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Illiniois Department of Energy and Natural Resources

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HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER
Illinois State Water Survey Division
1808 Woodfield Drive
Savoy, Illinois 61874
HWRIC RR-034

Conversion Feasibility of the KILnGAS Commercial Module (KCM) to a Hazardous Waste Facility: A Preliminary Assessment

by

David V. Nakles
Remediation Technologies, Inc.

Daniel D. Spanaus
Allis Chalmers Coal Gasification Corp.

Peter G. Garside
Xcel Group, Inc.

Robert R. Banks
Energy Systems Associates

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A PRELIMINARY ASSESSMENT

By
DAVID V. NAKLES
REMEDIATION TECHNOLOGIES INC.
1034 FIFTH AVENUE, SUITE 100
PITTSBURGH, PA 15219

DANIEL D. SPANAUS
ALLIS CHALMERS COAL GASIFICATION CORP.
1126 SOUTH 70TH STREET
WEST ALLIS, WI 53214

PETER G. GARSIDE
XCEL GROUP, INC.
1126 SOUTH 70TH STREET
WEST ALLIS, WI 53214

ROBERT R. BANKS
ENERGY SYSTEMS ASSOCIATES
1840 GATEWAY
PITTSBURGH, PA 15222

Prepared For
THE ILLINOIS HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER
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LIST OF ABBREVIATIONS

KCM	KILnGAS Commercial Module
RCRA	Resource Conservation and Recovery Act
HWRIC	Hazardous Waste Research and Information Center
SARA	Superfund Amendment and Reauthorization Act
BDAT	Best Demonstrated Available Technology
EPA	Environmental Protection Agency
NPL	National Priority List
IEPA	Illinois Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
MGP	Manufactured Gas Plant
DOT	Department of Transportation
NPDES	National Pollutant Discharge Elimination System

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ABSTRACT

This study presents the results of a preliminary assessment of the feasibility of converting an existing kiln facility, the KILnGAS Commercial Module (KCM) in East Alton, Illinois, to a hazardous waste incinerator. The study examined the RCRA and Superfund waste volumes and characteristics as well as the treatment and disposal capacity of the State of Illinois to identify potential incineration capacity shortfalls. A centerline waste, soils contaminated with PCBs, was selected to provide a reference case to study the facility conversion. A conceptual facility design was developed using the technical and environmental criteria for the selected waste as a design basis. Major process equipment was identified, sized, and priced. A heat and material balance was developed for a centerline mode of operation to forecast performance. Economics for waste treatment were examined based upon a range of competitive tipping fees and other parameters impacting commercial viability. Finally, tentative conclusions regarding the feasibility of the facility conversion are presented and a "next step" action plan is outlined to corroborate the technical, economic, and regulatory assumptions and to examine design alternatives with the potential for reducing facility costs and/or enhancing its performance or siting potential.

EXECUTIVE SUMMARY

The study objective was to conduct a preliminary assessment of the feasibility of converting an existing kiln facility to a hazardous waste incinerator. The work was commissioned in January, 1988, by the Hazardous Waste Research and Information Center of the Illinois Department of Energy and Natural Resources and was completed three months later with favorable findings. The study is part of a broader planning effort by the State of Illinois in anticipation of satisfying the specific provisions of the Superfund Amendment and Reauthorization Act of 1986 (SARA) which require states to develop plans for future hazardous waste treatment and disposal.

The subject facility is the KILnGAS Commercial Module (KCM)--a unique rotary kiln facility designed to gasify coal--located in East Alton, Illinois. The KCM was commissioned in 1983 and technically successful operating programs were conducted through 1987. However, market needs for the technology are constrained by worldwide energy prices. As a result, this modern, well maintained, highly instrumented facility is not currently operating.

The study examined the RCRA and Superfund waste volumes and characteristics and the current onsite/offsite treatment and disposal capacity in the State of Illinois. Based upon a recognized shortfall in incineration capacity for organic-contaminated soils, PCB-contaminated soils were selected as a centerline waste to provide a reference case to study facility conversion. PCBs were chosen as the contaminant since they represent a worst case pollutant and a typical treatment need in the state. A conceptual facility design was developed using the technical and environmental criteria for the selected waste as a design basis. Major process equipment was identified, sized and costed. A heat and material balance was developed for a centerline operating mode to forecast performance. Finally, economics were examined based on a range of competitive tipping fees and other parameters impacting commercial viability.

The results indicate that PCB-contaminated soils can be processed to satisfy emissions standards and other environmental requirements at throughput rates of at least 15 tons per hour--a capacity equivalent to the total incineration capacity currently available in the state. Total investment costs are estimated at approximately 24 million dollars. The economic analysis indicates a return-on-investment of 50 percent with a recovery of capital within five years at a highly competitive tipping fee $278 per ton. Assumptions used in the economic model, such as 50 percent plant utilization, are very conservative indicating the overall economics will likely be even more favorable.

The basic conclusion, subject to the limitations of the study, is that conversion of this existing kiln to a hazardous waste incineration facility is both technically and economically feasible. The ability to meet and exceed environmental standards for incineration are not in question. The principal risk is, no doubt, the siting/permitting feasibility. Although permitting is indeed technically feasible, the indeterminate factors relating to public hearings associated with the permitting and siting process cannot be forecast.

A "next step" action plan is outlined herein to complete this preliminary assessment by corroborating technical, regulatory and economic assumptions and by examining design alternatives with the potential of reducing facility costs and/or enhancing its performance and siting potential. The completion of this effort will provide a go/no-go decision on the facility conversion by October, 1989.

The converted facility could be operating commercially by the end of 1991 if the three-phase plan is implemented as recommended herein. The State of Illinois can play a major role in encouraging private enterprise to undertake this conversion. The converted facility would at least double the current incineration capacity available in Illinois for contaminated soils by offering capability for processing an additional 70,000 tons per year (at 50 percent capacity) of contaminated soils--a major contribution to satisfying the compliance obligations of the State of Illinois with the SARA provisions.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

1.1.1. Statement of the Problem

The United States is faced with a serious problem regarding the management of hazardous wastes generated within its boundaries. The problem is the shortfall of treatment and disposal capacity to meet the current volume of generated wastes. It is anticipated that this capacity shortfall will become even more severe in the future as conventional waste management options disappear (e.g., the land disposal ban of specific wastes) at a faster pace than the reduction of generated wastes is achieved. The State of Illinois is responding to the challenge of developing new capacity options for Illinois waste, in part, by the commissioning of this study, which was authorized in January 1988 by the Hazardous Waste Research and Information Center of the Illinois Department of Energy and Natural Resources.

This treatment and disposal capacity problem was acknowledged at the federal level during the passage of the Superfund Amendment and Reauthorization Act (SARA) of 1986 (SARA, 1986). SARA contains a provision to give the federal government the authority to withhold Superfund money in states that fail to make good faith efforts to plan for future hazardous waste disposal or treatment capacity. This provision becomes effective in October, 1989, and requires states to enter into contracts (or cooperative agreements) with the federal EPA for treatment of all hazardous wastes expected to be generated within the state over a 20-year period. This applies to RCRA hazardous wastes as well as to wastes generated by recovery or remedial actions at Superfund sites.

There are multiple treatment or disposal technologies which could provide the needed waste management capacity. However, further provisions of SARA dictate the use of "treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants". This requirement constrains the technology options that are available for use. Congress has further specified that, in general, the disposal of hazardous substances or contaminated materials without such treatment should be the least favored alternative remedial action where practicable treatment technologies are available. Similarly, regulatory bans on the management of selected RCRA wastes (Federal Register, 1988) are limiting the use of passive geotechnical solutions (e.g., landfilling) and advocating, by the specification of Best Demonstrated Available Technology, the destruction of the hazardous substances, pollutants, or contaminants.

For these reasons and others, the incineration of hazardous wastes is generally viewed as an acceptable technical and environmental approach to the management of many Superfund and RCRA wastes. However, the incineration capacity of Illinois is heavily oriented toward the treatment of liquid wastes with only three mobile treatment units (total treatment capacity of 18 tons per hour) available to manage hazardous waste solids, whether from RCRA or Superfund sites. Since all of these facilities are privately owned and operated, the State cannot be assured that the full incineration capacity located in Illinois will be available to manage Illinois waste. Nonetheless, even if such capacity were available, it is unlikely that it would be sufficient to manage the entire spectrum and volume of solid/contaminated soil wastes which are and will continue to be generated within the state.

1.1.2. A Possible Solution: An Existing Kiln Facility

Rotary kilns are well known as high-capacity, high-temperature, very reliable solids processing devices and have been proven effective for use as incinerators in contaminated soil remediation applications (Lee, et. al., 1986). Currently, a large kiln facility, originally designed for gasification of coal (600 tons per day), is located in East Alton, Illinois. This facility, shown in Figure 1, is referred to as the KILnGAS Commercial Module (KCM) and currently is not being operated, but rather is being maintained in a standby mode. This demonstration facility, supported by the State of Illinois, private industry and a dozen electric utilities, proved to be a technical success, but is not currently operating as a result of depressed energy prices.

The capacity shortfall for solids/soils treatment in Illinois, combined with the availability of the KCM facility, gave rise to the possible conversion of the facility to a hazardous waste incinerator. The concept appeared attractive for several reasons:

- This modern facility, commissioned in 1983, was already in-place and well maintained. This avoids the major investment, risks, and long lead times required to construct a new facility.
- The rotary kiln was designed to process 600 tons-per-day of coal and to achieve nominal operating temperatures of 1900^{o}F;
- The unique design aspects of the kiln offered the potential to operate a high throughput, technically efficient and cost-effective incineration process; and
- The potential existed for assessing the feasibility of the facility conversion and making a go/no-go decision in a time frame consistent with the October, 1989, requirements of SARA.

These factors led to the commissioning of this feasibility study, the results of which are presented herein.

FIGURE 1. KILnGAS Commercial Module - East Alton, Illinois

1.2 STUDY DESCRIPTION

1.2.1. Objectives

The overall objective of this study is to make a determination of the feasibility of converting the KCM to a hazardous waste incineration facility. The study identifies technical, environmental, and economic requirements associated with the facility conversion and examines them with the intent to:

(1) Determine the extent and degree of required equipment modifications with an emphasis on the rotary kiln and selected ancillary equipment (i.e., feed/treated solids storage and handling and combustion gas clean-up);

(2) Assess the ability to site the facility and to meet environmental permitting and performance specifications;

(3) Perform a preliminary economic analysis to evaluate the ability of the converted facility to provide cost-competitive thermal treatment services; and

(4) Develop a preliminary schedule for the facility conversion to determine if it can provide services in a timeframe consistent with the needs of the State of Illinois.

The achievement of these objectives will permit the identification of any inherent constraints which would preclude the facility conversion.

1.2.2. Technical Approach

The feasibility assessment was completed in five discrete steps which were executed in series. These steps were:

(1) An assessment of the waste generation rates and incineration capacity of the State of Illinois;

(2) Specification of facility design criteria including the definition of a reference, or centerline, waste and both technical and environmental operating constraints;

(3) Development of a conceptual process flowsheet for the incineration facility, including preliminary material and energy balances for a baseline mode of operation;

(4) Development of preliminary capital and operating cost estimates as well as a schedule for the facility conversion; and

(5) Development of conclusions and recommendations as well as a "next step" action plan that addresses the outstanding issues associated with the proposed baseline mode of operation and alternatives to address these issues.

A brief synopsis of each of these steps is provided below.

Waste Generation Rates and Incineration Capacity. The characterization and profiling of the Illinois' waste generation rates and incineration capacity presents a summary of the hazardous waste management situation in the State of Illinois. It is based upon industry data which has been gathered since 1983 and is supplemented with information obtained from conversations with employees of the Illinois Environmental Protection Agency and the Hazardous Waste Research and Information Center. This effort identifies the RCRA and Superfund waste volumes and characteristics as well as the current onsite/offsite storage, treatment, and disposal capacity in the State of Illinois. A comparison of the generation of incinerable wastes and the current in-state incineration capacity was performed to analyze for capacity shortfalls. The results of this analysis provided a basis for the subsequent design of the incineration facility.

Specification of Design Criteria. A centerline waste was identified to provide a reference case for the facility conversion. Soils contaminated with PCBs were chosen since they represent a current disposal problem in Illinois and a worst case treatment situation, i.e., a thermally stable pollutant which has a significant chlorine content and for which high direct reduction efficiencies are required. Other soil properties such as moisture content and size specifications were also established.

Having established the waste feed to the kiln, a solids residence time and exit gas temperature were established, as were the temperature and residence time for the kiln offgas combustor. Other gas clean-up requirements were dictated by the RCRA performance standards for hazardous waste incinerators. Lastly, criteria regarding the management of the contaminated soils and treated solids (e.g., storage capacity) were specified.

Conceptual Design. The conceptual design for the incineration facility was developed using the technical and environmental design criteria as a basis. The major process equipment was identified, material and energy balances were completed, and the primary equipment was sized. The baseline mode of operation was established to provide the counter-flow of gas and solids and the secondary combustion of the kiln offgases in an afterburner.

Preliminary Economics and Conversion Schedule. Modifications of the existing facility to meet the design specifications were identified. These modifications included the selective razing of existing equipment as well as the design and installation of new equipment. Capital cost estimates were prepared for all modifications and operating costs were estimated for the facility operation. Next, an implementation schedule for the facility conversion was established that included siting, regulatory, and technical considerations. Lastly, the costs and the schedule were incorporated into an economic analysis of the facility to provide an estimated cost per ton for the treatment of the centerline wastes.

Conclusions and Recommendations. A statement regarding the feasibility of the facility conversion was prepared. Actions required for the implementation of the conversion, including a more in-depth review of the technical, economic, and environmental issues associated with the baseline mode of operation, and a schedule for their implementation were also defined.

1.2.3. Report Organization

The findings of this study are organized into three primary chapters. Chapter 2, Status of Illinois Waste Generation and Incineration Capacity, describes the sources of incinerable waste within the state in more detail and presents an estimate of the volumes and characteristics of these wastes. This section also presents an estimate of the current incineration capacity in Illinois which is compared to the demand, identifying the treatment capacity shortfall.

Chapter 3 presents the reference case which formed the basis for the feasibility assessment. It describes the key technical and environmental design criteria and provides an overview of a conceptual design of the incineration complex including both a material and an energy balance. It also presents a preliminary evaluation of the process economics and a schedule for the facility conversion.

Chapter 4 presents the study conclusions and recommendations and defines the necessary actions to complete the assessment. This includes the need to corroborate key technical, regulatory, and economic assumptions associated with the reference case that have the potential to impact the feasibility of the facility conversion.

CHAPTER 2

STATUS OF ILLINOIS WASTE GENERATION AND INCINERATION CAPACITY

2.1 WASTE SOURCES

The nature and volumes of wastes currently generated and managed within the State of Illinois establish the basis for the definition of potential treatment, and more specifically, incineration, capacity shortfalls. This section discusses the waste streams currently managed within the state in order to:(1) determine if there is a need for additional incinerator capacity within the state, and, (2) in the event that such a need exists, define a "typical" waste profile to serve as a basis for the evaluation of the facility conversion.

This discussion centers principally upon wastes related to the Resource Conservation and Recovery Act (RCRA, 1976) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 1980) but also considers additional materials from non-listed facilities such as coal tar sites, as well as materials resulting from RCRA corrective actions and property transfer remediations. The primary sources of data for these discussions were: the Summary of Annual Reports on Hazardous Waste for 1983 through 1986 (Illinois EPA, 1987a) and the National Priority List (NPL), State Remedial Action Priority List (SRAPL), Clean Illinois, Federal Facilities and Completed Projects Monthly Status Reports (Illinois EPA, 1987b). Additional, specific information was obtained through the Hazardous Waste Research and Information Center (HWRIC) and telephone communications with project managers within the Illinois Environmental Protection Agency.

2.1.1 RCRA Wastes

The steps required to develop a RCRA waste profile for the proposed facility included (1) the identification of RCRA wastes that are managed within the State of Illinois, (2) an assessment of the fraction of the RCRA wastes that are incinerable, and (3) an evaluation of the portion of the incinerable wastes that are currently managed offsite. Each of these steps is briefly summarized below with the detailed results of the efforts presented in tabular form in Appendix A.

The RCRA waste types that are managed in Illinois are listed in the IEPA Annual Report on Hazardous Wastes based upon their associated hazardous waste number, a four-digit code consisting of a letter prefix and three digits. The letter prefixes identify general waste categories as provided below:

- D-Materials that exhibit the characteristics of ignitability, corrosivity, reactivity, and EP toxicity;
- F-Hazardous wastes from non-specific sources;
- K-Hazardous wastes from specific sources;
- P-Discarded commercial chemical products, off-specification species, container residues and spill residues that are designated as acutely hazardous or toxic;
- U-Discarded commercial chemical products, off-specification species, container residues and spill residues that are designated as toxic.

The report indicates that a total of 592 million gallons of this waste were treated, stored or disposed of within Illinois in 1986. This volume represents a 27 percent increase over the figures from 1983 when Illinois initiated their record-keeping program.

"Incinerable" wastes are defined as those RCRA wastes that were either organic in nature or currently being disposed of at incinerator facilities. Using this definition, approximately 37 percent of the RCRA waste numbers listed in the IEPA Annual Report were determined to be incinerable. This corresponds, on a volume basis, to 242 million gallons of incinerable waste (41 percent of the total 592 million gallons of the waste that was treated, stored, or disposed in 1986).

Significant wastes were then identified within this incinerable category. Significant wastes were defined as those that comprised 0.1 percent or greater of the total reported waste volume. The waste categories that resulted from this screening process are provided in Table 1. As indicated in the table, the designated significant, incinerable wastes are limited to seven specific and four mixed waste types. These categories, combined, comprise approximately 170 million gallons of the total 592 million gallons of RCRA wastes.

The evaluation then focused on those portions of the waste types from Table 1 that were managed at offsite facilities. Once again, data from the IEPA Annual Report on Hazardous Waste were used. These data indicated that approximately 40 million gallons of the total 170 million gallons of incinerable waste were managed at offsite facilities. The data further indicated that nearly 94 percent of those RCRA wastes that were incinerated (approximately 7 of the 170 million gallons) were treated in offsite facilities. As such, for the purposes of this report, it was presumed that the wastes (40 million gallons or 70,000 tons) which are currently managed offsite would be candidates for treatment in the proposed facility.

TABLE 1

SIGNIFICANT INCINERABLE RCRA WASTE CATEGORIES
1986 SUMMARY

RCRA Waste Number	Description
Specific Wastes	
D001	Waste with flashpoint <60°C
F001	Spent halogenated solvents
F002	Spent halogenated solvents
F003	Spent non-halogenated solvents
F005	Spent non-halogenated solvents
K001	Creosote/PCP Wastewater Sludges
K087	Tar Sludge
Mixed Wastes	
D-Wastes	-
F-Wastes	-
K-Wastes	-
U-Wastes	-

Significant wastes are defined as those that are comprised of 0.1% or greater of the total reported waste volume.

It should be noted that four of the waste types in Table 1, namely Mixed F, D001, Mixed D, and F005, comprise approximately 90 percent of these available wastes (or 36 million gallons). However, data provided by the Hazardous Waste Research and Information Center indicates that, although some mixed D wastes are currently being incinerated in Illinois, a significant portion of these wastes are primarily inorganic in nature, i. e. contain metallic species. Since metals typically pose problems for incineration systems in terms of particulate emissions, the mixed D category (approximately 6 million gallons of waste) has been eliminated from the list of available waste types for incineration in this study. Thus, the wastes shown in Table 1, with the exception of the mixed D wastes, represent the final reduced list of available, incinerable waste types that resulted from the screening process.

The results of these evaluations indicate that an appropriate stream of waste materials available for incineration within the State of Illinois might primarily consist of spent solvents (halogenated and non-halogenated) and waste materials with low flashpoints (<60°C). Approximately 35 million gallons or 137,000 tons of these materials were managed at offsite facilities in Illinois during 1986.

2.1.2 CERCLA Wastes

A review of the NPL, SRAPL, Clean Illinois, Federal Facilities and Completed Project Status Reports indicates that there are approximately 140 listed sites in Illinois. Remediation activities have been initiated or completed at 33 of these sites. Estimates of the types and volumes of wastes at the remaining sites are difficult to make since they are in widely varying stages of investigation.

An initial review of the project status reports was conducted for the 33 "active" sites in order to define which of them may contain "incinerable" waste materials. The criteria for this determination was similar to that used for RCRA wastes and included sites that had primarily organic contamination. Sites having obvious metal contamination were not considered. It should be stressed that the results from this evaluation represent a very preliminary estimate. The project status reports are extremely brief and indicate that the majority of the sites are in only the earliest stages of investigation.

This review resulted in the selection of 12 sites for further consideration. The EPA project managers of these sites were contacted for additional information regarding the nature of the contamination and the estimated volume of contaminated material (Personal Communication, 1988a). The results of these conversations are summarized in Table 2. The volume estimates in this table indicate that approximately 193,000 cubic yards of incinerable waste material may be generated from this limited set of sites. However, defining the rate at which these materials become available presents a significant problem. As stated previously, the programs at these sites are in varying states of completion, with most in the very early stages of investigation. The very nature of the remedial investigation and feasibility study process will result in the intermittent availability of these wastes over a period of the next five to ten years. As such, these sources represent a significant but somewhat variable and unpredictable source of wastes for the proposed facility.

The primary contaminant from the CERCLA sites would appear to be wood treating wastes, i.e. creosote and pentachlorophenol, as well as PCBs.

2.1.3 Manufactured Gas Site Wastes

In the early 1900's, many utility companies operated manufactured gas plants (MGP) to produce gas from coal. The residues remaining from the operation of these plants represent a source of contaminated material, soils, and tars for incineration. Although these residues are not currently listed as hazardous, the specific contaminants, i.e., phenolics, polynuclear aromatic hydrocarbons and cyanides, are consistent with other listed materials. The potential exists, with changes in the regulatory environment, for contaminated materials from these closed facilities to enter the permitted hazardous waste treatment marketplace.

Similar materials are routinely treated by thermal processes in the Netherlands and several vendors have proposed the use of stationary, indirect-fired rotary kilns and other process configurations, having capacities of up to 15 tons per hour, to process contaminated soils and sludges from these sites.

Table 2

Estimates of Incinerable Contamination at CERCLA Related Sites In Illinois

Site	Type of Waste	Areas	Estimated Volumes (cubic yards)
Koppers Galesburg	Wood Preserving	Lake Stream	~45,000
Republic Galesburg	Wood Preserving	Lagoon	48,400
Creosote Forest Products	Wood Preserving	2 Lagoons	~3,000
Moss-American Fuel Oils	Creosote	2 Ponds Processing Areas	~19,000
Koppers Carbondale	Wood Preserving	Stream Processing Areas	46,600
Frinks Ind. Waste Inc.	Waste Oils Solvents	2 Lagoons	Unknown
Beardstown-Casswood	Wood Preserving	Site soils	10,000
DuQuoin - MGP Site	Coal Tar Waste	Coal Tar, Soils	18,000
Shelbyville-Salvage	PCBs	Soils	~3,000
	Estimated Total Volume (Cubic Yards)		193,000

Current estimates indicate that 130 MGP sites are located in Illinois. Of this number, 30 are currently undergoing active investigations. Although the amount of contaminated soils and sludges present at each site is quite variable, estimates of 5,000 to 10,000 cubic yards per site are probably a reasonable first-order approximation (Gas Research Institute, 1987). As such, the total volume of contaminated soils and sludges at the currently active sites is estimated to be in the range of 150,000 to 300,000 cubic yards. For the entire set of 130 MGP sites, as much as 650,000 to 1,300,000 cubic yards of soils/solids may be generated if clean-up of all of the sites is required.

As in the case of the CERCLA-related wastes, it is not possible to accurately predict the availability of these waste materials over time. Furthermore, it is unlikely that these wastes will expeditiously find their way to permitted treatment or disposal facilities without increased regulatory pressure.

2.1.4 Other Wastes

Additional volumes of waste materials are likely to become available from other miscellaneous routes such as the closure of onsite treatment lagoons; RCRA corrective actions; and remedial activities associated with property transfer proceedings (ECRA regulations). Although it is not possible to accurately quantify these materials at this time, they could also represent a significant source of material for the proposed facility.

2.2 INCINERATION CAPACITY

Incineration currently is not a principal method of disposal within the State of Illinois. A review of the figures in the Annual Report on Hazardous Wastes indicate that only 1.2 percent of the total 592 million gallons of RCRA waste are managed in incineration facilities. However, the report data for 1983 to 1986 further indicate a general decline in the volume of wastes incinerated onsite and an increase in incineration at permitted offsite facilities. This trend, which is likely to continue, is due to increased environmental regulations and permitting requirements.

The capacity to dispose of hazardous waste materials at permitted incineration facilities currently exists within the State of Illinois. These facilities can generally be described as either stationary rotary kiln incinerators, used primarily for the disposal of liquid wastes, or transportable systems (rotary kilns or conveyor furnaces), which primarily handle contaminated soils and sludges. Discussions of the applications and capacities of these types of systems are provided below.

2.2.1 Stationary Incinerators

Two stationary, rotary kiln facilities are currently operating within the State of Illinois for the purpose of incinerating hazardous wastes. As indicated in the Annual Report on-Hazardous Wastes, these two facilities, SCA Chemical Services, Chicago and TWI, Sauget, were responsible for the incineration of 5.0 and 1.7 million gallons of RCRA waste, respectively, during 1986. These figures correspond with the total volume of RCRA waste incinerated at offsite facilities in the state.

An additional 4.1 million gallons of PCB waste was also incinerated in the State of Illinois during 1986. Although the IEPA Annual Report did not provide information on the specific facilities used for the disposal of this material, it is likely that the majority of this waste found its way to these facilities. PCB-contaminated liquids, in fact, appear to be the principal waste stream for these facilities. The treatment of these materials bring tipping fees in the range of $2200 to $3000 per ton (Personal Communication, 1988b). It is likely that the cost of incineration at these facilities will remain at this level as long as the units operate at an acceptable utilization rate and sufficient demand for the incineration of these PCB materials exists.

These facilities are primarily designed to handle liquid wastes. While rotary kilns used in these plants are capable of solid materials incineration, other facility resources may require extensive modifications to handle large volumes of solid wastes efficiently. Both facilities require that solid materials, such as contaminated soils and sludges, be placed into fiber drums to facilitate a batch feeding process. This presents a serious logistics and materials handling problem. Limited plant area for storage of incoming solids and onsite ash disposal are also potential constraints.

In summary, these stationary incineration facilities are generally operated to dispose of "premium" liquid waste materials at tipping fees in the range of $2200 to $3000 per ton. It is very likely that facility improvements would be necessary to handle large volumes of solid waste at economical cost. As such, the stationary facilities are not really comparable to the application envisioned for the KILnGAS plant.

2.2.2 Transportable Incinerators

The Illinois Environmental Protection Agency (IEPA) has contracted for the use of transportable incineration services at three sites within the state: LaSalle Electric; the Lenz Oil Site; and the Beardstown Lauder Salvage Yard Site. The principal waste materials at these sites are soils contaminated with waste solvents, semivolatile organics and PCBs. Table 3 presents a summary of the activities at these sites.

As indicated in the table, these systems are of two common designs: rotary kilns, which are capable of processing solids and liquid wastes, and conveyor furnaces which are primarily used for the treatment of soils. These systems have nominal throughputs of 4-6 tons per hour.

All of these systems are transported by truck and assembled onsite. Their mobilization and field assembly generally require 6-8 weeks to complete. The time required for mobilization, and associated demobilization/transport, can dramatically impact the actual utilization of these systems. For example, if a given system is relocated twice in a one year period, only 36 weeks remain for the actual processing of material. This translates to a utilization factor of 69 percent. When additional estimates for maintenance and process downtime (70 percent) are included, the utilization factor for the system is reduced to less than 50 percent. It is evident from this analysis that maximum utilization of these systems is achieved by operating at sites with sufficient volumes of waste to minimize the requirements for relocation. Estimates of the lower, economical size limit for systems of this throughput are in the range of 8,000 cubic yards of material (McCabe, 1987).

Table 3.

Summary of Transportable Incinerator Activities*

Site	Contractor	Technology	Site Contaminant	Estimated Volume	Time for Completion
Lenz Oil Semi-volatile Organics	ENSCO	Rotary Kiln	Solvents	7,000 yds.	6 months
Beardstown Lauder Salvage	R.F. Weston	Rotary Kiln	PCBs	10,000 yds.	3 months
LaSalle Electric	Westing-house/Furnace HAZTECH	Conveyor	PCBs	23,200 yds.	1.5 years

*Personal Communication, 1988b

An additional factor affecting the utilization of these transportable systems is regulatory permitting. Although the cost of permitting an incinerator in the current market is expensive, the more dramatic impacts are in the potential field delays while awaiting regulatory approval. A three month delay in securing a permit for a site would reduce the annual utilization of the system discussed above to approximately 30 percent.

The pricing for transportable incineration services at these sites ranges from $250 - 550 per ton of material (Personal Communication, 1988b; Frank, et. al., 1987).. These costs generally do not include excavation of material and are equivalent to the tipping fees at treatment, storage and disposal facilities.

2.3 Conclusions Regarding Waste Generation Rates and Thermal Treatment Capacity

There is a substantial volume of waste materials within the State of Illinois that are amenable to disposal by incineration. RCRA sources generate on the order of 140,000 tons of waste solvents and low flash point liquids on an annual basis. CERCLA cleanups could generate an additional 193,000 cubic yards of soils and sludges contaminated with wood treating residues, waste solvents and PCBs. In addition, significant amounts of contaminated materials, on the order of hundreds of thousands of cubic yards of soils and sludges, could also become available as a result of increased regulatory pressure on MGP sites (PNAs, phenolics, cyanides), as well as RCRA corrective actions, elimination of "onsite" lagoons, and ECRA property transfers.

The capability to incinerate these wastes within the State of Illinois currently exists in two stationary rotary kiln facilities (liquid wastes) and multiple transportable systems (contaminated solid materials such as soils and sludges). The current cost of disposal for liquid wastes at the stationary facilities, however, is generally not competitive with other RCRA treatment and disposal options. In addition, while the transportable systems have proven to be technically appropriate for the incineration of contaminated solids, there are concerns about future availability, mobilization, potential permitting delays and performance testing at each facility that can dramatically affect the pricing of these disposal services.

Predicting the course of treatment capacity and prices during the development of the remediation market within the State of Illinois poses a difficult problem. The refinement of the technologies and increase in competition among service contractors may serve to increase the capacity and stabilize or even lower the price of these services during the next several years. The more likely trend, however, given the current regulatory atmosphere and regulatory/financial barriers to entry into the incinerator marketplace, is that the current shortfall of offsite disposal capacity will continue and that the prices will track the increasing costs of land disposal. In this manner, contractors can offset the liabilities of the business while still offering a cost competitive-product.

In summary, the State of Illinois currently has the technical capability to incinerate both liquid and solid hazardous wastes. However, the capacity of these technologies may not be sufficient to treat the future influx of "incinerable" wastes at a cost-competitive price.

CHAPTER 3

BASELINE DESIGN FOR INCINERATION FACILITY

A baseline design of the modified KCM was developed to provide a basis for assessing the feasibility of the proposed facility conversion. A centerline waste material was chosen, required operating conditions and environmental regulations were applied, and a preliminary design with economics was prepared using the existing 12 foot diameter by 150 foot long kiln that was originally built for coal gasification as the core processing unit. Soil contaminated with PCBs was selected as the centerline feed material for establishing the technical requirements for the facility. A soil matrix was selected due to the demonstrated need for competitive-priced solids processing capacity in the state. PCBs were chosen as the contaminant since its high thermal stability will approximate a "worst case" design basis for the incineration facility. The design has not been optimized and, therefore, should represent a conservative economic scenario for assessing feasibility. Technical alternatives to this baseline design were identified and are discussed in Chapter 4, Conclusions and Recommendations.

3.1 BASELINE DESIGN CRITERIA

The design criteria specified for the baseline case include a centerline waste, a set of environmental operating constraints, and a set of plant operating conditions.

3.1.1 Waste Material Selection

The centerline feed waste material for the baseline design was soil contaminated with 1% PCB and containing 39% moisture. The soil will be screened to less than 3 inches prior to delivery. Material larger than 3 inches including rocks and construction debris will not be accepted at the site.

3.1.2 Environmental Criteria

The State of Illinois requirements applicable to the converted facility were reviewed. These requirements include provisions for both the facility siting and the granting of its operation permits.

Facility Siting. Prior to the submission of facility permits, the State of Illinois requires formal siting approval of all regional pollution control facilities. A regional pollution control facility is defined as any "waste storage site, sanitary landfill, waste disposal site, waste transfer station, or waste incinerator that accepts waste from or that serves an area that exceeds or extends over the boundaries of any local general purpose unit of government." Approval is required by the county board or the governing body of the municipality. The general siting criteria are present in Title X (Permits), Section 39.2 of the Environmental Protection Act of Illinois (State of Illinois, 1986) and summarized in Table 4.

TABLE 4

SUMMARY OF GENERAL SITING CRITERIA

- Facility is necessary to accommodate waste needs of the area;
- Facility is designed, located, and operated to protect public health and welfare;
- Facility is located to minimize incompatibility with surrounding area and to minimize the effect of value of surrounding property
- Facility is located outside boundary of 100 year flood plain or the site is flood-proofed in accordance with Illinois DOT standards
- Facility operations plan is designed to minimize danger from fire, spills or operational accidents
- Traffic patterns to or from facility are designed to minimize impact on existing traffic patterns
- Emergency response plan exists which includes notification, containment, and excavation procedures for use during accidental releases.

In addition to the siting criteria, the Act also specifies notification and meeting requirements to assure public participation in the siting process. Some of these requirements include:

(1) Written notification to property owners, the General Assembly from the legislative district in which the proposed facility is located, and a local newspaper ,14 days prior to a request for siting approval;

(2) Formal filing of the request with the county board or the governing body of the municipality; and

(3) Participation in a public hearing which will be held no later than 120 days from the submittal of the request.

It is further specified that the approval, if granted, will expire within two years if permit applications to develop the site have not been filed within that time frame.

Facility Permitting. Following the submission of proof to the Illinois Environmental Protection Agency that the local governing bodies have approved the facility siting, permits for the modification of the KCM facility can be filed. The permits specify performance standards, monitoring and reporting requirements, and other technical/procedural guidelines which must be met by the converted facility.

The issuance of permits for the converted facility will be governed by Titles X (Permits), II (Air Pollution), III (Water Pollution), and V (Land Pollution and Refuse Disposal) of the Illinois Environmental Protection Act. It is likely that the air and water permits will be developed as modifications of the permits which are now in place for the current KCM facility. The existing air permits addresses five point sources (afterburner, flare, oxidizer vent, fuel oil storage tank vent, and auxiliary generator stack) whereas the revised permit will focus on the primary incinerator stack. A preliminary review of the incinerator stack emissions indicate that the modified source will be a de minimus source and, as such, may not be considered a major facility modification. This determination would eliminate the need for atmospheric modeling as part of the permit process.

Three wastewaters (pretreated process condensate, ash discharge water, and storm water runoff) are addressed in a combination of cooperative agreements with the City of Alton and Illinois Power Company and an Illinois NPDES permit. However, only the stormwater runoff will be present in the modified facility. It is likely that this wastewater can be managed, and therefore permitted, the same manner as it had been in the original facility. The primary permitting effort for the modified facility will be compliance with the requirements of Title V, Land Pollution and Refuse Disposal, as presented in the Solid Waste Regulations of Illinois. These regulations establish:

(1) General standards for hazardous waste transportation, storage and disposal facilities;

(2) Specific performance standards in terms of organic destruction and hydrogen chloride and particulate emissions; and

(3) Specific monitoring and reporting requirements.

For the most part, these requirements emulate those of the Federal Resource Conservation and Recovery Act and Toxic Substances and Control Act (TSCA, 1986). Table 5 summarizes the primary requirements of concern to the converted facility.

3.1.3 Design and Operation Criteria

The modified KCM includes all facilities and equipment needed: (1) to receive and handle incoming soils and to provide for day storage, (2) to feed waste to, fire and treat soils in the kiln; (3) to cool and store the treated soils and to handle them for loadout from the plant, (4) to control and treat the incinerator offgas, and (5) to control potential spillage and run-off from the plant.

The kiln will treat the contaminated soil to a minimum temperature of 1600°F with a residence time of not less than 30 minutes. The kiln offgas will be combusted in an afterburner to 2200°F with a 2-second retention time. HCl removal from the afterburner offgas of 99% will be achieved and particulate emissions will be limited to 180 mg/Nm^3.

There will be no long term storage of contaminated soil on the plant site nor will there be permanent storage of treated soil. Onsite storage of both the feed materials and the treated soils will be limited to two to three days of system throughput.

Fugitive dust emissions will be controlled during the handling of all solids. The facility will be designed to avoid spillage of process materials on the ground and prevent contaminated water runoff from the plant site. Monitoring and recording equipment are included to control the process to guarantee minimum process conditions are always maintained.

3.2 INCINERATION FACILITY DESCRIPTION

This section describes the incineration facility that represents the baseline design case. The facility includes modifications to the kiln, the use of some existing facilities, and the addition of new auxiliary equipment.

The technical approach for the development of the baseline design case included the identification of all the facilities needed to effectively incinerate soils contaminated with PCBs. As such, the facility includes all needed controls for the protection of the public health, environment, and the safety of onsite personnel. However, with the exception of the rotary kiln itself, very little of the existing ancillary equipment was used in the development of the baseline case. This approach will not yield an optimal system design and should represent a conservative economic scenario for assessing the feasibility of the facility conversion.

TABLE 5

APPLICABLE FEDERAL PERFORMANCE CRITERIA GOVERNING HAZARDOUS WASTE INCINERATION

Application	Rule or Standard	Reference
Hazardous Waste Incinerators	Standards For Owners and Operators of Hazardous Waste Transportation, Storage and Disposal Facilities	40 CFR 264 Subpart O*
Performance Standards		40 CFR 264.343
-Principal Organic Hazardous Constituent (POHC)	99.99% Destruction and Removal Efficiency (DRE) $DRE = \frac{\text{Mass POHC In} - \text{Mass POHC Out}}{\text{Mass POHC In}}$	
-HC1 in Gas at rates greater than 1.8 Kg/h	99% removal efficiency	
-Particulates Emission	< 180 mg/Nm^3 at 7% Oxygen	
Incinerator Operation	Semi-continuous monitoring of process variable (e.g., CO, Air Flow, Waste Rate, Waste Feed Characteristics, Combustion Temperature, Gas Flow) Spec. Min. Gas residence times, Spec. Min. Temperature.	40 CFR 264.345
Conditions for PCBs Secondary Combustor (Assumed Guidelines)	Minimum Temperature 2012°F Minimum Residence Time, 2 sec. Minimum Combustion Efficiency (CE) 99.9% at 3% excess oxygen $CE = \frac{CO_2}{CO_2 + CO}$	40 CFR 761.70
Chlorinated Dioxins and Similar Compounds (Chlorinated dibenzo-p-dioxins, chlorinated dibenzofurans and chlorinated phenols)	Incinerators that achieve 99.9999 DRE for EPA Waste Codes F020-F028	40 CFR 264.343
PCB Nonliquid Incineration	99.9999 DRE	40 CFR 761.70

*Federal Code of Federal Regulations (CFR), Title 40, Protection of Environment

3.2.1 Facility Design and Operation

The incineration facility for contaminated soils will include the following primary processing and materials-handling steps:

(1) Thermal treatment of solids in the kiln,

(2) Cooling of the treated solids,

(3) Combustion of the kiln offgas,

(4) Cleaning and cooling of the afterburner offgas,

(5) Receiving, handling, and day storage of waste feed material, and

(6) Handling, day storage, and loadout of treated soils for shipment out of the plant.

The flowsheet for the process is shown in Figure 2. Each of these processing and support facilities are briefly described in the remainder of this section.

Kiln Thermal Treatment. The contaminated soils will be processed in a 12 foot diameter by 150 foot long rotary kiln. The internal processing dimensions are 10.5 foot diameter x 135 foot long. The kiln will treat 30,000 lb/hr of the specified soils. The soil will be fed to the up-hill end of the kiln, heated to a minimum temperature of 1600oF, and reside in the kiln for over seven hours. A natural gas fired burner rated at 50 MMBtu/hr will be located at the down-hill or discharge end of the kiln.

The kiln will operate under a draft condition of about 1/2 inches of water gauge. The buffered seals on the kiln, designed and tested at 60 psi, will provide a unique barrier to prevent against gas leakage out of the system should an operating upset occur.

The gas will be delivered to the downstream secondary gas combustor at 600oF. The offgas duct will be equipped with a cyclone system directly off of the kiln to remove heavy dust from the gas stream prior to the gas traveling to the secondary combustor. The dust will be returned to the kiln for treatment.

In this baseline design case, the kiln will undergo only limited modifications from its present configuration. However, many of the existing features used for gasification will not be needed. The following revisions and repairs are expected:

- The existing solids feeder will be replaced.
- Porting will be deactivated.
- Refractory will be upgraded.
- A new natural gas burner will be added.

- The offgas pipe and cyclone will be replaced with new duct, cyclone, and dust recycle piping.
- The solids discharge system will be replaced.

Solids Discharge and Cooling. The treated soils discharged from the kiln will be cooled to less than 300oF using a rotary cooler. Both indirect and direct cooling will be employed. The working duty of the cooler will be about 8 MMBtu/hr. A gas lock will be used on the cooler outlet to control air ingestion into the process. The cooled solids will be conveyed to a storage bin for holding during testing.

Secondary Combustion. For the baseline design case, a preliminary vendor design has been used which consists of a downfired vertical secondary combustor. This approach was selected so that the entrained particulate matter can drop out in the bottom of the combustor. Deposited material must then be removed during equipment downtime.

The unit will be 20 feet in diameter (inside) and 70 feet high. Because of the large size it will require field fabrication. The heat duty of the unit will be 160 MMBTU/hr and the exit gas will contain 5% 02 on a wet basis or 6.6% on a dry basis. The duty of the secondary combustor is quite large due to the low temperature (600^{o}F) and oxygen content (8.5 % Oxygen) of the gas from the kiln. Modifications to the process concept may allow for substantial reduction in this duty.

Air Pollution Control. The very high temperature (2200^{o}F) of the gas leaving the secondary combustor necessitates the removal of a great deal of heat. Direct water spray is the simplest way to cool the gas but the mass of water needed is about one half the mass of the gas. As such, the direct quench approach practically dictates the use of a dry scrubbing system since the latent heat of the water vapor would have to be removed and would necessitate the use of a large heat exchanger.

Wheelabrator Air Pollution Control offered a design in which a single vessel would be used for both spray cooling and scrubbing. The upper part of the tower would be refractory lined and used to cool the gas. A lime slurry would be used in the spray dryer/reactor section to remove the HCl. The dry reacted lime and other particulate would then be removed in a pulse-jet fabric filter. This material will be disposed of in a suitable landfill. It is anticipated that this small volume of solid residue would not be a hazardous waste. This assumption would have to be verified by actual tests of the material.

The cooler/dryer vessel would be 18 feet in diameter with a 60-foot cylindrical section having 60^{o} conical ends on the top and bottom. The lime would be supplied at a stoichiometric ratio of 3.5 to 1.

The fabric filter would consist of four pulse-jet modules each about 12 feet square and 57 feet high. These four modules can be placed to suit the restrictions of the plant site.

		1 Solids to Kiln		2 Solids Discharge	3 Heater Air		4 Heater Fuel	6 Cyclone Offgas		7 Incinerator Fuel
TEMPERATURE, F		60		1600	100		60	400		60
PRESSURE, PSIA		14.659		14.659	15.696		15.696	14.140		15.696
IN WG		-1		-1	27		27	-15		27
COMPONENTS	FORMULA	lb/hr	Vol %	lb/hr	lb/hr	Vol %	lb/hr	lb/hr	Vol %	lb/hr
Carbon Dioxide	CO_2	-	-	-	-	-	-	5315.17	3.7	-
Methane	CH_4	-	-	-	-	-	1937.50	-	-	6622.00
Nitrogen	N_2	-	-	-	54266.96	79.0	-	54266.96	60.1	-
Oxygen	O_2	-	-	-	16476.05	21.0	-	8746.82	8.5	-
Hydrogen Chloride	HCl	-	-	-	-	-	-	-	-	-
Sulfur Dioxide	SO_2	-	-	-	-	-	-	-	-	-
Steam	$H_2O(g)$	-	-	-	-	-	-	16051.56	27.7	-
SUBTOTALS		-	-	-	70743.01	100.0	1937.50	84180.51	100.0	6622.00
			Wt %			Wt %			Wt %	
Moisture	$H_2O(l)$	11700.00	39.0	-	-	-	-	-	-	-
PCB (l)	$C_xH_yCl_z$	300.00	1.0	-	-	-	-	300.00	.4	-
Soil		18000.00	60.0	17750.00	-	-	-	250.00	.3	-
Calcium Hydroxide	$Ca(OH)_2$	-	-	-	-	-	-	-	-	-
Calcium Chloride	$CaCl_2$	-	-	-	-	-	-	-	-	-
TOTAL MASS FLOW, LB/HR		30000.00		17750.00	70743.01		1937.50	84930.51		6622.00
TOTAL ENERGY, MMBTU/HR		0.000		8.283	.681		46.229	30.183		150.001
AMW, lb/lb-mole		-		-	28.85		16.04	26.19		16.04
ACFM		-		-	15663		716	43250		2448
SCFM		-		-	15529		765	20486		2614
Dew Point, F		-		-	-		-	151		-
HHV, Btu/scf		-		-	-		1007	-		1007

		8 Incinerator Air		9 Incinerator Offgas		10 Spray Dryer Offgas		11 Baghouse Offgas		12 Dust from Baghouse		13 Stack Gas		22 Slurry to Spray Dryer	
TEMPERATURE, F		60		2250		400		400		400		400		60	
PRESSURE, PSIA		15.696		14.029		13.955		13.511		13.955		14.696		14.696	
IN WG		27		-18		-20		-12		-20		0		0	
COMPONENTS	FORMULA	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %
Carbon Dioxide	CO_2	-	-	23910.36	6.6	23910.36	3.0	23910.36	3.0	-	-	23910.36	3.0	-	-
Methane	CH_4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen	N_2	102721.16	79.0	156980.12	67.7	156980.12	39.5	156980.12	39.5	-	-	156980.11	39.5	-	-
Oxygen	O_2	31187.27	21.0	13221.44	5.0	13221.44	2.9	13221.44	2.9	-	-	13221.44	2.9	-	-
Hydrogen Chloride	HCl	-	-	105.09	.1	1.05	.0	1.05	.0	-	-	1.05	.0	-	-
Sulfur Dioxide	SO_2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Steam	$H_2O(g)$	-	-	38986.04	20.7	137703.00	53.0	137703.00	53.0	-	-	137703.00	53.0	-	-
SUBTOTALS		133908.41	100.0	225211.04	100.0	331824.77	100.0	331824.77	100.0	-	-	331824.77	100.0	-	-
			Wt %		Wt %		Wt %		Wt %		Wt %		Wt %		Wt %
Moisture	$H_2O(l)$	-	-	-	-	-	-	-	-	-	-	-	-	106778.6	99.4
PCB (l)	$C_xH_yCl_z$	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil		-	-	250.00	.1	250.00	.1	-	-	250.00	19.6	-	-	-	-
Calcium Hydroxide	$Ca(OH)_2$	-	-	-	-	465.37	.1	.05	.0	465.32	36.6	-	-	651.52	.6
Calcium Chloride	$CaCl_2$	-	-	-	-	557.77	.2	.11	.0	557.66	43.8	-	-	-	-
TOTAL MASS FLOW, LB/HR		133908.43		225461.04		333097.91		331824.93		1272.98		331824.77		107430.20	
TOTAL ENERGY, MMBTU/HR		0.000		104.144		102.057		102.030		.019		102.030		0.000	
AMW, lb/lb-mole		28.85		27.20		23.36		23.36		-		23.36		-	
ACFM		27529		206524		156750		146190		-		148849		-	
SCFM		29394		52443		89955		89955		-		89955		-	
Dew Point, F		-		140		180		177		-		182		-	
HHV, Btu/scf		-		-		-		-		-		-		-	

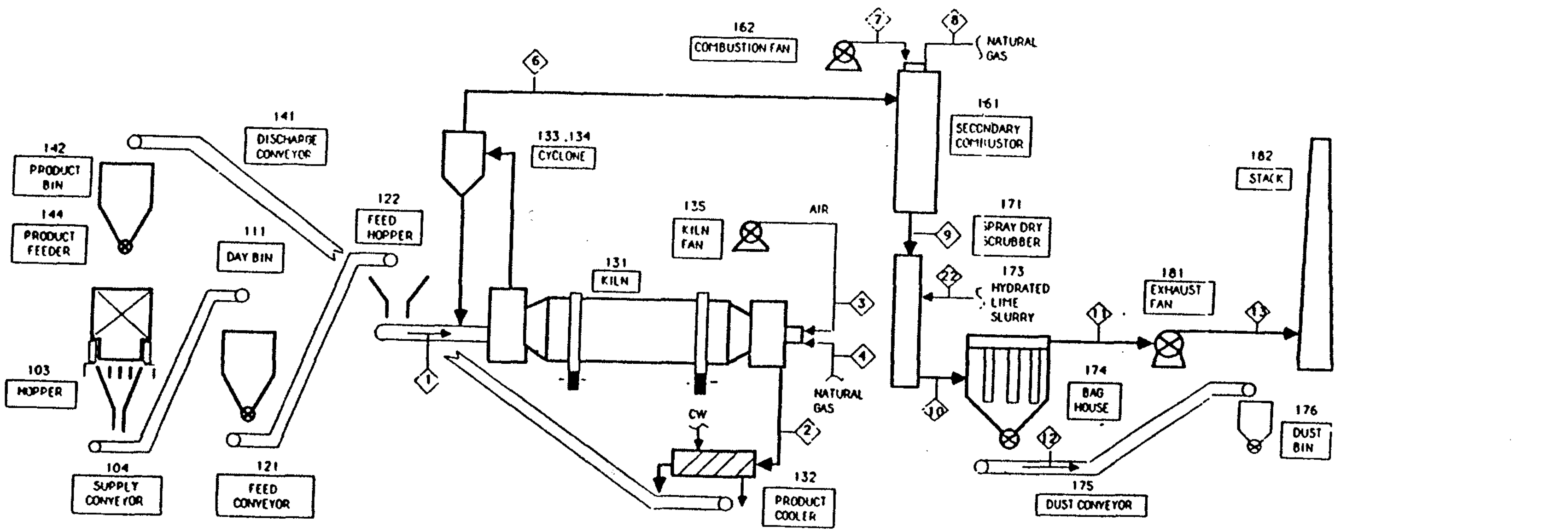


FIGURE 2. PROCESS FLOW DIAGRAM

(For larger version of this diagram, please see Appendix B)

The exhaust fan on the outlet of the air pollution control system will draw between 80-90,000 ACFM at about 30 in water gauge draft.

Waste Material Receiving, Storage, and Handling. The waste material can be received either by truck or rail car. It will be unloaded into an in-ground hopper and then conveyed to a day storage bin from which it will be fed directly into the kiln. The unloading station will be located within a building to totally enclose the material transfer operation. The materials handling areas will contain concrete pads with curbs, traps, and sumps to control any spillage and to provide for cleaning of trucks and rail cars as needed before they leave the plant site.

The unloaded material will be conveyed from the in-ground hopper to a feed storage bin (Day Bin) designed to handle one day (24 hours) of material (360 tons) for processing. The material will be discharged at a controlled rate from the bin and conveyed to a small hopper for feeding the kiln.

All conveyors will be totally enclosed and transfer points will have provisions for dust and spillage control. The unloading building will be maintained under negative draft by connecting it to the inlet of the incinerator air blower. The flow diagram in Figure 2 illustrates these transfer, day storage, and feeding operations.

Treated Soils Handling, Storage, and Loadout. The treated material produced from the kiln cooler will be conveyed to a product bin (sized for one day of material) where it will be accumulated prior to filling trucks or rail cars. The storage bin will be located above the car and truck unloading hopper. This will permit recycle back to the process if further treatment is required and will permit the receiving and loadout of materials at a single station.

Material in the bin can be sampled and analyzed as needed prior to leaving the plant site. Space will be provided to delay shipment of trucks and rail cars offsite if special approvals are needed prior to release.

3.2.2 Site Layout

It is expected that existing plant facilities that are not needed will be dismantled. The dismantling will provide sufficient space at the site for the planned modifications and for general facility operation. Figure 3 shows one possible layout for the converted incineration facility. The solids handling operation would be located on the north side of the kiln to provide access from the existing rail road tracks. Truck access can be readily provided since the loading and unloading stations are adjacent to blacktop and gravel service roads that already serve the plant. The gas cleaning equipment would be located on the north side of the kiln in the area of existing gas handling equipment.

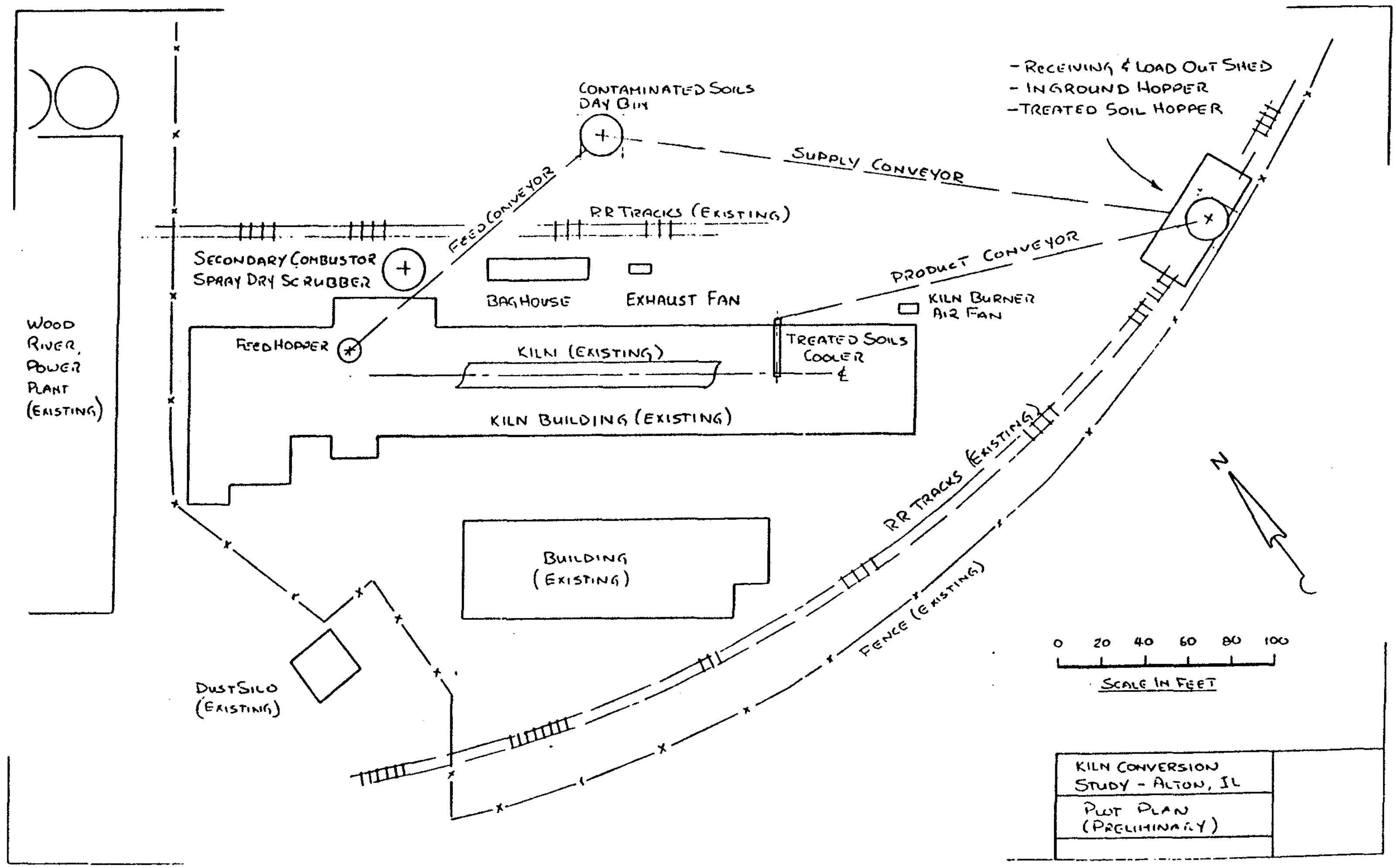


FIGURE 3. SITE PLOT PLAN

(For larger version of this diagram, please see Appendix B)

3.3 ECONOMICS

3.3.1 Centerline Case

The total investment to produce a working facility through its first trial burn is expected to be approximately $24,000,000 in constant 1988 dollars. Table 6 summarizes the capital investment estimate for the facility. This includes costs for design, permitting, and site preparation. Plant modification costs include purchase and installation of system components identified in the process flowsheet. In addition, a 30 percent contingency was added to the plant modification estimate. The "other owner" costs include purchase of the property on which the plant is located, charges for invested funds prior to receiving revenues, and start-up costs through the first trial burn.

TABLE 6

CAPITAL COST ESTIMATE (1988 DOLLARS)

Design, Permitting, Site Preparation	7,588,000
Plant Modifications	9,168,000
Other Owner Costs	4,645,000
Contingency	2,750,000
TOTAL INVESTMENT	24,151,000

The centerline economic forecast was based on a $278 per ton tipping fee which would be competitive with the lowest rates ($250 per ton) currently being charged by portable and transportable systems, and substantially better than their upper cost range ($550 per ton). A 50 percent return-on-investment was determined based on capital required, operating costs (personnel, insurance, taxes, maintenance, fuel, etc.), 50 percent plant utilization, and a five-year project life. This return should be very attractive to any potential investor.

3.3.2 Economic Sensitivity Analysis.

Since one of the greatest uncertainties associated with this type of feasibility study are the estimates of capital investment and operating costs, a sensitivity analysis was performed to better understand the impact of these two variables on overall economics. Two separate analyses were conducted. The effect on tipping fee was estimated as operating expenses were varied; the centerline capital investment and 50 percent return-of-investment were held constant. In the second analysis, the effect on tipping fee was again estimated, but this time as capital investment was varied; the 50 percent return was held constant. Table 7 identifies the parameters used for the two different analyses.

TABLE 7

ECONOMIC SENSITIVITY ANALYSIS

TIPPING FEE VS. OPERATING EXPENSES

PARAMETERS	CENTERLINE	OPTIMISTIC	PESSIMISTIC
Capital Investment	$24.1 MM	$24.1 MM	$24.1 MM
Design Capacity	15t/hr	15t/hr	15t/hr
Fuel Cost	$3/MM Btu	$2/MM Btu	$4/MM Btu
Electricity	$.055/kwh	$.050/kwh	$.060/kwh
Maintenance Factor	5%	4%	6%
Investment Return	50%	50%	50%
Facility Use Steps	10%	10%	10%
Fee @ 50% Capacity	$278	$253	$303

TIPPING FEE VS. CAPITAL INVESTMENT

PARAMETERS	CASE 1	CASE 2	CASE 3
Fee @ 50% Capacity	$250/t	$350/t	$450/t
Design Capacity	15t/hr	15t/hr	15t/hr
Plant Life (Yrs)	5	5	5
Income Tax Rate	35%	35%	35%
Investment Return	50%	50%	50%
Facility Use Steps	10%	10%	10%
Capital Investment	$19.0MM	$37.6MM	$56.3MM

The results of the sensitivity analysis are shown graphically in Figures 4 and 5. Figure 4 illustrates the effect of operating expenses on tipping fees. It shows the tipping fee that would result when operating expenses are varied optimistically and pessimistically. A plus or minus 17 percent variation (from centerline operating expenses) resulted in a plus or minus 9 percent change in tipping fees while maintaining a $253 to $303 per ton. These compare favorably with current low-end fees charged by competitive portable plants, which are also shown in Figure 4.

Figure 5 illustrates the effect of capital investment on tipping fees. For example, at 50 percent capacity utilization, tipping fees of $250 to $450 per ton would allow capital investments to range by $37 million while maintaining a 50 percent return.

Tipping fees charged by portable and transportable systems currently operating in Illinois are in the range of $250 - $550 per ton (Also at a plant utilization of approximately 50 percent.) From the economic analysis, a modified KILnGAS facility with a tipping fee of $278 per ton has the potential to provide lower cost treatment than mobile units. In addition, the sensitivity analyses further show tipping fees are competitive, even with adverse operating costs over a wide range of capital investment.

A comment regarding the current tipping fees for the mobile units is warranted at this point. It is likely that the quoted prices for thermal treatment are significantly biased, both high and low, by the status of the market environment. For example, many of the developers may attempt to recoup a large portion of their investment during the first several applications. In doing so, the developers can quickly cover their risks in the event that continuous, long-term treatment commitments are not forthcoming. This tactic will result in a much higher tipping fee than might be required if the costs were recovered over a longer time period. Alternatively, the developers may choose to lower the tipping fee to attract more of the market place and to assure high utilization of the equipment. With the equipment proven in the marketplace, the tipping fee can be gradually raised based upon what the market will bear. It would appear that it is this variety of corporate strategies and responses to the marketplace that have resulted in the range of prices presented in Figure 4.

3.4 SCHEDULE

The planning, site approval, design, permitting and construction of the converted facility would be expected to take two to three years. Figure 6 illustrates the schedule and phases of work that would be implemented.

FIGURE 4. OPERATING EXPENSES vs. TIPPING FEE

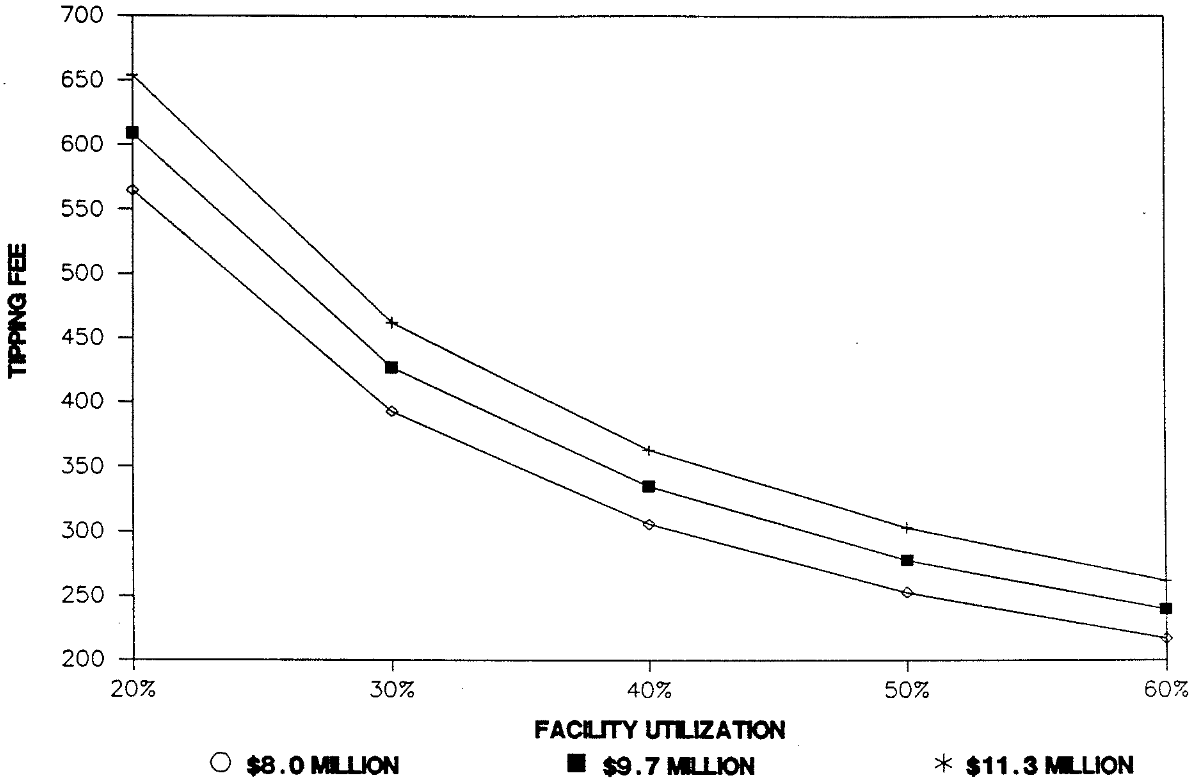
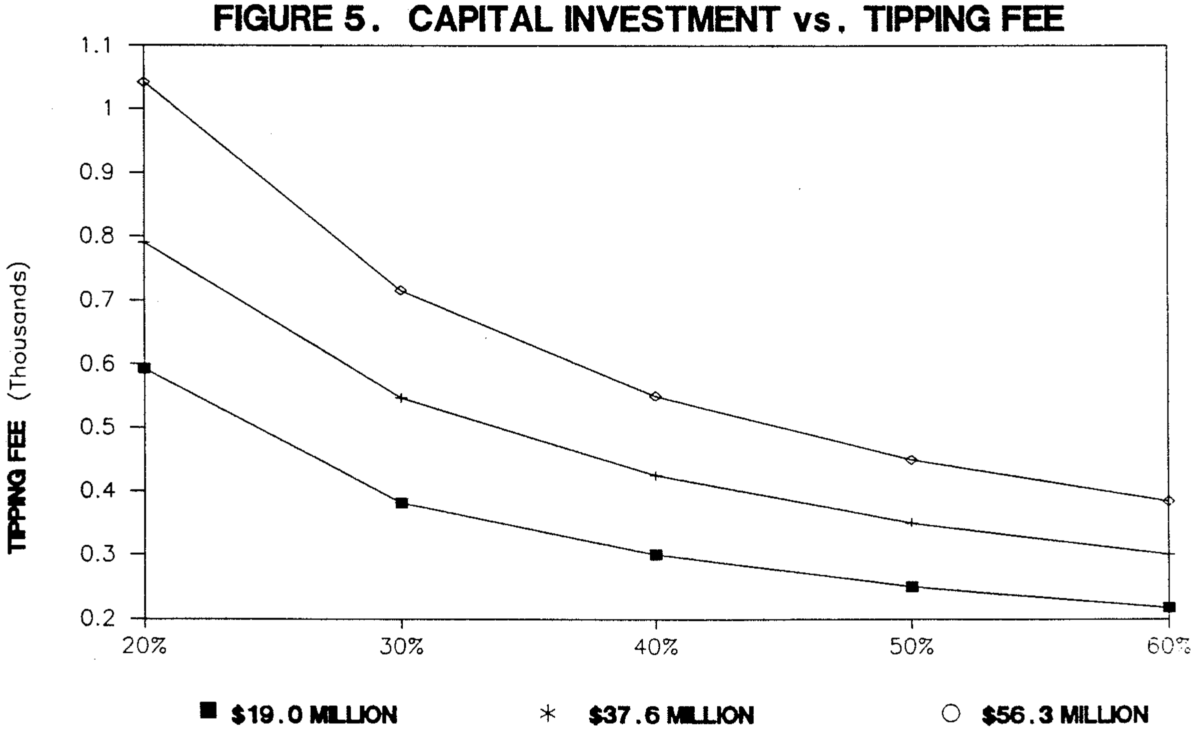


FIGURE 5. CAPITAL INVESTMENT vs. TIPPING FEE



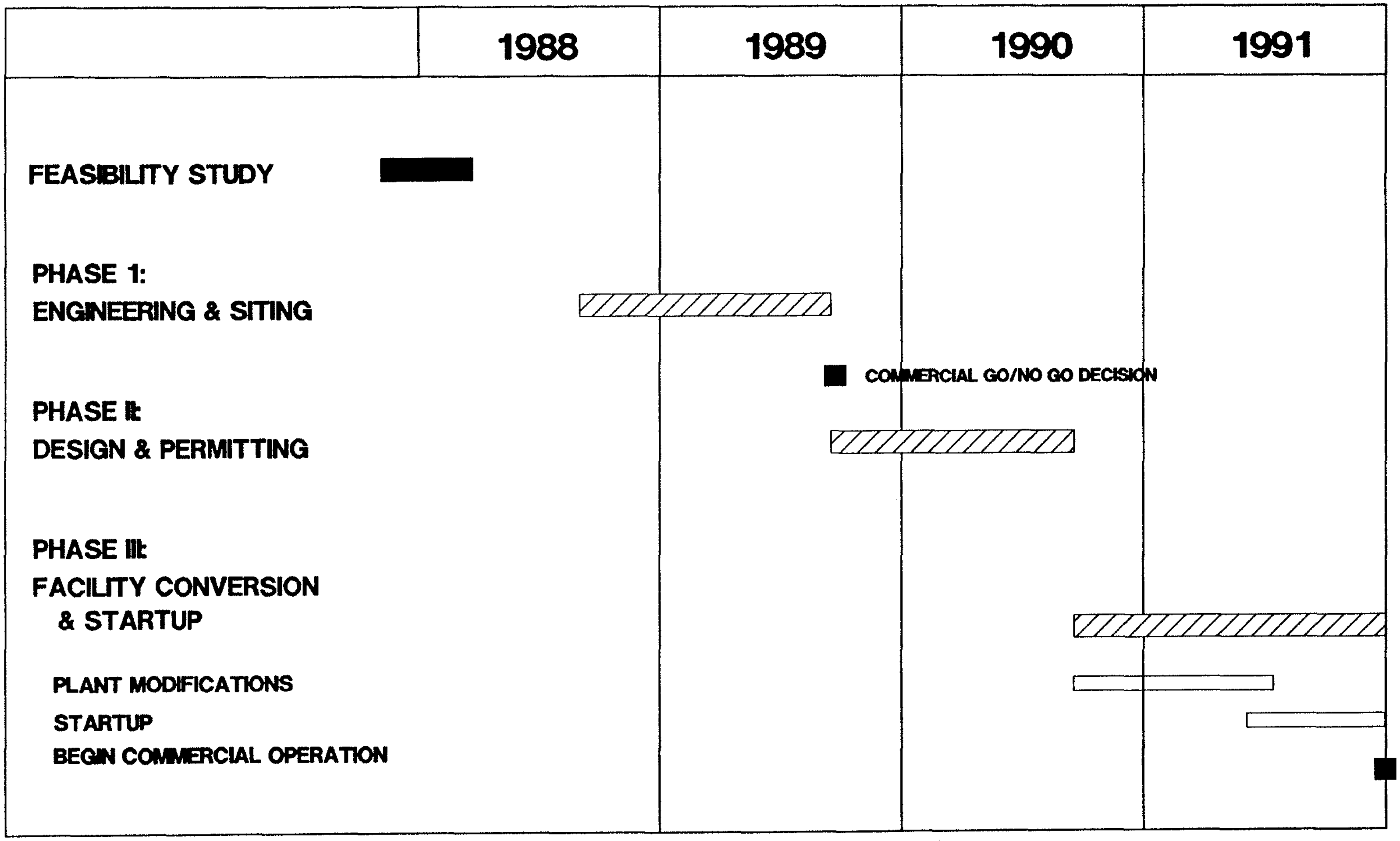
It is expected that two phases of work would precede the actual construction. The first phase would complete the technical definition of the facility and would address siting, primarily from a public perspective, in the Alton area. The second phase would complete the facility design and permitting. It is expected that two years may be needed to complete these first two phases of the effort. Facility modification would then be completed within one year, after which four to six months of startup and operation would be required to complete the test burn. Based upon these time estimates, the incineration facility would be ready for regular operation near mid-year, 1991.

3.5 IMPACT OF CONVERTED FACILITY ON THERMAL TREATMENT CAPACITY

The converted facility has been designed solely for the treatment of contaminated solids, i.e., soils and sludges. The design capacity of 15 tons per hour would approximately equal the nominal capacity of the three transportable systems that are currently operating within the state. Given the higher availability of a fixed facility, it is likely that the effective increase in overall capacity would be even greater than double. This additional capacity, as well as the economies-of-scale associated with the fixed facility, may also serve to stabilize the long term unit price for the thermal treatment of these soils and sludges as shown in Figure 4.

To place the capacity of the proposed incineration facility in perspective, it is useful to consider the length of time required for it to treat the projected volume of contaminated soils that was presented in Section 3, i.e., 193,000 cubic yards. Assuming a facility utilization of 60 percent (or annual treatment capacity of approximately 79,000 tons), a treatment time of approximately two and one-half years would be required. As will be seen in Chapter 4, it may be possible to increase the kiln capacity beyond 15 tons per hour should design criteria, such as soils moisture content or required solids residence time, be lower than projected. Furthermore, it may also be possible to take advantage of some of the unique design aspects of the kiln to increase soils throughput and/or to reduce the offgas processing equipment requirements. These and other design alternatives will be highlighted in Chapter 4 as topics for inclusion in the conversion implementation plan.

FIGURE 6. PRELIMINARY SCHEDULE FOR FACILITY CONVERSION



CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS: A STAGED IMPLEMENTATION PLAN

4.1 CONCLUSIONS

The study conclusions, subject to the limitations of the scope of the effort, are as follows:

(1)Additional incineration capacity for the treatment of contaminated soils and sludges is needed in the State of Illinois.

Quantification of the waste stream demand for incineration is difficult and possibly not meaningful. However, it is evident from the multiple active and latent sources identified, the regulatory trends, and the 1986 actual experience base, that the incineration capacity available at the present time is probably not sufficient to comply with the future capacity assurance requirements in the provisions of SARA.

(2)The conversion of the KILnGAS Commercial Module to a hazardous waste processing facility is both technically and economically feasible.

Performance. The baseline design case indicates that there is no doubt that the kiln is capable of achieving operating conditions required to destroy most pollutants of interest at a throughput rate of at least 15 tons per hour. At this rate, the facility will double the current statewide capacity. Furthermore, performance optimization issues were identified which could possibly increase the throughput. However, these issues could not be addressed in detail within the budget limitations of this study.

Economics. It is very likely that the facility can operate on a self-sustaining commercial basis with tipping fees in the range of 278 dollars per ton - a highly competitive rate in the current market environment. It is probable that the investment costs ($24 million) assumed in the economic study and the generous contingency provisions have sufficient margin to absorb unanticipated facility retrofit costs or performance shortfalls, if any. Furthermore, it is strongly believed that the economic forecasts are very conservative and that further investigation is likely to reduce costs and improve performance, resulting in higher returns or even lower tipping fees.

(3)<u>The siting and permitting process, by its very nature, is the primary concern and the area of highest risk relative to this preliminary feasibility study</u>.

The concern with the environmental siting and permitting is not based upon known facts, but rather on the myriad of indeterminate and difficult-to-predict factors that invariably arise out of siting/permitting procedures that involve public hearings for a major facility. This, however, is a national problem that is facing all treatment, storage, and disposal facilities and is not peculiar to the converted KCM facility.

(4)<u>The converted facility can be operational by mid-year, 1991, and will make a significant contribution towards meeting the SARA provisions</u>.

The schedule defined in the feasibility study specifies a three-year implementation program to take the facility from its current state through a trial burn of the incineration facility. The final go/no-go decision for the conversion can be made in a timeframe consistent with the SARA deadlines. A go-decision will produce a converted facility that will at least double the current statewide capacity for incineration of contaminated soils and solids by contributing an additional processing capacity of at least 70,000 tons per year of waste at a 50 percent capacity factor.

4.2 RECOMMENDATIONS

It is recommended that further engineering and technical investigations be promptly undertaken to validate the critical assumptions of this very limited study. "Next steps" are proposed in the following Implementation Plan with a detailed discussion of the initial phase of this effort. To meet the State's desired operational dates, it is also recommended that ultimate facility ownership issues be more thoroughly examined since they have a bearing on both schedule and economics. The State can play a key role in this latter area by considering its own options regarding ownership or by developing ways to encourage private investment.

4.3 IMPLEMENTATION PLAN: PHASE I- ENGINEERING AND SITING

The "next steps" necessary to proceed with an implementation plan are presented in this section. First and foremost, the issues and risks associated with the critical assumptions noted herein require investigation to confirm or refute the validity of the conclusions of this preliminary assessment. These assumptions are discussed in some depth in this section as they are the high priority action items that must be addressed if the state elects to give further consideration to the potential offered by this facility. Beyond this step, the typical phases of Engineering Design, Facility Permitting and Construction follow. These latter phases were incorporated into the implementation schedule presented in Figure 6 but are not discussed in detail as part of this study.

There are specific technical and regulatory assumptions that were made to develop the baseline design case presented in this study. These assumptions have the potential to impact the facility economics, and hence, price competitiveness of the converted facility. Key technical assumptions of interest are those that directly affect the kiln design and operation as well as the performance of other facility equipment (i.e., Secondary combustor, gas cooling and clean-up, and solids transportation, storage, and handling). The primary environmental and siting assumptions involve the ash (treated solids) management, the public acceptance of the facility, and the availability of the waste for treatment (i.e., the generation of contaminated soils and sludges over the lifetime of the plant). Each of these assumptions and the associated risks and/or issues are discussed in the balance of this section.

4.3.1. KILN PERFORMANCE AND CAPACITY

Co-flow of Gas and Solids. The baseline design case assumes counter flowing gas and solids. Most kilns that have been built for this type of operation use a co-flow configuration. The co-flow operation would produce a higher temperature gas leaving the kiln and significantly reduce the fuel requirements for secondary incineration and overall gas volume for subsequent treatment. However, soil treatment capacity could be reduced significantly from the design capacity of a counter-flow approach. On the other hand, it may be possible to carry out total gas incineration within the kiln due to its size and by controlling kiln firing. This may negate the need for a large external secondary combustor or, at a minimum, significantly reduce the relative cost of the gas treating section of the plant. The selection of the coflow versus counter-flow configuration of the kiln requires further design, operation and failure mode analyses.

Use of Ports and Coal. The ported configuration of the kiln provides a unique opportunity to incinerate the solids by direct burning within the kiln bed. In this case, coal would be simultaneously fed with the soil. Air would be injected through the ports to burn the coal and generate heat. This can produce considerable fuel cost savings and provide an opportunity to operate at higher soil processing rates. The direct combustion within the bed would also improve the incineration process. This may also enhance the capability to complete secondary gas combustion directly in the kiln.

Kiln Size . The processing length of the kiln is 135 feet with an inside diameter of 10.5 feet. The length-to-diameter ratio shows the kiln is much longer than is needed for this application. The kiln construction is such that it could be easily shortened to 75 feet with very little structural modification. This reduction in length would increase the capital investment required for the facility modification while at the same time decrease the supplemental fuel requirements and subsequent operating cost. The net effect of these capital and operating cost tradeoffs has not been determined.

Shell Configuration. The ends of the kiln are necked down to produce smaller diameters at each end. This reduction in the diameter at each end causes the kiln to operate with a solids residence time of nearly eight hours which is significantly longer than is required for the solids treatment. It would be desirable to reduce the solids residence time in the kiln to provide contingency for rapid shut down of the solids processing if process conditions can not be maintained or if separation is needed between batches of material being processed. It is possible to replace the neck sections at the down-hill end of the kiln to reduce the quantity of solids retained in the kiln and produce a residence time of less than one hour. In this mode of operation, longer residence times could be achieved by reducing rotational speed of the kiln during operation. The modifications to do this would include manufacture of new hoods, kiln end sections, and conventional kiln seals. It may be advisable to do this in conjunction with the reduction of the kiln length identified above.

4.3.2. OTHER FACILITY PERFORMANCE CONSIDERATIONS

Secondary Combustor. The design of the secondary combustor requires further analysis in coordination with the kiln evaluations. Combustor fuel requirements based on vendor contacts are two times theoretical needs because of the low temperature of the gas fed to the secondary combustor. This puts a very high cost penalty on the design both from a capital as well as an operating point of view.

Gas Cooling and Clean-up. The gas scrubbing system design is restricted to a high degree by the type of cooling used. When direct spray cooling of the gas is used, it is not practical to cool the gas to a reasonable temperature for wet scrubbing (approximately 150°F) as this would require the removal of tremendous amounts of latent heat of water vapor in cooler condensers followed by the rejection of the heat through cooling towers. The alternatives to wet scrubbing, a spray dryer or a dry reagent scrubber each followed by a fabric filter can be used, but suppliers feel that the temperature of the gas to the baghouse must be kept above 400°F to keep the deliquescent calcium chloride formed by the scrubbing reaction from forming a gummy layer on the bags. While operation at 400°F is practical, it is about the upper limit for retaining heavy metals in the fabric filter.

As alternatives to spray cooling, either a waste heat boiler or indirect air coolers can be used. The waste heat boiler is practical only if there is a market for the steam or hot water. Air coolers can be used in two ways. A large volume of air can be heated only one or two hundred degrees and vented, or a smaller amount of air can be heated to about 800°F and used for combustion air both in the kiln and in the secondary combustor.

The cooled gas from either a waste heat boiler or air cooler could be dry scrubbed at a lower temperature than spray cooled gas or could be cooled further and wet scrubbed. The lower temperature would also give more reliable control of heavy metal emissions. Gas volumes would be lower so that equipment would be smaller and fan power requirements would be less.

Use of the preheated combustion air approach would be particularly beneficial, as it lowers the fuel requirements and consequently the flue gas volume, and hence the size of the pollution control equipment. Combustion conditions in the secondary combustor would be greatly improved. It would, of course, add to the number of pieces of equipment.

Transportation and Storage of Solids. The baseline assumes delivery of solids to the plant site as the material is scheduled to be processed. This will necessitate a highly controlled and coordinated transportation system to maintain well scheduled delivery of materials to and from the facility. The degree and type of segregated storage at the plant site will need to be reviewed. Handling equipment for receipt and storage of contaminated soil will need special attention. Even with close specifications put on the feed soil, the selection and configuration of equipment to maintain steady and reliable operation will be a challenge. Facilities needed to support the scheduling of materials out of the plant will need further work especially if changes of feed material during operation require testing and approval of the treated soils prior to release from the process site.

4.3.3. ENVIRONMENTAL AND SITING CONSIDERATIONS

Facility Siting. The State of Illinois requires that the siting of new regional pollution control facilities must be approved by the local governing body before the facility can apply for construction and operating permits. This requirement would apply to the converted facility even though it has operated as a coal gasification plant in its current location for the past five years. This requirement can severely impact the feasibility of the facility conversion since it can significantly delay the process and negatively impact the project economics.

The acceptability of a hazardous waste facility to a local populace is difficult to predict. On the one hand, there is the projection of more jobs and an increased tax base for the community. On the other hand, there is the public perception of risk and the subsequent concern regarding facility emissions during operation as well as operational upsets and accidents. While these concerns can partially be allayed by the fact that the proposed incinerator will not process liquid, RCRA hazardous wastes (There is generally more concern over the storage and spillage of hazardous liquid wastes rather than soils or solids), there is no assurance that this fact will ease the siting process.

To address this issue, it is imperative that a more comprehensive siting study be performed. Such a study should more fully document the risks associated with the operation of the proposed incinerator and compare these risks with those resulting from grass roots facilities in other locations in the state. This analysis would provide assurances to the state and local populace that a thorough, comprehensive review of the site and plausible alternatives has been completed and that the operation of the proposed facility will not result in negative impacts on the public health or the environment.

Offsite Management of Treated Soils and Treatment of RCRA Liquid Wastes. The proposed incineration facility has been designed upon the basis that the treated soils will be returned to the site from which they originated. This mode of operation represents an important economic and siting factor since the thermal treatment of contaminated soils (which is the primary targeted waste for this facility) does not result in a significant volume reduction of the waste.

For example, the onsite management of the treated residuals would require the construction of a solids disposal facility. Since this facility would be located in a 100 year flood plain, its design requirements would be substantial and could add a significant cost to the operation of the facility. Furthermore, the disposal facility would have a limited lifetime and thereby could constrain the future availability of the incinerator. Both of these factors have the potential to threaten the cost-competitiveness of the converted facility.

On the other hand, the transport of large quantities of treated soil to and from a site will also add costs to the management of the wastes. This, of course, will be a function of the location of the waste volumes relative to the incineration facility and the means of transportation that are accessible to each site. In addition, the offsite management of the treated soils precludes the treatment of RCRA wastes in the primary kiln since this would, by regulatory definition, make them hazardous wastes. It is most certain that this hazardous waste designation of the treated waste would make its return to the site both unreasonable and uneconomical. Liquid RCRA wastes could, however, be incinerated in the secondary combustor. In this manner, only the offgas particulate would have to be collected and managed as a hazardous waste.

A more detailed economic analysis of the tradeoffs and impacts of the treatment of RCRA wastes and the offsite and onsite management strategies for the treated residual is required to define the most economical means of facility operation.

Availability of Contaminated Soils. Unlike the RCRA wastes whose generation is tied to a regular plant production schedule, the bulk of the contaminated soils will be produced as a result of the identification and negotiation of clean-ups at inactive sites. While it is clear that these activities can produce substantial quantities of wastes (as discussed in Chapter 2), the rate at which they will be generated is much less predictable. This uncertainty can impact the economic viability of the incinerator, especially if there is a significant lag in the quantities of contaminated soils that require treatment. This lag will negatively impact the cash flow of the facility which could result in its early economic demise.

The availability of contaminated soils for treatment should be more thoroughly examined to determine not only the quantity of materials that will require treatment but the timeframe over which such materials will be generated.

Facility Ownership. The economics presented earlier in this report made certain assumptions regarding the asset value of the KILnGAS Commercial Module, and the value of the property on which it is located. The economics will vary depending on ultimate ownership of the facility and property and will affect capital investment, return-on-investment, and therefore, tipping fees.

Further consideration of the following relationships should be taken into account:

The KCM is owned by KR&D Inc., a wholly owned subsidiary of the Allis-Chalmers Corporation (A-C).

The property on which the KCM is located is owned by Illinois Power Company and leased to KR&D Inc.

A Lease Agreement between Illinois Power and KR&D Inc. contains terms and conditions that must be satisfied prior to any alternative use for the KCM.

It is possible that A-C, Illinois Power, or a third party could become the ultimate owner of the facility.

For each ownership alternative, economics would vary depending on the sale transactions that would have to take place.

The resulting facility and property values would then have to be taken into account in constructing a total business investment, equity requirement, and proposed tipping fees.

The State of Illinois can play a key role in bringing the parties together to refine the preliminary economic forecasts provided by this report. There is also a question of timing. To meet the State's desired operational dates, ultimate ownership issues must be addressed soon. The State should also consider its own options regarding possible ownership and operation of such a facility and/or incentives that may encourage private investment.

REFERENCES

CERCLA, 1980. Comprehensive Environmental Response, Compensation and Liability Act, Public Law No. 96-510, 94 STAT. 2767.

Environmental Protection Agency, 1988. Land Disposal Restrictions for First Third of Scheduled Wastes, Federal Register, Volume 53, No. 68, Pages 11742 to 11791, April 8.

Frank, James E., Dinkel, Mary E., and Chari, Desi M., 1987. "Use of Mobile Incineration To Remediate the Lenz Oil Site," Superfund 1987 - Proceedings of the 8th National Superfund Conference, Washington, D.C., November 16-18.

Gas Research Institute, 1987. Management of Manufactured Gas Plant Sites, Volume II, Site Investigations, GRI-87/0260.2, November.

Illinois Environmental Protection Agency, 1987a. Summary of Annual Reports on Hazardous Waste for 1983 through 1986: Generation, Treatment, and Storage, IEPA/LPC/87-019, December.

Illinois Environmental Protection Agency, 1987b. Completed Project Monthly Status Reports.

Lee, C.C., Huffman, G.L., and Oberacker, D.A., 1986. An Overview of Hazardous/Toxic Waste Incineration, Journal of Air Pollution Control Association, Volume 36, No. 8, Pages 992 to 931, August.

McCabe, Mark M., 1987. Factors Affecting the Pricing of Onsite Thermal Treatment Services, Proceedings of APCA Specialty Conference "Thermal Treatment of Municipal, Industrial, and Hospital Wastes", Pittsburgh, Pa., November.

Personal Communications, 1988a. Mr. Gene Theios, Mr. Rich Lange, Mr. Robert Ohara, Mr. Stanley Black, Mr. Dennis Newman, Mr. Brian Martin, Mr. Tim Greetis, Mr. Jim Janssen, Ms. Sue Doubet, Mr. Ken Miller, and Mr. Jeff Larson of the Illinois Environmental Protection Agency, February 24 through 26.

Personal Communication, 1988b. Mr. Jim Frank of Illinois Environmental Protection Agency, April 4.

RCRA, 1976. Resource Conservation Recovery Act, Public Law No. 94-580, 90 STAT 95 (as amended).

SARA, 1986. Superfund Amendments and Reauthorization Act, Public Law No. 99-499, too STAT. 1613, October 17

State of Illinois, 1986. Illinois Environmental Protection Act, January 1, 1986.

TSCA, 1976. Toxic Substances Control Act, Public Law No. 94-469, 90 STAT 2003.

APPENDIX A:
DEVELOPMENT OF RCRA WASTE PROFILE

The information presented in this Appendix present the results, in tabular form, of a four step process which was used to develop a RCRA waste profile for the proposed incineration facility. These steps included:

(1)The identification of the RCRA wastes which were treated, stored, or disposed in the State of Illinois (Table A-1: Illinois EPA, 1987a);

(2)A summary of the "incinerable" RCRA wastes from Table A-1 with incinerable defined as wastes that were either organic in nature or currently being disposed of at incinerator facilities (Table A-2);

(3)Isolation of "significant" incinerable RCRA waste streams from Table A-2 with significant defined as those wastes that comprise 0.1 percent or greater of the total volume of incinerable wastes (Table A-3);and

(4)Identification of the fraction of the "significant" RCRA waste streams in Table A-3 which were managed offsite in 1986 (Table A-4).

In summary, the following observations can be made from the information presented in Tables A-1 through A-4. First, a total of 592 million gallons of RCRA wastes were managed (i.e., treated, stored, or disposed) within the State of Illinois in 1986 (Table A-1). Of this, approximately 242 million gallons (or 41 percent of the total) were determined to be "incinerable" (Table A-2). The "significant" incinerable RCRA waste streams in Table A-2 represent approximately 170 million gallons of waste (Table A-3). As a percentage, this volume of wastes represents 28 percent of the total RCRA wastes and 70 percent of the total incinerable waste volume. Lastly, approximately 40 million gallons of the significant incinerable RCRA wastes (Table A-4) are managed offsite.

Table A-1

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
D001	6,447,165	8,296,370	9,315,919	9,723,180	10,299,934	11,282,479	17,308,032	18,226,337
D002	6,408,694	7,760,090	7,006,496	6,198,906	204,674,784	193,929,258	182,113,063	214,527,011
D003	216,905	252,928	80,769	100,109	242,913	1,718,094	1,841,136	1,800,487
D004	0	10,336	81,375	33,837	667	368,454	357,187	1,407
D005	30,290	40,594	18,375	45,497	46,946	24,971	43,294	39,306
D006	682,534	1,031,018	428,274	356,057	795,155	1,427,256	921,549	948,349
D007	821,561	3,594,600	3,151,172	1,226,444	2,629,751	5,905,255	5,234,108	9,157,129
D008	2,837,577	4,513,215	4,830,118	6,336,162	8,227,614	8,541,333	10,037,847	14,962,180
D009	53,336	151,504	85,626	1,848,273	225,684	115,776	158,015	138,781
D010	13,288	7,748	104,166	7,920	29,189	20,148	17,980	14,020
D011	220	2,222	40	204	1,946	19	2,210	1,385
D012	0	30	0	0	3,325	55	0	43,894
D013	0	0	1,210	5,295	15,048	19,234	290,923	440
D014	250	0	0	388,648	0	110	2,122	392,693
D015	0	0	0	0	0	0	15,030	455
D016	0	0	0	468	819	28,501	297	1,885
D017	0	0	0	0	15	13	0	0
F001	844,023	508,878	610,696	669,515	1,592,622	1,369,452	1,331,995	1,664,661
F002	534,423	706,938	1,392,243	1,763,595	681,970	748,335	1,518,979	1,762,902
F003	2,266,071	2,100,664	1,630,944	1,716,687	783,484	1,634,576	1,730,214	2,081,172
F004	89,842	32,179	173,672	149,217	104,418	114,075	163,911	15,801
F005	3,054,460	2,877,925	3,777,377	3,347,819	4,266,139	22,283,167	26,425,555	16,031,840

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
F006	3,673,023	4,370,445	5,428,169	9,634,859	7,720,271	9,470,269	15,497,324	24,841,668
F007	79,142	82,885	69,130	50,842	6,897,050	8,235,944	8,859,187	6,571,784
F008	22,757	49,752	242,818	35,519	40,085	90,237	95,552	562,749
F009	241,493	23,491	44,697	19,968	19,282,790	314,516	143,110	24,618
F010	10	0	0	55	2,700	110	660	2,447
F011	1,090	1,420	6,617	42,210	5,849	1,165	15,065	40,440
F012	29,669	42,930	89,300	63,571	42,205	1,830	715	1,955
F017	550	0	0	0	0	100,155	0	0
F018	1,850	0	0	0	0	0	0	0
F019	19,267	18,505	37,660	15,940	42,168	26,968	40,079	35,386
F021	0	0	0	0	0	0	9	9
F024	0	0	0	0	0	0	0	165
F027	0	0	2,205	0	0	0	6,608	3,245
K001	22,018	75,952	0	0	58,152	885,077	716,281	504,535
K002	0	0	0	0	0	0	0	9,993
K004	0	0	0	0	0	6,636	0	0
K006	24,240	0	0	0	0	0	0	0
K016	0	0	0	0	218	0	16,920	0
K023	0	1,925	0	0	0	1,925	0	0
K024	0	0	48,415	153,490	0	0	78,445	157,315

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
K025	0	0	0	0	382	0	0	0
K027	0	0	0	0	0	0	650	0
K032	8,684	14,520	21,674	62,926	6,050	15,620	21,674	62,926
K033	0	0	0	170	69,423,860	67,002,400	68,148,000	4,237,811
K034	5,005	4,015	330	353	2,585	2,475	2,090	706
K035	0	330	1,100	0	150	550	2,650	39,000
K037	0	0	0	0	0	0	5,454	8,731
K044	0	0	47,508	0	9,400	70,212	65,207	669,869
K046	0	0	0	0	25,048	2,020	3,030	278,356
K047	4,644,336	0	2,472,388	0	0	0	0	0
K048	0	0	0	0	43,190,579	43,897,269	43,732,074	61,514,467
K049	5,921	38,113	6,245	5,050	343,434	766,188	1,485,632	528,538
K050	22,680	17,014	13,655	19,110	22,873	15,150	10,960	17,185
K051	7,506	92,071	205	122,300	3,922,386	6,738,266	6,533,054	6,596,078
K052	11,980	8,520	35,285	18,586	31,202	90,284	369,226	230,744
K060	605	0	0	0	232,125	0	0	0
K061	7,964,592	11,939,592	11,623,489	4,930,460	8,716,913	10,048,580	15,953,722	14,103,040
K062	7,902,257	10,633,626	10,237,319	9,358,236	38,247,589	31,158,140	30,102,446	33,564,545
K069	29,300	86,972	24,361	12,568	518,883	35,367	800	800
K073	0	0	0	0	17,412	6,732	0	0
K078	18,686	0	0	0	0	145,310	0	0
K083	629,913	595,378	324,412	0	5,512	0	10,942	38,517

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
K084	0	0	0	0	0	0	32,222	50,096
K085	21,416	19,025	30,335	34,085	9,266	26,191	30,335	34,525
K086	742,402	349,721	344,574	220,441	105,150	54,602	73,420	152,406
K087	318,554	1,616	103,650	0	882,060	527,470	705,924	401,444
K093	0	24,365	11,440	6,923	0	27,225	8,360	8,809
K094	67,155	109,285	19,800	15.400	165,165	116,215	18,370	1,485
K097	0	0	0	0	0	0	0	21,188
K100	2,812	0	0	0	0	0	0	0
P001	16,160	3,850	0	220	20,200	0	9,494	1,604
P002	0	0	150	0	0	0	370	0
P003	0	0	0	0	0	0	0	617
P004	35	0	0	15	0	0	0	384
P005	0	0	0	21	0	0	0	0
P009	0	4	0	0	0	0	0	0
P012	0	5	1	0	600	600	2	0
P014	0	0	0	5	0	0	0	0
P015	0	0	165	0	881	0	0	0
P018	0	0	0	202	0	0	0	202
P020	240	0	0	0	0	0	1,045	0
P021	0	0	0	0	0	0	404	312
P022	1,265	5	0	15	0	0	5	69
P028	0	0	0	3,215	0	0	0	3,190
P029	220	135	55	454	330	135	220	0
P030	24,184	13,146	23,458	3,029	7,208	2,377	6,366	7,486

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
P031	0	0	1	0	0	0	0	0
P034	0	0	0	0	0	0	55	0
P037	0	0	0	0	0	0	30	165
P038	0	0	480	0	0	0	0	0
P039	0	0	0	0	0	63	55	0
P045	0	0	0	0	0	10,437	0	0
P048	0	0	20	0	0	0	0	0
P050	0	0	2	72	0	0	0	0
P051	12,401	18,585	0	365	0	0	0	0
P058	0	0	0	0	0	0	0	0
P059	0	2,881,714	24	349	100	0	0	160
P063	0	0	0	0	0	0	810	0
P064	0	0	1,035	0	275	0	1,704	110.
P068	0	0	0	0	0	0	0	663
P070	0	0	0	0	0	0	0	4,470
P071	0	39	0	0	2	31	3,434	660
P075	0	0	0	86	0	101	0	0
P076	0	0	15	650	0	0	0	2
P077	186,637	184,385	0	5	596	0	830	0
P081	0	0	6,287	2,660	17,574	17,170	13,938	11,110
P082	50	0	0	0	0	0	0	0
P087	48	0	160	5	0	0	0	720
P089	0	0	0	0	0	5	0	156
P092	0	0	0	0	1,353	55	0	0

Table A-1
(continued)

RCRA WASTE	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
P094	0	2,116	19,248	18,555	14,140	27,396	75,659	116,291
P095	0	165	0	0	0	0	0	0
P098	1	30	50,574	7	501	40	0	0
P105	0	0	63	16	0	55	0	0
P106	4,851	4,715	951	894	0	0	0	705
P107	0	0	0	1	0	0	0	0
P108	1	0	0	0	0	0	0	0
P111	0	0	3,175	3,250	0	0	0	0
P115	1,020	2	0	0	0	0	0	0
P119	0	0	110	0	0	0	0	0
P120	935	1,430	165	5	2,640	1,430	0	0
P121	2,600	2	0	3,550	0	0	0	55
P122	6,060	6,045	0	0	0	0	55	0
P123	0	0	30	2,040	0	0	55	0
U001	0	118	86	24	2,762	1	0	0
U002	28,054	23,986	27,271	17,701	1,420	12,473	7,346	2,909
U003	5	142	4	684	0	450	0	0
U007	0	0	0	1,540	1,010	0	0	1,414
U008	1,980	1,427	1,007	24	1,980	0	0	0
U009	593	48	610	104,288	499	307	297	110,100
U010	0	0	0	0	0	0	0	1,690
U011	0	0	0	95	0	0	0	1,010
U012	53,387	27,395	0	0	52,690	1	0	0

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
U019	2,436	3,912	6,266	1,540	2,845	3,218	6,445	171,393
U022	0	0	0	0	0	0	0	380
U028	3,740	3,465	3,010	2,350	9,392	10,856	4,930	13,531
U029	0	0	6,540	0	0	0	3,216	0
U031	0	34	22,165	20,559	0	0	0	15,689
U032	277	8	115	0	388	115	0	0
U036	17,325	13,035	2,198,747	136,875	14,850	7,590	2,195,020	142,664
U037	1	0	400	0	0	881	1,650	4,919
U044	265	566	789	5,266	700	142	104	573
U045	1,320	0	0	0	0	0	0	0
U051	14,140	98,689	46,662	34,677	210,100	884,411	957,261	1,407,003
U052	0	0	0	110	55	1	48,501	34,519
U053	0	1	0	14	0	0	0	0
U056	5	6,561	7,520	11,641	0	0	0	0
U057	2	55	330	110	0	55	1,010	0
U060	0	0	35	5	0	0	0	0
U061	0	101	979	11,280	376	966	872	2,451
U062	0	0	0	0	0	0	0	631
U067	0	0	0	1	135	329	0	0
U069	0	220	605	605	0	220	4,790	605
U070	13,127	55	0	12,240	13,130	10	98,090	434
U071	0	3,300	4,675	70	0	3,300	55	0

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES 1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS 1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
U072	3,370	0	35	15,876	0	0	6,240	26,371
U073	0	0	0	0	0	0	4,850	0
U075	0	0	0	0	0	0	1,590	0
U076	48,255	0	0	0	0	0	0	0
U077	0	6	1,210	2	0	110	0	0
U080	3,661	2,359	73,362	13,335	930	1,565	72,109	21,053
U081	0	0	20	0	0	0	165	55
U087	0	0	0	0	0	0	30	0
U092	1	0	0	0	0	0	0	990
U093	0	0	0	0	0	0	30	0
U094	5	0	0	0	5	0	0	0
U096	0	0	0	751	0	0	0	0
U102	0	0	0	2,626	0	0	0	5,176
U103	205	1,602	0	0	331	1,375	0	0
U107	100	275	125	0	100	55	330	55
U108	48	203	0	8	0	0	50	1
U109	0	0	0	0	222	0	0	0
U112	4,667	3,719	4,318	6,708	0	51	0	50
U113	0	0	275	0	0	0	275	420
U116	0	5	0	0	0	5	0	0
U117	0	0	11	41	10	10	181	21
U118	0	0	3	0	0	0	0	0
U121	0	0	330	482	0	0	730	900

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
U122	1,128	1,731	4,531	1,890	105	4,112	57,059	12,941
U123	13	1	9	0	0	0	61	0
U125	0	0	0	0	0	0	0	115
U129	0	1,379,054	3	4,240	0	40	0	11,110
U130	595,122	158,555	3,795	561	1	48,450	51,531	11,966
U131	0	0	0	0	0	1	0	0
U133	0	0	225	90	0	51	335	872
U134	8	0	530	0	0	16,968	1,010	0
U135	0	0	0	0	0	55	0	0
U138	0	0	0	0	0	0	0	30
U140	12,090	28,050	0	0	0	0	0	0
U144	736	0	0	394	0	0	0	0
U145	0	0	0	2,750	0	0	0	0
U147	0	155	116	346	0	5	25,000	495
U151	5,339	273	805	64	5	627	3	19
U154	10,666	7,588	6,520	14,577	765	3,728	3,635	6,291
U155	17	2	0	0	0	0	0	0
U158	110	165	0	825	0	100	0	3,318
U159	35,762	27,425	32,294	98,227	36,254	42,027	46,605	10,396
U160	0	0	0	0	0	0	1,460	314
U161	450	0	0	0	110	0	342,941	46,824
U162	3,850	22,200	0	0	0	85	5,676	130
U165	1	381	2,594	4,985	1	326	2,255	3,575

Table A-1
(continued)

RCRA WASTE	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
U169	1	2	0	55	158,419	57	105	55
U171	0	0	0	0	0	0	0	85
U173	0	220	0	0	0	0	0	0
U174	0	320	0	0	0	0	30	0
U177	0	115	0	0	0	0	0	0
U181	0	0	0	0	0	110	0	0
U182	0	0	0	0	0	0	0	3,073
U184	275	0	0	0	275	0	0	0
U185	0	0	20	0	0	0	0	0
U187	0	0	0	0	1,428	0	0	0
U188	20,420	69,427	817	670	3,699	10,974	183,235	8,259
U189	0	0	0	216,000	0	0	0	0
U190	15,070	27,250	31,625	31,350	32,795	36,801	30,745	40,445
U191	0	0	0	30	0	20	0	0
U196	30	698	1,357	1,175	0	2	14	10
U197	0	0	78	0	0	0	0	0
U201	0	0	103	305	0	1	0	946
U202	0	0	0	0	0	0	0	1,440
U204	0	0	0	0	0	55	0	0
U209	0	0	0	1	0	0	0	570
U210	1,155	551	7,267	3,247	19,366	241,277	0	12,963
U211	72	74	311	875	392	431	670	350
U213	10,455	359	330	17	0	166	150	1,061
U219	0	110	0	0	0	110	0	0
U220	27,955	13,583	534,200	16,998	320,066	1,840	176,013	710
U221	0	0	0	28	0	0	0	0

Table A-1
(continued)

	TOTAL QUANTITY OF RCRA WASTE IN GALLONS DELIVERED TO OFF-SITE FACILITIES				TOTAL QUANTITY OF RCRA WASTE IN GALLONS STORED, TREATED, OR DISPOSED IN ILLINOIS			
RCRA WASTE	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS	1983 GALLONS	1984 GALLONS	1985 GALLONS	1986 GALLONS
U223	11,175	765	2,980	1,400	10,199	1,710	13,891	3,038
U226	19,249	35,831	22,369	16,437	8,346	4,545	11,504	70,022
U227	0	17	110	0	0	0	0	0
U228	23,963	20,829	6,303	12,362	10,100	2,949	165	37,313
U230	165	0	0	450	165	851	0	0
U235	0	0	0	0	518	0	0	0
U237	0	0	0	0	55	0	0	0
U238	0	1,770	385	0	0	1,550	385	1,646
U239	8,237	1,838	146,706	32,541	5,790	5,636	8,755	179,527
U240	0	25	140	8,366	50	3,709	1,681	56,367
U242	825	13,415	0	0	1,944	16,660	0	0
U244	0	0	1,131	14	0	690	0	0
U246	1	2	0	1	0	5	0	0
U247	0	0	3,675	0	0	0	0	0
U288	0	0	0	0	0	0	30,156	0
Mixed D	3,097,069	4,458,533	5,078,221	5,994,247	6,659,262	32,565,276	50,178,803	41,842,854
Mixed F	7,419,176	23,556,548	25,609,249	17,664,546	6,784,700	3,987,765	1,580,469	4,826,430
Mixed K	744,013	214,346	1,932,137	469,260	1,558,916	1,666,070	1,407,006	70,078,876
Mixed P	0	335	808	360	660	1,500	8,725	202
Mixed U	215,612	229,913	378,253	356,114	188,072	140,622	96,822	340,246
Mixed	9,668,572	9,614,100	7,113,782	8,743,581	14,309,615	69,965,643	56,838,972	35,536,577
TOTAL	73,229,870	103,772,855	107,465,773	96,375,379	465,098,356	539,222,757	556,474,700	592,412,959

Table A-2

1986 SUMMARY

RCRA Waste Number		Incinerable Wastes Treated, Stored or Disposed (Gallons)			Percentage of Wastes Treated Stored or Disposed	
		On-Site	Off-Site	Total	Total	Incinerable
D001	Waste with flashpoint <60 deg.C	8,553,157	9,723,180	18,276,337	3.1	7.5
D012	Endrin	43,894	0	43,894	.0	.0
D013	Lindane	0	0	0	0.0	.0
D014	Methoxychlorbismethoxphenyl ethane	0	5,295	440	.0	.0
D016	2,4 Dichlorophenoxyacetic acid	1,417	468	1,885	.0	0.0
D017	2,4 5Trichlorophenoxypropionic acid	0	0	0	0.0	0.7
F001	Spent halogenated solvents	995,141	669,515	1,664,661	0.3	0.7
F002	Spent halogenated solvents	0	1,763,595	1,762,902	0.3	0.9
F003	Spent non-halogenated solvents	364,485	1,716,687	2,081,172	0.4	0.9
F004	Spent non-halogenated solvents	0	149,217	15,801	.0	0.0
F005	Spent non-halogenated solvents	12,684,021	3,347,819	16,031,840	2.7	6.6
K001	Creosote/PCP wastewater sludges	504,535	0	504,535	0.1	0.2
K023	Dist. light ends	0	0	0	0.1	0.1
K032	Chlordane wastewater sludge	0	62,926	62,926	.0	.0
K034	Chlordane filter solids	376	330	706	.0	.0
K035	Creosote wastewater sludges	37,900	1,100	39,000	.0	.0
P039	Diethly-S-ethlphorodithioate	0	0	0	0.0	0.0
K046	Lead containing wastewater sludges	278,341	15	278,356	.0	0.1
K048	DAF Float	61,514,467	0	61,514,467	10.3	25.4
K049	Slop oil emulsion solids	538,488	5,050	528,538	0.1	0.2
K050	Refinery heat exchanger sludge	0	19,110	17,185	.0	0.2
K051	API separator sludge	6,473,778	122,300	6,596,078	1.1	2.7
K052	Tank Bottoms (leaded)	212,158	18,586	230,744	.0	0.1
K073	Chlorinated Hydrocarbons	0	0	0	0.0	0.0
K085	Chlorobenzene distillation bottoms	440	34,085	34,525	.0	.0
K087	Tar sludge	401,444	0	401,444	0.1	0.2
K093	Dist. light ends	1,886	6,923	8,809	.0	.0
K094	Dist. bottoms	0	15,400	1,485	.0	.0
P045	Dimethyl 2 Butanone	0	0	0	0.0	0.0
P071	Mthyl parathion	660	0	660	.0	.0
P075	Nicotine	0	86	86	.0	.0
P094	Phorate	97,736	18,555	116,291	.0	.0
U001	Acetaldehyde	0	24	24	.0	.0
U002	Acetone	0	17,701	2,909	.0	.0
U003	Actonitrile	0	684	684	.0	.0
U009	Acrylonitrile	5,812	104,288	110,100	.0	.0
U012	Aniline	0	0	0	0.0	0.0
U019	Benzene	169,853	1,540	171,393	.0	0.1
U028	Benzene dicarboxilic acid	11,181	2,350	13,531	.0	.0
U036	Chlordane	5,789	136,875	142,664	.0	0.1
U037	Chlorobenzene	4,919	0	4,919	.0	.0
U044	Chloroform	0	5,266	573	.0	.0
U051	Creosote	1,372,336	34,667	1,407,003	0.2	0.6
U052	Cresols	34,409	110	34,519	.0	.0
U057	Cyclohexanone	0	110	110	.0	.0
U061	DDT	0	11,280	2,451	.0	.0
U067	Ethylene dibromide	0	1	1	.0	.0
U069	Dibutylphalate	0	605	605	.0	.0
U070	o-Dichlorobenzene	0	12,240	434	.0	.0
U071	m-Dichlorobenzene	0	70	0	0.0	0.0
U077	Ehtylene dichloride	0	2	0	0.0	0.0
U080	Dichloromethane	7,178	13,335	21,053	.0	.0
U103	Sulfuric acid, dimethyl ester	0	0	0	0.0	0.0
U107	Benzene dicarboxilic acid	55	0	55	.0	.0
U112	Ethyl acetate	0	6,708	50	.0	.0
U116	Ethylene thiourea	0	0	0	0.0	0.0
U117	Ethyl ether	0	41	21	.0	.0
U122	Formaldehyde	11,051	1,890	12,941	.0	.0
U129	Hexachlorocyclohexane	6,870	4,240	11,110	.0	.0

Table A-2
(continued)

U130	Hexachloropentadiene	11,470	526	11,996	.0	.0
U131	Hexachloroethane	0	0	0	0.0	0.0
U147	Maliec anhydride	149	346	495	.0	.0
U154	Methanol	0	14,557	6,291	.0	.0
U158	Methylenebis (2-chlooaniline)	2,493	825	3,318	.0	.0
U159	Methyl ethyl ketone	0	98,227	10,396	.0	.0
U162	Methyl methancrylate	130	0	130	.0	.0
U165	Naphthalene	0	4,985	3,575	.0	.0
U169	Nitrobenzene	0	55	55	.0	.0
U161	Methyl 2-pentanone	46,824	0	46,824	.0	.0
U188	Phenol	7,589	670	8,259	.0	.0
U190	Phthalic anhydride	9,095	31,350	40,445	.0	.0
U191	2-Methyl pyridine	0	30	30	.0	.0
U196	Pyridine	0	1,175	10	.0	.0
U201	Resourceinol	641	305	946	.0	.0
U210	Perchloroethylene	9,716	3,247	12,963	.0	.0
U213	Tetrahydrofuran	1,044	17	1,061	.0	.0
U219	Thiourea	0	0	0	0.0	0.0
U220	Toluene	0	16,998	710	.0	.0
U223	Toluene siidocyanate	1,638	1,400	3,038	.0	.0
U226	Trichloroethane	53,585	16,437	70,022	.0	.0
U228	Trichloroethene	24,951	12,362	37,313	.0	.0
U230	2,4,6 Trichlorophenol	0	450	450	.0	.0
U238	Carbamic acid ethyl ester	1,646	0	1,646	.0	.0
U239	Xylene	146,986	32,541	179,527	.0	0.1
U240	Dichlorophenoxyacetic acid	48,001	8,366	56,367	.0	.0
U242	Pentachlorophenol	0	0	0	.0	.0
U244	Thiram	0	14	14	.0	.0
Total		94,685,280	18,279,152	112,647,798	18.9	46.4

Mixed Wastes

D Wastes	35,848,607	5,994,247	41,842,854	7.0	17.2
F Wastes	0	17,664,546	17,664,546	3.0	7.3
K Wastes	69,609,616	469,260	70,078,876	11.8	28.9
P Wastes	0	360	360	.0	.0
U Wastes	0	356,114	356,114	0.1	0.1
Total	105,458,223	24,484,527	129,942,750	21.9	53.9
Total Incinerable	199,826,869	42,763,679	242,590,548	40.8	100.0

Table A-3

1986 SUMMARY

RCRA Waste Number		Significant Incinerable Waste Streams Treated, Stored or Disposed (Gallons) On-Site	Off-Site	Total	Percentage of Wastes Treated Stored or Disposed Total	Incinerable
Specific Wastes						
D001	Waste with flashpoint <60 deg.C	8,553,157	9,723,180	18,276,337	3.1	10.7
F001	Spent halogenated solvents	995,146	669,515	1,664,661	0.3	1.0
F002	Spent halogenated solvents	0	1,763,595	1,762,902	0.3	1.2
F003	Spent non-halogenated solvents	364,485	1,716,687	2,081,172	0.4	1.2
F005	Spent non-halogenated solvents	12,684,021	3,347,819	16,031,840	2.7	9.4
K001	Creosote/PCP wastewater sludges	504,535	0	504,535	0.1	0.3
K087	Tar sludge	401,444	0	401,444	0.1	0.2
	Total	23,502,788	17,220,796	40,722,891	6.8	23.9
Mixed Wastes						
D Wastes		35,848,607	5,994,247	41,842,854	7.0	24.5
F Wastes		0	17,664,546	17,664,546	3.0	10.4
K Wastes		69,609,616	469,260	70,078,876	11.8	41.1
U Wastes		0	356,114	356,114	0.1	0.2
	Total	105,458,223	24,484,167	129,942,390	21.9	76.1
	Total Incinerable	128,960,318	41,704,963	170,665,281	28.7	100.0

Table A-4

1986 Summary

RCRA Waste Number		Significant Incinerable Waste Streams Treated, Stored or Disposed Off-Site (Gallons)	(Tons)	Percentage by Weight
Mixed F Wastes		17,664,546	70,658	42.3
D001	Waste with flashpoint <60 deg.C	9,723,180	48,616	29.1
Mixed D Wastes		5,994,247	17,983	10.8
F005	Spent non-halogenated solvents	3,347,819	13,391	8.0
F003	Spent non-halogenated solvents	1,716,687	6,867	4.1
F002	Spent halogenated solvents	1,763,595	3,527	2.1
F001	Spent halogenated solvents	669,515	2,678	1.6
Mixed K Wastes		469,260	1,877	1.1
Mixed U Wastes		356,114	1,424	0.9
Total		41,704,963	167,022	

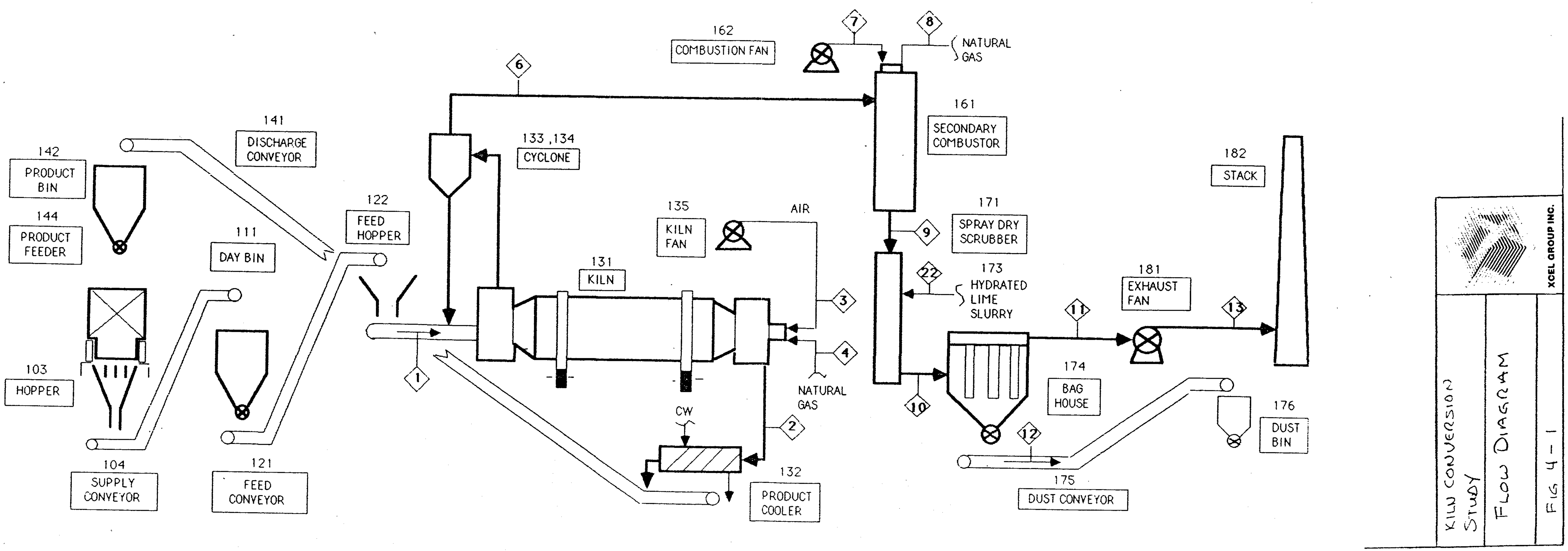
APPENDIX B:
ENLARGED FIGURES

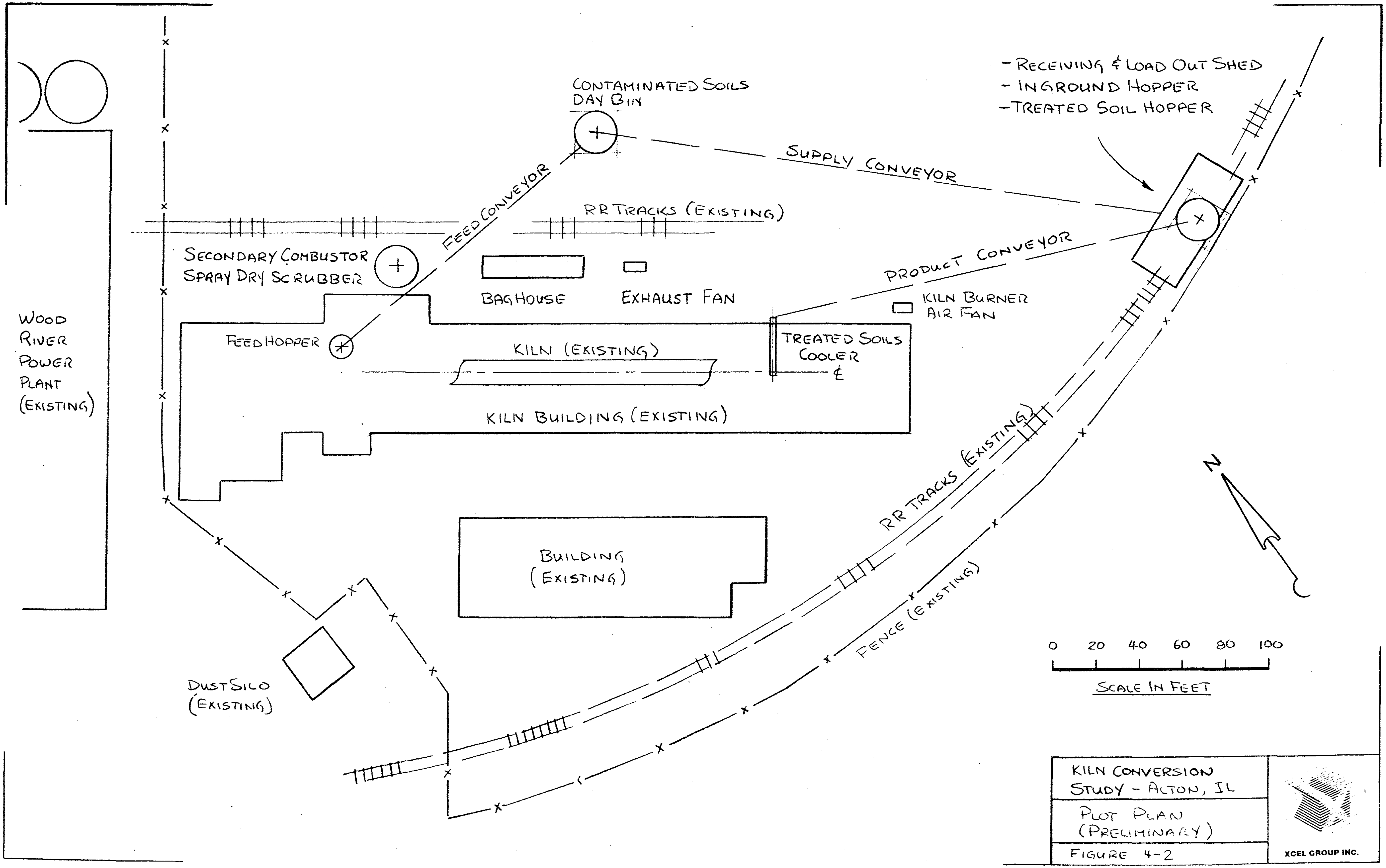
- Figure 2: Process Flow Diagram
- Figure 3: Site Plot Plan

NOTE: These figures are filed in the pocket affixed to the inside back cover.

		1		2	3		4	6		7
		Solids to Kiln		Solids Discharge	Heater Air		Heater Fuel	Cyclone Offgas		Incinerator Fuel
TEMPERATURE, F		60		1600	100		60	600		60
PRESSURE, PSIA		14.659		14.659	15.696		15.696	14.140		15.696
IN WG		-1		-1	27		27	-15		27
COMPONENTS	FORMULA	lb/hr	Vol %	lb/hr	lb/hr	Vol %	lb/hr	lb/hr	Vol %	lb/hr
Carbon Dioxide	CO_2	-	-	-	-	-	-	5315.17	3.7	-
Methane	CH_4	-	-	-	-	-	1937.50	-	-	6622.00
Nitrogen	N_2	-	-	-	54266.96	79.0	-	54266.96	60.1	-
Oxygen	O_2	-	-	-	16476.05	21.0	-	8746.82	8.5	-
Hydrogen Chloride	HCl	-	-	-	-	-	-	-	-	-
Sulfur Dioxide	SO_2	-	-	-	-	-	-	-	-	-
Steam	$H_2O(g)$	-	-	-	-	-	-	16051.56	27.7	-
SUBTOTALS		-	-	-	70743.01	100.0	1937.50	84380.51	100.0	6622.00
			Wt %			Wt %			Wt %	
Moisture	$H_2O(l)$	11700.00	39.0	-	-	-	-	-	-	-
PCB (1)	$C_xH_yCl_z$	300.00	1.0	-	-	-	-	300.00	.4	-
Soil		18000.00	60.0	17750.00	-	-	-	250.00	.3	-
Calcium Hydroxide	$Ca(OH)_2$	-	-	-	-	-	-	-	-	-
Calcium Chloride	$CaCl_2$	-	-	-	-	-	-	-	-	-
TOTAL MASS FLOW, LB/HR		30000.00		17750.00	70743.01		1937.50	84930.51		6622.00
TOTAL ENERGY, MMBTU/HR		0.000		8.283	.681		46.229	30.102		158.001
AMW, lb/lb-mole		-		-	28.85		16.04	26.19		16.04
ACFM		-		-	15663		716	43258		2448
SCFM		-		-	15529		765	20406		2614
Dew Point, F		-		-	-		-	151		-
HHV, Btu/scf		-		-	-		1007	-		1007

		8		9		10		11		12		13		22	
		Incinerator Air		Incinerator Offgas		Spray Dryer Offgas		Baghouse Offgas		Dust from Baghouse		Stack Gas		Slurry to Spray Dryer	
TEMPERATURE, F		60		2250		400		400		400		400		60	
PRESSURE, PSIA		15.696		14.029		13.955		13.511		13.955		14.696		14.696	
IN WG		27		-18		-20		-32		-20		0		0	
COMPONENTS	FORMULA	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %	lb/hr	Vol %
Carbon Dioxide	CO_2	-	-	23910.36	6.6	23910.36	3.8	23910.36	3.8	-	-	23910.36	3.8	-	-
Methane	CH_4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrogen	N_2	102721.16	79.0	156988.12	67.7	156988.12	39.5	156988.12	39.5	-	-	156988.11	39.5	-	-
Oxygen	O_2	31187.27	21.0	13221.44	5.0	13221.44	2.9	13221.44	2.9	-	-	13221.44	2.9	-	-
Hydrogen Chloride	HCl	-	-	185.09	.1	1.85	.0	1.85	.0	-	-	1.85	.0	-	-
Sulfur Dioxide	SO_2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Steam	$H_2O(g)$	-	-	30906.04	20.7	137703.00	53.8	137703.00	53.8	-	-	137703.00	53.8	-	-
SUBTOTALS		133908.43	100.0	225211.04	100.0	331824.77	100.0	331824.77	100.0	-	-	331824.77	100.0	-	-
			Wt %		Wt %		Wt %		Wt %		Wt %		Wt %		Wt %
Moisture	$H_2O(l)$	-	-	-	-	-	-	-	-	-	-	-	-	106778.6	99.4
PCB (1)	$C_xH_yCl_z$	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil		-	-	250.00	.1	250.00	.1	-	-	250.00	19.6	-	-	-	-
Calcium Hydroxide	$Ca(OH)_2$	-	-	-	-	465.37	.1	.05	.0	465.32	36.6	-	-	651.52	.6
Calcium Chloride	$CaCl_2$	-	-	-	-	557.77	.2	.11	.0	557.66	43.8	-	-	-	-
TOTAL MASS FLOW, LB/HR		133908.43		225461.04		333097.91		331824.93		1272.98		331824.77		107430.20	
TOTAL ENERGY, MMBTU/HR		0.000		184.144		182.057		182.038		.019		182.038		0.000	
AMW, lb/lb-mole		28.85		27.20		23.36		23.36		-		23.36		-	
ACFM		27529		286524		156750		161907		-		148849		-	
SCFM		29394		52443		89955		89955		-		89955		-	
Dew Point, F		-		140		180		178		-		182		-	
HHV, Btu/scf		-		-		-		-		-		-		-	





KILN CONVERSION STUDY - ALTON, IL

PLOT PLAN (PRELIMINARY)

FIGURE 4-2