U.S. ARMY ENGINEER DIVISION
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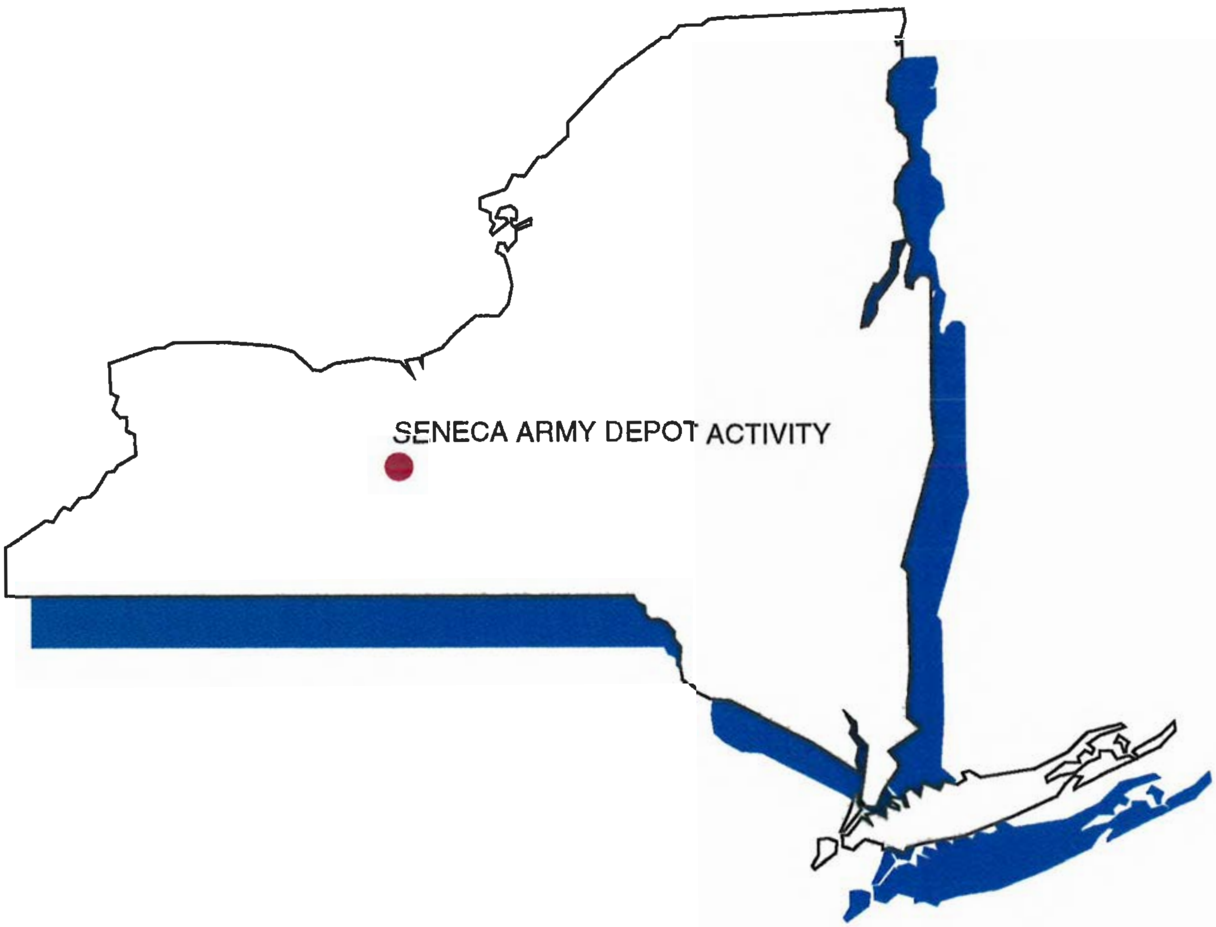

PROCESS EVALUATION OF DEACTIVATION FURNACE

DECEMBER 1995

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OF
DEACTIVATION FURNACE

(Final)

SENECA ARMY DEPOT ACTIVITY
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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

Parsons Engineering Science (Parsons ES) has been retained by the Army Corps of Engineers, Huntsville Division (CEHND), under contract DACA87-92-D-0022, Delivery Order 0037, to provide a process evaluation of the Ammunition Peculiar Equipment (APE) 1236 deactivation furnace and Air Pollution Control Devices (APCD) at Seneca Army Depot Activity (SEDA). The objective of the task is to evaluate the existing system and provide recommendations to meet the requirements of the "New Draft Strategy for the Combustion of Hazardous Waste", issued by the Environmental Protection Agency (EPA) in May 1993. An additional objective of this report is to review and identify all additional permits required for startup. This also includes obtaining all necessary forms for operation of the deactivation furnace and support application data required for submittal of these applications.

Information for the evaluation was obtained from various sources including SEDA, the Department of the Army (DOA) deactivation furnace technical staff at the Tooele Army Depot (TEAD), Lake City Army Ammunition Plant (LCAAP) and Red River Army Depot (RRAD).

1.2 SUMMARY OF FINDINGS AND RECOMMENDATIONS

This section summarizes the results of the SEDA process evaluation. It is focused in two areas, one is the changes required to meet the particulate emission values of the New Draft Strategy and the other is the ability of the existing afterburner to meet the regulatory required Destruction and Removal Efficiency (DRE).

The existing Nomex fabric filter system can meet the current particulate emission standard of 0.08 grains per dry standard cubic foot (dr/dscf) at 7% excess oxygen but will not meet the proposed particulate emission limits of 0.015 gr/dscf at 7% excess oxygen. Replacement of the existing Nomex fabric filters with Goretex Teflon B fabric filter and installation of new support cages is recommended as the most cost effective option.

Published data and trial burn test results at TEAD indicates difficulties in meeting destruction and removal efficiencies for the deactivation system currently in place at SEDA. Prior to implementation of the trial burn, Parsons ES recommends performance of a miniburn pre-test to optimize operational parameters in the afterburner in order to assure sufficient Principle Organic Hazardous Constituent (POHC) destruction.

The required operating temperature of the afterburner has caused lead carryover into downstream components was identified as a significant operational problem at the TEAD. At afterburner operating temperatures, exceeding 1600°F, TEAD reported condensation/plating of lead on the exposed surfaces of the downstream air to air coolers, eventually leading to the failure of one of the gas coolers. Due to this occurrence, Parsons ES recommends that the miniburn pre-testing program incorporate sampling of downstream ductwork to assess the potential lead carryover under the operating conditions expected at SEDA. Lead carryover appears to be closely related to afterburner temperature. The lower the afterburner temperature, the less the lead carryover. However, lower afterburner temperatures increase the probability of not achieving the required DRE. The problem should be addressed through periodic maintenance of the gascoolers.

1.3 BACKGROUND

SEDA is located in Seneca County, New York and occupies approximately 10,600 acres in a predominantly agricultural area. SEDA is bounded on the west by State Route 96A and on the east by State Route 96. Cities within 50 miles of the site are; Geneva (14 miles to the northwest); Rochester (50 miles to the northwest); and Ithaca (31 miles to the south).

The primary mission of the SEDA is the storage and management of military items. This mission involves the demilitarization of overstocked or off-specification munitions. The demilitarization mission is accomplished through several mechanisms, including the use of the APE 1236 deactivation furnace. Deactivation is accomplished by the heating of small arms ammunition and bulk propellant in a thick walled, steel rotary kiln until the items detonate, rendering the munitions harmless.

The existing APE 1236 deactivation furnace, used by SEDA to demilitarize various small arms munitions, was installed in 1962. This facility is housed in Building 376. Since its installation in 1962, the Army has periodically upgraded the system with various APCD including the installation of a baghouse in 1972 and a cyclone separator in 1978. In 1988 the system was modified for safety reasons following an accident at another depot that involved the waste feed conveyor system. These safety modifications included the installation of a dual conveyor feed system and an emergency release system.

In response to a November 8, 1989 deadline for compliance with promulgated Resource Conservation and Recovery Act (RCRA), Subpart O, hazardous waste incinerator requirements, the Army initiated a major improvement program in 1989 that included the addition of:

- High temperature gas cooler,
- Low temperature gas cooler,
- Automatic Waste Feed Shut Off System (AWFSO),
- Computer control system,
- Steel shroud over the rotary kiln,
- Continuous Emission Monitoring (CEM) equipment and,
- Elimination of the emergency release system.

This effort involved movement of equipment, installation of new ductwork and expansion of the concrete foundation slab.

The above-described furnace equipment upgrades for SEDA were not completed in time to meet the requirements of the RCRA Subpart O deadline of November 8, 1989. Consequently, the New York State Department of Environmental Conservation (NYSDEC) determined that, since the requirements of RCRA Subpart O were not met, the facility had to be closed and a new RCRA permit application had to be submitted. SEDA and NYSDEC agreed that full closure was not required since the Army intended to continue operation of the deactivation furnace once the upgrades were completed. NYSDEC agreed to allow partial closure of the facility but would not allow the deactivation furnace to operate until the requirements of RCRA Subpart O, including completion of an approved Trial Burn Plan (TBP) were met. In 1988, as part of the Part B permit application, SEDA submitted a final and a partial closure plan for the deactivation furnace. The partial closure plan was implemented in 1989 and 1990. As part of this plan, on November 1, 1989, surface soil sampling for various metals was performed in the vicinity of the deactivation furnace. Each sample was analyzed for toxicity characteristics using the procedures of the EP Toxicity test. Following the soil data collection effort, soil that exceeded the limits for toxicity was excavated and disposed of off-site as a characteristic hazardous waste.

Upon completion of the partial closure plan that included removal of soil, the Army completed deactivation furnace modifications and submitted a TBP as part of the RCRA Part B permit application in August 1990 to NYSDEC for approval. A revised permit, including a revised TBP, was submitted on or about October 16, 1990. A Notice of Incomplete Application (NIA) pertaining to the Part B Temporary Storage and Disposal (TSD) permit was provided to SEDA on March 29, 1991 by NYSDEC. The NIA did not include comments to the TBP. NYSDEC issued TBP comments on December 2, 1991 and indicated that the revised TBP must be provided by December 31, 1991 or NYSDEC will initiate enforcement action, permit denial or termination of interim status if a full and complete application was not received in a timely fashion. Chas. T. Main (MAIN), submitted the TBP to NYSDEC on December 31, 1991. Deficiencies were noted by NYSDEC in the February 3, 1992 comment letter and the Environmental Protection Agency (EPA), Region II, in their March 31, 1992 comment letter. Due to the nature of the comments and the level of effort required to resolve these issues, a new delivery order was issued to MAIN in order to address these comments. MAIN then responded to the comments and resubmitted the TBP on or about April 5, 1993.

During the subsequent NYSDEC review, EPA issued the "New Draft Strategy for the Combustion of Hazardous Waste" (new Draft Strategy) on May 18, 1993 which placed additional requirements on the licensing of hazardous waste incinerators. With this, EPA determined that new hazardous waste incinerators must meet additional requirements for licensing including: a multi-media risk assessment, sampling for dioxin, lower particulate emission concentrations and measurement of all Products of Incomplete Combustion (PIC). Since the April 5, 1993 TBP did not include provisions to comply with these new requirements, a modified TBP was required. EPA Region II issued formal comments indicating the need to comply with these new requirements on June 15, 1993. NYSDEC issued similar comments on August 9, 1993.

This process evaluation of the APE 1236 deactivation furnace is being conducted to determine what revisions, if any, to the existing equipment and operations are required to meet the lower particulate emissions.

1.4 NEW DRAFT STRATEGY FOR COMBUSTION OF HAZARDOUS WASTE

The New Draft Strategy establishes policy directives for hazardous waste source reduction. Specific measures of the New Draft Strategy have a direct impact on the Trial Burn and operation of the SEDA deactivation furnace. The particulate emission limit has been reduced from the current 0.08 grains per dry standard cubic feet (gr/dscf) at 7% excess oxygen to 0.015 (gr/dscf) at 7% excess oxygen. Since performing a trial burn is expensive, it is imperative that the capability of the existing deactivation furnace to meet the particulate limits be evaluated and modified to avoid failure of the trial burn. If existing systems will not meet these new emission limits, process changes should be defined and implemented to meet the new particulate emission limits.

1.5 RESULTS FROM THE TOOELE ARMY DEPOT TRIAL BURN

In August 1993, a trial burn was conducted at the Tooele Army Depot (TEAD) deactivation furnace facility to verify compliance with minimum operating performance requirements including testing to meet design criteria for DRE. This was the first trial burn performed by the Army that evaluated the potential to meet the requirements of the New Draft Strategy. A review of the compounds that comprise the list of approximately 200 different munitions that have the potential to be demilitarized in the deactivation furnace identified hexachlorobenzene (HCB) as the only Class I POHC on the list. Class I compounds, such as HCB, have been identified by EPA as the most thermally stable group of compounds. These compounds represent the components of the munitions that will be the most difficult for the Army in achieving the required DRE criteria. Accordingly, if compliance with the regulatory requirement are to be attained both TEAD and the SEAD deactivation furnaces will have to document that these systems can achieve the minimum DRE for hexachlorobenzene (HCB) of 99.99%. Due to the similarity of the equipment and operating parameters at both of these facilities the results of tests at TEAD were reviewed and incorporated in this study as the best evidence to determine if additional process changes are required to meet the DRE for HCB.

2.0 PARTICULATE EMISSION LIMITS

2.1 EXISTING PARTICULATE REMOVAL SYSTEM

Control of particulate emissions includes both fugitive emissions and controlled emissions of flue gas from the furnace. The principal method utilized to control fugitive emissions at SEDA is the maintenance of a slight negative pressure in the deactivation system. Any leakage will be into rather than out of the system. A shroud has also been placed over the kiln to minimize potential leakage at required entry points of the system. The APCD have been installed to remove particulate from the rotary kiln flue gas prior to discharge from the 32 foot stack. The APCDs that are currently used by the SEDA system for particulate removal consists of a cyclone separator (cyclone) followed by a baghouse containing fabric filters.

Partially combusted exhaust gases exits the deactivation furnace retort and is further combusted in the afterburner. The hot gases are then cooled by two air-to-air heat exchangers arranged in series. These heat exchangers reduce the gas temperature to approximately 250°F prior to entering the cyclone. Large particles (usually greater than 10 microns) are removed by the cyclone. The cyclone is a Ducon type VM, Model 700/150, size 165, constructed of 11 gage carbon steel. The cyclone provides clockwise rotation of flue gas entering tangentially and exiting vertically upward. Large particles separate from the flue gas and fall into the collection hopper at the bottom section of the cyclone where they are removed from the system. The design pressure drop of the cyclone is 2 to 5 inches water column (wc).

The exhaust from the cyclone then enters the baghouse. The carbon steel baghouse uses fabric filtration and on-line backpulsing for final particulate cleaning of the exhaust gas stream. The baghouse contains 100 bags, each 4.5 inches diameter and 8 feet long with a gross filter area of approximately 950 square feet. For a design flow of 4,000 standard cubic feet per minute (scfm) this represents an air-to-cloth (a/c) ratio of 5.0. The bag material is a fire and abrasion resistant Nomex felt. Particulate laden flue gas enters the baghouse through a 22 in. inside diameter (ID) duct near the bottom of the hopper where a diffuser distributes the gas to the filter bags. The filter bags are suspended and supported from the upper exhaust plenum support plate by a 10 wire cage on the inside of the filter bags. The

Nomex filter-fabric is located on the outside of the cage and clamped at the plenum upper support plate. An induced draft fan maintains a negative pressure relative to atmosphere in the baghouse with flow of particulate laden gas from the outside to the interior of the bag filter. Cleansed gas is collected in the upper discharge plenum where it exits to the induced draft fan and then to the discharge stack. Constant flow is maintained in the system by the induced draft fan controls. With collection of particulate on the outside of the fabric filter and constant flow, collection of particulates on the outside of the fabric filter causes a reduction in porosity through the fabric filter with a resultant increase in pressure differential. The baghouse utilizes a jet-pulse cleaning method for cleaning the bags of accumulated particles. Momentary surges of high pressure air are incorporated in a reverse direction to normal air flow in one single row of bags at a time. This cleaning mode is on-line, allowing continuous operation through the remaining filters and therefore only one baghouse is required. A compressor supplies high pressure air and an automatic timed sequence actuates one of a series of solenoid valves to clean a row of bag filters. The expanding high pressure air induces secondary flow of cleansed air from the discharge plenum. The resultant reverse flow and instantaneous pressure rise flexes the bags, releasing the collected cake. This particulate matter is exhausted through a double tipping gate valve into a sealed 55-gallon drum for disposal. Discussions with SEDA operating personnel indicated that the cycle of bag cleanings are continuous. The filter is normally bypassed during startup to prevent condensation of excess fuel in the baghouse and possible five. The baghouse is also bypassed under a condition of high inlet temperatures or on failure of the inlet air temperature input signal [1].

From a review of the trial burn test results generated at TEAD [2] and published data on fabric filter performance at other APE 1236 deactivation furnace facilities [3], it is clear that consistent particulate emissions of less than 0.04 gr/dscf are not achievable with the existing Nomex filters.

2.2 OPTIONS FOR MEETING PARTICULATE EMISSION LIMITS

Several particulate removal systems are available to meet the new particulate emission limits of 0.015 gr/dscf. Both wet and dry systems can be provided to meet the new particulate emissions. In either case a dry cyclone separator is typically installed upstream of all APCD, usually at the discharge of the rotary kiln. The cyclone separator reduces the chances of overloading the downstream APCD by removing large diameter particulates. It also reduces abrasion of the piping and ductwork and decreases the fouling of other downstream equipment such as gas coolers.

2.2.1 Wet Systems

Typical wet systems employ a high pressure venturi scrubber downstream of the cyclone separator to remove the remainder of large particulate matter. High differential pressures combined with mixing of the recirculated liquid sprayed into the flue gas is utilized for particulate removal in the venturi scrubber. With the existing equipment and the current operating conditions, the high differential pressure (i.e. greater than 30 in. wc) produced by wet scrubbers would exceed the existing induced draft fan capacity and would require higher design pressures for flue gas ductwork. This would necessitate substantial changes to the current system configuration and add significant cost.

Another option for particulate removal is Wet Electrostatic Precipitators (WESP). Particle collection is accomplished through the introduction of evenly distributed liquid droplets to the gas stream from sprays located above the electrostatic field sections. Liquid from the sprays form a continuous downward flowing film over collector plates that flush the collected particulates from the WESP. These units can be utilized downstream of a venturi scrubber, where additional particulate removal is required. Acid gas scrubbers can be incorporated as part of the WESP or provided separately in a tray tower for removal of acid gases (e.g. sulfur, chloride). Since fuels burned at SEAD are characterized as low sulfur fuels and contain no significant amounts of chlorides no acid gas scrubbing systems are required to meet discharge criteria.

Wet systems for particulate removal require either continuous or periodic blowdown of the process liquid streams to control suspended and dissolved solids concentrations. This blowdown requires liquid treatment systems and some discharge of liquid waste. Currently no water supply and liquid treatment facilities are available at the SEDA deactivation furnace. While any combination of these systems can be successfully used to achieve particulate removal any wet systems would require extensive design changes for and repermitting. Wet systems also require high capital and operating costs. The lack of wastewater treatment capability at the SEDA deactivation furnace facility coupled with major costs and permitting requirements, limit the viable options for particulate removal to dry systems.

2.2.2 Dry Systems

The current system used at the SEDA deactivation furnace for particulate removal is a dry system. Since it is an existing system, this evaluation will focus upon maintaining, yet improving, as much of the existing system as possible. Recommendations will focus on cost effective and reliable modifications of the existing system in order to meet the particulate emission limits. A key parameter in this evaluation will be minimizing process changes thereby eliminating any permit modifications that would be required due to new construction.

Potential dry methods evaluated for particulate collection include:

- Filter aid to the existing or modified bag filters,
- Replacement filters utilizing the existing baghouse and,
- Replacement filters utilizing a new or modified baghouse.

The use of filter aids, such as lime injection to the baghouse, would increase the in-depth filtration and lower particulate emissions but would add increased filter cake volume for disposal and additional operating cost for filter material and handling of the filter aid. Since the existing system employs on-line backpulsing for a portion of the baghouse, two separate baghouses would be required for the filter aid option; one on-line unit and one off-line for backpulsing. Because of this, the filter aid option, even though this option would be effective in meeting the requirements of increased particulate removal for the New Draft Strategy, is not considered cost effective for SEDA. The increased material and equipment costs in addition to the added disposal costs limit the attractiveness of this option.

Another option that is considered effective in meeting the particulate limit is replacement of the existing filter fabric material with a filter material that will increase particulate removal efficiency, eliminating the need for filter aid addition. An aspect of this option that has advantages over other options considered is that this option will not require major modifications of the existing baghouse or associated ductwork.

From a review of commercially available fabric filters, Goretex teflon B filter fabric was deemed the material of choice for this application. Goretex teflon B filter replacement bags are being used on a trial basis at other DOA deactivation furnaces to meet the lower particulate emission limits. For example, experience with Goretex Teflon B filters at the Radford Army Facility (RRAD) has been favorable [4], requiring only minor modifications to the existing baghouse. Following a trial period, Goretex Teflon B filters are being included with upgrade modifications at RRAD [5]. The Goretex teflon B fiberglass filter maintains a low operating pressure differential and will require only minor modifications in the existing SEDA baghouse.

The manufacturer of the Goretex membrane Teflon B fiberglass fabric filter controls the manufacturing process of the fabric filter so that particulate removal is accomplished at the surface. This mechanism has advantages over the current Nomex filter fabric that uses in-depth filtration to accomplish particulate removal. Nomex filter fabric is widely applied because this material does not support combustion. From a consideration of temperature resistance, the rating of the Nomex fabric filter is approximately 400°F for continuous dry service and can withstand short term exposure limits of up to 450°F. The temperature rating is reduced to 350°F if Nomex filters are operated in a moisture laden flue gas stream. The current recommended operating temperature at SEDA is 350°F. Alternatively, the Goretex filter is rated at 475°F for continuous operation in either dry or moisture laden flue gas streams utilizing reverse air for cleaning. Like the Nomex fabric, the Goretex Teflon B fabric filter does not support combustion.

The Goretex Teflon B filter fabric exceeds the performance of the Nomex filters in all areas except abrasion resistance. Abrasion is a concern with high solids loading that occurs principally at the inlet of the filter housing where velocities are higher and direct impingement on the filters can occur. At SEDA, this problem is not considered a major issue. Diffusers have been installed on the inlet to the baghouse and inlet velocities in the existing 22-inch duct are below 3,000 feet per minute (ft/min) limit for protection from abrasion. Discussions with the Goretex manufacturer have confirmed that filter material with higher abrasion resistance than the Teflon B is not necessary [6]. Experience at the LCAAP that included both Nomex and Goretex Teflon B filters indicate that an equivalent 2 year replacement cycle can be expected for the Goretex Teflon B material [7]. Since the teflon filter achieves particulate removal at the surface rather than obtaining filtration deeper in the fabric pores, the Goretex Teflon B filter's are easily backpulsed to remove particulates. This is typically performed on a minimum timed cycle (i.e. once per 8 hours) of operation or can be set for high differential pressures (i.e. approximately 5 in. wc) [8], [9].

The existing 10 wire support cages will not be satisfactory for support of the replacement Goretex Teflon B filters [6]. To provide adequate support 20 wire cages are recommended. The estimated costs for replacement of the existing Nomex filters with the Goretex Teflon B fabric filters and cages is provided in Appendix A. Total costs for replacement are estimated at approximately $11,600. This modification would utilize the existing baghouse and would not initiate additional permitting requirements. A visual inspection of the existing baghouse did not indicate that any maintenance or repair of the baghouse was required to implement this change [1].

2.3 CYCLONE SEPARATOR

The carbon steel cyclone separator is currently located downstream of the afterburner and the high and low temperature coolers but upstream of the fabric filter baghouse. The unit is intended to reduce the loading to the baghouse by removing larger sized particulates following gas cooling operations. Although the cyclone serves this purpose, relocating the cyclone separator was an option considered in this evaluation as way of improving the system efficiency by decreasing the particulate loading to the afterburner. In many instances the cyclone separator is located downstream of the primary combustion unit but upstream of the afterburner. The goal of locating the cyclone separator upstream of the afterburner, would be to protect the afterburner from fouling and abrasion. This would also have similar positive benefits to the downstream flue ducts and the air coolers. The air-to-air coolers uses sonic horns to prevent build-up of particulates, although fouling of the coolers has been reported as a common operational problem. Further, during the trial burn tests at the TEAD, fuel flow to the afterburner was temporarily halted, resulting in lower than required DRE's. This occurrence could have been due to fouling of the burner assembly due to excessive particulate loading. Locating the cyclone separator upstream of the afterburner and the air coolers was considered as a option due to the positive affects this could have on increasing afterburner performance, heat removal efficiencies in the air-to-air coolers and overall operational performance.

In the current location, the ash removed from the cyclone separator is classified as a characteristic hazardous waste due to toxicity from lead. Sampling of this material has consistently confirmed the classification of this material as a D008 characteristic hazardous waste. If the cyclone is placed prior to the afterburner, it is likely that the ash generated from the same demilitarization operations would also be hazardous due to lead and there is the potential for the ash to contain residual organics and reactive wastes that remain after being swept from the rotary kiln. Currently, there is no data available to quantitative the amount of unreacted munitions that could collect in the cyclone should the cyclone be placed upstream of the afterburner. From discussions with operators the TEAD, who are considering placing the cyclone upstream of the afterburner it appears unlikely that the cyclone ash will contain sufficient residual material to be considered a reactive waste. This is reasonable since, although the rotary kiln operates at a temperature low enough to cause detonation, usually 300°-400°F, destruction of the PEP occur during the detonation process where the organics are subjected to the high temperatures produced by the detonation reaction. Some residues will likely be produced but is not considered to be of sufficient quantity to be considered a reactive waste.

Relocating the cyclone upstream of the afterburner would require substantial changes to the outlet flue gas ducting. This is necessary in order to be able to collect the cyclone bottom ash discharge in an area outside of the enclosed rotary kiln operating area. The kiln is enclosed within concrete walls for safety, entering this area during the operation of the deactivation furnace is prohibited requiring the changes to the ductwork. In addition, the existing carbon steel cyclone separator has a temperature limit of 600°F. If the cyclone separator is relocated to the discharge of the kiln, the cyclone separator would have to be replaced with a separator fabricated of 304 stainless steel. TEAD has experienced lead carryover problems and is currently relocating the cyclone separator, see Section 3.2 for further discussion on the TEAD requirements for relocation and experience. Parsons ES recommends that SEDA review results from the TEAD tests prior to making additional changes.

Another alternative that was considered involved locating the cyclone separator downstream of the afterburner and upstream of the air coolers. This option would have required either lining the cyclone with refractory or total replacement with another high temperature material. Due to the cost implications associated with this option, it was not considered as cost effective and was eliminated from consideration early in the evaluation.

3.0 DESTRUCTION AND REMOVAL EFFICIENCY

3.1 THERMAL DESTRUCTION USING THE AFTERBURNER

Thermal destruction is accomplished in the afterburner from exposure of influent gases to high temperature with sufficient turbulence and residence time at temperature to disassociate compounds into carbon dioxide (CO_2), carbon monoxide (CO), hydrogen chloride (Hcl), chlorine (Cl_2) and water. Both systems at SEDA and at TEAD use this afterburner for this thermal destruction.

Successful operation of the SEDA APE 1236 deactivation furnace requires a minimum DRE for POHC of 99.99%. POHCs identified for testing at SEAD are Hexachlorobenzene (HCB) and Trichloroethylene (TCE). These Class 1 POHCs were selected based on their resistance to thermal destruction. HCB is a component in only two of over 200 different military items that could be demilitarized and is comprises only a small portion of the PEP. Given the detection limits of the methods to be used during the trial burn, it will be necessary to input approximately 4.1 lbs. of a Class 1 POHC in order to assure that the 99.99% DRE requirement can be met. Since the two items that contain HCB cannot be fed to the deactivation furnace in sufficient quantities to meet this requirement, due to safety limitations, HCB will have to be spiked as a supplement to the munitions. Another option that will be evaluated prior to the trial burn, during the miniburn, is the use of another Class 1 POHC, such as TCE. Unlike HCB, TCE, also a Class 1 POHC, is not contained in any munitions but has been proposed to be spiked into a munitions, i.e. a rocket motor, as part of the trial burn. Depending upon which POHC can be spiked the easiest and safest, that POHC will be used in the actual trial burn. By spiking HCB or TCE, it will be possible to evaluate the DRE performance of the afterburner for a Class 1 POHC.

The afterburner at SEDA is located downstream of the deactivation furnace. The afterburner is a ceramic lined carbon steel chamber. Propane is used as fuel for startup but is replaced with No. 2 fuel oil following system warm-up. A Hauck wide-range burner is the burner that is used to increase the afterburner temperature from between 1400° to 1600°F. The aluminum silicate insulation minimizes heat loss and is treated to prevent erosion. A separate fan feeds air to the burner at ambient conditions from the waste feed inlet conveyor enclosure to the burner. The afterburner's largest cross-section is 56 in. x 56 in. with a transition section to circular discharge duct. The total interior volume of the afterburner is 310 cubic feet (cu ft). The typical operating flow through the afterburner is approximately 13,500 actual cubic feet per minute (acfm) which calculates into an average residence time in the afterburner of 1.37 seconds. Optimal afterburner performance requires complete mixing of the gas. Turbulent conditions ensure intimate mixing and minimal "short cycling" through the afterburner. The dimensionless Reynolds number is used as a measure of turbulence with numbers of 23,000 or higher indicating turbulent conditions. Using this value and the known fixed volume of the afterburner as well as the flow it is possible to calculate the minimum flow at which turbulent conditions would exist. The analysis indicated that a minimum flow of 9900 acfm at 1600°F would be required to ensure turbulent conditions. Since the flow of the system is 13,500 acfm, turbulent, well mixed, conditions are present suggesting that afterburner performance will be optimal.

3.2 EXPERIENCE AT THE TOOELE ARMY DEPOT (TEAD)

A comparison of trial burn test results obtained from the recent trials conducted at TEAD and published literature for the DRE for HCB was made to evaluate the potential for the current system configuration to meet the criteria for the DRE. In August 1993, trial burns were conducted at the TEAD and consisted of three test burns intended to verify the ability of the APE 1236 deactivation system to achieve the required DRE for the Class 1 POHC, HCB. Two of the three test burns met the 99.99% DRE criteria, however, one test burn failed to meet the criteria. A DRE of only 99.9847% was obtained for the failed test burn, Test No. 3-1. The afterburner temperatures for all of these three test burns averaged within 2° of 1600°F target temperature. The only difference between the three test burns was a momentary shutdown of the afterburner fuel feed during the failed test, Test No. 3-1, for approximately 30 seconds with a subsequent short term temperature drop to 1230° F in the afterburner. Although the temperature drop was only for a short interval and average temperatures were still equivalent to other test runs, overall thermal destruction was reduced to below 99.99%. TEAD test operators indicated that their test conditions provide 1 second residence time in the afterburner. Following this failed test burn, an evaluation was conducted to determine the reasons for this failure. Although the reasons for the burner fuel feed shutdown was not conclusive, it is likely that excessive lead buildup may have been a contributing factor. Although the evaluation was not conclusive, the conclusion of this evaluation indicated that with stable operation at 1600° F and a minimum of 1 second residence time the APE 1236 deactivation system will meet the DRE for HCB without additional process changes.

The information compiled from these operations and subsequent evaluation are relevant and worth noting since it is applicable for other APE 1236 deactivation systems, including the system at SEDA. One facet of the system operation that was investigated was the occurrence of plating of solids on the surface of the air coolers that are directly downstream of the afterburner, eventually leading to the failure of the air cooler. Although the failure mechanism is not fully understood, experience at other operating facilities and TEAD suggested that the mechanism is a result of excessive carryover of particulate matter from the retort, through the afterburner. The higher operating temperature required in the afterburner vaporized lead entrained in the influent flue gas with subsequent condensation and plating on the colder surfaces of the high temperature air cooler. The resultant plating of lead on the air cooler surfaces caused localized failure (i.e. pitting) of heat exchanger materials within approximately 100 hours of initiating the trial burn testing.

TEAD determined that this operating difficulty occurred primarily because of the unique testing requirements imposed on the TEAD system. The TEAD testing protocol required maximum feed of all potential contaminants while performing the tests for the DRE. The operating problems occurred from the combined affects of excessive heavy metal feed rates (i.e. 575 pounds/hour (lb/hr) of lead shot) coupled with the higher operating temperature in the afterburner. TEAD concluded that the use of the more volatile form of lead, (i.e. lead powder and lead shot), instead of salts that are normally found in the munitions, is the reason for their excessive lead carryover problem. The Army Environmental Hygiene Agency (AEHA), who is also involved in performing trial burns confirmed that the use of lead salts will not produce this problem [10]. The addition of lead shot is not part of the proposed TBP testing at SEDA for destruction and removal efficiency. Heavy metals, including lead, will be introduced from munitions themselves and the loading will be less at SEDA than at TEAD. For example, the maximum lead input for the SEDA testing is less than 20 lb/hr as compared to 575 lb/hr at TEAD. Although considerably less quantity of heavy metals are planned for inclusion of the trial burns at SEDA, the high temperature required in the afterburner may still contribute some lead carryover to the air cooler. Frequent cleaning of the high temperature coolers will prevent the premature failure in the air coolers.

As a result of the lessons learned from the testing program, the following measures are being incorporated at TEAD to mitigate lead carryover:

- Relocation of the cyclone separator upstream of the afterburner. This change will require a repermitting of the system.
- Installation of an "expansion chamber" directly downstream of the afterburner. This uninsulated chamber is being installed to cool the outlet flue gas where it is believed that lead particulate will collect. Information gained from operation at other deactivation furnaces indicates that the lead carryover is in an easily removable particulate form at temperatures below 1200°F.

TEAD believes that with the lessons learned from the burn tests are sufficient to move forward with another trial burn. They are confident that a satisfactory DRE for HCB at the 1600°F afterburner temperature with approximately 1 second residence time will be adequate.

None of the above measures are recommended for SEDA. The results at TEAD and at other facilities planning trial burns indicate that well planned burns including pre-burns, (i.e. miniburns), are essential in order to establish stable operations and assure that all of the trial burns will be successful. Monitoring for lead carryover in the miniburn is also recommended.

3.3 PUBLISHED LITERATURE ON DRE FOR HCB

Published literature [11] indicates that a residence time of 2.3 seconds would be required for 99.99% destruction and removal efficiency of HCB at an operating temperature of 1600°F. With the existing flow, an additional 100 cubic feet of afterburner volume would be required to achieve this residence time at SEDA. Although the residence time is less than what would be required to assure 99.99% DRE of HCB, the TEAD trial burn test results indicated that 99.99% destruction and removal efficiency for HCB at residence times of slightly greater than 1 second can be achieved. Since 1600°F is an operating limit of the system, methods to either increase the efficiency the operation of the afterburner at 1600°F or methods to extend residence time, while maintaining turbulent conditions in the afterburner, are required.

3.4 OPTIONS FOR OPTIMIZING THE DRE

3.4.1 Maximizing Residence Time

The afterburner achieves destruction of organic compounds through prolonged exposure of the incoming flue gas to elevated temperatures. Residence time is calculated as the flue gas flow divided by the fixed volume (310 cu. ft.) of the afterburner. The downstream flue duct volume, leaving the afterburner, prior to the air coolers is limited to an elbow fitting discharging directly into the air coolers. This volume has been included in the residence time calculation since the temperature in this duct would be near the afterburner temperature since the duct is short and there will be little heat loss.

An effective method for increasing residence time is optimizing the air and fuel addition for combustion both in the deactivation furnace and in the afterburner. Minimal cost would be associated with this method but would require a "miniburn" prior to full trial burn testing to verify optimum conditions. The factors involved with optimizing combustion air to the system require that sufficient air be supplied in order to maintain carbon monoxide levels below emission limits and provide for complete combustion. In addition, minimum combustion air feed rates of 10% excess stoichiometric air must be maintained to the afterburner for stable burner operation. The flow through the afterburner must also be turbulent to minimize short circuiting through the afterburner. Figure 1 represents the heat and energy balance of the system by optimizing, all the above conditions and Figure 2 represents the most likely operating conditions that is considered realistically achievable. The maximum residence times for these operating conditions are 1.83 seconds and 1.57 seconds respectively and represent a potential increase in residence time from 33 to 14% above residence times projected in the existing TBP for SEDA. Maximizing operating conditions provides an additional safety factor with minimum investment. A miniburn is recommended to establish stable operation for the test conditions and to assure that DRE above 99.99% can be achieved.

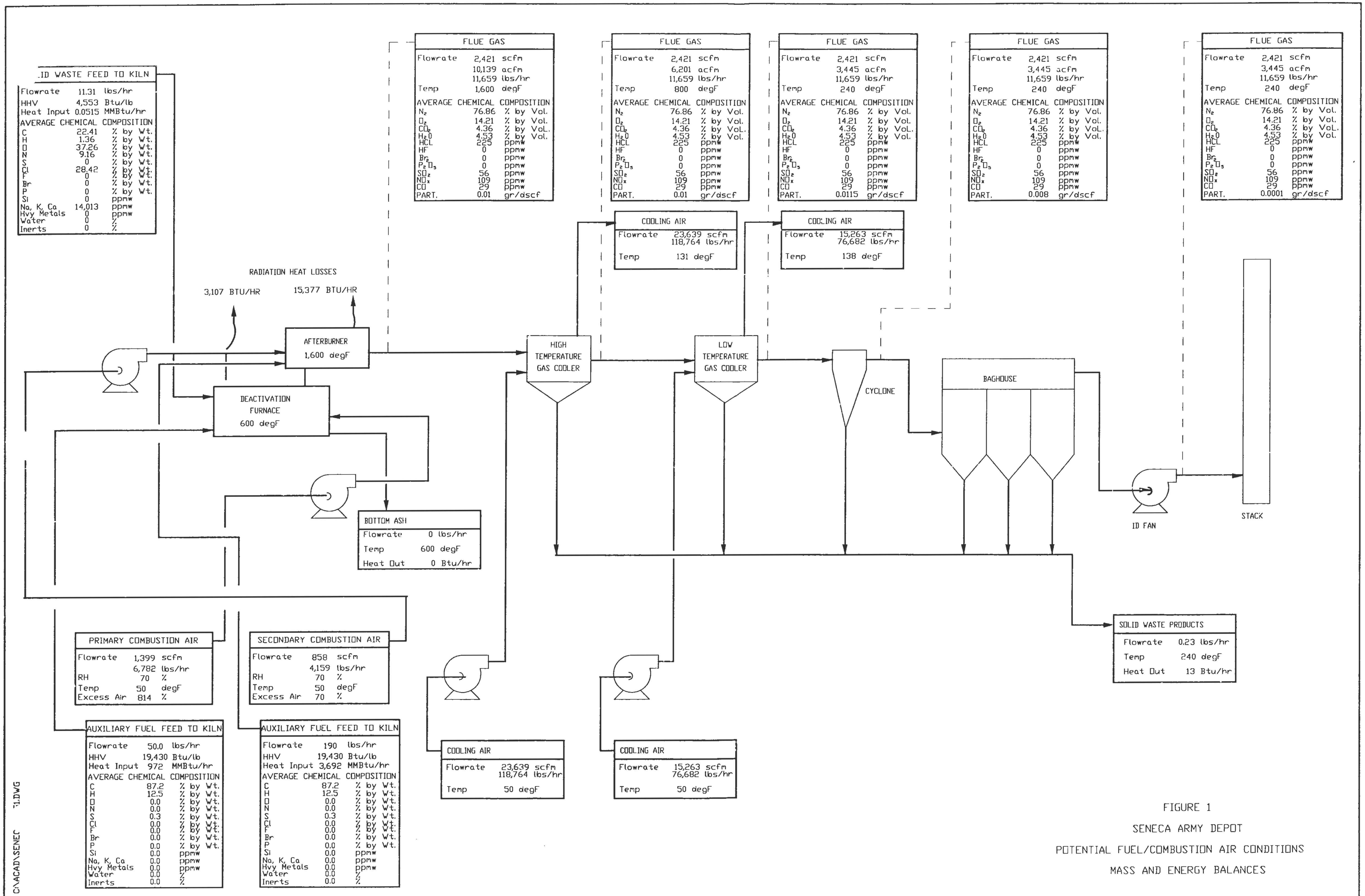

FIGURE 1
SENECA ARMY DEPOT
POTENTIAL FUEL/COMBUSTION AIR CONDITIONS
MASS AND ENERGY BALANCES

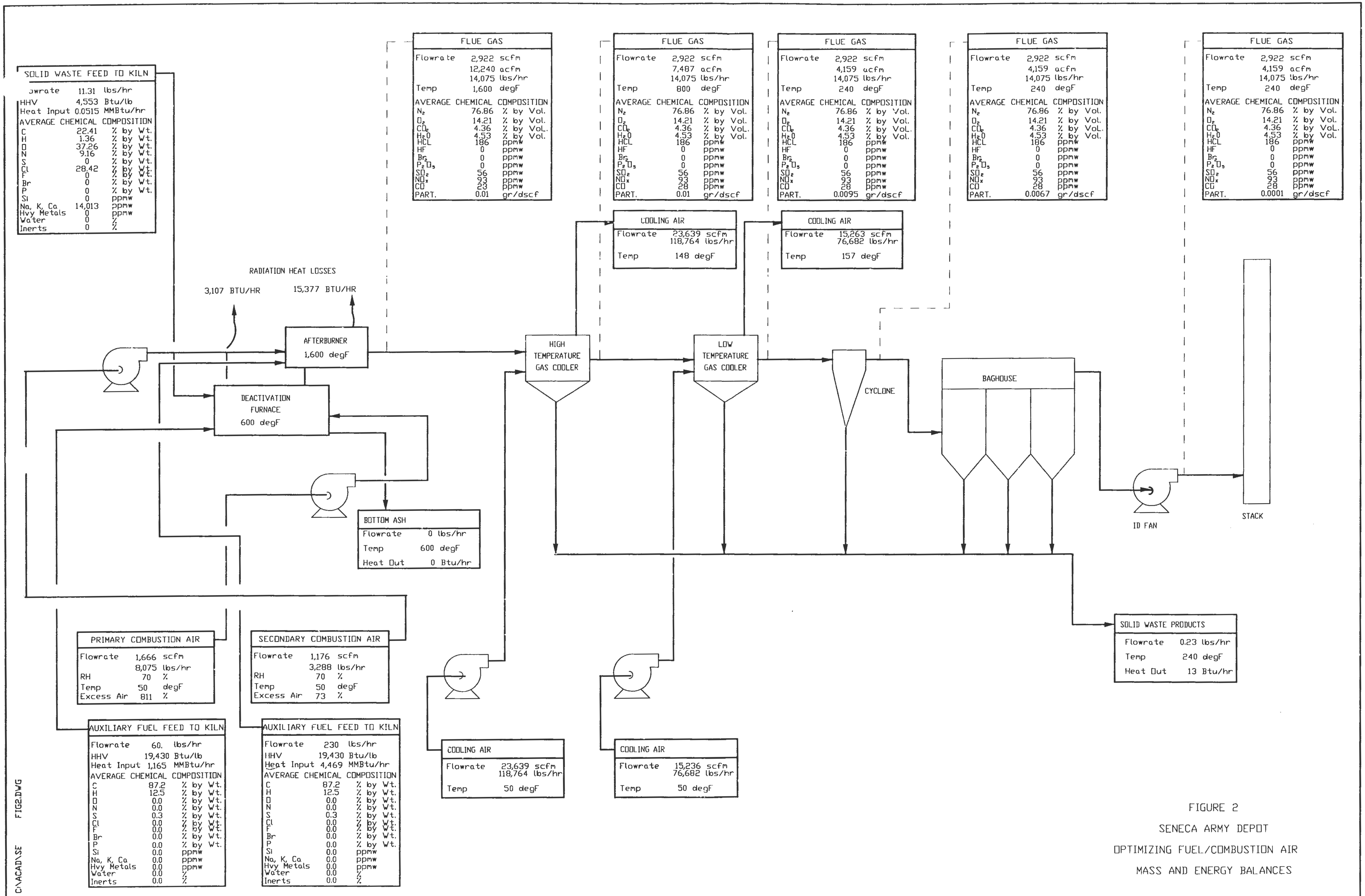

FIGURE 2

SENECA ARMY DEPOT

OPTIMIZING FUEL/COMBUSTION AIR

MASS AND ENERGY BALANCES

Another option for increasing residence time is to retrofit the afterburner with internal baffles to ensure adequate turbulence and prevent short circuiting in the afterburner. These devices are used if low flow or unstable conditions exist in afterburner operations. Devices such as internal baffles are not currently installed in the SEDA afterburner. The afterburner manufacturer, Southern Technologies Inc., incorporated these devices in the designs of new afterburners and can provide baffles as retrofits to improve afterburner performance in existing equipment. Southern Technologies Inc. have confirmed that internal baffles can provide measurable improvements in destruction and removal efficiency. However, results with internal baffles for retrofits have been mixed and the manufacturer will only guarantee that the installation of the internal baffles will not decrease DRE of the afterburner. With the potential for lead carryover and build-up on the baffles and no guaranteed improvements associated with installation of the baffles the option of internal baffles is not recommended as the most cost effective approach to increase the DRE performance.

Replacement of the afterburner with a larger afterburner was another option that had been considered. The afterburner manufacturer stated that two standard afterburner designs are provided to the Department of the Army for deactivation furnaces. The first design is currently in place at SEDA. The second standard afterburner provides approximately twice the internal volume of the existing SEDA afterburner and would double the residence time. However, due to the extensive and costly modifications to the ductwork the replacement of the existing afterburner this option is not recommended.

3.4.2 Preheating the Combustion Air

Another option that was evaluated to increase the DRE of the system is preheating the inlet air. Currently, no preheating of inlet combustion air to the afterburner is provided at the SEDA deactivation furnace. By preheating the combustion air, less fuel oil and resultant combustion air is needed for heating ambient air up to the required combustion temperature. This reduced volume would result in higher residence times in the afterburner. The maximum preheat conditions to the afterburner combustion air is limited by the burner components. The operating temperature limits of the Hauck burner assembly is 250°F. This air could be preheated with either exhaust air from the kiln or from waste heat from the high or low temperature ambient air coolers or could be heated with a separate electric heater. Figure 3 represents the heat and energy balance resulting from conditions associated with the option of preheating of the afterburner inlet combustion air to 180°F. The evaluation indicates that the fuel feed to the afterburner can be reduced by approximately 30 lb/hr, resulting in a decrease in the amount of combustion air required in order to maintain 1600°F in the afterburner. Reducing the combustion air flow corresponds to an increased gas residence time of 1.85 seconds. Additional controls would likely be required for over temperature protection of the inlet combustion air. Backup air or blending of ambient air and high temperature exhaust air from the air coolers would be required to provide tempered preheated air for combustion. System controls would add additional complexity to the operation and would require a permit modification and regulatory review and approval. Time to engineer and repermit this process does reduces the attractiveness of this option and it is not recommended as the most cost effective viable option.

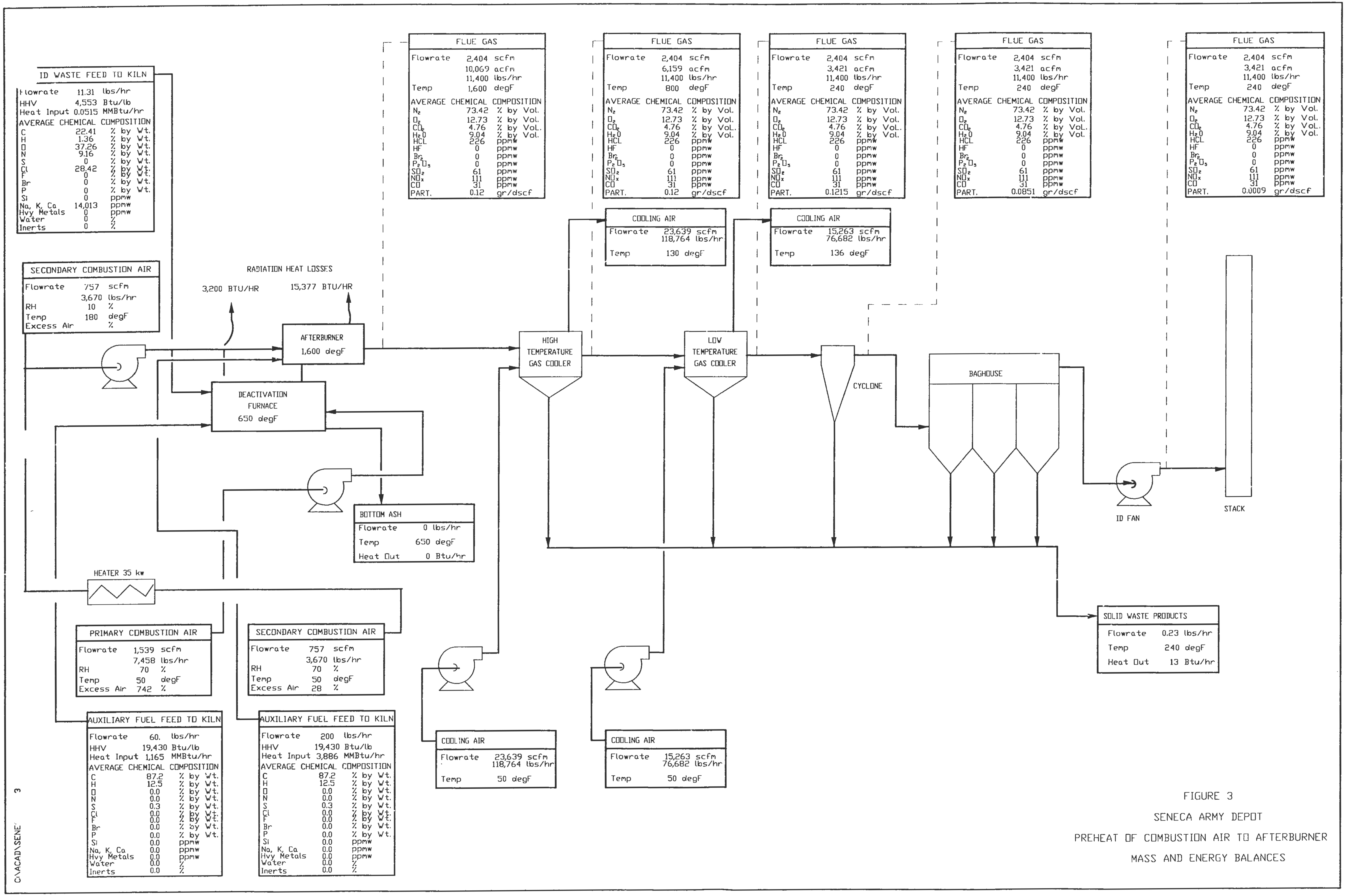

FIGURE 3
SENECA ARMY DEPOT
PREHEAT OF COMBUSTION AIR TO AFTERBURNER
MASS AND ENERGY BALANCES

4.0 PERMITS

The attached Table 1 provides a summary of the required environmental permits and status for this facility. SEDA is currently applying for a RCRA Subpart O permit for operation of the deactivation furnace. Additional permits required in the State of New York include the "Certificate to Operate Stationary Combustion Installation" in accordance with 6NYCRR 201.

Further, our review of the permit status indicates that the State Environmental Quality Review (SEQR), required under 6NYCRR 617 must also be submitted. Previous discussions with the New York State permit administrator suggested that specific sections of the Subpart O permit application would be provided to the SEQR permit reviewers. However, there is little documentation of this occurrence and it is suggested that a formal SEQR submittal be provided to NYSDEC to avoid any future misunderstandings and delays in obtaining the permit to begin deactivation operations.

UNITED STATES ARMY
Seneca Army Depot, Romulus, New York
Deactivation Furnace

Table 1
Summary of Environmental Permits and Status

Permit Requirement	Status
NYSDEC Air Permit to Construct/Certificate to Operate pursuant to 6 NYCRR 200, et al	Not submitted. Require submittal to and approval by NYSDEC.
NYS State Environmental Quality Review (SEQR) Approval pursuant to 6 NYCRR 617	Not submitted. Require submittal to and approval by NYSDEC.
NYSDEC Hazardous Waste Treatment Facility Permit pursuant to 6 NYCRR 373-1	Submitted to NYSDEC currently under review.

5.0 COSTS

A summary of cost presented in this section is included in Table 2.0, Estimated Costs for SEDA 1236 APE Deactivation Furnace Modifications.

5.1 CYCLONE SEPARATOR RELOCATION

Cyclone separator relocation is not deemed necessary in order to meet the requirements of a successful trial burn. The benefits associated with the relocation of the cyclone separator is not sufficient to recommend this option. This option should be pursued if the operational data obtained from the upcoming trial burn tests TEAD, that is relocating the cyclone separator upstream of the afterburner, indicates that a significant decrease in lead carryover can be achieved. Present worth costs associated with this option were estimated at $30,300.

5.2 BAGHOUSE FILTER REPLACEMENT

Appendix A presents costs for replacement filters and cages for the SEAD deactivation furnace baghouse. Parsons ES recommends replacement of the 100 filter bags with Goretex membrane Teflon B fiberglass filters and 20 wire vertical cages. In addition, 10% filter bag spares and 4 additional wire cages are recommended as spare parts. The capital costs for the filter bags and the cages is approximately $10,200. Approximate annual labor costs to replace the filters is estimated at $1,440. Total present worth costs for 15 years of operation is $46,900.

5.3 AFTERBURNER REPLACEMENT

Estimated capital and labor costs for an afterburner replacement is $250,000 which includes replacement of the existing unit and modification to existing discharge ducting.

5.4 PREHEATING OF THE AFTERBURNER COMBUSTOR AIR

This option involved recovering waste heat from the high or low temperature coolers to preheat combustion air to the afterburner. Estimated present worth costs for controls and heat exchanger for 15 years is approximately $103,800. This includes $75,000 in capital and installation costs and annual operational and maintenance costs of $3,800.

5.6 MINIBURN

Estimated costs for the mini-trial burn were estimated at $63,200.

UNITED STATES ARMY
SENECA ARMY DEPOT, ROMULUS NEW YORK
DEACTIVATION FURNACE

Table 2
ESTIMATED COSTS FOR POTENTIAL SYSTEM MODIFICATIONS
SEDA 1236 DEACTIVATION FURNACE

	Equipment & Installation Cost ($), (1),(2)	Other Direct & Indirect Costs,($), (3)	Operating & Maintenance costs,($) (6)	Estimated Operating Life, (yr.)	Salvage Value Year 15, ($) (6)	Present Worth ($) (6)	Benefit
Cyclone Separator Relocated to Disch. of Rotary Kiln	20300 (7)	10000	0	15	0	30300	Benefit not known. Assess data from tests conducted at Tooele. Recommend conducting Miniburn and monitoring for lead carryover.
Baghouse filter Replacement	10167.4 (8)	0	4831	2	0	46912	No Other Options Considered. This Option Provides Lowest Cost Expenditure For Particulate emissions.
Replace With Larger Afterburner	147200 (9)	102800	0	15	0	250000	Not Recommended. Miniburn is Recommended to improve / stabilize Operating Conditions.
Preheat Combustion Air	44200 (10)	30800	3786	15	0	103797	Not Recommended. Additional permit Costs & Complexity of Operation.
Miniburn	63,203 (11)	N/A	N/A	N/A	N/A		

Notes :

(1) Cost for permitting not included .

(2) 43.4 % of equipment cost assigned for ; installation(26 %) ,buildings(10.6%), piping (4.4%)and electrical(2.4%). Fixed cost of $6000 assigned to each option for instruments & controls.

(3) 100 % of equipment cost assigned to : yard improvements(3%), service facilities(16%), engineering(10%), construction &DOA management(20%), contractors fee(11%), and startup(10 %). A contingency of 30 % is included.

(4) Annual cost of replacement filter bags. 100 x$ 82.22/bag + $1440 for replacement every two years.

(5) Assumes 400 hrs. / yr. operation and 30 lb/hr. savings in fuel use , $1.00 /gal. of fuel; additional equip. maint costs of $ 3000; 50hr/yr added maint. labor @$50/hr.

(6) Present Worth Recovery factors for 15 years and 10 % interest .

(7) $ 5900 estimated cost provided by Ducon, T. Maccati, 1/6/95 for 304 ss cyclone separator. 705 adder assigned for testing and documentation.

(8) Quotation from W L Gore Associates, 1/4/95. Plus 32 hrs @ 50 /hr for installation @ $ 50/hr.

(9) Verbal estimate from Roger Hammmond from Southern Technologies , Jan. 1995. $100,000. Used $102650 for estimating.

(10) Equipment cost estimated for preheater @ $30800.

(11) Air pollution Emission Assessment No. 42-21-M665.

N/A - Not Applicable

6.0 RECOMMENDATIONS

6.1 RECOMMENDATIONS FOR CONTINUED OPERATIONS

The existing fabric filter system will not meet the new particulate emission limits of 0.015 gr/dscf at 7% excess oxygen. Parsons ES recommends replacement of the existing fabric filters and support cages with Goretex Teflon B fiberglass filter bags and 20 wire support cages. From visual inspection of the baghouse, no repair or modification of the baghouse is required. Parsons ES recommends a minimum back-pulse cycle of once per 8 hours of operation. Estimated cost for replacement of filters, including spare filters and cages is approximately $11,600. The new filter performance should be tested as part of a miniburn to verify future trial burn requirements.

6.2 RECOMMENDATIONS FOR MINIBURN TESTING

From experience at TEAD, trial burns for thermal destruction of HCB at SEDA may be marginal in meeting the 99.99% DRE for a Class I POHC. A miniburn is recommended to provide performance data that will be essential in optimizing air and fuel conditions in order to assure the success of the formal trial burn. As part of the miniburn, all the burners should be inspected and repaired and afterburner downstream ductwork and components should be cleaned and monitored for lead carryover. Estimated costs for the miniburn is approximately $63,200.

6.3 ADDITIONAL RECOMMENDATIONS

Relocation of the cyclone separator upstream of the afterburner is not recommended. TEAD is relocating the cyclone separator due to TEAD's trial burn testing protocol that requires the use of large quantities of lead shot. Parsons ES recommends that SEDA review possible relocation of the cyclone separator after the TEAD testing is completed and the results are available. The conditions of TEAD's trial burn is not reflective of actual operational conditions that the SEDA APE 1236 deactivation furnace would experience during normal operation. The trial burn plan proposed for SEDA does not involve the use of lead shot and therefore the situation of excess lead carryover should not be a problem at SEDA.

REFERENCES

1. Trip Report, Site inspection of the Seneca Army Depot Activity's APE 1236 deactivation furnace, Don Yonika, March 16, 1995.

2. Air Pollution Emission Assessment No 42-21-M665, 9-31-August 1993, RCRA Trial Burn for Deactivation Furnace, Tooele Army Depot, Tooele, Utah, 9-31, August 1993.

3. Combustion Emission Technical Resource Document, EPA A530-R-94-014, may 1994.

4. Waste Propellant Incinerator Compliance Incineration, Evaluation and Upgrade. Mark Sullivan, Hercules Incorporated, M. Guest, R. McCormick DRE Environmental.

5. Telecom with M. Crawford of the Red River Facility, January 4, 1995.

6. Faxed comments and suggestions for system modifications from G. Brinkman, W.L. Gore representative, to D. Yonika, Parsons ES, January 4, 1995.

7. Telecom with John Hosman, Olin Defense Systems, Lake City Army Ammunition Plant, February 6, 1995.

8. Telecom with John Martin at Dupont, Reference for Goretex filter units, January 9, 1995.

9. Telecom with Paul Pohawis, Aptus Inc. (Rollins), Reference for Goretex Filter Unit, January 9, 1995.

10. Telecom with Bob Wishard, U.S. Army Environmental Hygiene Agency (USAEHA), regarding trial burn testing at Tooele and proposed changes at Red River Army Depot deactivation furnaces, February 6, 1995.

11. B. Dillinger, Determination of the Decomposition Properties of 20 selected Hazardous Organic Compounds. Proceedings of the 10th Annual Research Symposium on the Incineration and Treatment of Hazardous Waste, EPA-600/9-84-0022, September 1984.

MASS AND ENERGY CALCULATIONS FOR OPTION 1, POTENTIAL FUEL/COMBUSTION AIR CONDITIONS

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

FEED COMPOSITION TO KILN	AUX FUEL	SOLID WASTE
WEIGHT % C =	87.20 %	22.41 %
WEIGHT % H =	12.50 %	1.36 %
WEIGHT % O =	0.00 %	37.26 %
WEIGHT % N =	0.00 %	9.16 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	28.42 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	13,013 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	100.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	4,553 Btu/lb
FEED RATE TO KILN =	50.00 lbs/hr	11.31 lbs/hr

FEED COMPOSITION TO SCC	AUX FUEL	LIQUID WASTE
WEIGHT % C =	87.20 %	0.00 %
WEIGHT % H =	12.50 %	0.00 %
WEIGHT % O =	0.00 %	0.00 %
WEIGHT % N =	0.00 %	0.00 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	0.00 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	0 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	0.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	0 Btu/lb
FEED RATE TO SCC =	190.00 lbs/hr	0.00 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

DESIGN CRITERIA

INCINERATOR DIMENSIONS	
KILN INSIDE DIAMETER =	2.54 feet
KILN LENGTH =	20.00 feet
KILN INSIDE VOLUME =	101 ft3
KILN SLOPE =	0.188 ft/ft
KILN ROTATIONAL VELOCITY =	1.00 rpm
SCC LENGTH =	4.67 feet
SCC WIDTH =	4.67 feet
SCC HEIGHT =	14.21 feet
SCC INSIDE VOLUME =	310 ft3
COMBUSTION INLET AIR CONDITIONS	
PRIMARY AIR TEMPERATURE =	50 degF
PRIMARY AIR REL HUMIDITY =	70 %
SECONDARY AIR TEMPERATURE =	50 degF
SECONDARY AIR REL HUMIDITY =	70 %
INCINERATOR OPERATING CONDITIONS	
WASTE FEED TEMPERATURES =	70 degF
KILN OPERATING TEMPERATURE =	600 degF
SCC OPERATING TEMPERATURE =	1,600 degF
HIGH TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	800 degF
LOW TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	240 degF
AIR POLLUTION CONTROL REMOVAL EFFICIENCIES	
PARTICULATE REMOVED AS ASH IN KILN =	0.0 %
PARTICULATE REMOVAL IN HIGH TEMP COOLER =	1.0 %
PARTICULATE REMOVAL IN LOW TEMP COOLER =	0.0 %
PARTICULATE REMOVAL IN CYCLONE =	30.0 %
PARTICULATE REMOVAL IN BAGHOUSE =	99.5 %
STACK GAS CONDITIONS	
STACK GAS TEMPERATURE =	240 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

MATERIAL BALANCES	KILN	SCC
LIQUID WASTE FEED =		0.00 lbs/hr
SOLID WASTE FEED =	11.31 lbs/hr	
AUXILIARY FUEL FEED =	50.00 lbs/hr	190.00 lbs/hr
STOICHIOMETRIC AIR REQ'D =	738 lbs/hr	2,716 lbs/hr
COMBUSTION AIR REQUIRED =	1,399 scfm	955 scfm
	6,782 lbs/hr	4,628 lbs/hr
EXCESS AIR REQUIRED =	814 %	70 %
FLUE GAS PRODUCED =	6,842 lbs/hr	11,659 lbs/hr
	238 lbmol/hr	405 lbmol/hr
BOTTOM ASH REMOVED =	0 lbs/hr	
KILN SOLIDS RESIDENCE TIME =	8.0 minutes	
MAX GAS RESIDENCE TIME =	1.98 seconds	1.83 seconds
FLUE GAS VELOCITY =	10.1 ft/sec	7.7 ft/sec

ENERGY BALANCES	KILN	SCC
HEAT RELEASE RATE =	1,022,994 Btu/hr	3,691,700 Btu/hr
OPERATING TEMPERATURE =	600 degF	1,600 degF
RADIATION HEAT LOSSES =	3,107 Btu/hr	15,377 Btu/hr
ASH REMOVAL HEAT LOSS =	0 Btu/hr	
SOLID WASTE HEAT INPUT =	51,494 Btu/hr	
AUX FUEL HEAT INPUT =	971,500 Btu/hr	3,691,700 Btu/hr
LIQUID WASTE HEAT INPUT =		0 Btu/hr
FLUE GAS ENTHALPY =	1,019,888 Btu/hr	4,696,211 Btu/hr
VOLUMETRIC HEAT RELEASE =	10,095 Btu/hr/ft3	15,203 Btu/hr/ft3

MATERIAL BALANCES	OFF-GAS CLEANING SYSTEM
COOLING AIR FOR HI TEMP GAS COOLER =	118,764 lbs/hr
=	23,639 scfm
COOLING AIR FOR LO TEMP GAS COOLER =	76,682 lbs/hr
=	15,263 scfm
DRY SOLIDS FROM HI TEMP COOLER =	0.00 lbs/hr
DRY SOLIDS FROM LO TEMP COOLER =	0.00 lbs/hr
DRY SOLIDS REMOVED IN CYCLONE =	0.07 lbs/hr
DRY SOLIDS REMOVED IN BAGHOUSE =	0.16 lbs/hr
TOTAL DRY SOLIDS REMOVED IN APCS =	0.23 lbs/hr

ENERGY BALANCES	
HEAT REMOVED BY HI TEMP COOLER =	2,611,713 Btu/hr
COOLING AIR TEMP OUT =	131 degF
HEAT REMOVED BY LO TEMP COOLER =	1,828,199 Btu/hr
COOLING AIR TEMP OUT =	138 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER SEC. COMB. CHAMBER	EMISSIONS AFTER HI TEMP GAS COOLER
FLUE GAS FLOWRATE :		
SCFM :	2,421 scfm	2,421 scfm
ACFM :	10,139 acfm	6,201 acfm
LBMOL/HR :	405 lbmol/hr	405 lbmol/hr
LBS/HR :	11,659 lbs/hr	11,659 lbs/hr
LBS/HR DRY :	11,330 lbs/hr	11,330 lbs/hr
FLUE GAS TEMPERATURE :	1,600 degF	800 degF
FLUE GAS SATURATION TEMP :	171 degF	149 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.4319	0.2003
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	225 ppmv	225 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.44 lbs/hr	1.44 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.02 lbs/hr	2.02 lbs/hr
CONCENTRATION :	109 ppmv	109 ppmv
CO :		
FLOWRATE :	0.32 lbs/hr	0.32 lbs/hr
CONCENTRATION :	29 ppmv	29 ppmv
PARTICULATES :		
FLOWRATE :	0.23 lbs/hr	0.23 lbs/hr
CONCENTRATION :	0.01 gr/dscf	0.01 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER LO TEMP GAS COOLER	EMISSIONS AFTER CYCLONE
FLUE GAS FLOWRATE :		
SCFM :	2,421 scfm	2,421 scfm
ACFM :	3,445 acfm	3,445 acfm
LBMOL/HR :	405 lbmol/hr	405 lbmol/hr
LBS/HR :	11,659 lbs/hr	11,659 lbs/hr
LBS/HR DRY :	11,330 lbs/hr	11,330 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	112 degF	112 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.0607	0.0607
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	225 ppmv	225 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.44 lbs/hr	1.44 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.02 lbs/hr	2.02 lbs/hr
CONCENTRATION :	109 ppmv	109 ppmv
CO :		
FLOWRATE :	0.32 lbs/hr	0.32 lbs/hr
CONCENTRATION :	29 ppmv	29 ppmv
PARTICULATES :		
FLOWRATE :	0.23 lbs/hr	0.16 lbs/hr
CONCENTRATION :	0.0115 gr/dscf	0.0080 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER BAGHOUSE	EMISSIONS AT STACK
FLUE GAS FLOWRATE :		
SCFM :	2,421 scfm	2,421 scfm
ACFM :	3,445 acfm	3,445 acfm
LBMOL/HR :	405 lbmol/hr	405 lbmol/hr
LBS/HR :	11,659 lbs/hr	11,659 lbs/hr
LBS/HR DRY :	11,330 lbs/hr	11,330 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	112 degF	112 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.0607	0.0607
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	225 ppmv	225 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.44 lbs/hr	1.44 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.02 lbs/hr	2.02 lbs/hr
CONCENTRATION :	109 ppmv	109 ppmv
CO :		
FLOWRATE :	0.32 lbs/hr	0.32 lbs/hr
CONCENTRATION :	29 ppmv	29 ppmv
PARTICULATES :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0.0000 gr/dscf	0.0000 gr/dscf

Note: Particulate concentration leaving stack, corrected to 7% oxygen on a dry basis in the stack gas is 0.0001 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ADDITIONAL MATERIAL BALANCE INFORMATION

WATER ENTERING IN ALL FEED STREAMS =	0 lbs/hr
WATER ENTERING IN COMBUSTION AIR =	60 lbs/hr
WATER IN FLUE GAS LEAVING SCC =	330 lbs/hr
WATER IN FLUE GAS LEAVING STACK =	330 lbs/hr
INERTS ENTERING KILN IN WASTE FEEDS =	0.00 lbs/hr
ASH FORMED IN KILN =	0.23 lbs/hr
TOTAL PARTICULATES FORMED IN KILN =	0.23 lbs/hr
TOTAL ASH REMOVED FROM KILN =	0.00 lbs/hr
TOTAL PARTICULATE LEAVING KILN =	0.23 lbs/hr
TOTAL PARTICULATE FORMED IN SCC =	0.00 lbs/hr
TOTAL PARTICULATES LEAVING SCC =	0.23 lbs/hr

PLUME FORMATION CONDITIONS AT STACK

CRITICAL TEMPERATURE =	21 degF
CRITICAL HUMIDITY =	0.0029 lbs H2O/lb dry air
CRITICAL EQUATION =	H = 0.00012 X T 0.00040

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR MASS BALANCES

KILN :

MASS SOLID WASTE IN =	11 lbs/hr
MASS AUXILIARY FUEL IN =	50 lbs/hr
MASS PRIMARY COMBUSTION AIR IN =	6,782 lbs/hr
MASS BOTTOM ASH OUT =	0 lbs/hr
MASS FLUE GAS OUT =	6,842 lbs/hr

SCC :

MASS FLUE GAS IN =	6,842 lbs/hr
MASS LIQUID WASTE IN =	0 lbs/hr
MASS AUXILIARY FUEL IN =	190 lbs/hr
MASS SECONDARY COMBUSTION AIR IN =	4,628 lbs/hr
MASS FLUE GAS OUT =	11,659 lbs/hr

HIGH TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	11,659 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,659 lbs/hr

LOW TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	11,659 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,659 lbs/hr

CYCLONE :

MASS FLUE GAS IN =	11,659 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,659 lbs/hr

BAGHOUSE :

MASS FLUE GAS IN =	11,659 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,659 lbs/hr

STACK :

MASS FLUE GAS OUT =	11,659 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
ENERGY BALANCES

KILN :

HEAT SOLID WASTE IN =	51,494 Btu/hr
HEAT AUXILIARY FUEL IN =	971,500 Btu/hr
HEAT BOTTOM ASH OUT =	0 Btu/hr
RADIATION HEAT LOSS =	3,107 Btu/hr
ENTHALPY FLUE GAS OUT =	1,019,888 Btu/hr

SCC :

ENTHALPY FLUE GAS IN =	1,019,888 Btu/hr
HEAT LIQUID WASTE IN =	0 Btu/hr
HEAT AUXILIARY FUEL IN =	3,691,700 Btu/hr
RADIATION HEAT LOSS =	15,377 Btu/hr
ENTHALPY FLUE GAS OUT =	4,696,211 Btu/hr

HIGH TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	4,696,211 Btu/hr
HEAT SOLIDS OUT =	1 Btu/hr
HEAT REMOVED BY COOLING AIR =	2,611,713 Btu/hr
ENTHALPY FLUE GAS OUT =	2,084,497 Btu/hr

LOW TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	2,084,497 Btu/hr
HEAT SOLIDS OUT =	0 Btu/hr
HEAT REMOVED BY COOLING AIR =	1,828,199 Btu/hr
ENTHALPY FLUE GAS OUT =	256,297 Btu/hr

CYCLONE :

ENTHALPY FLUE GAS IN =	256,297 Btu/hr
HEAT SOLIDS OUT =	4 Btu/hr
ENTHALPY FLUE GAS OUT =	256,294 Btu/hr

BAGHOUSE :

ENTHALPY FLUE GAS IN =	256,294 Btu/hr
HEAT SOLIDS OUT =	8 Btu/hr
ENTHALPY FLUE GAS OUT =	256,286 Btu/hr

STACK :

ENTHALPY FLUE GAS OUT =	256,286 Btu/hr

MASS AND ENERGY CALCULATIONS FOR OPTION 2, OPTIMIZING FUEL/COMBUSTION AIR

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

FEED COMPOSITION TO KILN	AUX FUEL	SOLID WASTE
WEIGHT % C =	87.20 %	22.41 %
WEIGHT % H =	12.50 %	1.36 %
WEIGHT % O =	0.00 %	37.26 %
WEIGHT % N =	0.00 %	9.16 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	28.42 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	13,013 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	100.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	4,553 Btu/lb
FEED RATE TO KILN =	60.00 lbs/hr	11.31 lbs/hr

FEED COMPOSITION TO SCC	AUX FUEL	LIQUID WASTE
WEIGHT % C =	87.20 %	0.00 %
WEIGHT % H =	12.50 %	0.00 %
WEIGHT % O =	0.00 %	0.00 %
WEIGHT % N =	0.00 %	0.00 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	0.00 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	0 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	0.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	0 Btu/lb
FEED RATE TO SCC =	230.00 lbs/hr	0.00 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

DESIGN CRITERIA

INCINERATOR DIMENSIONS	
KILN INSIDE DIAMETER =	2.54 feet
KILN LENGTH =	20.00 feet
KILN INSIDE VOLUME =	101 ft3
KILN SLOPE =	0.188 ft/ft
KILN ROTATIONAL VELOCITY =	1.00 rpm
SCC LENGTH =	4.67 feet
SCC WIDTH =	4.67 feet
SCC HEIGHT =	14.21 feet
SCC INSIDE VOLUME =	310 ft3
COMBUSTION INLET AIR CONDITIONS	
PRIMARY AIR TEMPERATURE =	50 degF
PRIMARY AIR REL HUMIDITY =	70 %
SECONDARY AIR TEMPERATURE =	50 degF
SECONDARY AIR REL HUMIDITY =	70 %
INCINERATOR OPERATING CONDITIONS	
WASTE FEED TEMPERATURES =	70 degF
KILN OPERATING TEMPERATURE =	600 degF
SCC OPERATING TEMPERATURE =	1,600 degF
HIGH TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	800 degF
LOW TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	240 degF
AIR POLLUTION CONTROL REMOVAL EFFICIENCIES	
PARTICULATE REMOVED AS ASH IN KILN =	0.0 %
PARTICULATE REMOVAL IN HIGH TEMP COOLER =	1.0 %
PARTICULATE REMOVAL IN LOW TEMP COOLER =	0.0 %
PARTICULATE REMOVAL IN CYCLONE =	30.0 %
PARTICULATE REMOVAL IN BAGHOUSE =	99.5 %
STACK GAS CONDITIONS	
STACK GAS TEMPERATURE =	240 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

MATERIAL BALANCES	KILN	SCC
LIQUID WASTE FEED =		0.00 lbs/hr
SOLID WASTE FEED =	11.31 lbs/hr	
AUXILIARY FUEL FEED =	60.00 lbs/hr	230.00 lbs/hr
STOICHIOMETRIC AIR REQ'D =	881 lbs/hr	3,288 lbs/hr
COMBUSTION AIR REQUIRED =	1,666 scfm	1,176 scfm
	8,075 lbs/hr	5,701 lbs/hr
EXCESS AIR REQUIRED =	811 %	73 %
FLUE GAS PRODUCED =	8,144 lbs/hr	14,075 lbs/hr
	283 lbmol/hr	488 lbmol/hr
BOTTOM ASH REMOVED =	0 lbs/hr	
KILN SOLIDS RESIDENCE TIME =	8.0 minutes	
MAX GAS RESIDENCE TIME =	1.67 seconds	1.52 seconds
FLUE GAS VELOCITY =	12.0 ft/sec	9.4 ft/sec

ENERGY BALANCES	KILN	SCC
HEAT RELEASE RATE =	1,217,294 Btu/hr	4,468,900 Btu/hr
OPERATING TEMPERATURE =	600 degF	1,600 degF
RADIATION HEAT LOSSES =	3,107 Btu/hr	15,377 Btu/hr
ASH REMOVAL HEAT LOSS =	0 Btu/hr	
SOLID WASTE HEAT INPUT =	51,494 Btu/hr	
AUX FUEL HEAT INPUT =	1,165,800 Btu/hr	4,468,900 Btu/hr
LIQUID WASTE HEAT INPUT =		0 Btu/hr
FLUE GAS ENTHALPY =	1,214,188 Btu/hr	5,667,711 Btu/hr
VOLUMETRIC HEAT RELEASE =	12,012 Btu/hr/ft3	18,338 Btu/hr/ft3

MATERIAL BALANCES	OFF-GAS CLEANING SYSTEM
COOLING AIR FOR HI TEMP GAS COOLER =	118,764 lbs/hr
=	23,639 scfm
COOLING AIR FOR LO TEMP GAS COOLER =	76,682 lbs/hr
=	15,263 scfm
DRY SOLIDS FROM HI TEMP COOLER =	0.00 lbs/hr
DRY SOLIDS FROM LO TEMP COOLER =	0.00 lbs/hr
DRY SOLIDS REMOVED IN CYCLONE =	0.07 lbs/hr
DRY SOLIDS REMOVED IN BAGHOUSE =	0.16 lbs/hr
TOTAL DRY SOLIDS REMOVED IN APCS =	0.23 lbs/hr

ENERGY BALANCES	
HEAT REMOVED BY HI TEMP COOLER =	3,152,825 Btu/hr
COOLING AIR TEMP OUT =	148 degF
HEAT REMOVED BY LO TEMP COOLER =	2,206,978 Btu/hr
COOLING AIR TEMP OUT =	157 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER SEC. COMB. CHAMBER	EMISSIONS AFTER HI TEMP GAS COOLER
FLUE GAS FLOWRATE :		
SCFM :	2,922 scfm	2,922 scfm
ACFM :	12,240 acfm	7,487 acfm
LBMOL/HR :	488 lbmol/hr	488 lbmol/hr
LBS/HR :	14,075 lbs/hr	14,075 lbs/hr
LBS/HR DRY :	13,677 lbs/hr	13,677 lbs/hr
FLUE GAS TEMPERATURE :	1,600 degF	800 degF
FLUE GAS SATURATION TEMP :	171 degF	149 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.4320	0.2003
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	186 ppmv	186 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.74 lbs/hr	1.74 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.09 lbs/hr	2.09 lbs/hr
CONCENTRATION :	93 ppmv	93 ppmv
CO :		
FLOWRATE :	0.39 lbs/hr	0.39 lbs/hr
CONCENTRATION :	28 ppmv	28 ppmv
PARTICULATES :		
FLOWRATE :	0.23 lbs/hr	0.23 lbs/hr
CONCENTRATION :	0.01 gr/dscf	0.01 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER LO TEMP GAS COOLER	EMISSIONS AFTER CYCLONE
FLUE GAS FLOWRATE :		
SCFM :	2,922 scfm	2,922 scfm
ACFM :	4,159 acfm	4,159 acfm
LBMOL/HR :	488 lbmol/hr	488 lbmol/hr
LBS/HR :	14,075 lbs/hr	14,075 lbs/hr
LBS/HR DRY :	13,677 lbs/hr	13,677 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	112 degF	112 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.0607	0.0607
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	186 ppmv	186 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.74 lbs/hr	1.74 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.09 lbs/hr	2.09 lbs/hr
CONCENTRATION :	93 ppmv	93 ppmv
CO :		
FLOWRATE :	0.39 lbs/hr	0.39 lbs/hr
CONCENTRATION :	28 ppmv	28 ppmv
PARTICULATES :		
FLOWRATE :	0.23 lbs/hr	0.16 lbs/hr
CONCENTRATION :	0.0095 gr/dscf	0.0067 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

PARAMETER	EMISSIONS AFTER BAGHOUSE	EMISSIONS AT STACK
FLUE GAS FLOWRATE :		
SCFM :	2,922 scfm	2,922 scfm
ACFM :	4,159 acfm	4,159 acfm
LBMOL/HR :	488 lbmol/hr	488 lbmol/hr
LBS/HR :	14,075 lbs/hr	14,075 lbs/hr
LBS/HR DRY :	13,677 lbs/hr	13,677 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	112 degF	112 degF
FLUE GAS ACTUAL HUMIDITY :	0.0291	0.0291
FLUE GAS SAT HUMIDITY :	0.0607	0.0607
FLUE GAS COMPOSITION :		
N2 :	76.86 %	76.86 %
O2 :	14.21 %	14.21 %
CO2 :	4.36 %	4.36 %
H2O :	4.53 %	4.53 %
EXCESS AIR :	229 %	229 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	186 ppmv	186 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.74 lbs/hr	1.74 lbs/hr
CONCENTRATION :	56 ppmv	56 ppmv
NOx :		
FLOWRATE :	2.09 lbs/hr	2.09 lbs/hr
CONCENTRATION :	93 ppmv	93 ppmv
CO :		
FLOWRATE :	0.39 lbs/hr	0.39 lbs/hr
CONCENTRATION :	28 ppmv	28 ppmv
PARTICULATES :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0.0000 gr/dscf	0.0000 gr/dscf

Note: Particulate concentration leaving stack, corrected to 7% oxygen on a dry basis in the stack gas is 0.0001 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ADDITIONAL MATERIAL BALANCE INFORMATION

WATER ENTERING IN ALL FEED STREAMS =	0 lbs/hr
WATER ENTERING IN COMBUSTION AIR =	72 lbs/hr
WATER IN FLUE GAS LEAVING SCC =	398 lbs/hr
WATER IN FLUE GAS LEAVING STACK =	398 lbs/hr
INERTS ENTERING KILN IN WASTE FEEDS =	0.00 lbs/hr
ASH FORMED IN KILN =	0.23 lbs/hr
TOTAL PARTICULATES FORMED IN KILN =	0.23 lbs/hr
TOTAL ASH REMOVED FROM KILN =	0.00 lbs/hr
TOTAL PARTICULATE LEAVING KILN =	0.23 lbs/hr
TOTAL PARTICULATE FORMED IN SCC =	0.00 lbs/hr
TOTAL PARTICULATES LEAVING SCC =	0.23 lbs/hr

PLUME FORMATION CONDITIONS AT STACK

CRITICAL TEMPERATURE =	21 degF
CRITICAL HUMIDITY =	0.0029 lbs H2O/lb dry air
CRITICAL EQUATION =	H = 0.00012 X T 0.00040

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR MASS BALANCES

KILN :

MASS SOLID WASTE IN =	11 lbs/hr
MASS AUXILIARY FUEL IN =	60 lbs/hr
MASS PRIMARY COMBUSTION AIR IN =	8,075 lbs/hr
MASS BOTTOM ASH OUT =	0 lbs/hr
MASS FLUE GAS OUT =	8,144 lbs/hr

SCC :

MASS FLUE GAS IN =	8,144 lbs/hr
MASS LIQUID WASTE IN =	0 lbs/hr
MASS AUXILIARY FUEL IN =	230 lbs/hr
MASS SECONDARY COMBUSTION AIR IN =	5,701 lbs/hr
MASS FLUE GAS OUT =	14,075 lbs/hr

HIGH TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	14,075 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	14,075 lbs/hr

LOW TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	14,075 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	14,075 lbs/hr

CYCLONE :

MASS FLUE GAS IN =	14,075 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	14,075 lbs/hr

BAGHOUSE :

MASS FLUE GAS IN =	14,075 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	14,075 lbs/hr

STACK :

MASS FLUE GAS OUT =	14,075 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : TRIAL BURN NO. 1
DATE : 01-16-1995

ROTARY KILN INCINERATOR ENERGY BALANCES

KILN :

HEAT SOLID WASTE IN =	51,494 Btu/hr
HEAT AUXILIARY FUEL IN =	1,165,800 Btu/hr
HEAT BOTTOM ASH OUT =	0 Btu/hr
RADIATION HEAT LOSS =	3,107 Btu/hr
ENTHALPY FLUE GAS OUT =	1,214,188 Btu/hr

SCC :

ENTHALPY FLUE GAS IN =	1,214,188 Btu/hr
HEAT LIQUID WASTE IN =	0 Btu/hr
HEAT AUXILIARY FUEL IN =	4,468,900 Btu/hr
RADIATION HEAT LOSS =	15,377 Btu/hr
ENTHALPY FLUE GAS OUT =	5,667,711 Btu/hr

HIGH TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	5,667,711 Btu/hr
HEAT SOLIDS OUT =	1 Btu/hr
HEAT REMOVED BY COOLING AIR =	3,152,825 Btu/hr
ENTHALPY FLUE GAS OUT =	2,514,885 Btu/hr

LOW TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	2,514,885 Btu/hr
HEAT SOLIDS OUT =	0 Btu/hr
HEAT REMOVED BY COOLING AIR =	2,206,978 Btu/hr
ENTHALPY FLUE GAS OUT =	307,907 Btu/hr

CYCLONE :

ENTHALPY FLUE GAS IN =	307,907 Btu/hr
HEAT SOLIDS OUT =	4 Btu/hr
ENTHALPY FLUE GAS OUT =	307,904 Btu/hr

BAGHOUSE :

ENTHALPY FLUE GAS IN =	307,904 Btu/hr
HEAT SOLIDS OUT =	8 Btu/hr
ENTHALPY FLUE GAS OUT =	307,895 Btu/hr

STACK :

ENTHALPY FLUE GAS OUT =	307,895 Btu/hr

MASS AND ENERGY CALCULATIONS FOR OPTION 3, PREHEAT OF COMBUSTION AIR TO THE AFTERBURNER

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

FEED COMPOSITION TO KILN	AUX FUEL	SOLID WASTE
WEIGHT % C =	87.20 %	22.41 %
WEIGHT % H =	12.50 %	1.36 %
WEIGHT % O =	0.00 %	37.26 %
WEIGHT % N =	0.00 %	9.16 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	28.42 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	14,013 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	100.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	4,553 Btu/lb
FEED RATE TO KILN =	60.00 lbs/hr	11.31 lbs/hr

FEED COMPOSITION TO SCC	AUX FUEL	LIQUID WASTE
WEIGHT % C =	87.20 %	0.00 %
WEIGHT % H =	12.50 %	0.00 %
WEIGHT % O =	0.00 %	0.00 %
WEIGHT % N =	0.00 %	0.00 %
WEIGHT % S =	0.30 %	0.00 %
WEIGHT % Cl =	0.00 %	0.00 %
WEIGHT % F =	0.00 %	0.00 %
WEIGHT % Br =	0.00 %	0.00 %
WEIGHT % P =	0.00 %	0.00 %
PPM Si =	0 ppm	0 ppm
PPM Na K B Ca Mg =	0 ppm	0 ppm
PPM HEAVY METALS =	0 ppm	0 ppm
WEIGHT % COMBUSTIBLES =	100.00 %	0.00 %
WEIGHT % WATER =	0.00 %	0.00 %
WEIGHT % INERTS =	0.00 %	0.00 %
HIGHER HEATING VALUE =	19,430 Btu/lb	0 Btu/lb
FEED RATE TO SCC =	200.00 lbs/hr	0.00 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

DESIGN CRITERIA

INCINERATOR DIMENSIONS	
KILN INSIDE DIAMETER =	2.54 feet
KILN LENGTH =	20.00 feet
KILN INSIDE VOLUME =	101 ft3
KILN SLOPE =	0.188 ft/ft
KILN ROTATIONAL VELOCITY =	1.00 rpm
SCC LENGTH =	4.67 feet
SCC WIDTH =	4.67 feet
SCC HEIGHT =	14.21 feet
SCC INSIDE VOLUME =	310 ft3
COMBUSTION INLET AIR CONDITIONS	
PRIMARY AIR TEMPERATURE =	50 degF
PRIMARY AIR REL HUMIDITY =	70 %
SECONDARY AIR TEMPERATURE =	180 degF
SECONDARY AIR REL HUMIDITY =	10 %
INCINERATOR OPERATING CONDITIONS	
WASTE FEED TEMPERATURES =	70 degF
KILN OPERATING TEMPERATURE =	650 degF
SCC OPERATING TEMPERATURE =	1,600 degF
HIGH TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	800 degF
LOW TEMP GAS COOLER OPERATING CONDITIONS	
FLUE GAS OUTLET TEMPERATURE =	240 degF
AIR POLLUTION CONTROL REMOVAL EFFICIENCIES	
PARTICULATE REMOVED AS ASH IN KILN =	0.0 %
PARTICULATE REMOVAL IN HIGH TEMP COOLER =	1.0 %
PARTICULATE REMOVAL IN LOW TEMP COOLER =	0.0 %
PARTICULATE REMOVAL IN CYCLONE =	30.0 %
PARTICULATE REMOVAL IN BAGHOUSE =	99.5 %
STACK GAS CONDITIONS	
STACK GAS TEMPERATURE =	240 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ROTARY KILN INCINERATOR
MATERIAL AND ENERGY BALANCES
100 % LOAD

MATERIAL BALANCES	KILN	SCC
LIQUID WASTE FEED =		0.00 lbs/hr
SOLID WASTE FEED =	11.31 lbs/hr	
AUXILIARY FUEL FEED =	60.00 lbs/hr	200.00 lbs/hr
STOICHIOMETRIC AIR REQ'D =	881 lbs/hr	2,859 lbs/hr
COMBUSTION AIR REQUIRED =	1,539 scfm	757 scfm
	7,458 lbs/hr	3,670 lbs/hr
EXCESS AIR REQUIRED =	742 %	28 %
FLUE GAS PRODUCED =	7,530 lbs/hr	11,400 lbs/hr
	261 lbmol/hr	402 lbmol/hr
BOTTOM ASH REMOVED =	0 lbs/hr	
KILN SOLIDS RESIDENCE TIME =	8.0 minutes	
MAX GAS RESIDENCE TIME =	1.72 seconds	1.85 seconds
FLUE GAS VELOCITY =	11.6 ft/sec	7.7 ft/sec

ENERGY BALANCES	KILN	SCC
HEAT RELEASE RATE =	1,217,294 Btu/hr	3,886,000 Btu/hr
OPERATING TEMPERATURE =	650 degF	1,600 degF
RADIATION HEAT LOSSES =	3,200 Btu/hr	15,377 Btu/hr
ASH REMOVAL HEAT LOSS =	0 Btu/hr	
SOLID WASTE HEAT INPUT =	51,494 Btu/hr	
AUX FUEL HEAT INPUT =	1,165,800 Btu/hr	3,886,000 Btu/hr
LIQUID WASTE HEAT INPUT =		0 Btu/hr
FLUE GAS ENTHALPY =	1,214,095 Btu/hr	5,084,718 Btu/hr
VOLUMETRIC HEAT RELEASE =	12,012 Btu/hr/ft3	16,457 Btu/hr/ft3

MATERIAL BALANCES	OFF-GAS CLEANING SYSTEM
COOLING AIR FOR HI TEMP GAS COOLER =	118,764 lbs/hr
=	23,639 scfm
COOLING AIR FOR LO TEMP GAS COOLER =	76,682 lbs/hr
=	15,263 scfm
DRY SOLIDS FROM HI TEMP COOLER =	0.02 lbs/hr
DRY SOLIDS FROM LO TEMP COOLER =	0.00 lbs/hr
DRY SOLIDS REMOVED IN CYCLONE =	0.68 lbs/hr
DRY SOLIDS REMOVED IN BAGHOUSE =	1.59 lbs/hr
TOTAL DRY SOLIDS REMOVED IN APCS =	2.29 lbs/hr

ENERGY BALANCES	
HEAT REMOVED BY HI TEMP COOLER =	2,553,572 Btu/hr
COOLING AIR TEMP OUT =	130 degF
HEAT REMOVED BY LO TEMP COOLER =	1,787,500 Btu/hr
COOLING AIR TEMP OUT =	136 degF

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

PARAMETER	EMISSIONS AFTER SEC. COMB. CHAMBER	EMISSIONS AFTER HI TEMP GAS COOLER
FLUE GAS FLOWRATE :		
SCFM :	2,404 scfm	2,404 scfm
ACFM :	10,069 acfm	6,159 acfm
LBMOL/HR :	402 lbmol/hr	402 lbmol/hr
LBS/HR :	11,400 lbs/hr	11,400 lbs/hr
LBS/HR DRY :	10,746 lbs/hr	10,746 lbs/hr
FLUE GAS TEMPERATURE :	1,600 degF	800 degF
FLUE GAS SATURATION TEMP :	174 degF	155 degF
FLUE GAS ACTUAL HUMIDITY :	0.0609	0.0609
FLUE GAS SAT HUMIDITY :	0.4896	0.2409
FLUE GAS COMPOSITION :		
N2 :	73.42 %	73.42 %
O2 :	12.73 %	12.73 %
CO2 :	4.76 %	4.76 %
H2O :	9.04 %	9.04 %
EXCESS AIR :	177 %	177 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	226 ppmv	226 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.56 lbs/hr	1.56 lbs/hr
CONCENTRATION :	61 ppmv	61 ppmv
NOx :		
FLOWRATE :	2.05 lbs/hr	2.05 lbs/hr
CONCENTRATION :	111 ppmv	111 ppmv
CO :		
FLOWRATE :	0.35 lbs/hr	0.35 lbs/hr
CONCENTRATION :	31 ppmv	31 ppmv
PARTICULATES :		
FLOWRATE :	2.30 lbs/hr	2.28 lbs/hr
CONCENTRATION :	0.12 gr/dscf	0.12 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

PARAMETER	EMISSIONS AFTER LO TEMP GAS COOLER	EMISSIONS AFTER CYCLONE
FLUE GAS FLOWRATE :		
SCFM :	2,404 scfm	2,404 scfm
ACFM :	3,422 acfm	3,421 acfm
LBMOL/HR :	402 lbmol/hr	402 lbmol/hr
LBS/HR :	11,400 lbs/hr	11,399 lbs/hr
LBS/HR DRY :	10,746 lbs/hr	10,746 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	125 degF	125 degF
FLUE GAS ACTUAL HUMIDITY :	0.0609	0.0609
FLUE GAS SAT HUMIDITY :	0.0912	0.0912
FLUE GAS COMPOSITION :		
N2 :	73.42 %	73.42 %
O2 :	12.73 %	12.73 %
CO2 :	4.76 %	4.76 %
H2O :	9.04 %	9.04 %
EXCESS AIR :	177 %	177 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	226 ppmv	226 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.56 lbs/hr	1.56 lbs/hr
CONCENTRATION :	61 ppmv	61 ppmv
NOx :		
FLOWRATE :	2.05 lbs/hr	2.05 lbs/hr
CONCENTRATION :	111 ppmv	111 ppmv
CO :		
FLOWRATE :	0.35 lbs/hr	0.35 lbs/hr
CONCENTRATION :	31 ppmv	31 ppmv
PARTICULATES :		
FLOWRATE :	2.28 lbs/hr	1.59 lbs/hr
CONCENTRATION :	0.1215 gr/dscf	0.0851 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

PARAMETER	EMISSIONS AFTER BAGHOUSE	EMISSIONS AT STACK
FLUE GAS FLOWRATE :		
SCFM :	2,404 scfm	2,404 scfm
ACFM :	3,421 acfm	3,421 acfm
LBMOL/HR :	402 lbmol/hr	402 lbmol/hr
LBS/HR :	11,398 lbs/hr	11,398 lbs/hr
LBS/HR DRY :	10,746 lbs/hr	10,746 lbs/hr
FLUE GAS TEMPERATURE :	240 degF	240 degF
FLUE GAS SATURATION TEMP :	125 degF	125 degF
FLUE GAS ACTUAL HUMIDITY :	0.0609	0.0609
FLUE GAS SAT HUMIDITY :	0.0912	0.0912
FLUE GAS COMPOSITION :		
N2 :	73.42 %	73.42 %
O2 :	12.73 %	12.73 %
CO2 :	4.76 %	4.76 %
H2O :	9.04 %	9.04 %
EXCESS AIR :	177 %	177 %
FLUE GAS CONTAMINANTS :		
HCl :		
FLOWRATE :	3.31 lbs/hr	3.31 lbs/hr
CONCENTRATION :	226 ppmv	226 ppmv
HF :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
Br2 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
P2O5 :		
FLOWRATE :	0.00 lbs/hr	0.00 lbs/hr
CONCENTRATION :	0 ppmv	0 ppmv
SO2 :		
FLOWRATE :	1.56 lbs/hr	1.56 lbs/hr
CONCENTRATION :	61 ppmv	61 ppmv
NOx :		
FLOWRATE :	2.05 lbs/hr	2.05 lbs/hr
CONCENTRATION :	111 ppmv	111 ppmv
CO :		
FLOWRATE :	0.35 lbs/hr	0.35 lbs/hr
CONCENTRATION :	31 ppmv	31 ppmv
PARTICULATES :		
FLOWRATE :	0.01 lbs/hr	0.01 lbs/hr
CONCENTRATION :	0.0004 gr/dscf	0.0004 gr/dscf

Note: Particulate concentration leaving stack, corrected to 7% oxygen on a dry basis in the stack gas is 0.0009 gr/dscf

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ADDITIONAL MATERIAL BALANCE INFORMATION

WATER ENTERING IN ALL FEED STREAMS =	0 lbs/hr
WATER ENTERING IN COMBUSTION AIR =	392 lbs/hr
WATER IN FLUE GAS LEAVING SCC =	654 lbs/hr
WATER IN FLUE GAS LEAVING STACK =	654 lbs/hr
INERTS ENTERING KILN IN WASTE FEEDS =	0.00 lbs/hr
ASH FORMED IN KILN =	2.30 lbs/hr
TOTAL PARTICULATES FORMED IN KILN =	2.30 lbs/hr
TOTAL ASH REMOVED FROM KILN =	0.00 lbs/hr
TOTAL PARTICULATE LEAVING KILN =	2.30 lbs/hr
TOTAL PARTICULATE FORMED IN SCC =	0.00 lbs/hr
TOTAL PARTICULATES LEAVING SCC =	2.30 lbs/hr

PLUME FORMATION CONDITIONS AT STACK

CRITICAL TEMPERATURE =	44 degF
CRITICAL HUMIDITY =	0.0070 lbs H2O/lb dry air
CRITICAL EQUATION =	H = 0.00028 X T-0.00517

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ROTARY KILN INCINERATOR
MASS BALANCES

KILN :

MASS SOLID WASTE IN =	11 lbs/hr
MASS AUXILIARY FUEL IN =	60 lbs/hr
MASS PRIMARY COMBUSTION AIR IN =	7,458 lbs/hr
MASS BOTTOM ASH OUT =	0 lbs/hr
MASS FLUE GAS OUT =	7,530 lbs/hr

SCC :

MASS FLUE GAS IN =	7,530 lbs/hr
MASS LIQUID WASTE IN =	0 lbs/hr
MASS AUXILIARY FUEL IN =	200 lbs/hr
MASS SECONDARY COMBUSTION AIR IN =	3,670 lbs/hr
MASS FLUE GAS OUT =	11,400 lbs/hr

HIGH TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	11,400 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,400 lbs/hr

LOW TEMPERATURE GAS COOLER :

MASS FLUE GAS IN =	11,400 lbs/hr
MASS SOLIDS OUT =	0 lbs/hr
MASS FLUE GAS OUT =	11,400 lbs/hr

CYCLONE :

MASS FLUE GAS IN =	11,400 lbs/hr
MASS SOLIDS OUT =	1 lbs/hr
MASS FLUE GAS OUT =	11,399 lbs/hr

BAGHOUSE :

MASS FLUE GAS IN =	11,399 lbs/hr
MASS SOLIDS OUT =	2 lbs/hr
MASS FLUE GAS OUT =	11,398 lbs/hr

STACK :

MASS FLUE GAS OUT =	11,398 lbs/hr

CLIENT : SENECA
JOB NO. : 726373
SUBJECT : AIR PREHEAT
DATE : 02-02-1995

ROTARY KILN INCINERATOR
ENERGY BALANCES

KILN :

HEAT SOLID WASTE IN =	51,494 Btu/hr
HEAT AUXILIARY FUEL IN =	1,165,800 Btu/hr
HEAT BOTTOM ASH OUT =	0 Btu/hr
RADIATION HEAT LOSS =	3,200 Btu/hr
ENTHALPY FLUE GAS OUT =	1,214,095 Btu/hr

SCC :

ENTHALPY FLUE GAS IN =	1,214,095 Btu/hr
HEAT LIQUID WASTE IN =	0 Btu/hr
HEAT AUXILIARY FUEL IN =	3,886,000 Btu/hr
RADIATION HEAT LOSS =	15,377 Btu/hr
ENTHALPY FLUE GAS OUT =	5,084,718 Btu/hr

HIGH TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	5,084,718 Btu/hr
HEAT SOLIDS OUT =	5 Btu/hr
IEAT REMOVED BY COOLING AIR =	2,553,572 Btu/hr
ENTHALPY FLUE GAS OUT =	2,531,141 Btu/hr

LOW TEMPERATURE GAS COOLER :

ENTHALPY FLUE GAS IN =	2,531,141 Btu/hr
HEAT SOLIDS OUT =	0 Btu/hr
HEAT REMOVED BY COOLING AIR =	1,787,500 Btu/hr
ENTHALPY FLUE GAS OUT =	743,641 Btu/hr

CYCLONE :

ENTHALPY FLUE GAS IN =	743,641 Btu/hr
HEAT SOLIDS OUT =	36 Btu/hr
ENTHALPY FLUE GAS OUT =	743,606 Btu/hr

BAGHOUSE :

ENTHALPY FLUE GAS IN =	743,606 Btu/hr
HEAT SOLIDS OUT =	83 Btu/hr
ENTHALPY FLUE GAS OUT =	743,523 Btu/hr

STACK :

ENTHALPY FLUE GAS OUT =	743,523 Btu/hr

APPENDIX A

COSTS FOR FABRIC FILTER REPLACEMENT

Filter Replacement Costs

Work performed by DOA maintenance staff

Filters

Goretex membrane/teflon "B" fiberglass		
Filter bags - 100 each plus 10 spares		
	110 x $82.22 each =	9,044.20

Vertical Support Wire

20 vertical wire 4.5" dia. x 96"		
Mild steel cages		
	100 each plus 4 spares	
	104 x $10.80 =	1,123.20

Installation Labor

Unload and cleanout baghouse		
Install filter bags and cages,		
dispose of old cages (non-hazardous)		
	32 hours x $45/hr. =	$ 1,440.00
	Total Estimated Cost	$11,607.40

QUOTATION

GORE
Creative Technologies Worldwide

W. L. GORE & ASSOCIATES, INC.
FILTRATION TECHNOLOGIES
101 LEWISVILLE RD. • P.O. BOX 1100
ELKTON, MARYLAND 21922-1100
PHONE: 410/392-3300 • FAX: 410/398-6624

Parsons Engineering Science
Prudential Center

Boston, MA 02199-7697

Attention: Mr. Don Yanika

No. JM2664

PAGE 1 **OF** 3

DATE: January 4, 1995

REF: Seneca Army Depot (Deactivation Furnace)

TERMS: Net 30 days   F.O.B. ELKTON, MD (FREIGHT COLLECT)

ITEM	QUANTITY	DESCRIPTION	U.S. DOLLARS
01	100	GORE-TEX® Membrane/SUPERFLEX™ Fabric (20 oz/yd² woven fabric) Filter Bags Gore part number to be assigned Designed to fit a MikroPul collector requiring bags 4.69" diameter x 99.75" long. Top: Open with sealing cuff Bottom: Closed, round with reinforced cuff Shipment: 10 - 12 weeks ARO	$ 109.03 ea
02	100	GORE-TEX® Membrane/Teflon® B Fiberglass Fabric (16.8 oz/yd² woven fabric) Filter Bags Gore part number to be assigned Designed to fit a MikroPul collector requiring bags 4.69" diameter x 99.75" long. Top: Open with sealing cuff Bottom: Closed, round with reinforced cuff Shipment: 5 - 7 weeks ARO	$ 82.22 ea
03	100	GORE-TEX® Membrane/Ryton® Felt (RASTEX® Scrim) (16 oz/yd² felted fabric) Filter Bags Gore part number to be assigned Designed to fit a MikroPul collector requiring bags 4.69" diameter x 99.75" long. Top: Open with sealing cuff Bottom: Closed, round with reinforced cuff Shipment: 10 - 12 weeks ARO	$ 106.38 ea

THE GORE-TEX APPROACH

Minimum Order: $500.00

ORDERS ARE ACCEPTED SUBJECT TO CREDIT APPROVAL AND TERMS AND CONDITIONS ON REVERSE SIDE.

PAYMENT MUST BE MADE AT PAR IN U.S. FUNDS.

PRICES QUOTED ARE SUBJECT TO ACCEPTANCE WITHIN 30 DAYS FROM DATE OF QUOTATION

BY [signature] Jay Middleton
Elkton, MD

QUOTATION

W. L. GORE & ASSOCIATES, INC.
FILTRATION TECHNOLOGIES
101 LEWISVILLE RD. • P.O. BOX 1100
ELKTON, MARYLAND 21922-1100
PHONE: 410/392-3300 • FAX: 410/398-6624

GORE Creative Technologies Worldwide

Parsons Engineering Science
Prudential Center

Boston, MA 02199-7697

Attention: Mr. Don Yanika

No. JM2664

PAGE 2 **OF** 3

DATE: January 4, 1995

REF: Seneca Army Depot (Deactivation Furnace)

TERMS: Net 30 days F.O.B. ELKTON, MD (FREIGHT COLLECT)

ITEM	QUANTITY	DESCRIPTION	U.S. DOLLARS
04	100	GORE-TEX® Membrane/Nomex® Aramid Felt (14 oz/yd² felted fabric) Filter Bags Gore part number to be assigned Designed to fit a MikroPul collector requiring bags 4.69" diameter x 99.75" long. Top: Open with sealing cuff Bottom: Closed, round with reinforced cuff Shipment: 5 - 7 weeks ARO	$ 90.35 ea
05	100	Gore part number to be assigned Mild Steel cages, 4.5" +0" -1/32" diameter x 96" +0" -1/16" long, 20 vertical wires, 8" horizontal ring spacing. Top: Split collar Bottom: Crimped cup Shipment: 5 - 6 weeks ARO	$ 10.80 ea
06	100	Gore part number to be assigned Mild Steel cages, 4.5" +0" -1/32" diameter x 96" +0" -1/16" long, 10 vertical wires, 8" horizontal ring spacing. Top: Split collar Bottom: Crimped cup Shipment: 5 - 6 weeks ARO	$ 8.19 ea

THE GORE-TEX APPROACH

Minimum Order: $500.00

ORDERS ARE ACCEPTED SUBJECT TO CREDIT APPROVAL AND TERMS AND CONDITIONS ON REVERSE SIDE.

PAYMENT MUST BE MADE AT PAR IN U.S. FUNDS.

PRICES QUOTED ARE SUBJECT TO ACCEPTANCE WITHIN 30 DAYS FROM DATE OF QUOTATION

BY [signature] Jay Middleton
Elkton, MD

QUOTATION

GORE Creative Technologies Worldwide

W. L. GORE & ASSOCIATES, INC.
FILTRATION TECHNOLOGIES
101 LEWISVILLE RD. • P.O. BOX 1100
ELKTON, MARYLAND 21922-1100
PHONE: 410/392-3300 • FAX: 410/398-6624

Parsons Engineering Science
Prudential Center

Boston, MA 02199-7697

Attention: Mr. Don Yanika

No. JM2664

DATE: January 4, 1995

REF: Seneca Army Depot (Deactivation Furnace)

TERMS: Net 30 days F.O.B. ELKTON, MD (FREIGHT COLLECT)

ITEM	QUANTITY	DESCRIPTION	U.S. DOLLARS

NOTES:

W. L. Gore & Associates, Inc.'s installation procedures shall be followed. Ten percent spares are recommended. The verification of all information for construction purposes prior to manufacturing is required.

This document is considered confidential and proprietary. It is intended only for the use of those who are employed by, or customers of Parsons Engineering Science and/or W. L. Gore & Associates, Inc.

Bag designed to fit a cage 4.5" +0" -1/32" diameter x 96.0" +0" -1/16" overall length, with a minimum of 20 vertical wires. All cages should be within above tolerances throughout, and free of all burrs. Bags quoted are for a one-piece cage unless otherwise noted.

Verification of cage dimensions and tolerances is required prior to manufacture of filter bags.

The above price(s) is/are subject to change upon bag, cage, and tube sheet hole dimension verification.

If the standard shipping schedule quoted above is not satisfactory, please don't hesitate to call and discuss your needs. *We will make every effort to meet your specific requirements!*

W. L. Gore & Associates, Inc. shall be given the option to supervise/observe installation of filter bags/cartridges; this service is free of charge. Please allow a minimum of five days' notice prior to installation.

We appreciate the opportunity to quote on your filtration needs.

cc: Jack Woolston, W. L. Gore & Associates, Inc., Windham, ME
John Czerwinski, W. L. Gore & Associates, Inc., Elkton, MD
Glenn Brinckman, W. L. Gore & Associates, Inc., Elkton, MD
Ken Walker, W. L. Gore & Associates, Inc., Elkton, MD

™SUPERFLEX is a trademark of W. L. Gore & Associates, Inc.
®Teflon is a registered trademark of E. I. duPont de Nemours & Co., Inc.
®Ryton is a registered trademark of Phillips Petroleum Company
®Nomex is a registered trademark of E. I. duPont de Nemours & Co., Inc.

THE GORE-TEX APPROACH

Minimum Order: $500.00

ORDERS ARE ACCEPTED SUBJECT TO CREDIT APPROVAL AND TERMS AND CONDITIONS ON REVERSE SIDE.

PAYMENT MUST BE MADE AT PAR IN U.S. FUNDS.

PRICES QUOTED ARE SUBJECT TO ACCEPTANCE WITHIN 30 DAYS FROM DATE OF QUOTATION

BY [signature] Jay Middleton
Elkton, MD

GORE-TEX® MEMBRANE FILTRATION PRODUCTS

FILTRATION LAMINATE TECHNICAL DATA:

GORE-TEX® MEMBRANE/ TEFLON® B FIBERGLASS FABRIC

Fabric Construction:	Modified Crowfoot
Fiber Content:	ECDE Fiberglass
Continuous Operating Temperature:	500°F (260°C)
Maximum Surge Temperature:	550°F (288°C)
Acid Resistance:	Very Good
Alkali Resistance:	Fair
Weight:	16.8 oz/yd^2
Breaking Strength:	
Machine Direction:	290 lbs/1" Ravel
Cross Machine Direction:	225 lbs/1" Ravel
Mullen Burst:	600 psi
Thickness:	0.028"

All data expressed as typical values.

Revised: May 16, 1991
®Teflon is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

W. L. Gore & Associates, Inc.
101 Lewisville Rd., P.O. Box 1100, Elkton, MD 21922-1100
Phone: 410-392-3300 Fax: 410-398-6624

W. L. GORE & ASSOCIATES, INC.

101 LEWISVILLE ROAD • P. O. BOX 1100 • ELKTON, MARYLAND 21922-1100
PHONE: 410/392-3300 FAX: 410/398-6624

FILTRATION TECHNOLOGIES

GORE
Creative Technologies Worldwide

FAX

DATE: February 3, 1995
ATTENTION: Mr. Don Yanika
COMPANY: Parsons Engineering Science, Inc.
LOCATION: Boston, MA
FACSIMILE NUMBER: 617-859-2043
FROM: Glenn Brinckman / OPERATOR: gab
TOTAL NUMBER OF PAGES: 2 *(including this cover page)*

If you do not receive all the pages specified above, please call 410/392-3300 as soon as possible. Thank you.

Dear Don:

Attached is a data sheet of achieved PM emissions on numerous dry scrubbing fabric filter systems. They are all medical waste incinerators in which the baghouse is the last piece of air pollution control equipment prior to the stack. As you can see, the achieved PM emissions are below the required 0.015 gr/dscf @ 7% O_2.

Call me if you need further clarification or information.

Sincerely,
Glenn A. Brinckman

cc: Mr. John Czerwinski
W. L. Gore & Associates, Inc.
Elkton, MD

GAB:seneca4.doc

Achieved PM Emission Results

GORE-TEX® membrane/Teflon® B fiberglass fabric (16.8 oz/yd²)

Dry Scrubbing Systems

I. Medical Waste Incinerator, AI

PM Emissions = 0.003 gr/dscf @ 7% O_2
8000 acfm @ 300°F, 30% H_2O
A/C = 2.4:1

II. Medical Waste Incinerator, FL

PM = 0.001 gr/dscf @ 7% O_2
16,980 acfm @ 350°F, 10% H_2O
A/C = 2.0:1

III. Medical Waste Incinerator, MI

PM = 0.0017 gr/dscf @ 7% O_2
7600 acfm @ 280°F, 10% H_2O
A/C = 1.8:1

IV. Medical Waste Incinerator, IL

PM = 0.007 gr/dscf @ 7% O_2
6500 acfm @ 265°F, 10% H_2O
A/C = 2.5:1

V. Medical Waste Incinerator, RI

PM = 0.00047 gr/dscf @ 7% O_2
3210 acfm @ 290°F, 9.5% H_2O
A/C = 3.96:1

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®Teflon is a registered trademark of E. I. du Pont de Nemours & Co., Inc.

APPENDIX A

COSTS FOR FABRIC FILTER REPLACEMENT

Filter Replacement Costs

Work performed by DOA maintenance staff

Filters

Goretex membrane/teflon "B" fiberglass
Filter bags - 100 each plus 10 spares
110 x $82.22 each = 9,044.20

Vertical Support Wire

20 vertical wire 4.5" dia. x 96"
Mild steel cages
100 each plus 4 spares
104 x $10.80 = 1,123.20

Installation Labor

Unload and cleanout baghouse
Install filter bags and cages,
dispose of old cages (non-hazardous)
32 hours x $45/hr. = $ 1,440.00

Total Estimated Cost $11,607.40

APPENDIX B

COMMUNICATIONS AND TRIP REPORT

APPENDIX B

COMMUNICATIONS AND TRIP REPORT

PARSONS ENGINEERING SCIENCE, INC.

TRIP REPORT

CLIENT: Seneca Army Depot

DIVISION:

PROJECT: Deactivation Furnace Process Evaluation

DISTRICT:

COMPANY VISITED: Seneca Army Depot

JOB NO.: 726373-01001

LOCATION: Romulus, N.Y.

SERIAL NO:

PERIOD COVERED: 3/16/95

DATE ISSUED: 3/21/95

PURPOSE OF TRIP: Review Deactivation Furnace

PAGE 1 OF 1

PERSONNEL CONTACTED: Earl Hayword
Lavarn Conover

COPIES: M. Duchesneau

Purpose of visit was to review system past operations with explosives operators and assess present condition of baghouse. System has not operated in Approx. 6 years. The following new equipment has been installed and not operated; cyclone separator, high and low temperature coolers, afterburner, automatic waste feed and monitoring system, vent shroud on retort, discharge conveyor.

Baghouse appears in good condition with all filter bags and cages removed. Nomex bags were only replaced twice during the 10 years the operators ran the system, once when a fire occurred. Nomex bags, when replaced, were difficult to condition. Pulse air unit cycles continuously to clean filter bags.

Previous system arrangement had a flame arrestor installed upstream of bag filter and had to be cleaned on a frequent basis. Combustion air to the afterburner huack burner is ducted from the inlet chute enclosure. Per system operators, access is required at the discharge chute outlet in case of system pluggage and to inspect for munitions.

Don Yonika

dy\lmf\D#12

PARSONS ENGINEERING SCIENCE, INC.

MEMORANDUM OF TELEPHONE CONVERSATION

	NAME	COMPANY	
WITH:	Mark Crawford	Red River Army Depot	JOB NO.: 726373-01001
			FILE NO.:
CLIENT:	Seneca Army Depot		DATE: 1/4/95
PROJECT:	Process Evaluation		TIME: 9:00 a.m.
SUBJECT OF CONVERSATION:	Bag Filter Retrofits, DRE for POHC.		INITIATED BY: D. Yonika
			TEL. NO.:903-334-2594

DISCUSSION

Red River and AEHA has just submitted their trial burn plan. Revisions incorporated for the trial burn include change of Nomex bag filters to Goretex units. The decision to use Goretex is based on the operating results obtained from retrofits at Radford, VA deactivation furnace and references obtained from other Goretex unit retrofits. The Goretex units are expected to last 1 1/2 to 2 years in service and require replacement of existing 10 wire cage with 20 wire cage. Red River did not wish to expend additional money for the proposed "Superflex" units for longer service life.

Red River is not planning on making changes to the afterburner or feed rates to meet DRE for HCB. Mark Crawford was not sure of the residence time proposed in the trial burn, but believes it is in the range of the Tooele/Seneca units residence times of 1 to 1.3 seconds.

Donald Yonika

DY/cmf/D#12

W. L. GORE & ASSOCIATES, INC.

GORE
Creative Technologies Worldwide

101 LEWISVILLE ROAD • P. O. BOX 1100 • ELKTON, MARYLAND 21922-1100
PHONE: 410/392-3300 FAX: 410/398-6624

FILTRATION TECHNOLOGIES

FAX

DATE: January 4, 1995
ATTENTION: Mr. Don Yanika
COMPANY: Parsons Engineering Science, Inc.
LOCATION: Boston, MA
FACSIMILE NUMBER: 617-859-2043
FROM: Glenn Brinckman / OPERATOR: deo
TOTAL NUMBER OF PAGES: 5 *(including this cover page)*

If you do not receive all the pages specified above, please call 410/392-3300 as soon as possible. Thank you.

Dear Don:

I have reviewed the data for the proposed system upgrade and the following are my comments and suggestions for further review and system analysis. The comments are based on both trial burn test No. 9 and No. 5.

1. Test No. 5 is considered to be the highest loading. However, this is only 2.57 gr/dscf entering the baghouse. This is relatively low as compared to loadings as high as 10 gr/dscf for many of our applications. In these applications, GORE-TEX® membrane filter bags have achieved outlet PM emissions lower than 0.002 gr/dscf @ 7% O_2. Therefore, 0.015 gr/dscf @ 7% O_2 should be no problem.

2. The fly ash evacuation system should be sized sufficiently enough as to prevent any hopper fillups with fly ash. Based on a loading of 3 gr/dscf and an airflow rate of 3200 scfm, the loading to the baghouse is about 82 pounds/hr. The hopper evacuation system should be sized to handle about 100 pounds/hr to allow for some margin of safety. Hopper level indicators are an effective tool to monitor the collection of ash within the hopper. Also, hopper vibrators are often used to prevent the hopper ash from bridging across the hopper outlet.

3. The pulse air system should have a pressure regulator so as to regulate the pulse pressure. The following are our recommendations for pulse air pressure:

   GORE-TEX membrane/woven fabric filter bags = 50 - 70 psig
   (such as SUPERFLEX™ fabric laminate)
   GORE-TEX membrane/felted filter bags = 80 - 100 psig
   (such as Nomex® felt laminate)

4. A photohelic should be incorporated with the pulsing system to allow the baghouse to pulse on-demand. This will help maximize filter bag life and minimize pulsed air consumption. Whereas this is not absolutely necessary, it adds to a more flexible style of operation.

5. The existing cages should be inspected for size and structural condition. First, are the existing cages in good condition, free of rust and other abrasive build-up, free of burns and broken wires, etc. If they are structurally sound, they can be reused if they are carefully removed and stored in a clean, dry location. Is space available for this type of storage?

6. If the cages are reusable, how many vertical wires do the cages have? For GORE-TEX membrane/woven fabric filter bags (such as SUPERFLEX fabric laminate), we recommend cages with a minimum of 20 vertical wires. For GORE-TEX membrane/felted filter bags (such as Nomex felt), only a ten vertical wire cage is necessary. However, a twenty vertical wire cage will also work, and it adds flexibility to your filter media of choice.

7. If the existing cages are to be reused, Gore would like to have one sent to our facility for evaluation and measurements. Precise measurements of the cage length and diameter across the length are imperative to good filter bag fit. Gore will not fabricate a woven fabric laminate bag without a sample cage to test fit. If new cages are required, they can be ordered from Gore. This way there is no problem in having a sample cage for test fit.

8. A measurement of the cross-section of the inlet duct would be helpful to be able to do a calculation of the velocity of the flue gas stream entering the baghouse. That is, the volumetric airflow divided by the cross-sectional area. If the collector has a baffle plate at the inlet, then an airflow inlet velocity of up to 3000 ft/min is acceptable. If the inlet velocity is too high, the filter bags will suffer excessive particulate abrasion induced by the high velocities, resulting in broken filter bags. Also, the condition of the baffle (if it exists) should be evaluated to ensure it is in good condition.

9. The conditions for the trial burn as outlined on your data sheet appear to be very acceptable and nothing out of the ordinary. Temperatures are well within the ranges of the quoted filter media and acid gas levels are minimal.

10. Attached please find price quotations for the various filter medias we discussed earlier. You should have the specification sheets from my previous FAX.

I hope this information is helpful to you and your colleagues. Please feel free to contact me if you have any further questions or problems.

Sincerely,

Glenn A. Brinckman

GAB (deo)

Attachment: Gore Quotation No. JM2664

cc: Mr. John Czerwinski, Ms. Mary Ann Null, W. L. Gore & Associates, Inc., Elkton, MD

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SUPERFLEX is a trademark of W. L. Gore & Associates,

PARSONS ENGINEERING SCIENCE, INC.

MEMORANDUM OF TELEPHONE CONVERSATION

NAME	**COMPANY**	
WITH: John Hosman	Olin Defense Systems	**JOB NO.**:
		FILE NO.:
CLIENT: Seneca Army Depot		**DATE**: 2/6/95
PROJECT: Deactivation Furnace Process Evaluation		**TIME**:
SUBJECT OF CONVERSATION:		**INITIATED BY**: D.Y. DY
Olin Defense System - Lake City DOA Deactivation Furnace		**TEL. NO.**: (816) 796-7477

DISCUSSION

Operation with higher temperatures in afterburner system has reflected increased problem with lead oxide scaling. At 1200°F a slight build up of lead oxide was noticed. Unit now operates at 1400 to 1450°f. Unit has to be shut down every 1 to 2 weeks to remove scale in downstream afterburner. 80% of this scale is in gas cooler with remainder picked up in the baghouse. The sonic horns in the discharge hopper of the aircoolers is capable of keeping the hopper clear of scale.

The cyclone separator removes very little material.

Discussed possibility of injecting dilution air downstream of afterburner, since lead carry over at 1200° F or less has been observed to be discrete particles & easily removed. System control is considered difficult with dilution air and trying to maintain slight negative pressure in retort.

Lake City reviewed changing from Nomex to Goretex filters. Space was available to add additional 20 plus bag units to reduce A/C ratio. This solved a problem with reentrainment of back pulsed cake into the process stream and changeover was not required to the Goretex units.

DY\lmf\D#12

PARSONS ENGINEERING SCIENCE, INC.

MEMORANDUM OF TELEPHONE CONVERSATION

	NAME	COMPANY	
WITH:	John Martin	Dupont	**JOB NO.:** 726373-01001
			FILE NO.:
CLIENT:	Seneca Army Depot		**DATE:** 1/9/95
PROJECT:	Process Evaluation Deactivation Furnace		**TIME:** 10:30 a.m.
SUBJECT OF CONVERSATION:			**INITIATED BY:** D. Yonika
			TEL. NO.: 409-886-6762

DISCUSSION

The Rotary Kiln incinerator at the Dupont, Sabine Texas plant has incinerated chemical wastes since May 1990. The baghouse processes a high solids loading (7 gr/ft.^{3} of fine particulate, mainly nickel and sodium) entering the baghouse at 450°F from the outlet of a quencher tower.

The baghouse is manufactured by United McGill, incorporating pulse-jet off-line cleaning and has a 4.07 A/C ratio. Flow is approximately 125,000 ACFM.

The original filter bags were not supplied by Goretex. The original filter bags were fiberglass with 10% teflon coating designed for in-depth filtration. These original units were required to operate at 4" W.G. differential but actually operated at 5-8" W.G. These original fabric filters and downstream scrubber were able to meet effluent specs of 0.03 gr/dscf (testing indicated effluent of 0.001 gr/dscf). The original filters were replaced with the Goretex fiberglass unit to meet operating pressure differential requirements.

The Goretex fabric filters are backpulsed automatically at either high differential pressure or operator has flexibility to adjust either to lower set point or on an adjustable time basis.

Service life of bags (continuous operation) is approximately 1 1/2 years.

Plant maintains 15% filter bag spares on-site. The Goretex units have operated satisfactorily since installation, vendor followup has been good.

Donald Yonika

DY/cmf/D#12

PARSONS ENGINEERING SCIENCE, INC.

MEMORANDUM OF TELEPHONE CONVERSATION

	NAME	COMPANY	
WITH:	Paul Pojawis	Aptus (Rollins)	JOB NO.: 726373-01001
			FILE NO.:
CLIENT:	Seneca Army Depot		DATE: 1/9/95
PROJECT:	Process Evaluation Deactivation		TIME: 11:00 a.m.
SUBJECT OF CONVERSATION:			INITIATED BY: D. Yonika
			TEL. NO.: 316-527-6380

DISCUSSION

System processes hazardous waste in the Aptus incinerator. A Procedair baghouse utilizes off-line pulse jet cleaning and 3.86 A/C ratio. Flow is approximately 65,000 acfm and has operated since 10/91.

Original fabric filters would last 6-8 weeks because of high particulate loading, high acid conditions and wet conditions in baghouse. The replacement 16 oz. fiberglass Gortex units have a service life of 14 months because of high HCL. These Gortex units operate at 4 to 5 in. w.g.to maximum of 10 in. w.g.,Goretex filters do have problems if PCB oils burned contain high silica or kaolin clay.

He feels that Goretex has an excellent product and follow-up.

Donald Yonika

DY/cmf/D#12

PARSONS ENGINEERING SCIENCE, INC.

MEMORANDUM OF TELEPHONE CONVERSATION

	NAME	COMPANY	
WITH:	Bob Wishard	USAEHA	**JOB NO.:** 726373-01001
			FILE NO.:
CLIENT:	Seneca Army Depot		**DATE:** 2-6-95
PROJECT:	Deactivation Furnace Process Evaluation		**TIME:**
SUBJECT OF CONVERSATION:			**INITIATED BY:** D. Yonika
	Testing at Toolle Deactivation Furnace - Red River Particulate Removal		**TEL. NO.:** 410-671-2509

DISCUSSION

Toolle has minimum of 1600°F temperature requirements in afterburner. Munitions are added (50 caliber) with difference required for trial burn as powder or lead balls. Utah requires measurement for DRE at maximum contaminant loading. The state is concerned with synergistic affects with all maximum contaminant feeds.

Scale developed in high temperature cooler and blocked passages due to scale build up of lead oxide. After 100 hours of operation pin hole leaks developed in the high temperature cooler. Bob explained that powders and salts do not function the same way in the furnace, his recommendation is to use salts in lieu of powders.

The site also used lead balls to supplement munitions. High molten lead conditions in furnace required revisions to discharge conveyors and internal slide plates to contain lead.

Plant now requires public comment for the following changes instituted to mitigate lead carryover: cyclone separator is to be installed upstream of afterburner and an "expansion pot" is to be installed between the afterburner and high temperature cooler. These changes are not recommended for all plants. When installation and tests are completed results will be made available to other plants for assessment.

Testing with Nomex shows particulate removal down to 0.03 gr./dscf. Red River is changing to meet 0.02 gr./dscf in their trial burn plan. Bob strongly recommends mini burn (700 hours operation) to work out all problems prior to trial burn.

Donald Yonika

DY/cmf/D#12

APPENDIX C

RESPONSE TO COMMENTS

COMMENTS FOR
RCRA PROCESS EVALUATION REPORT
SEAD DEACTIVATION FURNACE PROCESS EVALUATION C 4-171

<u>COMMENTS BY MR. B. PACE/JP/1873/ED-ME</u>

Comment #1	General. After the introduction, the report should contain a brief Summary of Findings and Recommendations and then go into the more detailed discussions in the balance of the document.
Response #1	Agreed, Section 1.2, Summary of Findings and Recommendations, has been added after Section 1.1.
Comment #2	Paragraph 1.2, Page 1. List at Bottom - First item should read a high and low temperature gas cooler. The way it is currently written sounds like there are two of each.
Response #2	Agreed. Section 1.2 has been revised to Section 1.3. Items have been corrected to read one high temperature gas cooler; one low temperature gas cooler.
Comment #3	Paragraph 1.4, Page 3. This paragraph should be retitled or more information should be included. There are no results provided.
Response #3	Agreed, this paragraph refers to the Tooele Army Depot (TEAD) trial burn testing results as input to the evaluation process.
Comment #4	Paragraph 2.1, Page 4. Fourth Sentence - Typo - wiil should be will.
Response #4	Agreed. Typographical error has been corrected.
Comment #5	Paragraph 2.2, Page 6. Third Paragraph, First Sentence - This needs to be rewritten for better clarity.
Response #5	Agreed. Sentence rewritten for clarity.
Comment #6	Paragraph 2.2, Page 6. Fourth Paragraph, Second Sentence - Typo - gages should be cages.
Response #6	Agreed. Typographical error has been corrected.
Comment #7	Paragraph 2.2, Page 6. Goretex vs. Nomex filters. There is no discussion of temperature. This should be included.
Response #7	Discussion on temperature rating of Nomex and Goretex teflon B filters has been added to Paragraph 2.2.2.
Comment #8	Paragraph 2.3, Pages 6 & 7. In discussions of locating the cyclone separator upstream of the afterburner are we sufficiently assured that all hazardous

constituents, organics, reactive wastes, etc., are completely destroyed at this point in the incineration process.

Response #8 Additional information has been added to Paragraph 2.3 regarding the discharge from the cyclone separator. Historical sampling of the ash produced from the ductwork and the separators indicate that the waste would be classified as a characteristic hazardous waste due to toxicity. It is unlikely that the ash could be considered reactive wastes.

Comment #9 Paragraph 3.1, Page 8. First Paragraph, Third Line - typo - there should be their.

Response #9 Agreed. Typographical error corrected.

Comment #10 General. Paragraph 1.1 states "An additional objective of this report is to identify all additional permits required for startup. This also includes obtaining all necessary forms for operation of the Deactivation Furnace and support application data required for submittal of these applications." I saw very little discussion of this except for that given on page 15, paragraph 4.0. Please add. Also, any additional costs for permitting, etc., should be provided.

Response #10 Table 1 has been prepared identifying permits and status of permits.

Comment #11 General. Paragraph 1.1 states "A major objective of the evaluation is to identify and evaluate systems for recommended modifications to meet the requirements of the Trial Burn Plan and "New Draft Strategy for the Combustion of Hazardous Waste", issued by EPA in May 1993." Paragraph 1.2 page 2 goes on to say that under the New Draft Strategy that incinerators must meet additional requirements for licensing including: a multi-media risk assessment sampling for dioxin, lower particulate emission concentrations, and measurement of all Products of Incomplete Combustion (PICS). Other than particulate emission, I do not see these issues discussed. Verify if these are items of concern in the SEAD incinerator process evaluation.

Response #11 Although the "New Draft Strategy" involves aspects not specifically evaluated in this report such as risk assessment and dioxin production, the items addressed will maximize the ability of the unit to meet the requirements. For example, the production of Products of Incomplete Combustions (PICs) that include dioxins and polynuclear aromatic hydrocarbons (PAHs) will be minimized by the recommendations of this evaluation that focus on the optimization of the afterburner optimization. Further, since the presence of PAHs and PICs are associated with particulate material, removal of this matter, which is the focus of this evaluation, will also increase the ability of the unit to meet the "New Draft Strategy" requirements. Production of PICs and dioxin cannot be reliably predicted from computer simulations. Consequently, the best way to minimize the production of risk producing compounds such as PAHs is to maximize afterburner residence time, which is the focus of this evaluation.

COMMENTS BY SCOTT BRADLEY

Comment #1	Section 1.4, page 3. Indicate that results from the Tooele Trial Burn are discussed and utilized in subsequent sections.
Response #1	Agreed. Section 1.4 has been revised to reference later discussions.
Comment #2	Section 2.1, page 4. Typo in fourth line: "wiil".
Response #2	Agreed. Typographical error corrected.
Comment #3	Section 2.2, page 6. Please rephrase the sentence beginning: "The Goretex Membrane Teflon B fabric filter controls the manufacture of the fabric...". This implies that the fabric is manufacturing the fabric.
Response #3	Agreed. Sentence rewritten for better clarity.
Comment #4	Section 5.0, page 16. Please summarize cost information in a table that provides a life cycle cost comparison.
Response #4	Table 2 has been included to provide equipment and life cycle cost data.
Comment #5	Section 6.0, page 17. Recommendations should be broken down into those applicable to trial burn actions and those applicable to continued operation. In addition, due to the potential for SEAD to be closed, recommendations should be provided for potential utilization by non-DOD entities. This should briefly discuss potential uses of the furnace in its current configuration and the recommended revised configuration.
Response #5	The site reclamation project at SEDA requires treatment of soils that are contaminated and not considered hazardous waste. Thermal desorption systems are utilized for treatment of contaminated soils. Thermal desorption systems employ the same basic process components as the SEDA deactivation furnace. It is likely that the rotary kiln, afterburner, air-to-air coolers and the discharge stack could be utilized in thermal desorption for site reclamation of contaminated soils. The balance of the SEDA deactivation furnace; materials handling, cyclone separator and baghouse would require alteration or replacement. Additional air pollution control equipment may also be required. If non-hazardous soils are processed, RCRA repermitting would not be required. However, revised air discharge permits would be required. The processing of non-DOD wastes from off-site sources may also be possible and would have to be reviewed on a case-by-case basis.

U. S. ARMY ENGINEER DIVISION HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS

PROJECT Process Evaluation Rpt-SEAD Deactivation Furnace, C 4-171

- ☐ SITE DEV & GEO
- ☐ ENVIR PROT&UTIL
- ☐ ARCHITECTURAL
- ☐ STRUCTURAL
- ☐ MECHANICAL
- ☒ MFG TECHNOLOGY
- ☐ ELECTRICAL
- ☐ INST&CONTROLS
- ☐ SAFETY
- ☐ ADV TECH
- ☐ ESTIMATING
- ☐ SPECIFICATIONS
- ☐ SYSTEMS ENG
- ☐ VALUE ENG
- ☐ OTHER

REVIEW TYPE: Draft
DATE: 2 May 95
NAME: Mr. B. Pace/jp/1873/ED-ME

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
1.	General	After the introduction, the report should contain a brief Summary of Findings and Recommendations and then go into the more detailed discussions in the balance of the document.	
2.	Para 1.2 Page 1	List At Bottom - First item should read a high and low temperature gas cooler. The way it is currently written sounds like there are two of each.	
3.	Para 1.4 Page 3	This paragraph should be retitled or more information should be included. There are no results provided.	
4.	Para 2.1 Page 4	Fourth Sentence - Typo - will should be will.	
5.	Para 2.2 Page 6	Third Paragraph, First Sentence - This needs to be rewritten for better clarity.	
6.	Para 2.2 Page 6	Fourth Paragraph, Second Sentence - Typo - gages should be cages.	
7.	Para 2.2 Page 6	Goretex vs. Nomex filters. There is no discussion of temperature. This should be included.	
8.	Para 2.3 Page 6 & 7	In discussions of locating the cyclone separator upstream of the afterburner are we sufficiently assured that all hazardous constituents, organics, reactive wastes, etc., are completely destroyed at this point in the incineration process?	
9.	Para 3.1 Page 8	First Paragraph, Third Line - Typo - there should be their.	

ACTION CODES:
A - ACCEPTED/CONCUR
D - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

U. S. ARMY ENGINEER DIVISION HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS

PROJECT Process Evaluation Rpt-SEAD Deactivation Furnace, C 4-171

☐ SITE DEV & GEO ☐ ENVIR PROT&UTIL ☐ ARCHITECTURAL ☐ STRUCTURAL ☐ MECHANICAL ☒ MFG TECHNOLOGY ☐ ELECTRICAL ☐ INST&CONTROLS ☐ SAFETY ☐ ADV TECH ☐ ESTIMATING ☐ SPECIFICATIONS ☐ SYSTEMS ENG ☐ VALUE ENG ☐ OTHER

REVIEW TYPE: Draft
DATE: 2 May 95
NAME: Mr. B. Pace/jp/1873/ED-ME

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
10.	General	Paragraph 1.1 states "An additional objective of this report is to identify all additional permits required for startup. This also includes obtaining all necessary forms for operation of the Deactivation Furnace and support application data required for submittal of these applications." I saw very little discussion of this except for that given on page 15, paragraph 4.0. Please add. Also, any additional costs for permitting, etc., should be provided.	
11.	General	Paragraph 1.1 states "A major objective of the evaluation is to identify and evaluate systems for recommended modifications to meet the requirements of the Trial Burn Plan and "New Draft Strategy for the Combustion of Hazardous Waste", issued by EPA in May 1993." Paragraph 1.2 page 2 goes on to say that under the New Draft Strategy that incinerators must meet additional requirements for licensing including: a multi-media risk assessment sampling for dioxin, lower particulate emission concentrations, and measurement of all Products of Incomplete Combustion (PICS). Other than particulate emissions, I do not see these issues discussed. Verify if these are items of concern in the SEAD incinerator process evaluation.	

ACTION CODES:
A - ACCEPTED/CONCUR
D - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

MRW

U. S. ARMY ENGINEER DIVISION HUNTSVILLE
CN 4-171, S:2 MAY 95
CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS

PROJECT PROCESS EVALUATION REPORT FOR OPNS APE 1236 DEACTIVITION FURNACE

- ☐ SITE DEV
- ☒ ENVIR PROT&UTIL
- ☐ ARCHITECTURAL
- ☐ STRUCTURAL
- ☐ MECHANICAL
- ☐ MFG TECHNOLOGY
- ☐ ELECTRICAL
- ☐ INST & CONTROLS
- ☐ SAFETY
- ☐ ADV TECH
- ☐ ESTIMATING
- ☐ SPECIFICATIONS
- ☐ SYSTEMS ENG
- ☐ VALUE ENG
- ☐ OTHER

REVIEW DRAFT REPORT
DATE 2 MAY 95
NAME SCOTT BRADLEY

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
1.	SECT 1.4 p. 3	Indicate that results from the Tooele Trial Burn are discussed and utilized in subsequent sections.	
2.	SECT 2.1 p. 4	Typo in fourth line: "wiil".	
3.	SECT 2.2 p. 6	Please rephrase the sentance beganning: "The Goretex Membrane Teflon B fabric filter controls the manufacture of the fabric...". This implies that the fabric is manufaturing the fabric.	
4.	SECT 5.0 p. 16	Please summarize cost information in a table that provides a life cycle cost comparison.	
5.	SECT 6.0 p. 17	Recommendations should be broken down into those applicable to trail burn actions and those applicable to continued opperation. In addition, due to the potential for SEAD to be closed, recommendations should be provided for potential utilization by non-DOD entities. This should briefly discuss potential uses of the furnace in its current configuration and the recommended revised configuration.	

ACTION CODES:
A - ACCEPTED/CONCUR
D - ACTION DEFERRED
W - WITHDRAWN
N - NON-CONCUR
VE - VE POTENTIAL/VEP ATTACHED

FORM 7 (Revised)

PREVIOUS EDITIONS OF T[illegible] ORM ARE OBSOLETE

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE (PROVISIONAL)
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

MCHB-DE-HR (40)

13 APR 1995

MEMORANDUM FOR Division Engineer, U.S. Army Engineering Division - Huntsville, ATTN: CEHND-ED-PM/ Ms. Richards, P.O. Box 1600, Huntsville, AL 35807-4301

SUBJECT: Draft Process Evaluation of Deactivation Furnace, Seneca Army Depot, Romulus, New York, April 1995

1. This document was reviewed on behalf of The Office of The Surgeon General without comment. This document does not have to be resubmitted to the U.S. Army Center for Health Promotion and Preventive Medicine (Provisional) (USACHPPM(PROV)) for further review prior to finalization.

2. The scientist reviewing this document was Mr. Keith Hoddinott, Health Risk Assessment and Risk Communication Program. Due to the limited scope of this document, it was only reviewed by our Health Risk Assessment and Risk Communication Program. The point of contact is Mr. Keith Hoddinott, DSN 584-5209 or commercial (410) 671-5209.

FOR THE COMMANDER:

for Dennis E. Druck

ARTHUR P. LEE, P.E.
MAJ, MS
Program Manager, Health Risk
Assessment and Risk Communication

CF:
HQDA (SGPS-PSP-E)
CDR, USAMEDCOM, ATTN: MCHO-CL-P
CDR, AMC, ATTN: AMCEN-A
CDR, Seneca AD, ATTN: SDSSE-HE
CDR, CEMRD, ATTN: CEMRD-ED-EH
CDR, USAEC, ATTN: SFIM-AEC-IRP/Mr. Turkeltaub