}{V(m)(\text{std})}$$

Reference Method 5 – Determination of Particulate Emissions from Stationary Sources
(continued)

Conversion Factors:

From	To	Multiply by
Scf	m ³	0.02832
G	mg	0.001
g/ft ³	gr/ft ³	15.43
g/ft ³	lb/ft ³	2.205 x 10 ⁻³
g/ft ³	g/m ³	35.31

Isokinetic Variation.

Calculation From Raw Data.

$$I = \frac{100 * T(s) * \left[K_{(3)} * V(lc) + \frac{V(m) * Y}{T(m)} * P(bar) + \frac{\Delta H}{13.6} \right]}{60 * \phi * v(s) * P(s) * A(n)}$$

Where:

K₍₃₎ = 0.003454 mm Hg - m³/ml - °K for metric units.
= 0.002669-in. Hg - ft³/ml - °R for English units.

Calculation From Intermediate Values.

$$I = \frac{100 * T(s) * V(m(std)) * P(std)}{60 * T(std) * v(s) * \phi * A(n) * P(s) * (1 - B(ws))}$$

$$= \frac{K_4 * T(s) * V(m(std))}{P(s) * V(s) * A(n) * \phi * (1 - B(ws))}$$

where:

K₄ = 4.320 for metric units
= 0.09450 for English units.

6.12 Acceptable Results. If 90 percent ≤ I ≤ 110 percent, the results are acceptable. If the particulate results are low in comparison to the standard, and I is over 110 percent or less than 90 percent, the Administrator may accept the results.

Seneca Depot
LTTD EPA23

Date: 30-Aug-00
Run #: 1

FIELD DATA

Standard Pressure P(std)	29.92 "Hg	Area of the nozzle	0.000456 ft ²
Standard Temperature, T(std)	68 °F	Pitot Coefficient, Cp	0.84
Meter Temperature, Tm	120.30 °F	Stack I.D.	19.75 inches
Stack Temperature, Ts	197.90 °F	Duct Length	0.00 inches
SQ. RT. dP	0.5859	Duct Width	0.00 inches
Meter Orifice, dH	2.24 "H ₂ O	Test Time	360.0 min.
Meter Volume, Vm	287.41 ft ³	Nozzle Diameter	0.2890 inch
Meter Correction, Y	0.9920	Stack Gas O ₂	14.00 % O ₂
Barometric Pressure, Pbar	29.82 "Hg	Stack Gas CO ₂	5.00 % CO ₂
Static Pressure, Pstatic	0.08 "H ₂ O	Stack Gas CO	0.00 % CO
Condensate - Vlc	467.8 grams	Stack Gas N ₂	81.00 % N ₂
		Stack Area, As	2.127 ft ²

CALCULATIONS

$Vm(std) = [T(std) + 460 / Pstd] \times Vm \times y \times (Pbar + (dH / 13.6)) / (Tm + 460)$	259.98	dscf
$Vw(std) = (0.04715 \text{ ft}^3/\text{g}) / 528 \times [T(std) + 460] \times Vlc$	22.06	scf
$Bws = Vw(std) / [Vm(std) + Vw(std)]$	0.078	
$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (\%N_2 + \%CO)]$	29.36	lb/lb-mole
$Ms = (Md \times (1-Bws)) + (18.0 \times Bws)$	28.47	lb/lb-mole
$P(Stack) = Pbar + [Pstatic / 13.6]$	29.83	"Hg
$vs = 85.49 \times Cp \times (Sq.rt.dP) \times [Sq.rt.(Ts + 460) / (Ms \times P(stack))]$	37.03	ft/sec
$Qs = vs \times As \times 60$	4727.25	acfm
$Qs(std) = Qs \times (1-Bws) \times [(T(std) + 460) / (Ts + 460)] \times (P(stack) / Pstd)$	3486.16	dscfm
$I = 100 \times Ts [0.002669 \times Vlc + (Vm \times Y / Tm) (Pbar + dH / 13.6)] / (Test\ time \times vs \times Pstack \times An \times 60)$	96.74	%

Seneca Depot
LTTD EPA23

Date: 1-Sep-00
Run #: 2

FIELD DATA

Standard Pressure P(std)	29.92 "Hg	Area of the nozzle	0.000456 ft ²
Standard Temperature, T(std)	68 °F	Pitot Coefficient, Cp	0.84
Meter Temperature, Tm	109.30 °F	Stack I.D.	19.75 inches
Stack Temperature, Ts	197.50 °F	Duct Length	0.00 inches
SQ. RT. dP	0.5787	Duct Width	0.00 inches
Meter Orifice, dH	2.19 "H ₂ O	Test Time	360.0 min.
Meter Volume, Vm	273.401 ft ³	Nozzle Diameter	0.2890 inch
Meter Correction, Y	0.9920	Stack Gas O ₂	14.00 % O ₂
Barometric Pressure, Pbar	29.74 "Hg	Stack Gas CO ₂	5.00 % CO ₂
Static Pressure, Pstatic	0.07 "H ₂ O	Stack Gas CO	0.00 % CO
Condensate - Vlc	478.3 grams	Stack Gas N ₂	81.00 % N ₂
		Stack Area, As	2.127 ft ²

CALCULATIONS

$Vm(std) = [T(std) + 460 / Pstd] \times Vm \times y \times (Pbar + (dH / 13.6)) / (Tm + 460)$	251.38	dscf
$Vw(std) = (0.04715 \text{ ft}^3/\text{g}) / 528 \times [T(std) + 460] \times Vlc$	22.55	scf
$Bws = Vw(std) / [Vm(std) + Vw(std)]$	0.082	
$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (\%N_2 + \%CO)]$	29.36	lb/lb-mole
$Ms = (Md \times (1-Bws)) + (18.0 \times Bws)$	28.42	lb/lb-mole
$P(Stack) = Pbar + [Pstatic / 13.6]$	29.75	"Hg
$vs = 85.49 \times Cp \times (Sq.\text{rt.}dP) \times [Sq.\text{rt.}(Ts + 460) / (Ms \times P(stack))]$	36.65	ft/sec
$Qs = vs \times As \times 60$	4677.91	acfm
$Qs(std) = Qs \times (1-Bws) \times [(T(std) + 460) / (Ts + 460)] \times (P(stack) / Pstd)$	3427.15	dscfm
$I = 100 \times Ts [0.002669 \times Vlc + (Vm \times Y / Tm) (Pbar + dH / 13.6)] / (Test\ time \times vs \times Pstack \times An \times 60)$	95.15	%

PARSONS ENGINEERING SCIENCE, INC.

Company: SENECA ARMY DEPOT
 Test Location: LTD OUTLET STACK
 Test Method / Parameter: EPA-23 (DIOXIN)
 Stack Dimensions: 19.75
 Barometric Pressure: 29.74 "Hg
 Static Pressure: 0.07 "H₂O
 Pitot Coeff.: 0.84
 Filter #: BROWN 1
 Control Box #: 1.81 / 0.992
 Orifice dH@ / y: QTZ 16'
 Probe Type / Length: 1.0.289
 Nozzle # / Size: 1.0.289

Run #: RUN 2
 Date: 9-1-00
 Operator: W.S.

K-FACTOR: 0.538

IMPINGER CONTENTS, grams				GAS COMPOSITION				
Impinger	Contents	Final	Initial	Net	Time	O ₂	CO ₂	CO
1	D	857.1	587.8	269.3		14.0	5.0	
2	D1	774.1	632.9	141.2				
3	D4	520.9	415.8	5.1				
4	N/A							
5	N/A							
Silica Gel				952.2	889.5	62.7		
				TOTAL: 478.3				

LEAK RATE (cm³/lpm)
 Initial 0.010
 Final 0.014

Sample Point	Time	Gas Meter (ft ³ or liters)	dP "H ₂ O	dH "H ₂ O	Meter	Temperature, °F			Vacuum Hg	Rotameter (liters/min)	Comments	
						Stack	Probe	Oven				
1	0	170.130	0.32	2.09	100	193	250	228	50	9.0	N/A	START 0927
2	15	183.055	0.32	2.09	101	192	250	229	51	9.0		
3	30	195.105	0.33	2.16	103	193	250	230	52	9.0		
4	45	206.285	0.32	2.09	104	193	250	230	51	9.0		
5	60	217.140	0.33	2.16	103	191	250	231	52	9.0		
6	75	228.511	0.33	2.46	104	193	250	230	53	9.0		
7	90	239.90	0.34	2.22	105	195	250	231	53	9.0		
8	105	251.47	0.33	2.16	106	195	250	230	53	9.0		
9	120	262.704	0.34	2.22	107	198	250	231	53	9.0		
10	135	274.6	0.35	2.29	107	200	250	232	54	9.0		
11	150	285.3	0.34	2.22	110	201	250	230	55	9.0		
12	165	296.981	0.34	2.20	112	201	250	229	52	9.0		
13	180	308.437				PORT	CHANGE					

Company: US ARMY Run #: 1
 Test Location: SENECA ARMY DEPOT (Pint B/LN) Date: 8-30-00
 Test Method / Parameter: EPA-23 (Dioxin) Operator: WAS JD
 Stack Dimensions: 19.75" K-FACTOR: 7.0538
 Barometric Pressure: 29.82 "Hg
 Static Pressure: 0.08 "H₂O
 Pitot Coeff.: 0.84
 Filter #: BR0013
 Control Box #: BR0013
 Orifice dH@ / y: 1.81 / 0.992
 Probe Type / Length: Q1Z / 6'
 Nozzle # / Size: 10289 / 1.0289

PARSONS ENGINEERING SCIENCE, INC.

IMPINGER CONTENTS, grams				GAS COMPOSITION			
Impinger	Contents	Final	Initial	Net	Time	O ₂	CO
1	DIH ₂ O	843.7	628.9	214.8		14.0	5.0
2	DIH ₂ O	820.9	615.0	205.9			
3	EMPTY	545.9	541.9	4.0			
4	N/A						
5	N/A						
Silica Gel				705.0	721.9	43.1	
TOTAL:				467.8			

LEAK RATE (cfm) lpm "Hg Vacuum
 Initial 0.010 15
 Final 0.013 10"

Time	dH H ₂ O	dH H ₂ O	Water	Stack	Temp Probe	Oven	Impinger	Volume	Temp
1 0	882.110	0.33	106	189	250	221	52	7.0	N/A
2 15	893.950	0.33	108	190	250	220	51	7.0	
3 30	905.115	0.33	120	198	250	225	51	7.0	
4 45	916.850	0.32	124	197	250	222	51	7.0	
5 60	920.720	0.32	124	199	250	225	52	7.0	
6 75	940.680	0.34	127	198	250	226	51	7.0	
7 90	956.990	0.35	126	199	250	228	51	7.0	
8 105	964.255	0.35	124	200	250	225	50	7.0	
9 120	975.980	0.34	125	200	250	225	52	7.0	
10 135	987.960	0.35	126	200	250	226	53	7.0	
11 150	999.8	0.36	124	194	250	227	52	7.0	
12 165	1011.78	0.35	120	195	250	225	52	7.0	
180	1023.621								

Temp °F

1211 start 668
 622
 622
 578
 570
 601
 575
 630
 765
 572
 548
 533
 540

Appendix D
Operating Data Logs

LTTD OPERATING DATA

Company: SENECA ARMY DEPOT

Test Location: LTTD

Date: 9/1/2000

Time	Rotary Kiln	Afterburner	High Temp	Low Temp	Draft	Burner End	Fuel	Rotary	Outlet	
	Temp	Temp	Cooler	Cooler					Soil Temp	Barrels
	°F	°F	°F	°F	Fan	Temp	Usage	Kiln	°F	
					%	°F	Gals	RPM		
900	513	1572	678	244	32	1413	1903	1.1		1
930	489	1577	676	247	33	1398	1924	1.1		3
1000	441	1563	670	250	33	1466	1962	1.1		6
1030	441	1566	670	250	42	1454	1976	1.1		8
1100	449	1567	673	250	35	1421	2007	1.1		12
1130	474	1579	679	251	39	1381	2023	1.1		14
1200	426	1570	673	251	36	1409	2048	1.1		16
1230	438	1575	675	252	32	1364	2071	1.1		18
1300	494	1596	686	256	34	1387	2104	1.1		21
1330	428	1596	685	256	33	1435	2131	1.1		24
1400	430	1596	682	256	33	1425	2158	1.1		26
1430	433	1601	686	250	34	1414	2171	1.1		28
1500	451	1613	680	252	32	1383	2197	1.1		31
1530	429	1620	689	256	34	1437	2219	1.1		34

LTTD OPERATING DATA

Company: SENECA ARMY DEPOT

Test Location: LTTD

Date: 9/20/2000

Time	Rotary Kiln Temp	Afterburner Temp	High Temp Cooler	Low Temp Cooler	Draft Fan %	Burner End Temp °F	Fuel Usage Gals	Rotary Kiln RPM	Outlet Soil Temp °F	
	°F	°F	°F	°F					Barrels	Barrels
1130	373	1425	627	202	46	1178	2294	1.2		
1200	369	1463	640	205	48	1171	2324	1.2		
1230	455	1549	672	210	33	1183	2348	1.2		
1300	456	1551	674	210	32	1183	2372	1.2		
1330	457	1549	672	212	31	1285	2396	1.2		
1400	450	1590	679	215	31	1305	2420	1.2		
1430	444	1592	680	215	33	1311	2448	1.2		
1500	442	1595	682	219	33	1321	2468	1.2		
1530	440	1620	695	220	33	1345	2498	1.2		
1600	402	1639	697	223	33	1366	2540	1.2		
1630	408	1610	694	220	33	1365	2568	1.2		
1700	410	1604	696	222	33	1360	2599	1.2		
1730	325	1703	717	223	36	1491	2629	1.2		

LTTD OPERATING DATA

Company: SENECA ARMY DEPOT

Test Location: LTTD

Date: 9/21/2000

Time	Rotary Kiln Temp	Afterburner Temp	High Temp Cooler	Low Temp Cooler	Draft Fan	Burner End Temp	Fuel Usage	Rotary Kiln	Outlet Soil Temp	Barrels
	°F	°F	°F	°F	%	°F	Gals	RPM	°F	
1230	341	1490	644	192	34	1244	2694	1.5		
1300	274	1533	656	193	41	1333	2719	1.2		
1330	280	1601	660	200	33	1370	2743	1.5		
1400	320	1580	661	199	33	1420	2775	1.4		
1430	370	1575	664	200	34	1480	2799	1.4		
1500	368	1554	665	198	33	1534	2824	1.4		
1530	369	1550	660	201	38	1560	2848	1.4		
1600	375	1440	663	213	41	1484	2872	1.4		
1630	388	1447	664	212	41	1447	2896	1.4		
1700	379	1451	665	212	42	1450	2926	1.4		
1730	380	1451	665	211	41	1450	2951	1.4		
1800	385	1451	663	214	42	1451	2985	1.4		
1830	384	1465	670	213	42	1471	3022	1.4		

LTTD OPERATING DATA

Company: SENECA ARMY DEPOT

Date: 9/22/2000

Test Location: LTTD

Time	Rotary Kiln Temp	Afterburner Temp	High Temp Cooler	Low Temp Cooler	Draft Fan %	Burner End Temp °F	Fuel Usage Gals	Rotary Kiln RPM	Outlet Soil Temp °F		Barrels
	°F	°F	°F	°F					°F	°F	
1035	316	1436	664	213	35	1158	3082	1.5			
1100	332	1537	697	223	44	1226	3112	1.2			
1130	348	1550	699	220	44	1226	3137	1.5			
1200	409	1577	722	230	44	1256	3161	1.4			
1230	415	1573	716	228	44	1260	3192	1.4			
1300	407	1587	719	231	43	1291	3237	1.4			
1330	406	1585	710	231	43	1290	3261	1.4			
1400	399	1588	726	233	44	1294	3298	1.4			
1430	399	1585	728	230	44	1298	3329	1.4			
1500	372	1618	728	233	44	1370	3369	1.4			
1530	399	1616	729	232	45	1377	3394	1.4			
1600	341	1612	732	234	48	1377	3418	1.4			
1630	403	1593	721	233	44	1381	3442	1.4			

LTTD OPERATING DATA

Company: SENECA ARMY DEPOT
Test Location: LTTD

Date: 9/23/2000

Time	Rotary Kiln Temp °F	Afterburner Temp °F	High Temp Cooler °F	Low Temp Cooler °F	Draft Fan %	Burner End Temp °F	Fuel Usage Gals	Rotary Kiln RPM	Outlet Soil Temp °F	Barrels
0915	407	1478	675	209	41	1271	3507	1.5		
1015	342	1608	729	230	41	1368	3570	1.2		
1115	585	1599	723	216	52	1379	3630	1.5		
1215	449	1565	696	216	45	1368	3682	1.4		
1315	551	1600	726	227	46	1323	3750	1.4		
1350	530	1595	728	228	45	1337	3778	1.4		

Appendix E
Detailed Cost Estimate

APPENDIX E
SENECA ARMY DEPOT ACTIVITY
SEAD-59 SOIL REMEDIATION USING LTDD PROCESS
COST ESTIMATE
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Introduction

A detailed cost estimate was developed for remediation of SEAD-59 soils using the LTDD process. The cost estimate was developed using the site information for SEAD-59 contained in the *Decision Document for Removal Actions at SWMUs SEAD-59 and SEAD-71 Seneca Army Depot Activity*, April 2001. Quantities used were based on figures presented in Section 4. Costs were based on information from the Micro Computer Aided Cost Engineering System (MCACES, a component of the Tri-Service Automated Cost Engineering System, TRACES), Version 1.2 (copyright 1994-1997). Quotes from area suppliers, generic unit costs, vendor information, conventional cost estimating guides and prior experience were used to supplement this information. The cost estimates presented have been prepared for guidance in project evaluation. The actual costs of the project will depend on true labor and materials costs at the time of construction, actual site conditions, competitive market condition, final project scope, and other variables.

Construction costs include those expenditures required to implement the remedial action. Both direct and indirect costs are considered in the development of construction cost estimates. Direct costs include construction costs or expenditures for equipment, labor, and materials required to implement a remedial action. Indirect costs include those associated with engineering, construction management, and other services necessary to carry out a remedial action. O & M and monitoring costs, which include labor, maintenance materials, and purchased services, have also been estimated.

Assumptions

The following assumptions were used to develop the cost estimates:

- The contractor(s) will mobilize to the site, clear and grub the area of work, establish access roads and survey the areas to be remediated. It was estimated that 3 acres of land will require light clearing and grubbing. Clearing and grubbing is necessary to perform soil excavation.
- Erosion control (silt fence and haybales) will be installed around drainage swales, excavation areas, and stockpile areas. Erosion control is necessary to prevent soil particles from

migrating off-site and into drainage swales during construction. The erosion control will be maintained throughout construction.

- A temporary chain link fence will be constructed around the excavation areas. The fence will be removed following backfilling.
- A surveyor will be on site for approximately 10 days to layout the excavation areas and survey record information.
- In situ volumes of material are based on the areas and proposed excavation depths presented in Figures 4-1 of the SEAD-59 Decision Document. For estimating purposes, an expansion factor of 30 percent was used to estimate ex situ volumes for soil. An additional 10% was used to address the uncertainty of the volume estimation. A conversion factor of 1 cubic yard equals 1.5 tons of moist material was used for estimating purposes. The volume of material requiring excavation is estimated at 32,235 cy.
- It is assumed that approximately 20 55-gallon drums will be encountered during the excavation. The drums will be overpacked and sent to a hazardous waste landfill. Additionally, 3,800 tons of non-hazardous debris will be encountered during the excavation.
- Cleanup verification sampling of the excavations will be conducted at a frequency of one sample every 50 feet of excavation walls or floors. This frequency will be revised based on the actual cleanup verification work plan.
- The excavations will need to be dewatered prior to performing cleanup verification sampling. It is assumed that four 21,000 gallon steel tanks will be required to hold the water prior to sampling and treatment. An air stripper will be used to treat the soil. Approximately 15 water samples will be analyzed to confirm the effectiveness of treatment.
- Excavated soils will be placed in a stockpile area prior to treatment. The stockpile areas will be lined (and covered) with a 6-mil polyethylene liner. Each pile will consist of 150 cubic yards and will occupy a space of approximately 5000 square feet. Prior to treatment, one composite sample from each pile will be obtained and submitted for analysis.
- Depending on the results of the testing, the soil will either be processed by LTTD or transported and placed back in the excavation areas. It is assumed that 75 percent of the excavated soil will be treated due to the presence of PAHs and TPH.
- The LTTD treatment process will be completed by three operators. Maintenance of the equipment will be minimal. Fuel oil consumption of 12 gallons per ton was based on the treatability study.
- Additional costs for the LTTD process will include a screen, input and exit conveyors, continuous emissions monitoring equipment, controls, and a trial burn test. A wheeled front-end loader will be used to unload the piles from the conveyor for transport back to the excavation areas.
- The treated soils will be sampled and analyzed at a rate of one sample for every 150 cy of treated soils.

- The excavated soils and treated soil results will be compared to NYSDEC TAGM 4046 standards or background. Untreated or treated soils which meet the TAGMs will be backfilled. It is assumed that 15 percent of the soils will require retreatment to further decrease concentrations below TAGMs.
- Area 1 will be backfilled using treated soil which meets the TAGMs. All other areas will be backfilled with clean common fill. Six inches of topsoil will be placed to finalize the grade and establish vegetative growth.
- Confirmatory soil borings will be advanced in the vicinity of the excavated areas to show that soils above TAGMs are not present. One sample will be collected and analyzed from each of 60 borings. One sample per drum of boring cuttings will be sampled and analyzed.

Post-Closure Monitoring

- Site groundwater will be monitored on a semi-annual basis. Four new wells will be installed as necessary to ensure that the monitoring program is sufficient to detect any migration from the area.

Operations and Maintenance (O & M)

- It is assumed that long-term operations and maintenance will not be required.

Contingencies

The following markups were used to develop the cost estimate.

Contractor costs are calculated as a percentage of the running total as:

- 5% for field office support. Field office support includes items such as supervision at the job, site, temporary facilities, temporary material storage, temporary utilities, operation and maintenance of temporary job-site facilities, preparatory work, health and safety supplies and requirements, transportation vehicles, cleanup, and equipment costs not chargeable to a specific task.
- 15% for home office support. Home office support includes items such as management and office staff salary and expense, main office building furniture and equipment, utilities, general communications and travel, supplies, general business insurance, and taxes. It also includes job specific items such as engineering and shop drawings/surveys, insurance (project coverage), schedules & reports, and quality control.

- 10% for profit. Profit provides the contractor with an incentive to perform the work as efficiently as possible. The profit used in the cost estimates is based on the current average profit for contractors in the Syracuse area.
- 4% for bond. The bond rate is based on recommendations from the USACE Engineering Instructions – Construction Cost Estimates (September 1997) for hazardous, toxic and radioactive waste (HTRW) projects.

Owner's cost are calculated as a percentage of running total as:

- 10% for design contingency. Design contingencies include construction cost increases due to design incompleteness, detail changes, alternative design changes, and associated costing inaccuracy. The design contingency used is based on recommendations from the USACE Engineering Instructions – Construction Cost Estimates (September 1997) for remedial action projects.
- 3% for escalation. This item reflects the cost inflation beyond the effective pricing date of the baseline estimate. A rate of 3% per year is assumed.
- 25% for construction contingency. Construction contingencies are a reserve for construction cost increases due to adverse or unexpected conditions such as unforeseeable relocations, site conditions, utility lines in unknown locations, quantity overruns, or other unforeseen problems beyond interpretation at the time of or after contract award. The construction contingency used is based on recommendations from the USACE Engineering Instructions – Construction Cost Estimates (September 1997) for remedial action projects and on experience.
- 3.5% for other costs. Other government costs include the following: engineering during construction (EDC) (1.5%), as-builts (0.5%), operation and maintenance (O&M) manuals (0.5%), and government laboratory quality assurance (1.0%). These rates are based on recommendations from the USACE Engineering Instructions – Construction Cost Estimates (September 1997) for remedial action projects.
- 8% for construction management. These rates are based on recommendations from the USACE Engineering Instructions – Construction Cost Estimates (September 1997) for remedial action projects.

Thu 03 May 2001
Eff. Date 10/03/96

Tri-Service Automated Cost Engineering System (TRACES)
PROJECT LTDX_: SEAD-59 - EXCAVATION/LTTD/VEGETATIVE COVER
LTTD Cost Estimate

TIME 14:37:00

TITLE PAGE 1

SEAD-59
EXCAVATION/LTTD/VEGETATIVE COVER
OVER TREATED SOILS

Designed By: Parsons ES
Estimated By: Parsons ES

Prepared By: Parsons ES

Preparation Date: 12/12/00
Effective Date of Pricing: 10/03/96
Est Construction Time: 120 Days

Sales Tax: 7.0%

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Release 1.2

Currency in DOLLARS

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No Backup Reports...

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PROJECT BREAKDOWN:

The estimate is structured as follows and uses a 2 digit number at each level. The 2 digit numbers for the first 3 title levels are taken from the HTRW Remedial Action Work Breakdown Structure. The 2 digit numbers for the remaining title levels are user defined. The detail items are at LEVEL 6.

- LEVEL 1 - WBS Level 1 (Account)
- LEVEL 2 - WBS Level 2 (System)
- LEVEL 3 - WBS Level 3 (Subsystem)
- LEVEL 4 - User Defined (Assembly Category or Other)
- LEVEL 5 - User Defined (Assembly or Other)

PROJECT DESCRIPTION:

The following is a summary of the activities that are presently included in Alternative 2.

- LTTD: Excavate/Treat/Solid Waste Cover
- Mobilize, site prep, clear/grub, erosion control, and survey
 - Excavate soils from Areas 1, 2, 3, 4 and Others.
 - Treat water by air stripping.
 - Screen excavated soils to remove drums, paint cans, debris.
 - Drums to hazardous waste landfill and construction debris to solid waste landfill.
 - Install 40 soil borings in the area south of the road between Areas 2,3,4,Other to fill data gap by confirming that no contamination in these areas.
 - Transport soils with PAHS > TAGM to on-site LTTD and treat.
 - Backfill excavations south of road with clean fill.
 - Backfill Area 1 with treated soil.
 - Cover Area 1 with vegetative cover to protect the eco system.
 - Demobilize
 - Long term monitoring.

PRODUCTIVITY:

Productivity, as a baseline and as taken from the Unit Price Book

(UPB) Database, assumes a non-contaminated working environment with no level of protection productivity reduction factors. When required, productivity for appropriate activities will be adjusted for this project as follows:

1. Level of Protection A - Productivity ___%
2. Level of Protection B - Productivity ___%
3. Level of Protection C - Productivity ___%
4. Level of Protection D - Productivity 85%.

All activities are conducted in Level of Protection D.

The following daily time breakdown was assumed.

	Level A	Level B	Level C	Level D
Available Time (minutes)	480	480	480	480
Non-Productive Time (minutes):				
Safety meetings	20	20	10	10
Suit-up/off	60	60	40	10
Air tank change	160	20	0	0
*Breaks	60	60	40	30
Cleanup/decontamination	20	20	20	20
<hr/>				
Productive Time (minutes)	160	300	370	410
Productivity:	160/480	300/480	370/480	410/480
	X100%	X100%	X100%	X100%
	33%	63%	77%	85%

Example:

Normal Production Rate (CY/HR)	250	250	250	250
X Productivity	.33	.63	.77	.85
=Reduced Production Rate(CY/HR)	83	158	193	213
* Break time ranges (minutes)	60-140	60-140	40-140	30-70

The following list are the areas where there is the biggest potential for changes in cost due to uncertainties:

-
- Quantities of soil over TAGMs could increase based on the results of the confirmatory sampling done in the excavation.
 - The quantities of soil requiring disposal as hazardous waste could increase based on the results of the confirmatory sampling done in the soil piles.

Contractor costs are calculated as a percentage of running total as

- 5 % for field office support
- 15 % for home office support
- 10 % for profit
- 4 % for bond

Owner's cost are calculated as a percentage of running total as

- 2 % for design contingency
- 3 % for escalation
- 25 % for construction contingency
- 3.5 % for other costs
- 8 % for construction management

OTHER GOVERNMENT COSTS:

Other Government Costs consist of:

*Engineering and Design During Construction (EDC)	1.5%
As-Builts	0.5%
Operation and Maintenance (O&M) Manuals	0.5%
Laboratory Quality Assurance	1.0%

Total, use	3.5%

33.01. Mobilization	QUANTITY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST
33. Remedial Action									
33.01. Mobilization									
USR AA Mobilization	1.00	EA	0	793	2,500	535	0	3,828	3827.72
33.02. Sampling, & Testing									
33.02.06. Groundwater									
Groundwater from holding tanks									
HTW AA For Disposal: NYSDEC CLP TCL VOCs, volatile organics, groundwater (Severn Trent Lab 9/98) (Assume 1 sample for each tank)	15.00	EA	0	0	0	0	2,625	2,625	175.00
AFH AA For Disposal: NYSDEC CLP TAL SVOCs modified, groundwater, (Severn Trent Lab, 9/98) (Assume 1 sample per tank)	15.00	EA	0	0	0	0	5,550	5,550	370.00
AFH AA For Disposal: NYSDEC TAL - Inorganics, groundwater (Severn Trent Lab, 9/98) (Assume 1 sample per tank)	15.00	EA	0	0	0	0	2,325	2,325	155.00
33.02.11. Soil									
Areas 2,3,4,Other for Treatment. Assume 1 sample every 150 cy + 20 OC = 23,025 cy x 1.40/150 x 1.20 = 260									
HTW AA For Treatment: Volatile organics, soil (Severn Trent	260.00	EA	0	0	0	0	31,200	31,200	120.00
AFH AA For Treatment: SVOCs, soil (Severn Trent Lab, 9/99) (Assume 1 sample every 150cy)	260.00	EA	0	0	0	0	59,800	59,800	230.00
AFH AA For Treatment: TAL Metals (Assume 1 sample every 150cy)	260.00	EA	0	0	0	0	31,200	31,200	120.00
33.02.16. Confirmatory-Soil									
Areas 1,2,3,4,Other									
HTW AA Confirmatory: NYSDEC CLP, volatile organics, soil (Severn Trent Lab, 9/99) (Assume 1 sample every 50 ft of wall adn floor or excavation.	156.00	EA	0	0	0	0	27,300	27,300	175.00
AFH AA Confirmatory: NYSDEC CLP-SVOCs , soil (Severn Trent Lab, 9/99) (Assume 1 sample every 50 ft of wall and floor of excavation.	156.00	EA	0	0	0	0	57,720	57,720	370.00
AFH AA Confirmatory: NYSDEC CLP TAL - Metals, soil (Severn Trent	156.00	EA	0	0	0	0	24,180	24,180	155.00

33.02. Sampling, & Testing	QUANTY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST

33.02.17. Post LTTD Treatment									
HTW AA	TCLP, volatile organics (SW-846 Methods 1311&8240), soil (Severn Trent Lab, 9/99) (Assume 1 sample every 150cy)	140.00	EA	0	0	0	16,800	16,800	120.00
AFH AA	TCLP-SVOCs (SW-846 Methods 1311 & 8270A), soil (Severn Trent Lab, 9/99) (Assume 1 sample every 150cy)	140.00	EA	0	0	0	32,200	32,200	230.00
AFH AA	TCLP - Metals (SW-846 Methods 1311 & 6010 & 7470), soil (Severn Trent Lab, 9/99) (Assume 1 sample every 150cy)	140.00	EA	0	0	0	16,800	16,800	120.00
33.02.18. Soil Boring Grid South of Road from soil boring south of road to confirm no contamination between Areas 2,3,4, Others									
HTW AA	Confirmatory: NYSDEC CLP, volatile organics, soil (Severn Trent Lab, 9/99) (Assume 1 sample per boring)	60.00	EA	0	0	0	10,500	10,500	175.00
AFH AA	Confirmatory: NYSDEC CLP-SVOCs, soil (Severn Trent Lab, 9/99) (Assume 1 sample per boring)	60.00	EA	0	0	0	22,200	22,200	370.00
AFH AA	Confirmatory: NYSDEC CLP TAL - Metals, soil (Severn Trent, 9/99) (Assume 1 sample per boring)	60.00	EA	0	0	0	9,300	9,300	155.00
33.02.20. IDW from Soil Borings									
HTW AA	IDW: NYSDEC CLP, volatile organics, soil (Severn Trent Lab, 9/99) (Assume 1 sample per drum.)	20.00	EA	0	0	0	3,500	3,500	175.00
AFH AA	IDW: NYSDEC CLP-SVOCs, soil (Severn Trent Lab, 9/99) (Assume 1 sample per drum.)	20.00	EA	0	0	0	7,400	7,400	370.00
AFH AA	IDW: NYSDEC CLP TAL - Metals, soil (Severn Trent - assume one sample per drum)	20.00	EA	0	0	0	3,100	3,100	155.00
33.03. Site Work									
33.03.02. Clearing and Grubbing									
AF AA	Clearing, brush w/dozer & brush rake, light brush	3.00	ACR	48	1,298	1,887	0	3,185	1061.54

33.03. Site Work	QUANTY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST
33.03.08. Survey Remediation Area									
Survey remediation area									
USR AA Survey remediation area	10.00	DAY	0	15,000	2,500	2,675	0	20,175	2017.50
33.03.11. Erosion control									
B MIL AA Silt Fence: Installation and materials high, polypropylene	16000	LF	3,360	80,000	8,000	25,680	0	113,680	7.11
B HTW AA Hay bales - stalked	16000	LF	5	2,720	0	17,120	0	19,840	1.24
B MIL AA Maintain silt fence and remove	16000	LF	107	2,720	0	17,120	0	19,840	1.24
33.04. Fencing									
MIL AA Site dml, chain link fence, remove & salvage for reuse	2000.00	LF	103	2,600	0	0	0	2,600	1.30
MIL AA Fence, CL scty, std FE-6, 6' high, no gates/signs	2000.00	LF	96	2,820	0	39,847	0	42,667	21.33
MIL AA Fence, CL, set in conc, 6' H, indl, corner post, galv stl, 4" OD	4.00	EA	2	55	9	295	0	358	89.48
MIL AA Fence, CL, double, 24' W, indl, gates, swing, 6' high	1.00	EA	0	0	0	435	0	435	435.38
33.05. Wastewater									
33.05. 1. Wastewater									
L MIL AA Pump, cntfgl, 6" D, horiz mtd, horiz spltd, sgl stg, 1500GPM, 50HP	1.00	EA	0	0	0	10,767	0	10,767	10766.88
M HTW AA 21,000 Gal, Steel, hold tank stationary	4.00	EA	0	0	0	5,264	0	5,264	1316.10
33.07. Air Stripping									
HTW AA HTRW, PTTU, 1' dia, 14.5' pkng hgt, 30GPM, 850CFM, FRP shell	1.00	EA	97	3,257	0	7,009	0	10,265	10265.47
AFH AA HTRW, PTTU, >= 12' high, install air strip tower, 1'- 3' diam.	1.00	EA	91	3,035	226	0	0	3,261	3261.05
HTW AA HTRW, PT opt, air flow switch (loss of air flow - motor failure)	1.00	EA	0	0	0	512	0	512	511.81
33.10. Soil Remediation									
33.10.02. Sitework - Soils									
Excavating Areas 1,2,3,4,Other. (23,025 cy insitu)									
Volumes are increased by 30% for expansion and 10% for contingency. For weight calculations, the volume is increased by 10% only.									
All fill, topsoil, and seeding items for soil remediation are included in the Sitework - Soils category.									
USR AA Excavate, screen, and stockpile Soil	32235	CY	0	0	0	0	644,700	644,700	20.00
USR AA Plastic sheeting for ground: 6mil polyethylene liner (1000sf)	537250	SF	0	0	0	45,989	0	45,989	0.09

33.10. Soil Remediation	QUANTY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST

USR AA Cover stockpiles w/ plastic sheeting: Plastic sheeting: 6mil polyethylene liner (1000sf / roll; 1 roll = \$75)	537250	SF	0	0	0	45,989	0	45,989	0.09
MIL AA Loam or topsoil, furnish & place, imported, 6" deep	700.00	CY	62	1,869	973	13,654	0	16,496	23.57
USR AA Common fill (6") - Material for Backfill, includes cost of material (bank sand) and delivery (DeWitt 1999)	6425.00	TON	0	0	0	29,905	0	29,905	4.65
AF AA Fill, spread borrow w/dozer	5445.00	CY	65	1,960	3,539	0	0	5,499	1.01
AF AA Compaction, steel wheel tandem roller, 5 ton	5445.00	CY	39	1,143	980	0	0	2,124	0.39
CIV AA Hauling, off hwy haulers, 85 CY, 1 mile RT @ 20 mph (4.2 cyc/hr) to haul to LTTD	22230	CY	80	2,001	14,227	0	0	16,228	0.73
RSM AA Seeding, athletic field mix, 8#/MSFpush spreader	19.10	MSF	19	483	0	850	0	1,333	69.79
33.10.04. Drum Removal									
Approx. 20 drums in Area 1									
L MIL AA Excavator for drum removal at Level B	20.00	EA	2	323	445	0	0	768	38.40
L MIL AA Excavator for drum moving at Level B	20.00	EA	2	323	445	0	0	768	38.40
L MIL AA Level B breathing unit, suit, overboots, gloves	4.00	EA	0	0	2,000	0	0	2,000	500.00
33.10.06. Disposal: hazardous									
Disposal and transport of drums to hazardous waste landfill; disposal of debris to solid waste landfill.									
HTW AA HW packaging, overpacks, 18"dia x 34"H, 16ga stl drum, 55gal, DOT 17C	20.00	EA	0	0	0	1,583	0	1,583	79.13
USR AA Drums/Paint Cans: Transportation of Drums by dedicated van	1.00	EA	0	0	0	0	546	546	545.70
USR AA Drums/Paint Cans: Disposal of Drums (Price quoted by Waste	20.00	EA	0	0	0	2,862	0	2,862	143.11
USR AA Extra fees for overpack use	20.00	EA	0	0	0	0	800	800	40.00
USR AA Debris: Transport and Dispose nonhaz waste, bulk solid,	3800.00	TON	0	0	0	0	152,000	152,000	40.00
33.10.10. Vegetative Cover at Area 1									
MIL AA Loam or topsoil, furnish & place, imported, 6" deep	2835.00	CY	250	7,569	3,941	55,300	0	66,810	23.57
RSM AA Seeding, athletic field mix, 8#/MSFpush spreader	63.90	MSF	64	1,615	0	2,844	0	4,460	69.79
AF AA Fill, spread borrow w/dozer, to backfill stabilized soils	26700	CY	320	9,612	17,355	0	0	26,967	1.01

33.10. Soil Remediation	QUANTY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST

33.10.15. LTTD									
Treatment of soils with PAHs > TAGM									
25,650 tons of soils from Areas 1,2,3,4,Other									
Assuming that 10% is debris/drums by weight									
Assuming that 75% remaining soil will require treatment because of PAHs									
Assuming LTTD processes 5 tons soil/hour									
Assuming that 15% of soil has to be retreated to reduce PAHs below TAGMs.									
Assuming that 20% of the time that operators are on stand by.									
L MIL AA	Three operators to run LTTD; unit price is for 3 operators @ \$40/hr each	21238	HR	0	849,520	0	0	849,520	40.00
USR AA	Fuel oil, 12 gal. per ton of soil with 5 tons of soil/ hr	424760	GAL	0	0	731,734	0	731,734	1.72
B AF AA	Screen, conveyors, CEM equipmen t and controls	1.00	EA	0	0	275,000	0	275,000	275000.00
HTW AA	HTRW, incin,w/analysis, rotary kiln,trial burn,TSCA/RCRA,3-4hr min	1.00	EA	0	0	0	132,333	132,333	132333.33
MIL AA	Excavate & load, wheeled loader 1.5 CY, medium matl	22230	CY	418	12,671	6,669	0	19,340	0.87
33.18. Confirmatory Soil Borings									
B CIV AA	Mob/Demob facility	2.00	EA	0	0	0	800	800	400.00
L AFH AA	Decon Pad	1.00	EA	0	0	0	150	150	150.00
L AFH AA	Decon Time	40.00	HR	0	0	0	6,000	6,000	150.00
M HTW AA	HW packaging, DOT steel drums, 55 gal,	15.00	EA	0	0	0	750	750	50.00
L AFH AA	Move drums	15.00	EA	0	0	0	375	375	25.00
L MIL AA	Borings, auger holes in earth, no samples, 4" dia	280.00	LF	0	0	0	3,920	3,920	14.00
L HTW AA	Split spoon sampling OD	16.00	LF	0	0	0	192	192	12.00
L AFH AA	Standby Time	4.00	HR	0	0	0	600	600	150.00
L AFH AA	Grout Boreholes	280.00	LF	0	0	0	1,680	1,680	6.00
33.26. Demobilization									
TOTAL	Decontaminate Equipment	1.00	EA	0	1,321	5,000	2,500	8,821	8821.20
TOTAL	Demobilization	1.00	EA	0	528	2,500	500	3,528	3528.48
33.28. Remedial Design									
B HTW AA	Remedial Design Workplan	1.00	EA	0	27,600	0	2,568	30,168	30168.00
B HTW AA	Preliminary Design Report	1.00	EA	0	46,000	0	4,280	50,280	50280.00
B HTW AA	Pre-final/Final Design Report, Including O&M Plan, S&A Plan, QA Plan, Contingency Plan, Waste	1.00	EA	0	168,000	0	7,490	175,490	175490.00

33.28. Remedial Design	QUANTY	UOM	MANHOUR	LABOR	EQUIPMNT	MATERIAL	SUBCONTR	TOTAL COST	UNIT COST
B HTW AA Remedial Action Workplan, including QA/QC Plan, H&S Plan	1.00	EA	0	47,500	0	2,675	0	50,175	50175.00
B HTW AA Project Closeout Plan	1.00	EA	0	48,000	0	2,140	0	50,140	50140.00
33.30. Well Installation									
B CIV AA Mob/Demob facility	1.00	EA	0	0	0	0	600	600	600.00
L AFH AA Decon Pad	1.00	EA	0	0	0	0	150	150	150.00
B HTW AA Installation of Monitoring well threaded	4.00	EA	0	0	0	0	2,320	2,320	580.00
L HTW AA Monitor well, drilling, HS auger, 4.25" ID x 8" OD	40.00	LF	0	0	0	0	720	720	18.00
TOTAL SEAD-59				5,230	1,342,337	348,195	1,080,121	1,312,336	4,082,990

** PROJECT OWNER SUMMARY - SUBSYSTEM (Rounded to 10's) **

	QUANTY UOM	CONTRACT	DES CONT	ESCALATN	CON CONT	OTHER	CON MGMT	TOTAL COST	UNIT COST
33 Remedial Action									
33.01 Mobilization	1.00 EA	5,290	110	160	1,390	240	570	7,760	7761.84
TOTAL Mobilization	1.00 EA	5,290	110	160	1,390	240	570	7,760	7761.84
33.02 Sampling, & Testing									
33.02.06 Groundwater	1.00 EA	14,500	290	440	3,810	670	1,580	21,290	21291.88
33.02.11 Soil	1.00 EA	168,800	3,380	5,170	44,340	7,760	18,360	247,800	247796.91
33.02.16 Confirmatory-Soil	1.00 EA	150,850	3,020	4,620	39,620	6,930	16,400	221,440	221435.54
33.02.17 Post LTTD Treatme	1.00 EA	90,890	1,820	2,780	23,870	4,180	9,880	133,430	133429.10
33.02.18 Soil Boring Grid	1.00 EA	58,020	1,160	1,780	15,240	2,670	6,310	85,170	85167.51
33.02.20 IDW from Soil Bor	1.00 EA	19,340	390	590	5,080	890	2,100	28,390	28389.17
TOTAL Sampling, & Testi	1.00 EA	502,410	10,050	15,370	131,960	23,090	54,630	737,510	737510.11
33.03 Site Work									
33.03.02 Clearing and Grub	3.00 ACR	4,400	90	130	1,160	200	480	6,460	2152.58
33.03.08 Survey Remediatio	1.00 ACR	27,870	560	850	7,320	1,280	3,030	40,910	40910.82
33.03.11 Erosion control	1.00 LF	211,850	4,240	6,480	55,640	9,740	23,040	310,980	310983.09
TOTAL Site Work	1.00 EA	244,120	4,880	7,470	64,120	11,220	26,540	358,350	358351.66
33.04 Fencing	1.00 EA	63,630	1,270	1,950	16,710	2,920	6,920	93,400	93400.60
33.05 Wastewater									
33.05. 1 Wastewater	1.00 EA	22,150	440	680	5,820	1,020	2,410	32,510	32508.19
TOTAL Wastewater	1.00 EA	22,150	440	680	5,820	1,020	2,410	32,510	32508.19
33.07 Air Stripping	1.00 EA	19,390	390	590	5,090	890	2,110	28,470	28466.90
33.10 Soil Remediation									
33.10.02 Sitework - Soils	1.00 EA	1,116,520	22,330	34,170	293,250	51,320	121,410	1,638,990	1638993.16
33.10.04 Drum Removal	1.00 EA	4,880	100	150	1,280	220	530	7,170	7170.29
33.10.06 Disposal: hazardo	1.00 EA	217,970	4,360	6,670	57,250	10,020	23,700	319,970	319967.21
33.10.10 Vegetative Cover	1.00 EA	135,700	2,710	4,150	35,640	6,240	14,760	199,200	199203.98
33.10.15 LTTD	1.00 EA	2,773,710	55,470	84,880	728,520	127,490	301,610	4,071,670	4071671.22
TOTAL Soil Remediation	1.00 EA	4,248,780	84,980	130,010	1,115,940	195,290	462,000	6,237,010	6237005.86
33.18 Confirmatory Soil Bo	1.00 EA	19,980	400	610	5,250	920	2,170	29,340	29336.15
33.26 Demobilization									

Thu 03 May 2001
 Eff. Date 10/03/96

Tri-Service Automated Cost Engineering System (TRACES)
 PROJECT LTDX_: SEAD-59 - EXCAVATION/LTTD/VEGETATIVE COVER
 LTTD Cost Estimate
 ** PROJECT OWNER SUMMARY - SUBSYSTEM (Rounded to 10's) **

TIME 14:37:00
 SUMMARY PAGE 2

		QUANTITY UOM	CONTRACT	DES CONT	ESCALATN	CON CONT	OTHER	CON MGMT	TOTAL COST	UNIT COST
33.26.04	Decontaminate Equ	1.00 EA	12,190	240	370	3,200	560	1,330	17,890	17887.61
33.26.06	Demobilization	1.00 EA	4,870	100	150	1,280	220	530	7,160	7155.04
TOTAL Demobilization		1.00 EA	17,060	340	520	4,480	780	1,860	25,040	25042.66
33.28	Remedial Design	1.00 EA	492,120	9,840	15,060	129,260	22,620	53,510	722,410	722409.10
33.30	Well Installation	1.00 EA	5,240	80	160	1,370	240	570	7,650	7646.83
TOTAL Remedial Action		1.00 EA	5,640,160	112,780	172,590	1,481,380	259,240	613,290	8,279,440	8279439.91