27/ 8-29-83 gmc ①

uc-95e

I-10933

Prepared for:

DOE/SS/50373-1

U.S. Department of Energy

Assistant Secretary, Conservation
and Renewable Energy

Office of Renewable Technology

Washington, D.C. 20585

Under Contract No. DE-FG01-80RA50373

September 1983

FEASIBILITY STUDY:

WASTE-INCINERATION RESOURCE-RECOVERY SYSTEM

FOR DAYCO CORPORATION AND COLLETON COUNTY, SOUTH CAROLINA

DO NOT MICROFILM
THIS PAGE

tes United States United Stat
Energy Department of Energy
s United States United States
artment of Energy Departmen
nited States United States U
Department of Energy Depar
States **United States** United &
nergy **Department of Energy**

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

"This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

DO NOT MICROFILM
THIS PAGE

This report has been reproduced directly from the best available copy.

Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Price: Printed Copy A07
Microfiche A01

Codes are used for pricing all publications. The code is determined by the number of pages in the publication. Information pertaining to the pricing codes can be found in the current issues of the following publications, which are generally available in most libraries: *Energy Research Abstracts, (ERA)*; *Government Reports Announcements and Index (GRA and I)*; *Scientific and Technical Abstract Reports (STAR)*; and publication, NTIS-PR-360 available from (NTIS) at the above address.

September 1983

Prepared for:

U.S. Department of Energy
Assistant Secretary, Conservation
and Renewable Energy
Office of Renewable Technology
Washington, D.C. 20585

DOE/CS/50373--1

DE83 016964

FEASIBILITY STUDY

✓ WASTE-INCINERATION RESOURCE-RECOVERY SYSTEM
FOR DAYCO CORPORATION AND COLLETON COUNTY, SOUTH CAROLINA: ✓

NOTICE

PORTIONS OF THIS REPORT ARE ILLIBLE.

It has been reproduced from the best
available copy to permit the broadest
possible availability.

Prepared by:

Dayco Corporation, Inc.?

Dayton, Ohio 45401

Under Contract No. DE-FG01-80RA50373

tes United States United Stat
Energy Department of Energy
s United States United States
artment of Energy Departmen
nited States United States U
Department of Energy Depar
States **United States** United &
nergy **Department of Er** ergy

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ACKNOWLEDGMENTS

We wish to thank all those who assisted in this activity. These individuals include local government officials, local industry leaders, Dayco Corporation personnel, and members of the Lowcountry Council of Governments. Their assistance contributed significantly to the success of this feasibility study.

EXECUTIVE SUMMARY

The data requisition and technology evaluation of the Waste Incineration Resource Recovery System Feasibility Study for Dayco-Colleton County has been completed.

The total annual solid combustible waste produced and/or disposed of at the Colleton County landfill is 28,184 tons. Of this total, 5,564 tons (or 19.7%) of the total is produced out of Colleton County. All of the solid waste accumulated and disposed of at the landfill is environmentally acceptable for incineration.

The total available energy in the solid waste is $249,273.7 \times 10^6$ Btu. Based on several incinerator manufacturers' data, the overall system efficiency for conversion of solid waste to energy is at least 70%. However, for the sake of conservatism, a conversion efficiency of 60% has been used. On this basis, the potential energy recovery capability is equivalent to an annual production of $149,544.3 \times 10^6$ Btu of low heat content gas. This indicates that the low-Btu gas to solid waste ratio is 2,653 to 1 on a Btu/lb basis.

The results of the Feasibility Study indicate that the incineration of solid waste to produce an energy source is technically feasible, environmentally acceptable, and economically sound with appropriate funding.

The basic intent of the proposed project was to provide an environmentally sound method of solid waste disposal for the County of Colleton, South Carolina, and to provide a reliable alternative source of energy. The solid waste management aspect of the project requires that there be no adverse environmental impact because of the project. Proper equipment and responsible facility design are necessary to accomplish this. The major areas of assessment that have been considered in these designs include, but are not limited to, emission control, residual disposal, water quality control, noise, and aesthetic impact.

The beneficial aspects of the proposed project are numerous with respect to technological and economic considerations. From a technical point of view, the proposed facility will be able to accept and dispose of all the solid waste collected within the county. Accumulated solid waste presently has little, if any, classified hazardous wastes. However, thermal decomposition of the accumulated solid waste will produce a sterile ash that is acceptable for landfill disposal. When completed, the proposed project will decrease the quantity of accumulated waste now disposed of in landfills by at least 85%. Because of the county's high water table, this feature of minimal landfill use is extremely advantageous for both the near and long term.

Colleton County is a rural area that has not experienced substantial population or employment growth. Recent studies by the South Carolina Development Board and the Governor's Office of Economic Development and Transportation show that the county has a "less developed or distressed economy." For example, Colleton County currently ranks third in unemployment (annual rate) and consistently has rates of unemployment that are higher than state or national averages. Furthermore, the county has a substantial concentration of minority population and minority unemployment.

Manufacturing is very important in Colleton County and could improve local economic conditions. Dayco, who employs 400 persons, or 20% of manual labor force, is a major employer. This energy project will result in a long-term commitment from Dayco to remain in the community. It is anticipated that Dayco will expand their Walterboro plant because of the energy savings.

Products manufactured at the Walterboro plant can be produced more economically. Therefore, an additional capacity can be accrued to the Walterboro plant resulting in more jobs, more local taxes, and other economic benefits.

This project will result in an energy savings that will reduce dependence on foreign oil as well as improve local economic conditions. Given President Carter's initiatives for energy and for rural areas, the project will provide an opportunity for the private sector to respond to these initiatives. The Dayco Corporation efforts should be recognized and supported.

CONTENTS

ABSTRACT	1
INTRODUCTION	3
BACKGROUND	5
SOLID WASTE	7
PROCESS DESCRIPTION	19
GENERAL DESCRIPTION OF OPERATIONAL MODE	25
SITE LOCATION	31
SOCIAL/ENVIRONMENTAL IMPACT	35
ECONOMICS	37
LANDFILL	43
IMPLEMENTATION SCHEDULE	45
RISK FACTOR	49
CONCLUSIONS	53
COMPENDIUM	55
APPENDIX A: Subsurface, Structural, and Foundation Information/ Data on the Proposed Site	57
APPENDIX B: Regional Investment Strategy - Lowcountry Region . .	67

LIST OF FIGURES

1 MSW Quantities vs Population	12
2 The Relationship of Solid Waste Thermal Output at Various Efficiencies	16
3 Material Flow, Residue, Heat Generated, and Utility Require- ment for an Average Day	17
4 Diagram of the Process	20
5 Starved-Air Fuel Requirements	22
6 The Basic System	23

LIST OF FIGURES (continued)

7	Trucks are Weighed as They Enter the Facility	26
8	Recording and Ticketing	26
9	Trucks Enter the Facility	27
10	Skid Steer Tractors	27
11	Proper Design for Storage and Use of Waste	27
12	The System Wet Ash Sump and Removable Ash Containers	28
13	Ash Handling Trucks	28
14	Architect's Rendering of the Proposed Colleton County Facility	34

LIST OF TABLES

I	Classification of Waste	8
II	Solid Waste Distribution, Daily	10
III	Daily Accumulation of Waste	11
IV	Total Heat vs Potential Heat Available	13
V	Auxiliary Fuel, Etc.	14
VI	Operational Cash Flow with DOE Assistance	41
VII	Operational Cash Flow without DOE Assistance	42

ABSTRACT

The proposed program addresses the development of an alternative fuel brought about by the chemical changes of solid waste materials in the presence of heat. The pyrolyzates predominantly will be carbon monoxide (low-Btu gas) and carbon particles, with carbon monoxide representing about 75-80% of the total. The low-Btu gas will be used to replace and/or as a substitute for such fossil fuels as natural gas and fuel oil. From a technical and economical viewpoint, it is suggested that the low-Btu gas be used as an alternative energy source.

The objective of the program is twofold and the benefits that can be derived will be beneficial to both industries and municipalities. However, the prime objective is the development of an alternative fuel to replace present fuels used in plants for heat treating, etc. Another benefit that must not be overlooked is the possibility of disposing of solid waste by environmentally sound methods.

Because of existing local and industrial problems, a joint effort was formulated to confront these problems. This effort concluded that the quantity and quality of the local solid waste was sufficient to generate an alternative energy source for use by local industry. This approach will extend the county landfill for years and replace more expensive energy with a less expensive, alternative energy.

A comprehensive analysis was used to develop the alternative energy source that successfully met local technical and economical parameters. The selected system will handle and dispose of the solid waste presently accumulated within the county and will dispose of potential waste from future projected industrial concerns. The generation of the alternative energy source will be accomplished at an overall efficiency of about 70%, making it competitive with more recognizable energy systems (such as boilers).

Although not finalized, the organizational structure will include Dayco Corporation as the owner of the facility. The operation and maintenance of the facility could be a joint venture, shared between the county and industry. The implementation phase will be managed by Energy Appraisal Associates, Inc. Local architectural and engineering firms, as available, will be used to design and document preparation of the facility. The anticipated time frame is approximately 16 months from contract awards to operating condition.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

INTRODUCTION

The Dayco-Colleton County Waste Incineration Resource Recovery System Feasibility Study was started August 1, 1980. Initially, local people were familiarized with the data gathering procedure and project tasks that had to be addressed chronologically during development of the feasibility study.

Actual data accumulation and technology assessment began the second week of the study. This consisted of field studies and related functions.

Many variables were considered while determining this geographic area's potential for resource recovery from solid waste. Among the variables considered are current and projected population, population versus refuse quantities, frequency and consistency of refuse collection, and the quantity of recoverable energy. The variance in solid waste produced among communities in a specific area can be attributed to seasonal and climatic variations, socioeconomic conditions, local laws, density of industry and office buildings, motels, etc. Therefore, the evaluations must consider the refuse situation of that specific community.

Normally there are two general resource recovery energy opportunities or options. The first and probably more extensive option is to use the "as-received" waste as fuels for incineration and to recover the latent energy as either steam or low-Btu gas. This option is known as mass burning and the technology already is well established. There are variations of this option, such as waterwall incineration and the use of a waste heat boiler. The second option is to process the waste, removing such components as glass, stone, metals, etc., to yield a refuse-derived fuel (RDF), as well as to recover marketable materials for sale. This type of system is expensive and will not enable an economical use of capital for the proposed site area.

This report contains all the data collected, as well as an evaluation of the data, which is summarized in the compendium.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

BACKGROUND

A U.S. Department of Energy (DOE)-funded comprehensive study to determine the feasibility of developing an alternative energy source from solid waste concluded that the project is both technically and economically viable.

The proposed process is well defined and represents state-of-the-art technology. The total amount of solid waste accumulated within the County of Colleton, South Carolina, is sufficient to generate the equivalence of 572,000 million Btu of alternative fuel daily. Because of the mix of solid waste, which includes industrial and residential waste, the average value is 4422 Btu/lb. The county government is willing to commit the total solid waste collected, on a negotiated basis, to Dayco Corporation for alternative fuel development.

The economics of the project are excellent. The total project costs, including equipment and labor, are approximately \$3,000,000, based on preliminary proposals. First-year operating costs are expected to be about \$240,000; these costs were determined by comparative evaluations of other similar facilities. A cash flow analysis has been developed and is included.

Raw materials are in sufficient supply based on the current population of the county. Additionally, the county favors the proposed project and will assist wherever necessary to complete the project. Although financing details are incomplete, negotiations are in progress for land or site acquisition. Site selection has been completed and the availability of utilities, end-user location, and legal entanglements has been determined as technically and economically appropriate.

The process selected offers the best technology currently available for satisfying both county and industry requirements. The thermal or pyrolytic reduction of solid waste will result in generation of a low-Btu gas. The equivalent energy in the low-Btu gas generated is on the order of 24,000,000 Btu/h. This low-Btu gas is available for satisfying the end-user's thermal requirements.

Risks associated with the proposed project are minimal and relate specifically to the operational improvements that will result with experience. To minimize operational difficulties, extensive training will be available with technical assistance from manufacturers, notwithstanding the technical expertise within Dayco Corporation.

The feasibility study also indicates that the county, the raw material supplier, will accrue additional benefits of an environmental and socioeconomic nature. Preliminary analyses suggest that 13 new jobs will be created within the county immediately. As a result of this proposed project and because of the availability of a reliable and less expensive energy source, Dayco Corporation is planning to expand their plant. This also will result in additional jobs.

THIS PAGE
WAS INTENTIONALLY
LEFT BLANK

SOLID WASTE

General

The particular solid waste collected within the County of Colleton, South Carolina, consists of nonhomogeneous waste materials. The waste materials collected are generated by residential, commercial, and industrial customers. Residential wastes represent about 70% of the total annual accumulation, while industrial and commercial customers represent the remainder, or 30% of the total annual accumulation.

The quantity and components in solid waste are important to solid waste managers and planners. The objective in municipal solid waste (MSW) management is to collect and dispose of waste in the most efficient (least costly) manner. There are two basic advantages for utilizing energy recovery from waste incinerator systems. These are fuel and landfill conservation.

Solid waste typically is classified by type and description and consists of seven categories. Table I shows the classification of wastes with respect to relative Btu values. Basically, the solid waste collected in Colleton County falls into the first four categories of Table I. Additionally, incinerators are classified, and the type is Class V. These incinerators are suitable for Type 0, 1, 2, and 3 wastes, or a combination of all four, and are rated in tons per hour (tph) or tons per day (tpd).

Residential Waste - Type 2

The characteristics of the residential solid waste generated in Colleton County were determined by analyzing county landfill records, by observing and discussing the characteristics with landfill operators, and by weighing selected trucks to determine the average weight of the load for disposal.

Weighing trucks was the most necessary and important step in the evaluation. This was absolutely necessary in determining the compaction ratio and/or volume of solid waste the trucks carried. The landfill operators record the amount of solid waste disposed of by registered load. That is, a 20-yd packer would represent 20 yd of solid waste regardless of the volume or weight it was carrying. Approximately 25 county trucks were weighed and the average weight of the load carried was 8750 lb. Based on published density of Type 2 waste (17.5 lb/ft³), the average amount of solid waste carried per truck was about 18.5 yd. This indicates that the average truck load is about 72% of its rated capacity.

The county normally disposes of 45 loads of residential solid waste per week at the landfill. On this basis, the weekly accumulation of residential solid waste is 393,750 lb, calculated as

$$\frac{45 \text{ trucks}}{\text{week}} \times \frac{8750 \text{ lb}}{\text{truck}} = 393,750 \text{ lb/week.}$$

The City of Walterboro disposes of a registered 480 yd of solid waste per week. Several of these trucks were weighed, and the average weight

Table I. Classification of Waste

Classification of Waste Type	Description	Principal Components	Approximate Composition, wt %	Moisture Content, %	Incombustible Solids, %	Btu Value per lb Refuse As-Fired	Btu of Aux. Fuel per lb of Waste Included in Combustion Calculations	Recommended Min. Btu/hr Burner Input per lb Waste
*0	Trash	Highly combustible waste, paper, wood, cardboard cartons, including up to 10% treated papers, plastic, or rubber scraps; commercial and industrial sources	Trash 100	10	5	8500	0	0
*1	Rubbish	Combustible waste, paper, cartons, rags, wood scraps, combustible floor sweepings; domestic, commercial, and industrial sources	Rubbish 80 Garbage 20	25	10	6500	0	0
*2	Refuse	Rubbish and garbage; residential sources	Rubbish 50 Garbage 50	50	7	4500	0	1500
*3	Garbage	Animal and vegetable wastes, restaurants, hotels, markets; institutional, commercial, and club sources	Garbage 65 Rubbish 35	70	5	2500	1500	3000
4	Animal Solids and Organic Waste	Carcasses, organs, solid organic waste; hospital, laboratory, abattoirs, animal pounds, and similar sources	Animal and Human Tissue - 100	85	5	1000	3000	8000 (5000 primary) (3000 secondary)
5	Gaseous, Liquid or Semiliquid Waste	Industrial process waste	Variable	Dependent on Predominant Components	Variable According to Waste Surveyed	Variable According to Waste Surveyed	Variable According to Waste Surveyed	Variable According to Waste Surveyed
6	Semisolid and Solid Waste	Combustibles requiring hearth, retort, or grate burning equipment	Variable	"	"	"	"	"

*The above figures on moisture content, ash, and Btu as-fired have been determined by analysis of many samples. They are recommended for use in computing heat release, burning rate, velocity, and other details of incinerator designs. Any design based on these calculations can accommodate minor variations.

per load was 11,300 lb. On this basis, the weekly accumulation of solid residential waste disposed of by the city is 226,000 lb, calculated as

$$\frac{20 \text{ trucks}}{\text{week}} \times \frac{11,300 \text{ lb}}{\text{truck}} = \frac{472.5 \text{ lb}}{\text{yd}} \times 0.72^* = \frac{136,080 \text{ lb}}{\text{week}}.$$

The total weekly production of Type 2 residential waste is 755,830 lb, equivalent to about 54 tpd, 7 day/week. On the basis of a county population of 28,000, the apparent daily production of waste per capita is

$$\frac{755,830 \text{ lb}}{7 \text{ days}} \times \frac{1}{28,000 \text{ pop.}} = \frac{3.86 \text{ lb}}{\text{person/day}}.$$

In addition to type and classification, Table I shows the Btu value per pound of the various types of as-fired waste. These data were determined by analyzing many samples and represent the industry standard for computing heat release, burning rate, etc., for incinerator design. The heating value of Type 2 residential waste is 4300 Btu/lb. Therefore, on a weekly basis, the total latent heat available in the solid waste is

$$\frac{755,830 \text{ lb}}{\text{week}} \times \frac{4300 \text{ Btu}}{\text{lb}} = 3250.1 \times 10^6 \text{ Btu/week}.$$

This amount of heat is equivalent to 3,250,100 ft³ of natural gas or 23,215 gal. of home heating oil.

Industrial Waste - Type 0

Almost all of the industrial, Type 0, solid waste comes from Dayco Corporation and J. P. Stevens. Of the two, the Dayco Corporation accounts for about 88% of the total on a volume basis and 98% on a weight basis.

The Fennell Company, under contract to the Dayco Corporation, services the facility on a two load per day basis. The capacity of the Fennell Company packer is 30 yd and, based on the average of the net load, the first load per week is 9500 lb and the remaining loads average 16,000 lb/load. On this basis, the weekly accumulation of waste is

$$\frac{1 \text{ truck}}{\text{week}} \times \frac{9500 \text{ lb}}{\text{truck}} = 9,500 \text{ lb}$$

$$\frac{9 \text{ trucks}}{\text{week}} \times \frac{16,000 \text{ lb}}{\text{truck}} = \underline{144,000 \text{ lb}}$$

Total 153,500 lb/week.

The J. P. Stevens facility accumulates and disposes of an average of about 40 yd/week. The total weight of the solid waste, on a weekly basis, is about 4000 lb.

All of this solid waste has a higher Btu content than Type 2 waste, since it contains paper, cardboard, rubber, and plastic.

*The ratio of load to rated capacity.

Based on the 8500 Btu/lb heating value of this material, the total available heat per week is

$$\frac{157,500 \text{ lb}}{\text{week}} \times \frac{8500 \text{ Btu}}{\text{lb}} \times 0.85^* = 1137.9 \times 10^6 \text{ Btu/week.}$$

Institutional Waste - Type 3

The Fennell Company also disposes of about 60 yd in two, 30 yd packers per day, of restaurant and motel waste. This type of solid waste consists of about 65% garbage and 35% rubbish. Because of the relatively high moisture content, the heating value is lower than the other types. Although these trucks were not weighed, it is fair to assume that the compaction ratio is similar to the trucks weighed. On this basis, the weight of each load would be

$$\frac{30 \text{ yd}}{\text{truck}} \times \frac{27 \text{ ft}^3}{\text{yd}} \times \frac{30 \text{ lb}}{\text{ft}^3} \times 0.75 = 17,495 \text{ lb/truck.}$$

The weekly weight disposed of from this source is 87.5 tons, and the total available latent heat is

$$\frac{87.5 \text{ ton}}{\text{week}} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{2500 \text{ Btu}}{\text{lb}} = 437.5 \times 10^6 \text{ Btu/week.}$$

Table II is a summary of the solid waste collected by type, source, registered value, and weight on a daily basis.

Table II. Solid Waste Distribution, Daily

Source	Type	Description	Registered Volume, yd	Wt, ton
County	2	Refuse	216	39.4
City	2	Refuse	96	22.6
Seko	2	Refuse	80	13.6
Fennell	0	Trash	60	15.3
J.P.Stevens	0	Trash	8	0.4
Fennell	3	Garbage	60	17.5
Total			472**	108.8

**Although the column total is 520 yd, the actual yards registered are 472, based on observations of loads entering.

Table II indicates that the daily volume of solid waste collected is 472 yd. Extrapolation of this on an annual basis generates a yearly total of 122,720 yd. Based on county records, the annual collection is about 142,787 yd. However, Table II considers only the solid waste of the first four types. Considering the daily accumulation of tree limbs, leaves, etc., accumulated by the city and solid waste from other miscellaneous sources, the annual recorded volume collected and calculated shows reasonable agreement.

*This factor considers the amount of noncombustibles.

- The city disposes of about 80 yd/day of tree limbs, leaves, etc. On this basis, the annual volume would be 20,800 yd of this material, and the total annual recorded volume would be 143,520 yd. Other miscellaneous sources of solid waste represent only a small portion of the total collected.

Based on the total solid waste collected within the county, less out of county, the solid waste quantity versus population is

$$\frac{22,620 \text{ ton}}{\text{yr}} \times \frac{2000 \text{ lb}}{\text{ton}} \times \frac{\text{yr}}{365 \text{ day}} \times \frac{1}{28,000 \text{ pop.}} = 4.4 \text{ lb/day per person.}$$

Figure 1 shows the relationship of the solid waste produced to population and frequency of collection.

In summary, there are three basic classifications of waste collected within Colleton County. These classifications are Types 0, 2, and 3. Table III shows the daily accumulation of waste and the characteristics of each type.

Table III. Daily Accumulation of Waste

<u>Classification</u>	<u>Daily Total, tons</u>	<u>% of Total</u>	<u>Heating Value, Btu/lb</u>
Type 0	15.7	14.4	7,225
Type 2	75.6	69.5	4,300
Type 3	<u>17.5</u>	<u>16.1</u>	<u>2,500</u>
Subtotal	108.8	100.0	14,025

Miscellaneous (limbs, leaves, etc.)

The average weighted heating value is 4422 Btu/lb of solid waste as delivered, or 8,855,000 Btu/ton, which breaks down to:

<u>Classification</u>	<u>Amount, lb</u>	<u>Heating Value, Btu</u>
Type 0	0.144	1040
Type 2	0.695	2989
Type 3	<u>0.161</u>	<u>393</u>
Totals	1.000	4422

Ideally, this would represent the charge rate mix to maintain the average weighted Btu value. On the basis of 108.8 tpd accumulation, the ideal charge rate to the incinerator would be

<u>Classification</u>	<u>Charge Rate, lb/h</u>	<u>Heating Value, Btu/h</u>
Type 0	1306	9,435,850
Type 2	6301	27,094,300
Type 3	<u>1460</u>	<u>3,561,450</u>
Totals	9067	40,091,600

Figure 1. MSW Quantities vs Population

Waste and a potential byproduct have a very modest impact on the system. Because of the relatively high temperature in the primary or lower combustion chamber, the system produces a quality sterile ash. The positive contributions of this ash are that it will

1. improve the quality of the landfill's residue and permit the site to comply with state and federal hazardous waste regulations
2. because of its 9 to 1 compaction ratio, prolong the life of the landfill.

Pursuant to a potential byproduct of this sterile ash, several pilot-scale commercial applications currently exist for such waste. The principal application is as a filler ingredient for asphalt. However, for this rural operation, any commercial use for the waste (ash) will not be considered as an intrinsic part of the proposed alternative fuel system.

No specific source separation will be used in this process since refuse haulers discriminate against such items as cast-off appliances, which do not lend themselves to normal municipal incineration systems. However, the proposed starved-air operation will be able to process unprepared, as-received waste in packer trucks. This allows the waste to be processed and the energy to be generated at the lowest initial capital cost.

Table IV shows the relationship between total heat available from the accumulated solid waste and the potential available heat.

Table IV. Total Heat vs Potential Heat Available

Type	Heat Content, Btu/lb	Annual Accumulation, tons	Annual Heat Available, 10 ⁶ Btu
0	7,225	3,978	57,482.1
2	4,300	19,656	169,041.6
3	2,500	4,550	22,750.0
Total		28,184	249,273.7

The daily accumulation of solid waste presently is on the order of 108.8 tpd and the total available heat in the solid waste is 962.2×10^6 Btu/day. This quantity of heat is equivalent to 6873 gal of heating oil. On an annual basis, the total available heat in the solid waste is $249,273.7 \times 10^6$ Btu, and the fuel oil equivalence is 1,780,526 gal of heating oil.

The waste recovery section will handle the energy equivalence of 962,200,000 Btu/day. At a conservative overall conversion rate of 60% efficiency, the useful heat will be 577,320,000 Btu/day.

Consequently, with the average Btu content from the combined solid waste mix approximately 4422 Btu/lb, and with an overall anticipated system efficiency of 60% (0.60×4422), it will develop a useful heat of 2653 Btu/lb of municipal and industrial solid waste.

Figure 2 shows the relationship of the solid waste thermal output at various efficiencies. For this system, the average hourly burning rate is 9067 lb/h and the energy input will be 40.1×10^6 Btu/h. At an efficiency of 60%, the thermal output will be 24.1×10^6 Btu/h. Figure 2 shows the effect of system efficiency on thermal output.

The thermal recovery system will be equipped with an auxiliary external burner designed to burn natural gas. This system will be used only when starting up the system. The anticipated external heat required until temperature is reached to achieve its own sustained combustion will be about 15,000,000 Btu. The annual amount of auxiliary natural gas required should not exceed 800,000 ft³.

Note that if the system operated with a higher overall conversion ratio than the conservative projection of 60%, the economic gain is minimal since there is no immediate commercial end user to absorb any significant gain in energy generation. This, coupled with the fact that MSW must be incinerated daily, regardless of the energy produced from a ton of feedstock (waste), renders the conversion factor academic. Consequently, the proposed alternative fuel system has been estimated at an overall 60% efficiency because it provides an almost optimum balance between feedstock and commercial end-user requirement.

The solid waste accumulation and waste recovery system appear to be an ideal utilization mix. The system utilization capacity is on the order of 100%, and, in this condition, overall loading should be at the highest attainable level of efficiency.

Figure 3 shows material flow to the various units, the ash or noncombustible residue, the useful heat generated, and the utility requirement for an average day. This schematic represents a general flow of material. Depending on final facility design, the specific equipment location/entrance into the system could be altered. Nevertheless, size restrictions basically will be the same for incineration of the accumulated solid waste.

From a net energy gain, Table V tabulates the auxiliary utilities that would be consumed during normal operation of the MSW alternative fuel system.

Table V.

Auxiliary Fuel (natural gas):

$$\$25,000 \times \frac{10^6 \text{ Btu}}{\$2.25} = 11,111 \times 10^6 \text{ Btu}$$

Fuel for Vehicles (facility) (gasoline):

$$\begin{aligned} \frac{\$9,800}{\$1.00/\text{gal}} &= 9800 \text{ gal} \times \frac{6.5 \text{ lb}}{\text{gal}} \\ &\times \frac{20,700 \text{ Btu}}{\text{lb}} = 1,318.6 \times 10^6 \text{ Btu} \end{aligned}$$

Table V. (continued)

Electric Power:

$$\frac{\$14,040}{\$0.03/\text{kWh}} = 468,000 \text{ kWh}$$

$$\times \frac{3,413 \text{ Btu}}{\text{kWh}} =$$

$$\frac{1,597.3 \times 10^6 \text{ Btu}}{}$$

Total

$$14,026.9 \times 10^6 \text{ Btu}$$

$$\frac{14,026.9 \times 10^6 \text{ auxiliary Btu requirement}}{149,564.2 \times 10^6 \text{ Btu generated}} = 9.4\% \text{ conversion rate}$$

From the above calculation, it is apparent that the net energy gain of 91.6% is substantial pursuant to this form of alternative energy source.

The availability of the resource (MSW) used to generate low-Btu (270) gas is excellent. The supply of this resource will increase proportionately to the demand for processed fuel. This resource will allow flexibility in selecting a resource mix to meet the demand of the end users. The resource presently is being accumulated and disposed of regardless of the latent energy source it contains. The method of accumulation will remain intact, with only the method of disposal changed.

The process is flexible regarding the type of resource and the needs of the end user. The facility can be used as a captive energy source or publicly as an energy source. The only requirement is that the resource must be matched to end-user demand. This stipulation already has been documented in an in-depth area resource audit and appears in Sec. 4 of this project task. At this point, the resource base currently generates 28,184 tons of combustible waste each year with an energy value of $249,234 \times 10^6$ Btu. Based on a conservative 60% efficiency, the potential energy recovery is equivalent to approximately 25,436 barrels of oil annually.

Figure 2. The Relationship of Solid Waste Thermal Output at Various Efficiencies

BASIS: 108.8 tpd

9,067 lb/h

Figure 3. Material Flow, Residue, Heat Generated, and Utility Requirement for an Average Day

7/7/18

DO NOT MICROFILM
THIS PAGE

PROCESS DESCRIPTION

The task is to implement an existing state-of-the-art technology at a specific site with documented economic factors, not to develop a new process.

Consequently, the anticipated time for production startup would be about 12 to 18 months, because of the above technical situation. Only the application can be considered innovative. Figure 4 shows that this proposal addresses applied technology rather than research and development, which permits a high degree of technical readiness.

The primary integral unit of the plan is sound and operational. The other integral units, which can be built easily, depend on the form the energy source will take. This depends on the results of the pending legislation affecting technologies applicable to Public Law 96-304, which involves burning urban waste.

Congressional dictates will determine the acceptable energy form for using the alternative fuel source derived from MSW. The hardware for the total system is ready for production.

The proposed alternative fuel system is the flat-hearth, starved-air system that uses two chambers to accomplish the controlled air incineration process. These chambers are known as the lower (or primary) and the upper (or secondary or pollution control) chambers. The performance of the antipollution features of the system depends on controlling the conditions in these two chambers. The lower chamber must operate at low interior gas velocities and under controlled temperature conditions. This is done by limiting the air introduced into the primary chamber to less than that required for complete combustion. (Hence, the system is called "starved air.") This gives the lower chamber the operating characteristics of a partial oxidation system.

Heat release in the lower chamber is controlled by limiting the introduction of combustion air to an amount that will partially oxidize the waste in the chamber. This heat release sustains partial oxidation reactions. The effluent from the lower chamber, which will include various pyrolytic and oxidative compounds, passes into the upper chamber through a turbulent mixing zone where ignition takes place and additional air is added to complete the oxidation reactions. The noncombustible portion of the waste and carbonous residue from the reactions remain in the lower chamber. The noncombustibles are rendered sterile by the relatively high temperature, while the carbonous material is oxidized further by the incoming air. The result is a high-quality sterile ash.

The gas velocity in the lower chamber is influenced by several factors. The gas that evolves from the chamber is a result of the interaction between the air and the oxidation and volatilization products from the waste. The quantity of gas from the waste varies substantially depending on chamber conditions and the waste and would, therefore, alter the lower chamber velocity significantly. The upper and lower chamber air flow controls are integrated to minimize this peaking activity to provide a uniform flow of gases. This is important for controlling pollution performance as well as for an efficient energy recovery system.

Figure 4. Diagram of the Process

When volatilization proceeds at an excessive rate as a result of high temperatures, two distinct adverse effects occur. First, the velocities in the lower chamber exceed the design velocity and particles that are too large to be oxidized properly will be carried into the upper chamber. With excess air incinerators, this process is uncontrollable and contributes to their inability to maintain low pollution exhaust. Second, the gases will flow to the upper chamber at a rate that exceeds the capacity of the chamber and can result in excessive particulate emissions or smoking.

The function of the starved-air upper chamber is to complete the oxidation reactions of the combustible products as they are received from the lower chamber. To accomplish this, conditions in the chamber must be controlled within a narrow band from inputs which vary widely. State-of-the-art control systems are designed to maintain the required conditions by modulating both air and fuel to the system. In effect, this controls the air input and gas flow from the lower chamber. Modulation is done automatically in accordance with pre-set requirements.

The process operation is illustrated in Figure 5. This curve shows the characteristic relationship between the flame temperature and the air-fuel ratio for a typical hydrocarbon fuel. The operating regime for both upper and lower chambers has been superimposed on the curve. The fuel is the waste material. The partial oxidation-pyrolysis-type reactions occur in the lower (primary) chamber at moderate temperatures under a reducing (insufficient air for complete combustion) atmosphere. This is illustrated on the left side of the curve. Without adequate control of the lower chamber, the system is subject to substantial fluctuations in burning rate from normal operations.

The gases pass from the lower chamber into the upper chamber through a turbulent mixing region in a controlled manner. Additional air is introduced into the system and the gases are ignited, again under controlled conditions. At this point, the upper gas temperature is somewhat higher than in the lower chamber and the atmosphere is oxidizing more than sufficient air for complete combustion. This process is illustrated on the right side of the curve in Figure 5. Temperatures in the upper chamber are limited to less than 2500°F to minimize the nitrogen oxide production and in the interest of equipment durability. On the lower temperature side, it is recommended that at least 1800°F be maintained to stabilize an adequate reaction rate to complete the combustion process. The desired temperature operating point is adjustable, but can be preset for maximum performance. The primary means of controlling the temperature in the upper chamber is to control the quantity of combustion air. Air is reduced when the temperature drops below the setpoint and air is increased when the temperature rises above the setpoint. Although the upper chamber is capable of operation over a wide range of conditions, the controls are designed to limit the process to conditions within the limits described. The lower and upper chamber controls are integrated to accomplish this.

The equipment for the proposed alternative fuel system is similar to ongoing operations in other large industries and small municipalities. The specific starved-air system has performed in approximately 3500 applications of the controlled air technology. The most relevant experience has been gained through application of this technology to continuous-duty operations with recovery of energy at high efficiency.

Figure 5. Starved-Air Fuel Requirements

Figure 6. The Basic System

The successful installation of waste-to-energy systems requires experience in specific areas. These areas are materials handling, emissions control, and overall system efficiency.

The first major hardware vendor began manufacturing antipolluting, controlled-air incineration systems in 1965. Through their unique design, these systems are able to reduce a wide variety of waste products while maintaining high air-quality standards. With passage of the Clean Air Act Amendments of 1970, the demand for these systems increased and larger sized systems were developed to accommodate the industrial and municipal markets.

Consequently, this technology is refined and can be compared to the transition from a 707 to a 747 jet plane. The basic laws of physics are valid, larger modules are just being considered.

GENERAL DESCRIPTION OF OPERATIONAL MODE

The Walterboro facility will function similar to that shown in Figures 7 through 13. Traffic handling is simplified by the flexibility of the existing and proposed Walterboro Industrial Park service roads. Public access will not be permitted, thereby eliminating a large number of vehicles that often must be handled in similar facilities.

All waste packers or other trucks delivering waste to the facility will stop first at the facility truck scales, where all incoming trucks will be weighed to determine the amount of waste coming into the facility. All scale operations are to be controlled from the scale operator's station within the facility office structure. Scale readout will be accomplished from this station. Individual truck tare (empty) weights will be maintained and checked periodically so that trucks will not have to be weighed empty each time they deliver waste to the facility.

After weighing, the trucks carrying solid waste will proceed to the rear of the facility where they will back into the building through one of two large overhead doors, providing general access to the tipping floor.

After discharging the solid waste material, the trucks will leave the building and go to the side of the building to the main access road. Any trucks that do not have a proper tare weight established will have to proceed over the truck scales to be weighed again. It is anticipated that this generally circular traffic pattern will minimize any congestion that could occur on the site.

The only other significant on-site truck movement will be movement of the facility ash residue vehicle.

Site Development

The site will be developed to support the specific use of the facility. Existing utilities in the area include gas, water, sewers, and power. All of these services are adequate to support the proposed site land use.

Facility Building

The selected building will be a pre-engineered, rigid frame-type structure set on reinforced concrete foundation. The specific design will be compatible to the existing site and proposed use conditions. The building size conforms to standard building sizes as much as possible, which are available from superior quality pre-engineered building manufacturers.

The building can be designed so that all the equipment can be completely enclosed and protected from the weather. The line drawing in Figure 4 shows the general cross section of the building with location of the tipping floor and equipment. The proposed dimensions for the size of facility required are 140 x 160 ft with a 28 x 56-ft contiguous office structure. The main building is subdivided into a tipping (waste-receiving) floor and an equipment floor. The difference in elevation between the tipping floor and the equipment floor is necessary for proper materials flow through the facility.

Figure 7. Trucks are Weighed as They Enter the Facility. The above photograph demonstrates how an incoming truck will be weighed on a remote recording scale. This particular arrangement has a separate scale house, but could be incorporated into the main building for better facility control.

Figure 8. Recording and Ticketing are provided by a remote recording printout system to record weights. The office housing the recorder also will act as a traffic control center. The controller will have full view of both the scales and access to the tipping floor so that traffic can be controlled with a minimum of congestion.

Figure 12. The System Wet Ash Sump and Removal Ash Containers. As the ash containers are filled, they are hauled to the landfill for dumping. A volume reduction of about 9 to 1 is expected from the incineration effect. This will automatically increase the life of the landfill to be used for disposal of ash residue. Spare containers will be provided at the facility to keep ash receiving in full force at all appropriate times.

Figure 13. Ash Handling Trucks are an integral part of this incineration system. The use of closed bottom containers in this system will eliminate leakage and spillage when removing ash from the facility to be disposed of at the landfill site.

Figure 9. Trucks Enter the Facility as Shown here, where the un-processed waste is discharged onto the tipping floor.

Figure 10. Skid Steer Tractors move the waste into the automatic loading devices shown here. The operator will use a simple pushbutton to open and close the feed hopper. The remainder of the operation is fully automatic.

Figure 11. Proper Design for Storage and Use of Waste will allow daily cleaning and disinfection of the tipping floor. A high concrete wall around the tipping floor protects the metal building from damage due to tipping floor activity.

The tipping floor will receive all waste into the facility. The overall size of the tipping floor will be about 138 x 80 ft (11,040 ft²). A 10-ft-high concrete push wall will surround most of the tipping floor. This will allow for waste storage along the wall with no damage to the metal building. This tipping floor arrangement will allow for proper materials handling. The equipment floor will house all of the processing units, as well as necessary support equipment.

Facility Rolling Stock

The facility operation will require two forms of rolling stock. These include: (a) skid steer tractors for tipping floor and (b) an ash hauling truck. The skid steer tractors will move the waste on the tipping floor and load the hoppers for the automatic loaders. Three skid steer tractors should be maintained. Under normal operation, two tractors will be used with the third tractor serving as a standby. These will be rotated on a regular basis to achieve even wear.

The ash hauling truck will have proper containers. This truck will be able to handle the full ash containers for hauling to the sanitary landfill.

DO NOT MICROFILM
THIS PAGE

SITE LOCATION

The suitability of the selected site was determined by the unique relationship Dayco Corporation has as the sole commercial carbon-monoxide market. Consequently, Dayco has negotiated a suitable area with the Colleton County Resource and Development Board for the location of the proposed alternative fuel operation. While much of the geographical area in Walterboro's developing industrial park could accommodate the process, a prime selection factor is the economic necessity that it be as close as possible to the end user. In this case, Dayco is an ideal customer and has accepted the Development Board's decision to use Dayco's annexed property as the site from which to operate the alternative fuel system.

The site provides an optimum relationship between a process and resource base. Pursuant to current and pending hazardous waste regulations, Colleton County's sanitary landfill only has a one-year life cycle. Consequently, the site, which is contiguous to a year-round carbon-monoxide market, is both practical and mutually economical in development of an alternative fuel and extension of the 10-yr lifetime of the landfill.

One prerequisite for implementing a viable commercial incineration resource recovery system is identification of an end user who will offer the necessary economic balance. Consequently, site location is most critical pursuant to the relationship of available energy resource and customer.

The major selection factors guiding site determination of the proposed alternative fuel system from municipal waste briefly follow:

1. Major Resource Customer
 - a. 20 million Btu/h (approx.) requirement
 - b. 12-month continuous demand operation
 - c. long-range contractual commitment
 - d. economically reliable.
2. Facility/Utility Logistics
 - a. available contiguous property for interfacing with resource recovery system
 - b. convenient utility hookups to the proposed incinerator facility.
3. Time
 - a. customer must be ready to make a long-range commitment
 - b. the lifespan of landfilling is critical, each month delay costs 6- to 8-month equivalence of extended operation.

Fortunately, the Dayco Corporation already has negotiated a suitable area with the Colleton County Resource and Development Board for the

proposed alternative fuel operation. Tests and evaluations show that the combustible refuse available for the alternative fuel plant (100 tpd) balances out with production and Dayco's energy requirements.

An in-depth energy audit was performed by Energy Appraisal Associates, Inc., a consulting firm, at Dayco's Walterboro facility to document the operation's process gas requirements. While a 42.1% reduction was realized, the operation still consumed approximately 920,000,000 ft³ of gas per day. The annual combustible refuse from municipal waste available to support the alternative fuel plant has an equivalent usable Btu value of 60,000 barrels of oil.

A description of the subsurface, structural, and foundation information/data of the proposed site appears as Appendix A and was prepared by Foundation & Materials Engineering, Inc., Columbia, South Carolina.

The Walterboro, South Carolina, area is situated on a slight rise and is drained by Ireland Creek and the Great Swamp to the west, and the lesser tributaries of the Ashepoo River to the east. The soils of Colleton County are well-drained and loamy.

The proposed site is situated within an industrial park previously developed by the Industrial Commission of Colleton County. The area presently is supplied with natural gas, electric power, water, and sewers. The area has been developed and the roadways are in place, functioning properly, and in good condition. The area supports a relatively strong traffic volume. The proposed site is located within Walterboro, the county seat of Colleton County.

Natural gas is supplied in Walterboro by South Carolina Electric and Gas Company (SCE&G), who purchases it from Southern Natural Gas. The rates, service, safety, and quality of gas of the distributors are regulated by the South Carolina Public Service Commission and Federal Power Commission.

Average specific gravity	0.60
Average Btu value per ft ³	1060

Firm, preferred, interruptible, and uninterruptible natural gas can be sold to new industry.

The air quality of the county is exceptional, primarily because of the lack of industrial operations and the relatively minimum use of vehicles.

Walterboro uses extended aeration to treat its municipal wastewater. The treatment plant has a daily capacity of 1.85×10^6 gal/day and the current daily peak demand is approximately 800,000 gal/day.

Sewer rates are based on water consumption; the rate schedule follows:

Within City:	\$0.95 per 1000 gal of water used
Outside of City:	\$1.60 per 1000 gal of water used

Electric power suppliers in the county are SCE&G and Coastal Electric Cooperative (CEC). SCE&G provides power to the city of Walterboro, the

immediate vicinity, and the industrial area. CEC buys its power from the South Carolina Public Service Authority and provides power to rural residents of the county.

SCE&G has a modern generating plant which guarantees adequate electrical power for the industry. The cooperative's experienced personnel will service new and expanding industries without cost or obligation.

Although the county, as well as the state, constantly is recruiting new industry to the area, technology often has been a stumbling block. Therefore, the proposed project will encourage new industry to locate there, and, as a result, unemployment within the county will decrease.

The labor force within Colleton County is relatively small, but manpower is available and ready for increased productivity. Therefore, the local government is interviewing and soliciting new businesses to expand its base. However, maintaining the environment is a constant consideration. The proposed facility is illustrated in Figure 14.

Previous experience with similar facilities indicates that the operation of the facility will have no deleterious effect on the environment with respect to any form of pollution, whether it be air, solid waste (ash), noise, etc.

Because of similar facilities, the safe operation of this facility is enhanced because of the experience already achieved. Because of Dayco's extensive operations, the organization has personnel that are available for development and analysis, etc., of all procedures necessary to insure safe operation.

Figure 14. Architect's Rendering of the Proposed Colleton County Facility

SOCIAL/ENVIRONMENTAL IMPACT

The proposed project will benefit Colleton County. These benefits include not only the maintenance, but also the enhancement of the ecology of the county. For example, the lifetime of the present landfill is about one year. Based on results from the preliminary study, the landfill life could be extended by at least 8 years because of the volume reduction of the disposed solid waste. Also, sometimes the sterile ash, which must be removed from the system, can be used for roadbeds, erosion control, etc.

In addition to benefits accrued by the county, the industrial population will benefit accordingly. Besides an alternative energy source, these benefits include a means for disposal of most hazardous wastes. This will encourage industrial growth, increase manpower needs, and improve the economic environment of the county.

The Dayco Corporation will adhere to all the rules and regulations that affect the project during the implementation phase and during the operation of the facility. Jerry Wood, Dayco Corporation, will ensure regulatory compliance and will monitor and be familiar with proposed legislation as it relates to the project. Dayco Corporation, and its support personnel, will be able to complete the project successfully. Project management also will use small disadvantaged and/or minority businesses during design, construction, and operation of the facility.

DO NOT MICROFILM
THIS PAGE

ECONOMICS

Regardless of the type of incineration system utilized, the technology requires similar, if not identical, auxiliaries. That is, the material handling, processing, and building requirements are compatible and/or a requirement of any type of system utilized for incinerating the solid waste and recovering the potential heat energy.

These auxiliary items and anticipated costs are listed as follows:

Building	\$256,400
Utility Extension	48,000
Natural Gas	
Water	
Power	
Sewer	
Gas Line	50,000
Gas Cleaning System	23,600
Equipment	<u>80,000</u>
Subtotal	\$458,000
Contingency	<u>43,800</u>
Total	\$501,800

The equipment required for incineration, energy generation, and related integral components such as stacks and induced draft fans are more variable than the auxiliary requirements. This is dependent on the system utilized since the capital cost impact is a function of the end use of the available or potential energy. For example, the capital costs of a system that will utilize the energy for electrical power generation will more than double the capital costs for a system that utilizes low- to medium-pressure steam at the point source. The following represents the manufacturers' estimated costs for several systems:

Basis: 100 tpd Capacity

Type of System	Equipment Cost, \$/Ton	Construction Cost \$/Ton	Total Cost, \$/Ton
Flat Hearth	8,250	4,100	12,350
Rotary Kiln	11,560	5,800	17,360

The total estimated cost for a flat hearth-type incinerator/heat recovery system would be on the order of \$1,235,000, and the total estimated cost for a rotary kiln system is \$1,736,000.

The following table shows the comparative total capital costs for each of the systems:

Item	Rotary Kiln	Flat Hearth	Auxiliary
Incinerator/Heat Recovery	\$1,736,400	\$1,325,000	
Building			\$256,400
Utility Extension			48,000
Gas Line			50,000
Gas Cleaning System			23,600
Miscellaneous Equipment			80,000
Contingency			43,800
Subtotal	\$1,736,000	\$1,235,000	\$501,800
Engineering & Legal Fees	140,000	120,000	
Escalation (6 mos. @ 6.0%)	67,130	52,100	
Auxiliary	501,800	501,800	
Total	\$2,444,930	\$1,908,900	

As shown, these capital costs do not include site acquisition or improvement. We estimate that this cost would be on the order of about \$125,000, which would include all the necessary facilities and/or requirements to satisfy the expeditious handling of about 25 disposal trucks daily.

The total capital costs for each of the systems will be on the order of:

Rotary Kiln	\$2,569,930
Flat Hearth	\$2,033,900

The operating and maintenance (O&M) costs for the two systems are comparable. An estimate of these costs follows:

Item	Annual Costs
Auxiliary Fuel (Natural Gas)	\$ 25,000
Fuel for Vehicles (Facility)	9,800
Ash Removal	12,800
Water for Cleanup	4,600
Chemical Treatment	5,200
Electric Power	14,040
Maintenance (Active and Reserve)	45,000
Insurance and Miscellaneous Expense	16,000
Subtotal	\$131,640
<u>Labor</u>	
Supervisor (1) 2,080 h x \$7.50/h	15,600
Clerical (1) 2,080 h x \$4.50/h	9,360
Boiler Operators (3) 6,240 h x \$5.25/h	32,760
Equipment Operators (3) 6,240 h x \$4.25/h	26,520
Laborer (1) 2,080 h x \$3.50/h	7,280
Subtotal	\$ 91,520
Overhead/Benefits	15,184
Total Labor	\$106,704
Total O&M	131,640
Grand Total	<u>\$238,344</u>

Annual \$/Ton = \$8.46.

The economic advantage most obvious to the county after the system is in operation is the extension of the life of the landfill or the reduction in size of a comparable site. The volume reduction of solid waste that can be expected is about 90% of the present volume of solid waste now being disposed. Based on the average daily throughput of solid waste of 108.8 tpd, the equivalence to 472 yd, the average amount of ash or residue will be 16.3 tons and the volume will be about 47 yd. This indicates that the average density of the residue will be about 25.7 lb/ft³. Based on truck unloadings, the traffic will be reduced from about 25 trucks to 2 trucks.

The residue or ash from the system is an inert material that may be used for roadbeds, landscaping, etc. After system implementation and startup, the ash will be evaluated chemically and the potential for reuse will be determined.

As mentioned previously, the useful heat to be realized from the incineration of solid waste is 149,564 million Btu annually. Based on equivalent units, this quantity of heat is equal to 1,068,316 gal of heating fuel oil. Currently, fuel oil entitlements pay local government-owned facilities \$6.00 per barrel of fuel oil equivalents. On this basis, the county would be eligible for an income of \$152,617 annually from this source, which breaks down as:

$$\frac{1,068,316 \text{ gal}}{\text{yr}} \times \frac{\text{Bbl}}{42 \text{ gal}} \times \frac{\$6.00}{\text{Bbl}} = \$152,617/\text{yr}.$$

The operational cost of the present landfill will be reduced by at least 33% of its present operational cost. This will result from less covering of waste, less trucks handled, etc. In addition, the ash will be compacted and will require less attention when disposed of in the appropriate trenches or fill areas.

Tipping fees currently are charged based on the registered volume of solid waste disposed. These charges are currently \$0.50/yd for in-county solid waste and \$1.00/yd for out-of-county solid waste. These charges are incurred by commercial haulers only. Based on an average density of the collected solid waste, the charges on the basis of weight are:

In-county

$$\frac{\$0.50}{\text{yd}} \times \frac{\text{yd}}{412.8 \text{ lb}} \times \frac{2,000 \text{ lb}}{\text{ton}} = \$2.42/\text{ton}$$

Out-of-county

$$\frac{\$1.00}{\text{yd}} \times \frac{\text{yd}}{412.8 \text{ lb}} \times \frac{2,000 \text{ lb}}{\text{ton}} = \$4.84/\text{ton}.$$

The annual unit cost of handling the solid waste, based on O&M costs, is \$8.46/ton. The tipping fees charged to commercial haulers, at the same rate as now imposed, will offset the facility operating costs as follows:

$$\text{Income: In-county} \quad \frac{\$2.42}{\text{ton}} \times \frac{6,500 \text{ ton}}{\text{yr}} = \$15,730/\text{yr}$$

$$\text{Income: Out-of-county} \quad \frac{\$4.84}{\text{ton}} \times \frac{5,564 \text{ ton}}{\text{yr}} = \$26,930/\text{yr}$$

$$\text{Total Annual Charge Rate} \quad \$47,660/\text{yr.}$$

This is equivalent to \$1.51/ton, on an annual basis and based on total solid waste collection.

Predicated on the initial capital investment and operating cost, Tables VI and VII reflect the cash flow tabulated to reflect what the proposed alternative fuel system negatively would generate without support or assistance from the synfuel cooperative agreement. While the extrapolated payback appears viable in 10 yr, such an extended timeframe is financially unattractive for a project of this dimension. However, with the introduction of 50% capital assistance from the DOE cooperative agreement, the economics of the proposed alternative fuel system is substantially enhanced. This is particularly valid if a delayed balloon-type repayment plan could be scheduled.

Tables VI and VII indicate how the proposed alternative fuel systems fare economically with and without DOE assistance.

TABLE VI. Operational Cash Flow with DOE Assistance

Period	1 Facility Annual Opera- ting Costs	2 Repayment Schedule Fixed	Total Annual Costs	3 Derived Income	Difference of Costs vs Earnings	4 Accumula- tive Cash Flow
1981	\$238,344	\$175,000	\$413,345	\$ 330,000	(\$ 83,345)	(\$ 83,345)
1982	252,645	175,000	427,645	379,500	(48,145)	(131,490)
1983	267,803	175,000	442,803	436,425	(6,378)	(137,868)
1984	283,872	175,000	458,872	501,889	43,017	(94,851)
1985	300,904	175,000	475,904	577,172	101,268	6,417
1986	318,958	175,000	493,958	663,748	169,790	176,207
1987	338,096	175,000	513,096	763,310	250,214	426,421
1988	358,381	175,000	533,381	877,807	344,426	770,847
1989	379,884	175,000	554,884	1,009,478	454,594	1,225,441
1990	402,677	175,000	577,677	1,160,900	583,223	1,808,664

1 - 6% inflation rate factored into operating costs

2 - \$1,500,000 capital investment @ 10% annual interest

3 - Gross energy income from alternative fuel system at 15% escalation rate

4 - Net accumulative cash flow on total project

TABLE VII. Operational Cash Flow without DOE Assistance

Period	1 Facility Annual Opera- ting Costs	2 Repayment Schedule Fixed	Total Annual Costs	3 Derived Income	Difference of Costs vs Earnings	4 Accumula- tive Cash Flow
1981	\$238,344	\$350,000	\$588,344	\$ 330,000	(\$258,344)	(\$258,344)
1982	252,645	350,000	602,645	379,500	(223,145)	(481,489)
1983	267,803	350,000	617,803	436,425	(181,378)	(662,867)
1984	283,872	350,000	633,872	501,889	(131,983)	(794,850)
1985	300,904	350,000	650,904	577,172	(73,732)	(868,582)
1986	318,952	350,000	668,958	663,748	(5,210)	(873,792)
1987	338,096	350,000	688,096	763,310	75,214	(798,578)
1988	358,381	350,000	708,381	877,807	169,426	(629,152)
1989	379,884	350,000	729,884	1,009,478	279,594	(349,558)
1990	402,677	350,000	752,677	1,160,900	408,233	58,675

- 1 - 6% inflation rate factored into operating costs
 2 - \$3,000,000 capital investment @ 10% annual interest
 3 - Gross energy income from alternative fuel system at 15% escalation rate
 4 - Net accumulative cash flow on total project

LANDFILL

While there can be degrees of variables influencing the replacement cost of a new sanitary landfill, several factors are reasonably certain.

1. Any new site will require approximately 50 acres not only to accommodate Colleton County's future requirements, but also to qualify for environmental certification.
2. A reasonable estimate for the acquisition of a new sanitary landfill is approximately \$2,000 per acre plus the following associated requirements:

- Environmental Impact Statement
- Site Improvement
- Road Work
- Security Fencing
- Utility Hookups
- Control Facility, etc.

Consequently, the initial \$100,000 price for raw land acquisition could be doubled by the time it became operational.

Should the contract be let out for construction of the waste incineration recovery system in fiscal 1980, it would be 15 to 18 months before it could be operational. On that basis, Colleton County will have only 1 to 2 years of dump life remaining at the present landfill. Fortunately, the incinerated ash residue has a compaction ratio of about 8 to 1. This could extend the lifetime of the site by as much as 10 years and, in effect, provide a significant cost avoidance by holding in abeyance the need for a new landfill site during the remaining decade.

DO NOT MICROFILM
THIS PAGE

IMPLEMENTATION SCHEDULE

Figure 15 is the schedule for the proposed project. The times used to procure purchased items and for equipment fabrication are based on information from suppliers and on past experience. The site work and building construction times are based on experience with other similar structures. The schedule shows a reasonable completion time, through acceptance tests, of 58 weeks from contract signing. Delays in permit issuance, bad weather during construction, or similar factors could change the schedule. However, the 18-month requirement for complete construction can be met even if delays are encountered. The exact time of contract award will influence the schedule to some degree because of poorer construction conditions during the winter months.

The schedule involves parallel fabrication of the equipment with construction of the building. Long lead items, such as the pressure components of the energy system, the truck scales, the standby generator, will be ordered shortly after the contract is signed. The fabricated equipment will be constructed and assembled at the prime component's manufacturing facility. Building construction and installation will be done by local subcontractors as much as possible.

To expedite the project further, construction fast-tracking of facility site work and foundations may be considered during contract negotiations.

Equipment	Completion Period	Expenditure
Drawings	1-2nd month	\$
Unit No. 1	3rd month	395,237
Unit No. 2	4th month	379,475
Structural Platform No. 1	4th month	126,000
Structural Platform No. 2	4th month	126,000
Energy System No. 1	7th month	362,000
Energy System No. 2	7th month	362,000
Installation	10th month	175,000
Subtotal		\$1,925,712
<u>Engineering</u>	1-12th month	\$ 120,000
Preliminary Drawings		
Final Drawings		
Building Bidding		
Award Contracts		
Inspection		
Subtotal		\$ 120,000
<u>Building, Equipment, and Auxiliary</u>		
Site Development	2nd month	\$ 125,000
Building Foundation	6th month	82,500
Building Structure	8th month	167,500
Process Gas Line and Equipment	9th month	75,000

Equipment	Completion Period	Expenditure
Building Final	10th month	\$ 25,000
Miscellaneous Fees (legal)	12th month	5,000
Equipment (internal)	12th month	105,000
Installation	10th month	120,000
Gas Cleaning System	12th month	40,000
Miscellaneous (including escalation and contingency, etc.)	-	<u>178,110</u>
Subtotal		\$ 923,110
Grand Total		<u>\$2,968,822</u>

Successful implementation of the project will require a close coordinated effort by the team formed to perform the project effort phases. The work phases to be performed by the project team follow:

Final Design Phase
Construction Phase
Startup and Testing Phase
Commercial Operations Phase

The four separate project task areas must be integrated by the implementation teams under the direction of capable management.

In the initial stages of the final design phase, the design team will consult with both Dayco and Colleton County to pursue alternative facility arrangements that will achieve the objectives at the lowest possible capital cost. During this initial phase, if a suitable design evolves that results in lower costs, the proposer naturally will pass these savings back into the contract.

Construction

Two distinct construction efforts are required in system implementation. The facility superstructure will be constructed through construction management techniques under supervision of Energy Appraisal Associates. In parallel to this, the two, 50-ton incinerators and energy recovery appurtenances will be manufactured at the prime component's manufacturing facility.

Subcontractors will be used during prime construction for such projects as:

Site Work
Concrete (foundations)
Metal Pre-engineered Building
Plumbing
Electrical
Pressure Piping
Carpentry
Painting
Flooring

If circumstances warrant, site and foundation subcontractors will be selected immediately on completion of that portion of the design. Construction then will begin on the site work and foundations while the remainder of the design is being completed.

1. The site contractor will begin his activities by providing access to the site. The site then will be cleared and grubbed to remove any interference with the proposed construction. Topsoil will be stripped and stockpiled, where feasible, for use in final site landscaping. Site grading will be undertaken.

2. Utility installments will begin. At the same time, excavation will begin by the site contractor for foundation installation.

3. The foundation contractor then will begin to install foundation and retaining walls. Site work will continue during this period.

4. After the foundations have been installed, the metal building contractor will move onto the site to begin erection of the building frame. Before installation of the building shell and roof system, the incineration units and energy recovery systems will be installed onto waiting foundations.

5. After closing in the building, the finish internal work will be performed on the main building and the office structure will be completed. During this period, the remaining site work (paving, landscaping, etc.) will be completed if weather will allow.

During the construction phase, the incinerators and energy recovery modules will be produced by the selected manufacturer. Each of these units will be fabricated in accordance with approved plans and specifications. After manufacturing the components of each module, each unit is assembled at the factory and tested. After approval for shipment, the units will be trucked to Waltherboro for installation. The weight of each component of the modules will require a large crane for equipment installation.

Startup and Testing

At the end of the construction phase, solid waste will be delivered to the facility for use during startup operations. All startup procedures will be in accordance with pre-established procedures to ensure proper curing and testing of the units. All startup procedures will be performed by trained manufacturer's technicians.

During this period, most of the facility operating personnel will be hired for proper training and indoctrination before full commercial operation. All components will be tested for proper function during this phase. Actual tests for guarantee conformance will be performed during the initial stage of the commercial operating phase. All tests will be performed under full operating conditions in accordance with a test protocol to be negotiated as part of the final contract negotiations. Operating characteristics that are to be tested include:

1. air quantity and quality
2. ash quality
3. supplementary fuel use.

RISK FACTOR

All figures used in the various calculations and cost estimates in this report are conservative. The estimated initial cost of incineration equipment is based on a recent price quotation from a supplier. So this figure may be verified, the equipment could be bid ahead of the remaining portion of the project. This would "tie down" the most important feature, and the rest of the project then could be designed around that chosen equipment. The O&M cost and gas production quantities are based on the most realistic figures possible.

O&M could be considered a risk factor because most incinerator/energy installations are relatively new and, thus, there is no long-range operational experience on actual life expectancy of the equipment. Operating costs also could be higher than predicted, particularly if maintenance of the facility were to become slack. However, there are now quite a few similar installations currently operating or starting up and the risk conditions appear to be minimal at this time.

While it is known that the proposed pyrolysis incineration equipment presently conforms to state and federal Air Pollution Control Standards, it is possible that future stiffer regulations could require equipment adjustments to bring the system into compliance.

Another risk involves selling the energy to an establishment within the community's private sector. With such a business, there is always uncertainty and a chance of a closedown of operation. However, this is not likely with the proposed end user, Dayco Corporation, a diversified, well-established, AAA firm. This fact is documented in Project Task IB. Consequently, the likelihood of reduced production, which could close one of the shifts, appears remote. Conversely, the loss of feedstock (municipal waste) to support the system could present a risk. However, since this proposed system aids Colleton County's solid waste disposal problem, this contingency is most unlikely (see Figure 16).

A prevention maintenance and inspection program will be instituted and maintained to keep emergency repairs to a minimum. Maintenance will be carried out so that it does not require a fixed, scheduled off-line period.

The modular starved-air system proposed is designed so that unscheduled and emergency repairs can be made to major plant components without shutting down the entire system. Any reasonable unscheduled failure would not, therefore, result in diminished capacity for the plant to process waste and produce energy.

The extensive experience of the proposed flat hearth technology with approximately 80 municipal modules in municipal operation indicates that the following failures could occur on an unscheduled basis. The list of failures and required repair times indicates those failures that have occurred in the past as well as some estimated failures that may occur in the future.

50
Supervisor of Colleton County

COLLETON COUNTY, SOUTH CAROLINA

SUPERVISOR
THOMAS F. FENNELL

P. O. BOX 147
WALTERBORO, S. C.

September 22, 1980

Mr. Jerry Wood
Corporate Energy Manager
Dayco Corporation
333 West First Street
Dayton, Ohio 45402

Dear Mr. Wood:

Colleton County will provide to the Dayco solid waste/ incineration system all solid waste generated in the County. As indicated in the feasibility study, the solid waste generated can be delivered in an uninterrupted supply which we understand is very necessary to the operation of said system.

Providing solid waste to the system will help reduce the Countys expenses of maintaining a landfill and will provide new permanent jobs to the people of this County. These are our main reasons for cooperating with Dayco on this project.

Sincerely,

Thomas Fennell
County Supervisor

Figure 16.

Refractory Failure: The most time-consuming plant component that could fail and cause considerable unplanned down time of a single module is the failure of a major refractory area. This type of failure is more time consuming than any other because repairs can be made only by entry into the hot areas of the system and substantial time is required for cooldown. In certain sections of the machine, at least 48 h cooling would be required coupled with a repair that could take as much as six hours in the most extreme case, followed by a drying and recuring period that could require up to 48 h. A major refractory failure, therefore, could result in a down time of up to five days. This type of failure is extremely rare, however, and periodic inspections normally uncover impending failure and allow for minor repairs to be made before a major refractory failure. Starved-air systems have had experience with the refractory used in the units proposed for this cooperative agreement. Seldom does a refractory failure occur without some prior knowledge of an impending repair requirement.

The area in which an unexpected failure is most likely to occur is in the region where materials handling imposes the most severe mechanical abrasion. Unexpected failures in the gas handling section are almost nonexistent.

The most serious refractory failure in the system could occur in the manifold section. However, the system is designed with shutoff, refractory-lined fire doors. Even here a failure would not cause a shutdown on the entire facility. Repairs could be made on a single section without disturbing the operation of the rest of the system.

Wet Ash Conveyor System: The conveyor systems are designed to limit torque through the use of hydraulic drive motors. The most common occurrence resulting in failure of the drag chain systems has been due to unexpected jams. The proposed system's drag belt conveyor is designed with special nonjamming cleats which minimize failures of this sort. However, on certain occasions, odd-shaped objects or excessive wires can be tangled in the system and cause the system to stall. In this case, it may be necessary to drain the system and remove the obstruction before starting the hydraulic drive. Although this kind of failure can consume as much as three hours, the system normally is not out of operation since loading can be continued for some time without completely removing the ash.

Hydraulic Failures: Failures in any hydraulic system periodically occur. Failures that tend to interrupt the operation usually are associated with ruptured lines or complete seal failures. Since these parts are outside the high-temperature environment and are repairable while the machine is still at operating temperature, such failure would not be expected to put the system, or a given module, out of operation any longer than five hours. A failure occurring during the second or third shift when the chief mechanic is not on duty can be expected to take longer, depending on the time of failure. The system can remain at operating temperature without loading for up to six hours. If the repair time runs longer than this, it will be necessary to run the machine through its shutdown procedure. Under these circumstances, the module could be off line for as much as 12 h.

Each incinerator module is provided with its own separate hydraulic system which prevents failure of a single system from affecting the operation of any of the other systems. Spare pumps and motors for the hydraulic systems are maintained in the spare parts inventory and require no more than 3-h replacement time.

Generally, if a cylinder begins to lose its seal, a repair can be planned for replacement before hydraulic leakage becomes excessive.

Electric Motors: The most prevalent unexpected failure is with electric motors. The system will be provided with spares of all motors used. Generally, switching a motor on a system on a single module requires no more than four hours. The failure of certain electric motors, however, will put the system out of service and will require that the redundant module be brought into service or loading temporarily reduced for the entire system depending on which motor failure occurs. The critical motors are the induced draft fan motor downstream of the energy system, the air supply for the secondary chamber or pollution control chamber, and the electric motor for the hydraulic drive system. The normal failure of an electric motor is not of major consequence to the system operation and motor exchanges are rapidly made.

Control Relays: The proposed system uses sealed control relays for sequencing functions. Quick exchange can be made in case of failure. Normal relay replacement requires only a few minutes downtime.

Limit Switches: The system uses several limit switches to sequence events. These limit switches occasionally fail. However, repair can be made in less than one hour. Spares are always retained in stock.

Skid Steer Loaders: The skid steer loaders have water-cooled diesel engines, hydrostatic drive, and solid tires. Three loaders are provided so that one unit is always on standby. The standby time will be used for maintenance. Spare parts also are provided to minimize repair time if a failure should occur. Belt breakage has been the most common failure encountered. Approximately 30 minutes are required to make this repair.

CONCLUSIONS

1. Based on projected labor, equipment, and fuel costs, an incineration/energy production facility, capable of processing 100 tons of waste per day, is feasible for Colleton County. This is predicated on executing a workable agreement between the county and the customer, Dayco Corporation.
2. The initial energy agreement should be for a fixed period of time that is commensurate with the scheduled revenue agreed upon to retire the capital investment (the county loan).
3. Colleton County should have provisions in the agreement that would enable the county to receive damage compensation from Dayco in the event they should discontinue operation before the end of the agreed upon contract period.
4. The management of the waste/resource incineration and the operating personnel is a key area that must be addressed in a contractual arrangement between Colleton and Dayco.
5. Because of the importance of the fourth statement above, it is IMPERATIVE that representatives of Colleton County and Dayco Corporation work out a mutually agreed upon formula for administration and operation of the proposed facility. This will guarantee a working partnership and should be the first order of business following the Feasibility Report.

DO NOT MICROFILM
THIS PAGE

COMPENDIUM

To help clarify and summarize the results of the study, this section has been included to emphasize the salient points and/or discussions of the study.

1. Sufficient solid waste is produced within the county that, when incinerated and by utilizing new recovery technology, more than 24,000,000 Btu/h will be generated.
2. The facility will provide solid waste disposal in an environmentally sound manner, at a reasonable and stabilized cost. Colleton County will no longer have to be totally dependent on relatively short-term landfill site acquisitions and improvements.
3. Colleton County will be participating in a major fossil fuel conservation program that will yield the energy equivalence of about 25,436 barrels of fuel oil per year.
4. The as-received solid waste mix is so well proportioned that the operator can selectively change the incinerator based on energy requirements with equivalent weight of the type classification of wastes. Basically, the solid waste mix will produce 2,600 Btu/lb of solid waste. The pounds of waste (per type) to produce 2600 Btu/lb follow:

<u>Classification</u>	<u>Amount Required, lb</u>	<u>Energy Generated, Btu</u>
Type 0	0.6	2600
Type 2	1.0	2600
Type 3	1.8	2600

5. The recommended site is close to the customer, necessary utilities, and is easily accessible for vehicular traffic. This location permits good capital cost utilization as utility extensions and steam lines are minimal.
6. The capital costs required for implementation and the annual operating and maintenance costs, when compared with the benefits to be derived, show the excellent financial characteristics that are appropriate for the county.
7. The final design will include such things as heat recovery of waste heat, disposition of residue, etc. These considerations will improve the overall efficiency of the system, thereby increasing the benefits to be derived.
8. The study concludes that the Waste Incineration Resource Recovery System is a viable solution to present county environmental problems; a solution that is economically attractive, environmentally correct, and technically feasible.

DO NOT MICROFILM
THIS PAGE

APPENDIX A

Subsurface, Structural, and Foundation
Information/Data on the Proposed Site

DO NOT MICROFILM
THIS PAGE

Foundation & Materials Engineering, Inc. • 724 Meadow Street Columbia, South Carolina 29205 • Phone (803) 254-4540

October 10, 1980

Mr. Jerry Friedner
Carlisle Associates
1015 Gervais Street
Columbia, SC 29201

Re: Proposed Cogeneration Facility
Walterboro, South Carolina

Dear Jerry:

Per your request, our firm has made a preliminary subsurface investigation at the site of the proposed cogeneration facility in Walterboro, South Carolina. The site is located off Recold Road behind the existing Dayco Plant in the Colleton County Industrial Park. Two test borings, extending to a depth of 30 feet, were made in our investigation. The purpose of the borings was to provide preliminary data concerning the on-site soil conditions with respect to their ability to support the proposed cogeneration facility. A log of each test boring, along with a Location Plan showing the approximate boring locations, is attached.

SITE DESCRIPTION AND SUBSURFACE CONDITIONS

At present, the proposed site is lightly wooded with relatively light undergrowth. A visual inspection indicated the site to be relatively flat with no indications of ponding water or drainage problems. The soils encountered in the two test borings were uniform in both composition and consistency. For the purpose of this engineering study, the subsurface soils were separated into two separate strata although the soils are quite similar in composition through the 30 feet depth with slight difference noted in relative density and soil color. The first stratum is a surface layer of generally very loose fine sand. Very little fine material (silt & clay) was noted in this stratum. Penetration resistances from the Standard Penetration Test ranged between 2 and 5 blows per foot. The stratum extended to an approximate depth of 8 feet in each boring. A second stratum, extending from approximately 8 feet to boring termination at 30 feet consisted of generally firm to very firm fine sands with a small amount of fines. Penetration resistances ranged between 10 and 24 blows per foot with a general increase in density with depth noted. For a more complete description of the soils encountered, as well as graphical presentation of the penetration test data, refer to the accompanying Test Boring Records.

At the time of our investigation, the ground water table was noted at a depth of 6.5 feet below existing grade in each test boring. The water table location will fluctuate with weather conditions and may occur at a higher elevation than that indicated during periods of extended or heavy rainfall.

Mr. Jerry Friedner
Re: Cogeneration Facility - Walterboro, SC

Page Two
October 16, 1980

STRUCTURAL INFORMATION

It is our understanding that the proposed cogeneration facility will be a light to moderately loaded structure containing reinforced concrete slabs and equipment pits and a steel framed super-structure. The facility will be constructed on several levels with the ash pit at the lowest elevation. Approximately 6 feet above the ash pit an equipment floor will be constructed. The highest floor level will be the tipping floor which will be approximately 7 feet above the equipment floor. No excessively large concentrated or uniform loading conditions are anticipated.

FOUNDATION RECOMMENDATIONS

Based upon the results of our two test borings and our understanding of the proposed structural scheme, the site will be suitable for the proposed development of the cogeneration facility. Due to the loose surface soil conditions, some remedial site work will be required prior to construction. The remedial site work will be in the form of removal and recompaction of the loose surface soils. The amount of material to be removed and recompacted will depend upon the elevation of the various floor levels. We also note that some variation may also occur depending upon the final location of the plant on the site.

Using the ground water table location as the governing criterion, we do not recommend that the lowest floor level (ash pit) be placed deeper than approximately 4 feet (to bottom of foundation) below existing grade. If ground water will not affect the operation of the ash pit, it could be placed at a lower elevation; however, construction at or below the water table would be required with appropriate dewatering of this particular portion of the building area. Should the ash pit be located at a shallow depth above the indicated ground water elevation, considerable fill will be required to elevate the remaining site to the indicated equipment and tipping floor level elevations.

Since removal and recompaction of the surface soils and additional filling within the building area will be required, the most economical foundation scheme will be to employ shallow spread footings placed at a minimum depth below finished floor elevation. A design bearing capacity in the range of 3000 pounds per square foot (psf) could be used.

It appears that approximately 3 to 5 feet of loose surface material will be removed depending upon the final building location. After removal of the surface soils, the excavated area should be thoroughly proof-rolled using a heavy vibratory compactor. The replacement soils and any additional fill can then be placed and compacted in thin lifts to final grade. Compaction of the fill soils to 98% of the soils' Standard Proctor maximum dry density should be required.

Mr. Jerry Friedner
Re: Cogeneration Facility - Walterboro, SC

61

Page Three
October 16, 1980

In summary, our preliminary investigation did not reveal any conditions which would preclude the proposed development. Some remedial site work will be required to densify the loose surface soils prior to constructing foundations or placing additional fill. Once a final building elevation has been established, we recommend that a number of additional shallow test borings be made to allow a more exact determination of the extent of the remedial site work.

If you have any questions concerning the enclosed information or if we can be of any further assistance in the location or preliminary design of the facility, please do not hesitate to contact us.

Very truly yours,

FOUNDATION & MATERIALS ENGINEERING, INC.

Zane W. Abernethy, P.E.
President

ZWA/ss

Enclosures

TEST BORING RECORD

BORING NO. 1

ELEVATION	DEPTH (FEET)	SOIL CLASSIFICATION	SAMPLE DEPTH	PENETRATION RESISTANCE (BLOWS PER FOOT)													
				N	1	2	3	4	5	6	7	8	10	20	30	50	70
*	8	Very Loose to Loose Tan and White Fine Sand (SP)	1.5	4													
			4	5													
			6.5	4													
		Firm to Very Firm Brown, Tan and Grey Slightly Silty Fine Sand (SP-SM)	9	12													
			14	14													
			19	13													
	30		24	17													
			29	27													
		BORING TERMINATED @ 30 FEET															
		* ELEVATION NOT AVAILABLE															

Ground Water Table
(Depth Below Ground Surface)
6.5 FEET

Job: COGENERATION FACILITY
WALTERBORO, SOUTH CAROLINA

Date Drilled: 10/03/80

TEST BORING RECORD

BORING NO. 2

ELEVATION	DEPTH (FEET)	SOIL CLASSIFICATION	SAMPLE DEPTH	PENETRATION RESISTANCE (BLOWS PER FOOT)																
				N	1	2	3	4	5	6	7	8	10	20	30	50	70			
*	8	Very Loose Tan and White Fine Sand (SP)	1.5	2																
			4	4																
			6.5	3																
		9	10																	
		14	20																	
		19	17																	
		24	16																	
30	BORING DETERMINATED @ 30 FEET * ELEVATION NOT AVAILABLE	29	24																	

Ground Water Table
(Depth Below Ground Surface)
6.5 FEET

Job: COGENERATION FACILITY
WALTERBORO, SOUTH CAROLINA

Date Drilled: 10/03/80

BESTEEL

DAYCO

Recold Road

Original Property Line

B-2

B-1

B-1

A.B.I.

Lot 12-A

Lot 6-A

Lot 5-A

BORE LOCATION PLAN

COGENERATION FACILITY - WALTERBORO, SOUTH CAROLINA

SCALE: 1" = 400'

APPROVED BY:

DRAWN BY SS

DATE: 10/16/80

REVISED

FOUNDATION & MATERIALS ENGINEERING, INC.
Columbia, South Carolina

CARLISLE ASSOCIATES

DRAWING NUMBER

C-017-555

PREPARED BY: [illegible]
 DATE: [illegible]
 SCALE: [illegible]

COLLETON COUNTY RESOURCE & DEVELOPMENT BOARD
 WALTERBORO, SOUTH CAROLINA

MASTER PLAN
 WALTERBORO INDUSTRIAL PARK

APPENDIX B

Regional Investment Strategy
Lowcountry Region

DO NOT MICROFILM
THIS PAGE

REGIONAL INVESTMENT STRATEGY:
Lowcountry Region

Economic Indicators

Prepared by the
LOWCOUNTRY COUNCIL OF GOVERNMENTS

Planner-in-Charge
Brenda T. Day,
Economic Development Planner

Stenographers
Glenda Beaton
Doreen Plyler

Graphics
Janet Bowling
Judy Blankenship

The preparation of this report was financed in part through a comprehensive planning grant from the Department of Housing and Urban Development.

SC-04-00-1019

Ranking of CCDs
Percent Minority Population, 1970

<u>Rank</u>	<u>County</u>	<u>CCD</u>	<u>% Minority</u>
1.	Hampton	Furman - Scotia	85.0%
2.	Beaufort	Sheldon	81.8
3.	Colleton	Green Pond	77.7
4.	Beaufort	St. Helena	74.8
5.	Hampton	Yemassee	65.1
6.	Jasper	Grays - Tillman	63.9
7.	Colleton	Hendersonville	59.6
8.	Jasper	Hardeeville	56.6
9.	Colleton	Cottageville	56.3
10.	Hampton	Estill	54.3
11.	Jasper	Ridgeland	53.0
12.	Colleton	Walterboro South	50.6
13.	Hampton	Brunson	45.6
14.	Colleton	Smoaks	45.2
<hr/>			
15.	Beaufort	Bluffton	40.7
16.	Colleton	Walterboro	38.1
17.	Colleton	Broxton	36.5
18.	Hampton	Varnville	36.1
19.	Colleton	Walterboro North	32.3
20.	Hampton	Hampton	27.7
21.	Beaufort	Beaufort	25.3
22.	Beaufort	Port Royal	17.6
REGIONAL AVERAGE			41.6%

SOURCE: Lowcountry Areawide Housing Element, July, 1976.

Ranking of CCD's
Percent Poverty Population, 1970

<u>Rank</u>	<u>County</u>	<u>CCD</u>	<u>%Poverty</u>
1.	Beaufort	Sheldon	71.9%
2.	Colleton	Green Pond	69.6
3.	Hampton	Furman - Scotia	56.6
4.	Hampton	Yemassee	54.6
5.	Colleton	Hendersonville	53.3
6.	Beaufort	St. Helena	49.4
7.	Jasper	Grays - Tillman	48.6
8.	Colleton	Cottageville	45.5
9.	Jasper	Ridgeland	42.9
10.	Hampton	Estill	41.9
11.	Colleton	Walterboro North	36.8
<hr/>			
12.	Colleton	Smoaks	30.1
13.	Colleton	Walterboro South	29.6
14.	Beaufort	Bluffton	28.3
15.	Hampton	Varnville	28.0
16.	Jasper	Hardeeville	26.7
17.	Colleton	Broxton	24.5
	Hampton	Hampton	24.5
18.	Colleton	Walterboro	24.4
19.	Hampton	Brunson	23.1
20.	Beaufort	Beaufort	20.1
21.	Beaufort	Port Royal	9.0
REGIONAL AVERAGE			34.5%

SOURCE: Lowcountry Areawide Housing Element, July, 1976.

Ranking of CCDs
Percent Unemployed, 1970

<u>Rank</u>	<u>County</u>		<u>% Unemployed</u>
1.	Colleton	Walterboro South	8.5%
2.	Beaufort	Port Royal	5.9
3.	Jasper	Hardeeville	5.7
4.	Beaufort	Beaufort	5.6
5.	Beaufort	Sheldon	5.2
	Hampton	Furman - Scotia	5.2
6.	Colleton	Hendersonville	4.7
	Colleton	Walterboro North	4.7
7.	Colleton	Cottageville	4.6
<hr/>			
8.	Colleton	Green Pond	4.1
9.	Jasper	Ridgeland	3.8
10.	Hampton	Hampton	3.7
11.	Colleton	Walterboro	3.6
	Colleton	Smoaks	3.6
	Jasper	Grays - Tillman	3.6
12.	Hampton	Estill	3.1
13.	Beaufort	St. Helena	2.7
14.	Colleton	Broxton	2.5
15.	Hampton	Yemassee	2.3
16.	Beaufort	Bluffton	1.8
17.	Hampton	Brunson	.9
18.	Hampton	Varnville	.0
REGIONAL AVERAGE			4.3%

SOURCE: 1970 Census of Population, Fourth and Fifth Count Tapes,
S.C. Division of Research and Statistics.

Ranking of CCDs
Percent Substandard Units, 1970

<u>Rank</u>	<u>County</u>	<u>CCD</u>	<u>% Substandard</u>
1.	Colleton	Green Pond	49.3%
2.	Hampton	Furman - Scotia	48.4
3.	Beaufort	Sheldon	44.8
4.	Colleton	Hendersonville	41.8
5.	Hampton	Estill	40.3
	Hampton	Yemassee	40.3
6.	Jasper	Grays - Tillman	39.6
7.	Colleton	Smoaks	38.1
8.	Colleton	Cottageville	35.6
9.	Jasper	Hardeeville	34.3
10.	Colleton	Walterboro South	33.5
11.	Jasper	Ridgeland	31.9
12.	Colleton	Broxton	31.4
13.	Beaufort	Bluffton	28.3
	Beaufort	St. Helena	28.3
14.	Hampton	Brunson	26.6
15.	Colleton	Walterboro North	25.8
<hr/>			
16.	Hampton	Varnville	22.0
17.	Hampton	Hampton	18.8
18.	Colleton	Walterboro	17.0
19.	Beaufort	Beaufort	8.6
20.	Beaufort	Port Royal	7.2
REGIONAL AVERAGE			23.2%

SOURCE: Lowcountry Areawide Housing Element, July, 1976.

UNITED STATES
DEPARTMENT OF ENERGY
WASHINGTON, D.C. 20585

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF ENERGY
DOE 350

FIRST CLASS MAIL

DO NOT MICROFILM
THIS PAGE