DEPARTMENT OF THE NAVY SELF-DUPLICATING NOTE

Use only for an informal, preferably hand-written note. Make duplicate only when required for follow-up or working file. See correspondence manual for formal, official memoranda.

TO: LT COL FITZGERALD, FACILITIES OFFICE

☐ ACTION	☐ COORDINATE	☐ PREPARE FOR SIGNATURE
☐ AS DISCUSSED	☐ CORRECTION	☐ REPORT BACK
☐ CALL/SEE ME	XX INFORMATION	☐ RETURN
☐ COMMENT/CLEAR	☐ PREPARE DRAFT	☐

Subj: Solid Waste and Wood Waste Burning and Cogeneration Options

1. Report is being sent to you for your review. On completion please return to Planning Branch.

E. G. JONES, Jr.

Keep this until the Volume II is returned in file

FROM: Planning Br., Public Works
MCB, CLNC

DATE 15 Nov 82

EXT. 1833

OPNAV 5216/142 (Rev. 5-74) S/N 0107-LF-778-7110

☆U.S. GPO: 1981—703-100/8607 2-1

DEPARTMENT OF THE NAVY ROUTING SLIP

TO: LT COL FITZGERALD [illegible]

Subj: [illegible] [illegible] Eagle [illegible] [illegible]

1. Report [illegible] being sent to you for your [illegible]

[illegible] consideration [illegible] [illegible]

[illegible]

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DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511

TELEPHONE NO.
444-9582
AUTOVON 690-9582

IN REPLY REFER TO:
111:JDT:ejc
11300

14 APR 1982

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Distribution

Subj: Solid and Wood Burning and Co-generation Study, Contract No. 80-B-3801 at Marine Corps Base, Camp Lejeune, and Marine Corps Air Station, Cherry Point

Encl: (1) J. E. Sirrine Company Final Report

1. Enclosure (1) is forwarded for your review and retention.

2. Upon your review and with your concurrence, the J. E. Sirrine Company will meet to discuss the report findings and recommendations. Timely resolve of the report is necessary to accomplish early project submission. The J. E. Sirrine Company is flexible in the time and place of the proposed meeting.

3. Coordination of the proposed meeting or any questions regarding enclosure (1) shall be directed to Mr. J. D. Torma, AUTOVON 690-9582 or FTS 954-9582.

A. J. Hansen

A. J. HANSEN, P.E.
By direction

Distribution:
CMC (Code LFF-2)
CG MCAS CHERRY PT (two copies of encl (1))
CG MCB CAMP LEJEUNE (two copies of encl (1))

Copy to:
COMNAVFACENGCOM (Code 111B)

THIS REPORT SUPERCEDED.
SEE LATER VERSION.

Tommy Give this back to planning.

Feasibility Study

SOLID WASTE AND WOOD WASTE BURNING AND COGENERATION OPTIONS

MARINE CORPS BASE, CAMP LEJEUNE
MARINE CORPS AIR STATION, CHERRY POINT, N.C.

Contract no. N62470-80-B-3801

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
Naval Facilities Engineering Command
lorfolk, Virginia

Phase II
FINAL REPORT

J. E. SIRRINE COMPANY
North Carolina Division
Sirrine Job No. R-1628

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Section I

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SECTION I

I. EXECUTIVE SUMMARY

The purpose of Phase II of the solid waste, wood burning and cogeneration study was to perform engineering cost estimates and economic evaluations of three systems for burning solid waste and one for burning wood. The two fuels were not considered in a unified system because of equipment compatibility problems. Since the primary purpose of the total project is to dispose of the solid waste, this fuel was given first priority and wood was studied as a "battery limits" system. Also, wood fuel has an associated harvesting cost, and solid waste is available at no incremental cost since the waste collection costs must be incurred whether it is burned or landfilled. Also, potential organizational policy and accounting problems exist if the Navy forests are the source of the wood fuel. Existing forest management practices do not lend themselves to economical wood fuel harvesting.

The three systems for burning solid waste are:

Case 1A - Steam would be generated at a nominal 150-200 PSIG saturated pressure and would tie into the existing steam distribution systems of Camp Geiger and the Air Station.

Case 2A - Steam would be generated at 600 PSIG and 725°F. The steam would drive a turbine generator with exhaust at 150 PSIG. The exhaust steam would be tied into the existing Camp Geiger and Air Station systems. The power generated would be tied into the electrical distribution system.

Case 3A - Steam would be generated at 600 PSIG and 725°F. All steam, except that required for feedwater heating, would be sent to a condenser. The electricity generated would be tied to the electrical distribution system.

The capital and operating costs were estimated for each refuse-burning system. The costs of each system was then compared to the cost of existing operations which could be eliminated if the refuse-burning plant was built. Existing operations include landfilling refuse and burning oil to generate steam (Cases 1B, 2B and 3B).

Costs were analyzed on a present value basis which considers the impact of the cash flows over the life of the project. Uniform annual costs were computed from the total project present values.

Table 1 summarizes the capital costs, present values and uniform annual costs of the three refuse plant cases. The table also breaks down the total and annual savings that could be realized in each case if the refuse plant described in that case is constructed. The largest savings over existing operations can be realized when steam only is generated from burning refuse. In this case, more oil-generated steam is replaced with refuse-generated steam than in the other cases. Revenues from the sale of electricity are not high enough to offset the price of the oil that would continue to be used.

A total project present value savings of $65,174,194 or uniform annual savings of $6,843,153 could be realized by constructing the system as described in Case 1A. Therefore, it is recommended that the Navy continue with design, and construct a refuse-burning plant located between Camp Geiger and the Air Station complexes, to produce steam only.

TABLE 1
COST SUMMARY
DESIGN ANALYSIS (FY87)

	Construction Costs (1982 $)	Total Project Cost Present Value	Total Refuse Plant Savings	Uniform Annual Cost	Annual Refuse Plant Savings
Case 1A - Refuse-fired plant producing steam only	15,229,000	37,376,628	65,174,194	3,924,467	6,843,153
Case 1B - Incremental cost of landfill for refuse and oil for steam	--	102,550,814	--	10,767,620	--
Case 2A - Refuse-fired plant producing steam and electricity with a backpressure turbine	18,891,000	36,420,129	54,159,165	3,824,037	5,686,599
Case 2B - Incremental cost of landfill for refuse and oil for steam	--	90,579,294	--	9,510,636	--
Case 3A - Refuse-fired plant producing electricity with a condensing turbine	17,936,200	19,742,745	--	2,072,947	--
Case 3B - Incremental cost of of a landfill	--	11,306,613	<8,436,132>	1,187,171	<885,776>

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SECTION II

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SECTION II

II. INTRODUCTION

The purpose of Phase II of the solid waste, wood burning and cogeneration study is to perform engineering cost estimates and economic evaluations for the preferred alternatives determined in Phase I. The options studied in Phase I appeared to be of little advantage to the Navy because the proposed plant(s) would replace a 75% coal and 25% oil fuel mix at Central Heating Plant 1700.

Also, the steam that could be generated with the new fuel(s) would not match the steam demand for the specified area. The other reasons are that the use of wood with refuse would cause equipment compatability problems in boiler design; and the procurement and management of the wood would require a major policy adjustment from present systems.

To make the study investigations more advantageous to the Navy, the following guidelines were outlined by NAVFAC for Phase II:

1. Solid waste would be the primary boiler fuel.
2. The fuel replaced would be 100% oil.
3. A steam demand compatible with the fuel availability was needed.
4. Options providing steam, extraction steam with by-product electrical power, and condensing electrical power were to be included.
5. A "battery limit" type plant for burning wood (30-40,000 lb/hr steam output) would be included as a guide for any further wood fuel investigations.

The first guideline, fuel supply, would be met by utilizing the combined solid wastes of Camp Lejeune and Cherry Point. The second and third guidelines would be met by a refuse energy plant located between Camp Geiger and the Air Station complexes. This plant would be tied into both steam systems.

To satisfy the fourth guideline, three cases were investigated:

Case 1A - In this case steam would be generated at a nominal 150-200 PSIG saturated pressure and would tie into the existing steam distribution systems.

Case 2A - In this case steam would be generated at 600 PSIG and 725°F and would feed a turbine generator. The steam would exhaust at 150 PSIG and be tied into the existing steam distribution systems. Electrical power generated would be tied into the electrical system.

Case 3A - In this case steam would be generated at 600 PSIG and 725°F and would feed a turbine generator. All steam, except that needed for feedwater heating and deaeration, would be condensed. Electrical power generated would be tied into the electrical system.

The fifth guideline is handled as a separate item of the study.

As according to the purpose, this report discusses the general plant concept, methods for determining project costs and the basis for economic analysis. It also provides a detailed description, cost estimate and life cycle cost analysis for each of the three cases. The cases are then compared to each other and recommendations are made as to the best alternative for the Navy.

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SECTION III

III. GENERAL PLANT DESCRIPTION

The plant concept emphasizes overall plant efficiency and availability. Two boilers and precipitators, along with a spare material feed crane, will provide the 80% availability used in the economic analysis.

The boiler sizes were based on the available tons of trash from Cherry Point and Camp Lejeune as determined from the SCS "Solid Waste Management Master Plan," 1977. In that report, available tons were projected to 1985 and 2000. These figures were extrapolated to 2011 for the purpose of this report. It was assumed that the percent composition of burnables and non-burnables would remain constant throughout the study period. See Table 2 for a yearly schedule of available trash.

The alternatives considered to convert refuse to energy were: modular incinerators with waste heat boilers, waterwall boilers using mass firing or suspension burning, and fluidized bed combustion or other new technology.

The modular incinerator concept was not pursued since a plant of this type has not been successful for the refuse volume of this installation (200 T/D), and it was felt the availability and thermal efficiency were not attractive. Fluidized bed combustion, pyrolysis, and other new technologies were not considered to be state of the art and the original scope document on this project specifically stated that systems which would require an advance in technology were not to be considered.

Waterwall boilers were considered since that type of system could be expanded upon for all three options to be investigated, simplifying the evaluation. Mass firing was chosen for overall availability, thermal

efficiency and cost for a facility of this size. Operating and maintenance costs for preparing the refuse for suspension firing would be excessive. Mass firing plants in this size range exist at Hampton, Virginia (200 T/D) and the Norfolk Naval Station (180 T/D).

The following is a general description of the Waterwall boiler system with mass firing.

Fuel Feed

The collection process for the refuse to be disposed of at the refuse energy facility will be selective. Large metal items (55-gallon drums, appliances, etc.), highly flammable or explosive items, and bulky items will have to be collected separately and disposed of at landfills.

The refuse collection trucks will enter an enclosed tipping area and dump the refuse into a storage pit. The pit is of sufficient size to store at least a 3-day supply of refuse.

An overhead crane with a grapple will feed the refuse into the boiler charging hoppers. Since this crane is the only means of fuel feed, a spare crane will be available for standby service.

Boilers

Two refuse-fired steam generators, each sized for burning 100 tons per day, are proposed. The available refuse from Cherry Point and Camp Lejeune in 1985 will be 130 tons per day.

The plant design capacity (200 T/D) will provide:

- extra margin during a boiler outage;
- capability of the boilers to operate near their most efficient design point during a 2-boiler operation;
- capability for accommodating an increase of the refuse available through the projected life of the plant.

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- capability for accommodating an increase of the refuse available through the projected life of the plant.

After the refuse is fed into the hopper it will be sent to the stoker by means of an hydraulic ram feeder. The stoker will be a reciprocating grate type which will provide mixing and break-up of the refuse. A forced draft fan will supply overfire air. The combustion air

will be drawn from the tipping room area to reduce odor and provide a negative draft in that area.

Supplementary fuels will not normally be used; however, a provision for firing No. 2 fuel oil is included. This will be used for flame stabilization at low load and for start-up only. No. 2 oil is used to minimize storage and handling difficulties.

Feedwater System

There will be two boiler feed pumps, one turbine driven and one motor driven. The Boiler code requires a turbine driven boiler feed pump on all solid fuel boilers. During normal operation the pump will be driven by the motor since this will be more efficient.

A tray type deaerator will provide feedwater heating. A 20-minute storage tank will be incorporated with the deaerator.

Case 1A, the low pressure boilers, will use a zeolite softening system for boiler feedwater treatment. Cases 2A and 3A will use the softeners plus silica removal equipment. Feedwater chemical treatment for control of alkalinity and oxygen scavenging will be provided.

Emission Control

Federal standards of performance for municipal refuse fired boilers address particulate matter only. The limit is 0.08 grains/SDCF corrected to 12% CO_2. This limit far exceeds the capabilities of mechanical dust collector and low energy scrubbers. While high energy scrubbers and bag filterhouses may be applicable to mass fired boilers in the future, the most preferred system in use today is the dry type electrostatic precipitator. Compliance will be achieved through use of an electrostatic

precipitator on each boiler. An I.D. fan will be installed after each precipitator and discharge will be through a common stack.

Ash Handling

The bottom ash will be handled with water-filled submerged scraper conveyors. The bottom ash will contain all non-combustible materials which pass through the boiler. Since the possibility of fouling or pluggage is great, a flop gate valve will be located at the bottom of the ash discharge chute. Two troughs will be provided on each boiler. Fly ash will be handled dry and will be deposited at the upper end of the ash discharge chute. A sloped conveyor (to achieve some dewatering) will carry the ash to a dumpster station outside the building.

The following Tables 3 and 4 and Graphs 1, 2, and 3 portray the present steam usage figures for the Camp Geiger/Air Station complexes. As portrayed by Graph 3, Combined Location Usages, the best match for the refuse energy plant would be a location where both sites could be supplied. Such a location was found on the Air Station property to the north of the housing area and to the east of the Camp Geiger steam plant. The site is portrayed in Drawing MG1. It is approximately 2150 feet to the Geiger steam plant and 6500 feet to the Air Station steam plant.

Drawings MG2 and MG3 show the conceptual arrangement of the proposed facility.

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TABLE 2
AVAILABLE
TONS OF TRASH

Year		CAMP LEJEUNE Total	CAMP LEJEUNE Burnable (73%)	CHERRY POINT Total	CHERRY POINT Burnable (75%)	TOTAL BURNABLE Tons/yr.	TOTAL BURNABLE Tons/dy.
1985	1	44520	32500	20037	15028	47528	130
	2	44877	32760	20377	15282	48043	132
	3	45234	33021	20717	15538	48559	133
	4	45591	33281	21057	15793	49074	134
	5	45948	33542	21397	16048	49590	136
1990	6	46305	33803	21737	16303	50106	137
	7	46662	34063	22077	16558	50621	139
	8	47019	34324	22417	16813	51137	140
	9	47376	34584	22757	17068	51652	142
	10	47733	34845	23097	17323	52168	143
1995	11	48090	35106	23437	17578	52684	144
	12	48447	35366	23777	17833	53199	146
	13	48804	35627	24117	18088	53715	147
	14	49161	35888	24457	18343	54231	149
	15	49518	36148	24797	18598	54746	150
2000	16	49875	36409	25137	18853	55262	151
	17	50232	36669	25477	19108	55777	153
	18	50589	36930	25817	19363	56293	154
	19	50946	37190	26157	19618	56808	156
	20	51303	37451	26497	19873	57324	157
2005	21	51660	37712	26837	20128	57840	158
	22	52017	37972	27177	20383	58355	160
	23	52374	38233	27517	20638	58871	161
	24	52731	38494	27857	20893	59387	163
	25	53088	38754	28197	21148	59902	164
	26	53445	39015	28537	21403	60418	166
2011	27	53802	39275	28877	21658	60933	167

Source: Extrapolated from SCS Report

CAMP GEIGER
STEAM DATA

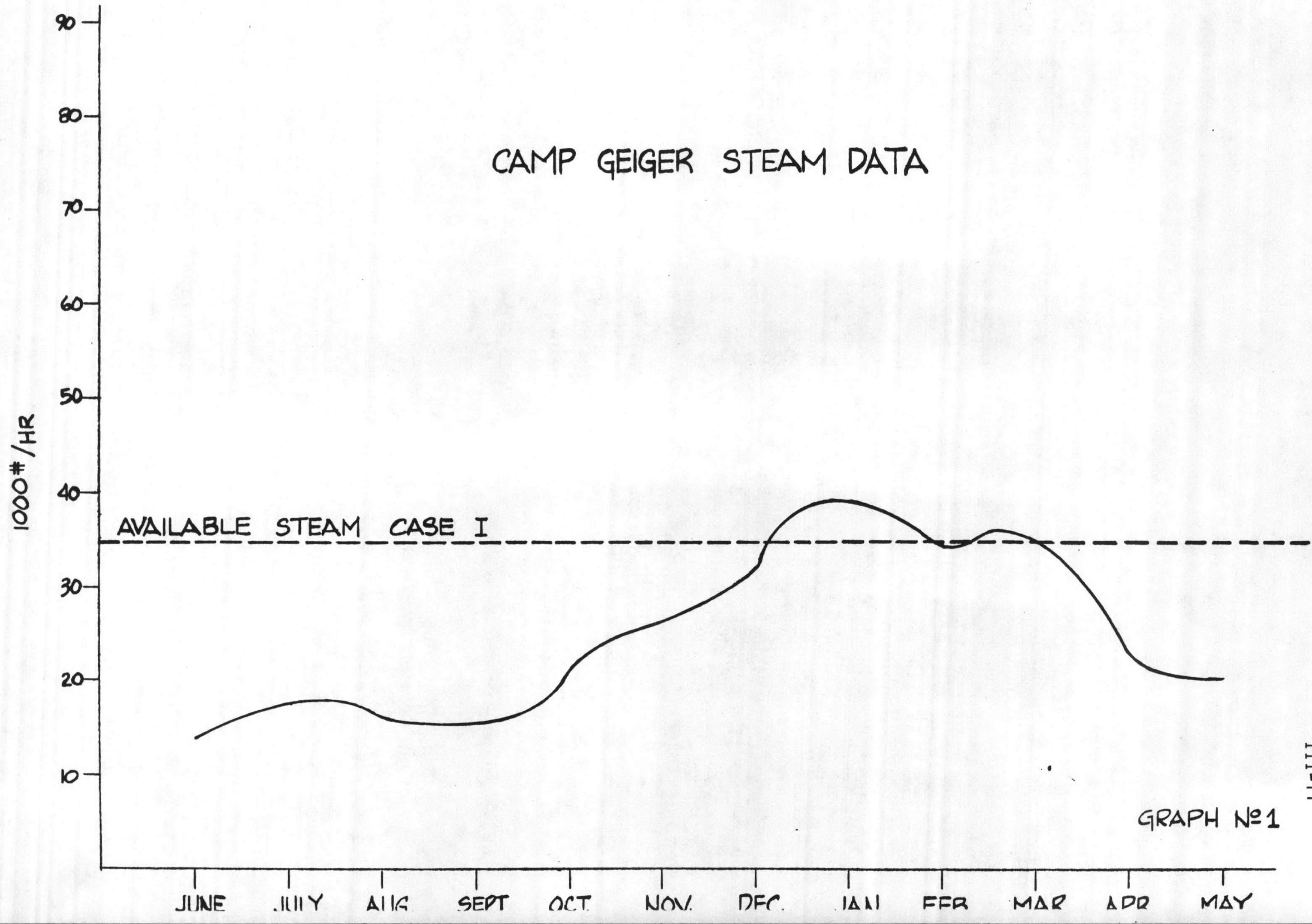
TABLE 3

	Avg. Load	Highest Load	Avg. % Make-Up
Jan. '81	38,400	52,250	43.2
Feb. '81	33,400	51,300	41.6
March '81	33,600	43,800	43.2
April '81	21,400	35,500	75.1
May '81	19,300	34,000	85.5
June '81	14,000	26,500	62.8
July '80	17,000	23,500	60.2
August '80	16,100	24,000	43.7
Sept. '80	15,000	19,500	44.5
Oct. '80	20,800	27,500	50.1
Nov. '80	26,400	39,900	41.7
Dec. '80	31,700	44,700	41.0
Annual Average	23,950		52.7%

NEW RIVER
STEAM DATA

TABLE 4

	Avg. Steam Load	Highest Load	Avg. % Make-Up
Jan. '81	35,500	48,600	27.1
Feb. '81	31,800	54,000	32.5
March '81	28,000	40,500	39.8
April '81	14,600	25,200	62.3
May '81	12,200	19,350	55.6
June '80	11,100	17,000	61.0
July '80	12,600	15,750	55.9
August '80	12,400	12,550	51.7
Sept. '80	12,400	46,800	54.8
Oct. '80	14,500	32,400	52.8
Nov. '80	25,000	40,200	29.5
Dec. '80	30,100	43,200	27.2
Annual Average	20,000		45.9%


CAMP GEIGER STEAM DATA
1000#/HR
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20
10
AVAILABLE STEAM CASE I
JUNE
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DEC.
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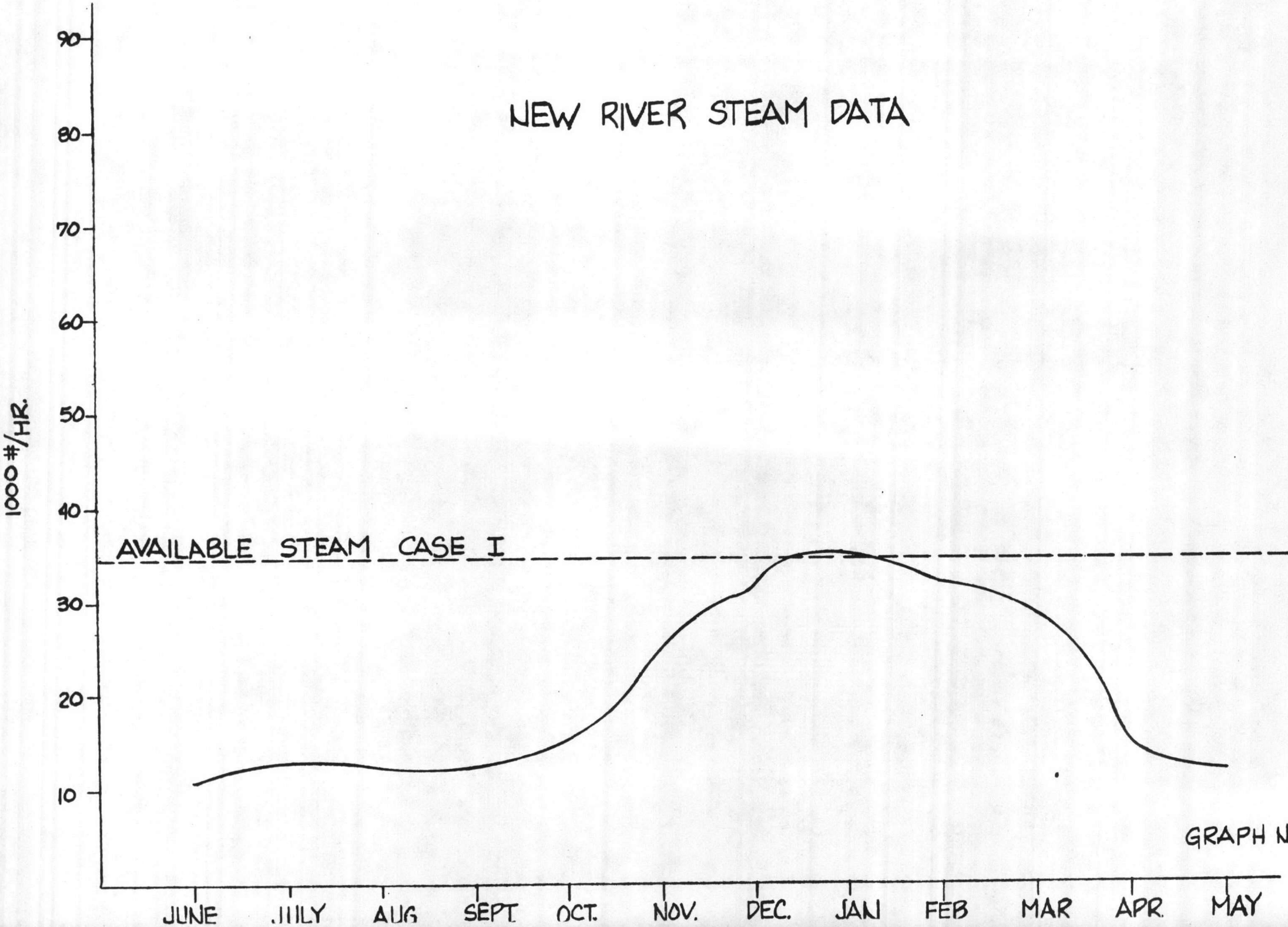
APR
MAY
GRAPH №1


NEW RIVER STEAM DATA
1000 #/HR.
90
80
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AVAILABLE STEAM CASE I
JUNE
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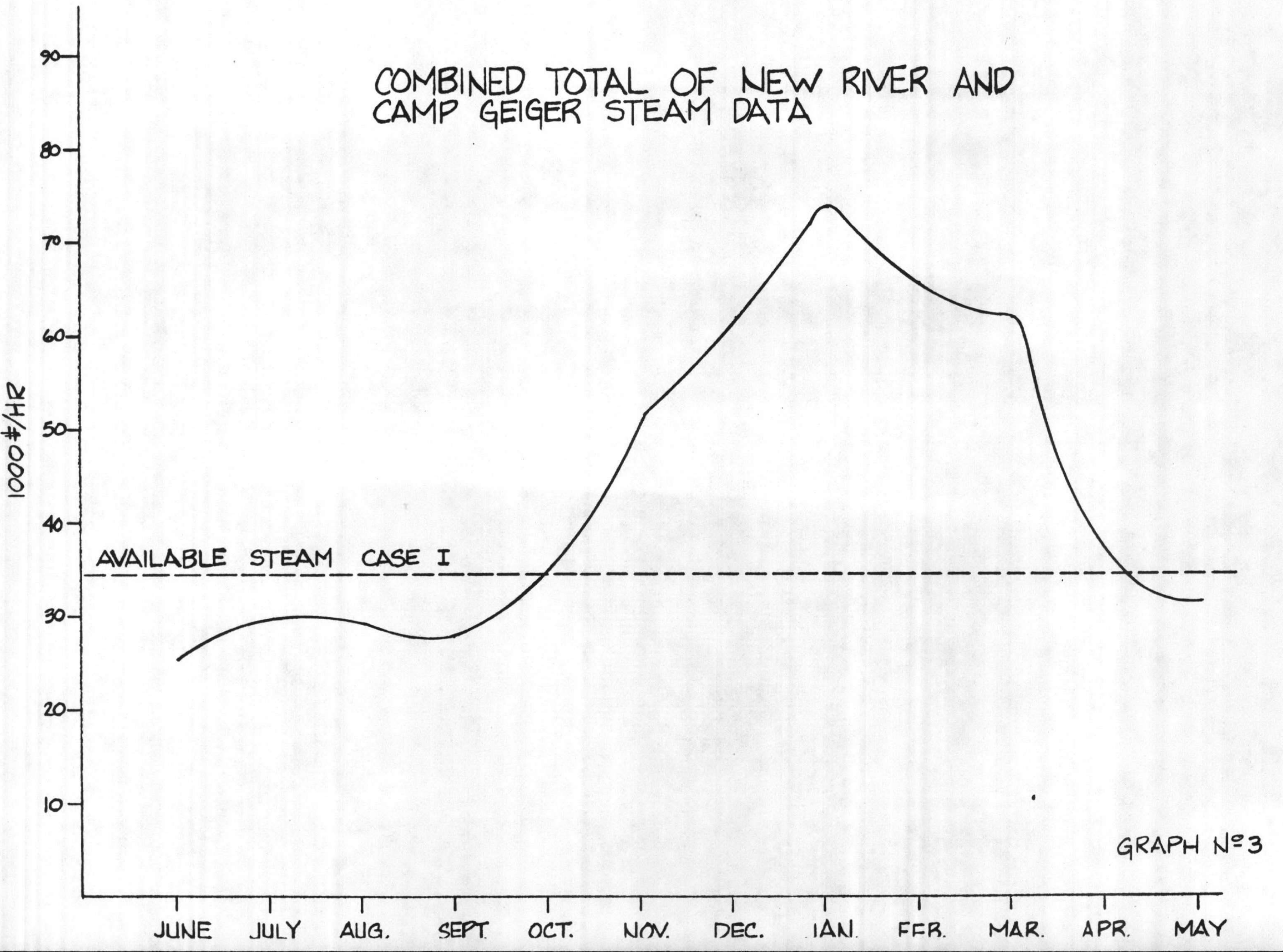
JAN
FEB
MAR
APR.
MAY

GRAPH Nº2


COMBINED TOTAL OF NEW RIVER AND
CAMP GEIGER STEAM DATA
1000#/HR
90
80
70
60
50
40
30
20
10
AVAILABLE STEAM CASE I
JUNE
JULY
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OCT.
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DEC.
JAN.
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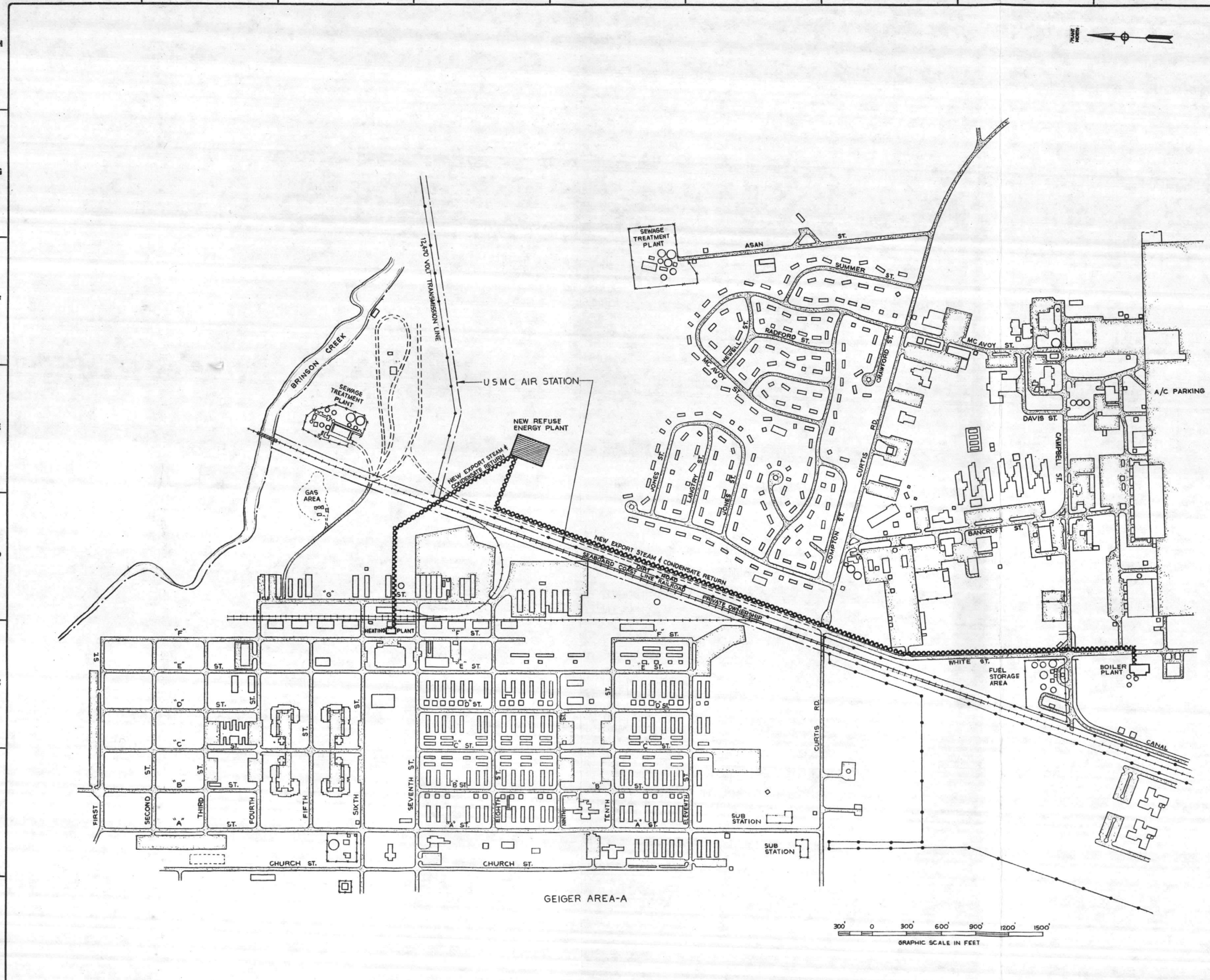
MAY
GRAPH Nº 3



NOTES

REV. NO.	CODE / REV. BY	CIRCLES	DATE	DESCRIPTION
0	W.A.K.		3/15/82	ISSUED FOR REPORT

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ISSUE CODE					
A	PRELIMINARY	D	MAT'L PURC.	F	CONST'N
B	DESIGN	E	BIDS		
C	MAT'L T.O.				

SEAL

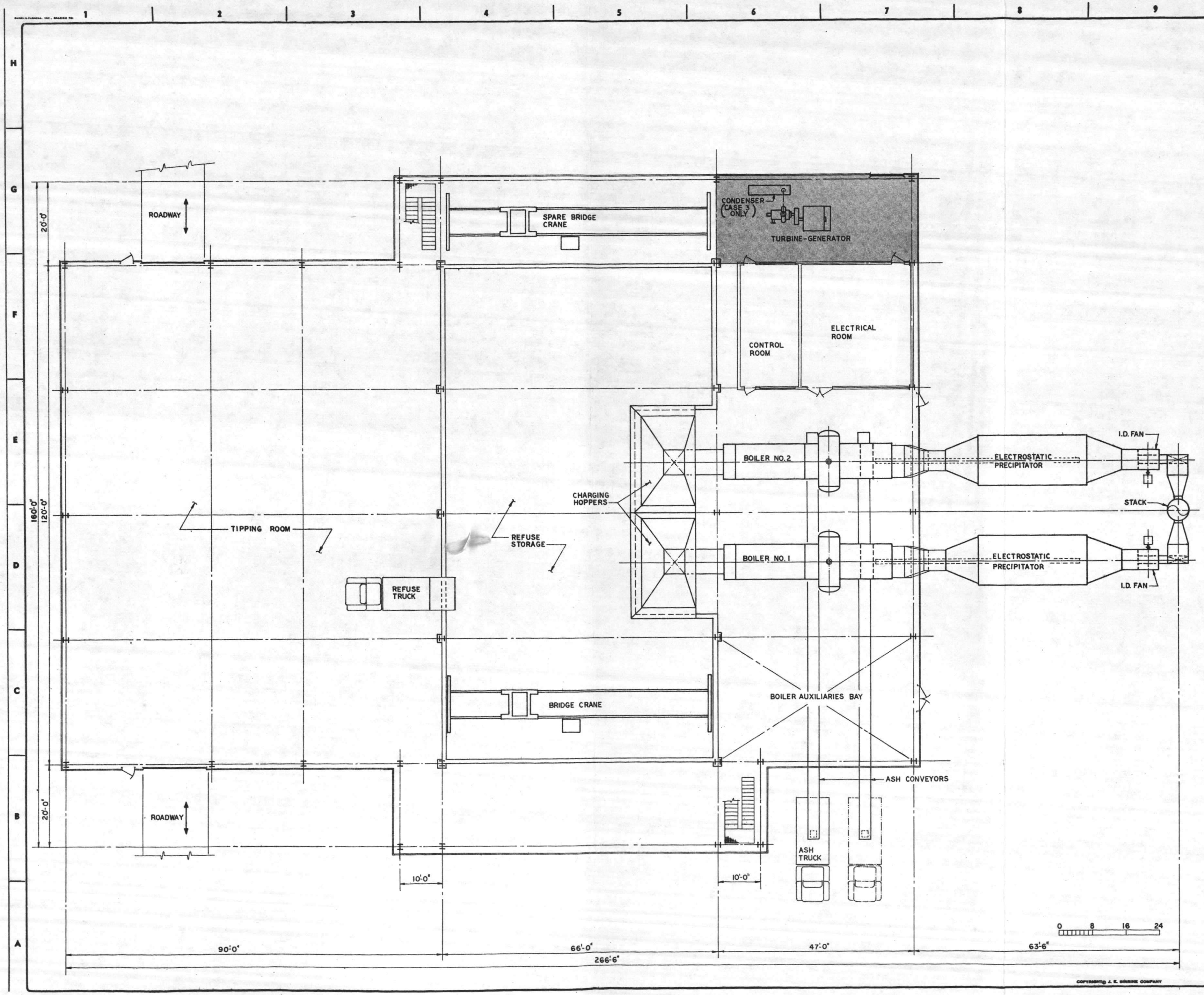
J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN. W. KOOS	SCALE AS NOTED
DR. D. CARROLL	DATE
CK. W. KOOS	SIRRINE FILE NUMBER
APPV. H. STIKES	

DRAWING TITLE
SITE PLAN
SOLID WASTE FUEL COGENERATION STUDY
NAVFAC
CAMP LEJEUNE, N. C.

CLIENT DRAWING NUMBER

SIRRINE DRAWING NUMBER
R-1628-MGI



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SHADED AREA FOR CASES 2 & 3

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ISSUE CODE		
A PRELIMINARY	C MAT'L T.O.	F CONST'N
B DESIGN	D MAT'L PURC.	
	E BIDS	

SEAL

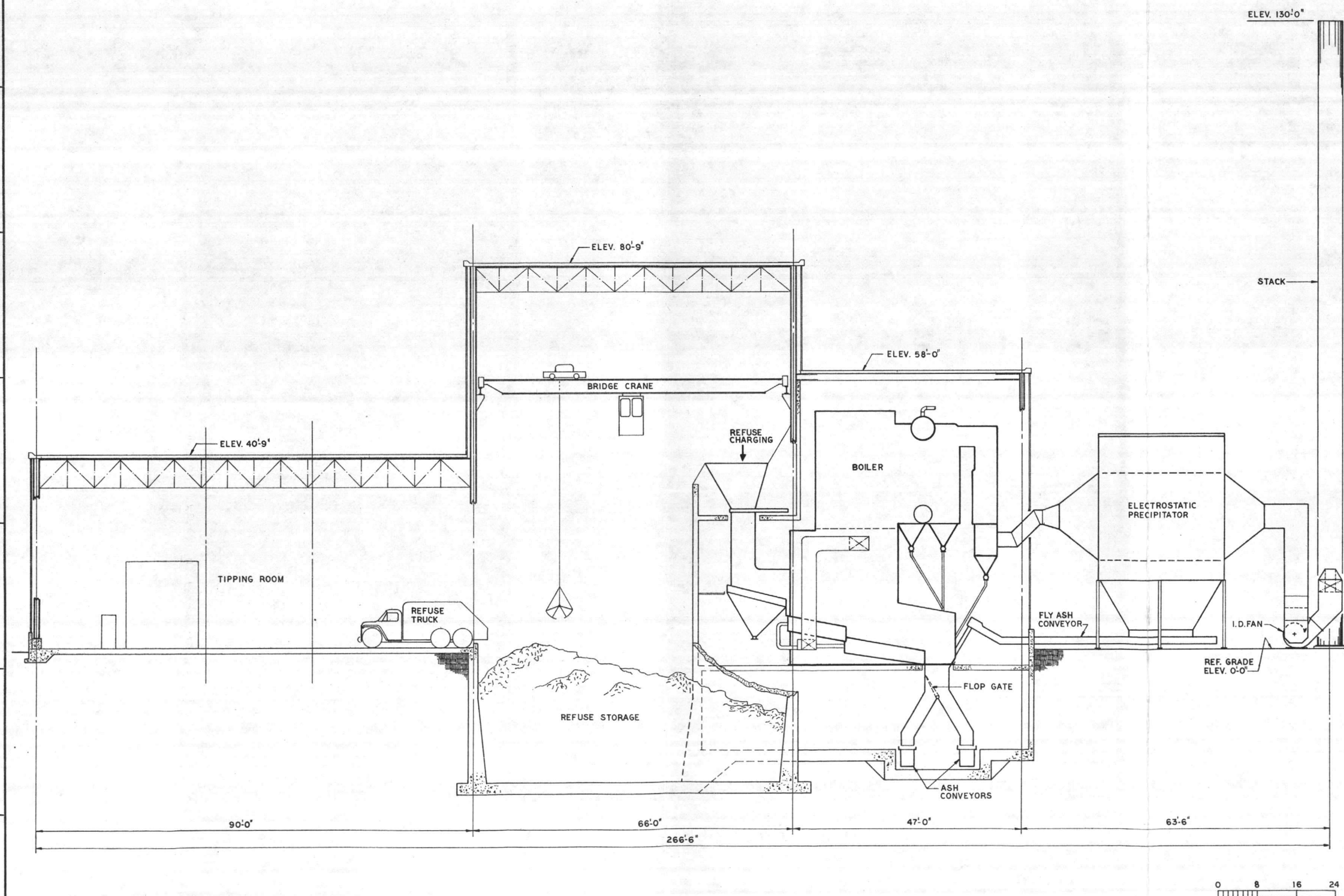
J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN.	T. STABLES	SCALE	GRAPHIC
DR.	T. STABLES	DATE	
CK.	W. KOOS	SIRRINE FILE NUMBER	40-3
APPV.	H. STIKES		

DRAWING TITLE
GENERAL ARRANGEMENT PLAN
SOLID WASTE FUEL–COGENERATION STUDY
NAVFAC
CAMP LEJEUNE, N.C.

CLIENT DRAWING NUMBER

SIRRINE DRAWING NUMBER
R1628-MG2



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ISSUE CODE			
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	E BIDS	

SEAL

J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN. T.STABLES	SCALE GRAPHIC
DR. T.STABLES	DATE
CK. W.KOOS	SIRRINE FILE NUMBER 40-3
APPV. H.STIKES	

DRAWING TITLE
GENERAL ARRANGEMENT SECTION
SOLID WASTE FUEL — COGENERATION STUDY
NAVFAC
CAMP LEJEUNE, N.C.

CLIENT DRAWING NUMBER

SIRRINE DRAWING NUMBER
CR1628-MG3

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SECTION IV

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IV. COST ESTIMATING AND ANALYSIS METHODS

Life Cycle Cost Analysis

The purpose of the Life Cycle Cost and Design Analysis is to provide a method of determining which, if any, of several project alternatives is the most cost effective to the Navy over the life of the project. For these analyses, the first step was to compare the cost of the refuse plant and its design options to existing operations so the Navy can decide whether the project itself is cost-effective. The second step was to compare which of the three project design options entails the least cost (highest savings) to the Navy.

At present, the Navy is disposing of solid waste in landfills at Cherry Point and Camp Lejeune, and steam is provided to the Air Station and Camp Geiger by existing oil-fired boilers. The proposed refuse plant project would use the burnable solid waste from Cherry Point and Camp Lejeune to generate steam and/or electricity in a new refuse-fired boiler, displacing a portion of the steam from the existing oil boilers at Camp Geiger and the Air Station. The Life Cycle Cost and Design Analysis, then, compares, over a 25-year period, the costs of a new refuse plant with the costs of operating two landfills for the portion of solid waste that could be burned and the cost of oil that could be displaced by steam from the refuse plant.

All costs and benefits of each alternative were estimated in today's dollars (unless previously published information was used). These costs (benefits) were then escalated to year 1 of the analysis. Year 1 of the analysis is 1987. A discount factor was then applied, with applicable differential factors, to compute the

present value of each cost/benefit over the 25-year analysis period. A 25-year analysis was used to coincide with the life of the project equipment. The present values of each of the costs/benefits were then summed to provide a total project present value. The total project present value was then divided by the 25-year discount value to determine the Uniform Annual Cost. The alternative with the smallest present value uniform annual cost is the most advantageous plan of action for the Navy.

One note about the Design Analysis Computations of present value - due to the detail of the calculations, rounding was necessary for report presentation. Therefore, the products and/or sums of the numbers may not match the totals precisely.

Capital Costs

The construction cost estimates for the refuse plant were prepared in advance of detailed plans and specifications. The estimating method was to apply budget prices to an itemized list of the equipment that should be required for a complete installation. Prices for major pieces of equipment are based on quotations from reliable manufacturers. Major pieces of equipment and manufacturer's submitting prices were:

1. Boilers - E. Keeler Company, and Riley Stoker Corp.
2. Precipitator - Precipitair Pollution Control
3. Ash Handling Equipment - Beaumont Birch Company
4. Cranes - Krano, Inc.
5. Stack - Warren Environment Co.

6. Water Treatment - Illinois Water Treatment Company

7. Turbine Generators - Trane, and Terry Turbine

Pricing of minor pieces of equipment was based on recent prices received for similar equipment on other projects.

Building and structural estimates were prepared based on preliminary arrangement drawings. Piping costs were prepared based on preliminary flow diagrams and arrangement drawings. Electrical and installation costs were derived from past projects of similar design and size.

Operating Costs

Operating costs for the refuse plant were developed for the specific requirements of each case based on the following items.

Labor -In each case a crane operator, boiler operator and boiler mechanic are required 24 hours per day. A supervisor is required two shifts each day. Salaries and classifications were obtained from Camp Lejeune, Base Maintenance Department.

Maintenance - The installed cost of major equipment items was multiplied by a use factor to obtain the annual maintenance cost. The use factor is based on Sirrine experience in the industry.

Plant Overhaul - Standard industry practice is to inspect and overhaul turbine generators every 5 years.

Ash Disposal - This cost includes $.51 per ton of ash, which covers the operation and maintenance cost of a truck and dumpsters to haul ash from the plant site to the Camp Lejeune landfill, a distance of approximately 15 miles. The cost also includes $8.84/hr. (source: Camp Lejeune Base Maintenance) for a part-time

employee to do the hauling. The assumptions to determine the amount of ash to be disposed of are:

- 20% ash per ton of trash
- 80 lbs/cf
- 30% moisture
- disposal 5 days per week

Based on this data, it will take 9 trips per week until 1994 and 10 trips per week thereafter to dispose of the ash.

Incremental Electrical Costs -This cost includes the price of electricity to run equipment in the new refuse plant. Horsepower was converted to kilowatts. Both the demand and per kwh costs were included. The cost was taken from the actual rates charged Camp Lejeune by Carolina Power and Light Co.

Trash Transfer Cost -A price of $10 per ton (1977 dollars) was used to determine the cost of hauling trash from Cherry Point to Camp Lejeune. This price was taken directly from the SCS "Solid Waste Management Master Plan."

Generated Electricity Sold to CP&L -In the cases where electricity is generated, the refuse plant would be tied to the utility system and the generated electricity would be sold back to CP&L under their cogeneration avoided cost rate Schedule CSP-2A, variable annual rate. (See Appendix). The revenues collected from CP&L for this electricity should be higher by the time the refuse plant is built. This rate schedule is presently being revised and a new one is due to be approved by the NC Utilities Commission to go into effect in June, 1982. The prices now paid to small power producers are expected to increase from 20-30%.

Cost of Existing Operations

Landfills - Information from the SCS "Solid Waste Management Master Plan," 1977, was used as much as possible in determining the effects of burning trash on the landfills at Camp Lejeune and Cherry Point. The SCS report contains assumptions, recommendations, costs and schedules of development for the landfills. The principal logic used in the development of landfill costs for this design analysis is that volume reduction from burning trash has an associated cost reduction at the two landfills, taking into consideration that ash from the refuse plant would be disposed of at the Camp Lejeune landfill. Certain other factors were assumed in developing the landfill costs:

- The life of the current landfill at Cherry Point is approximately 10 years (1982-1992).
- The composition of waste at Cherry Point and Camp Lejeune remains constant over the 25-year analysis period.
- Inert waste has a density of 2000 pounds per cubic yard.
- Trash has a density of 800 pounds per cubic yard.
- Ash from burnable trash has a density of 80 pounds per cubic foot at 30% moisture.
- Inert and oversized waste will remain at Cherry Point and all burnable trash will be hauled to the refuse-burning plant throughout the life of the project.
- All costs in the SCS report are based on an average volume over the period of analysis.
- Estimated remaining life of the landfill at Cherry Point (1987-1992) would be sufficient to dispose of inerts and oversized waste for 1987-2011.

- Estimated volume reduction at Cherry Point and Camp Lejeune has a direct relationship to landfilling costs and maintenance costs at each base.

Cherry Point -Based on the SCS breakdown of the waste consistency, it was projected that approximately 15% of the waste would be inert or oversized, 75% would be burnable, and 10% would be recycled or removed by waste reduction. The percentage breakdowns were based on a tonnage weights. A corresponding volume for each projected tonnage was calculated and used to determine a volume reduction of approximately 90% at the Cherry Point landfill, based on removing the burnable trash.

Costs were estimated to be directly related to the volume reduction on items such as landfill preparation and maintenance of disposal equipment. Based on a recent projection, provided by McDowell and Jones, all of the wastes at Cherry Point could be disposed at the current landfill for the next 10 years (1982-1992). If burnable trash was removed from Cherry Point beginning in 1987, it was estimated the remaining volume would be sufficient to dispose of the inert and oversized waste for the life of the project. The SCS schedules of landfill development and associated costs were utilized to estimate costs for this analysis, beginning with the preparation of Forest Service land in 1992. It was assumed that the Forest Service site would have to be utilized beginning in 1992 if the refuse plant project is not undertaken. All landfill development and maintenance costs were increased over the life of the project to reflect the constantly increasing volume that would have to be disposed.

Camp Lejeune -Waste volumes and constituencies were estimated for Camp Lejeune using the same methodology that was applied at Cherry Point. Based on tonnage, it was estimated that approximately 72% of the waste would be burnable, 24% would be inert or oversized, and 3% would be recycled or removed by waste reduction. It was estimated that a total volume of approximately 2.6 million cubic yards would be required to dispose of waste at Camp Lejeune if the trash is not burned. If trash was burned from Cherry Point and Camp Lejeune, the estimated volume reduction would be approximately 95%. This volume reduction considered the disposal of ash in the Camp Lejeune landfill, and that some burnable trash (see Table 5) would be disposed in the landfill during plant outages of more than three days. The plant has a 3-day storage capacity for refuse. The estimated costs associated with the volume reduction at Camp Lejeune were calculated on the same basis as the costs at Cherry Point. All costs were increased over the life of the project to reflect a continual increase in volume that would have to be disposed.

Incremental Cost of Fuel Oil -The amount of fuel oil that does not have to be burned because of steam generated by the refuse plant depends on the availability of the refuse plant. This availability, in turn, determines the number of tons of trash that can be burned. A total system availability of 80% has been assumed. The outage times used are 15% scheduled and 5% unscheduled. This works out to 7000 hours of total plant on line availability with 1320 hours of scheduled down time and 440 hours of unscheduled outage time.

The scheduled outage time would be in the summer months, May - September. The required scheduled maintenance was assumed to be 10 days per month per unit. This would give the facility a single unit capability of 100 T/D during this period. Since the storage pit was sized for only three days of storage, some landfilling of refuse would be required during a long unit outage. It was assumed that the unscheduled outages will be less than 3 days, so the pit would absorb the excess refuse. The combined unit capability of 200 T/D would give the ability to deplete the excess. There would be a use for the excess steam during these times.

To arrive at the total displaced fuel oil potential for the facility the following was assumed:

- The Camp Geiger and Air Station steam loads will increase at the same rate as the refuse.
- The 1320 hours of scheduled outage time would be spread over five months, since both units will not be out simultaneoulsy.
- The unscheduled outage time would be handled with pit storage and burning up to the design capacity of both units to deplete the excess.
- The scheduled outage would give 10-day operation at a 100 T/D burn rate and 20 days at the normal collection rate (133 T/D 1987).
    - 10 days at 100 T/D = 25,800 lb/hr of steam
    - 20 days at 133 T/D = 34,500 lb/hr of steam
    - Weighted average = 31,600 lb/hr of steam

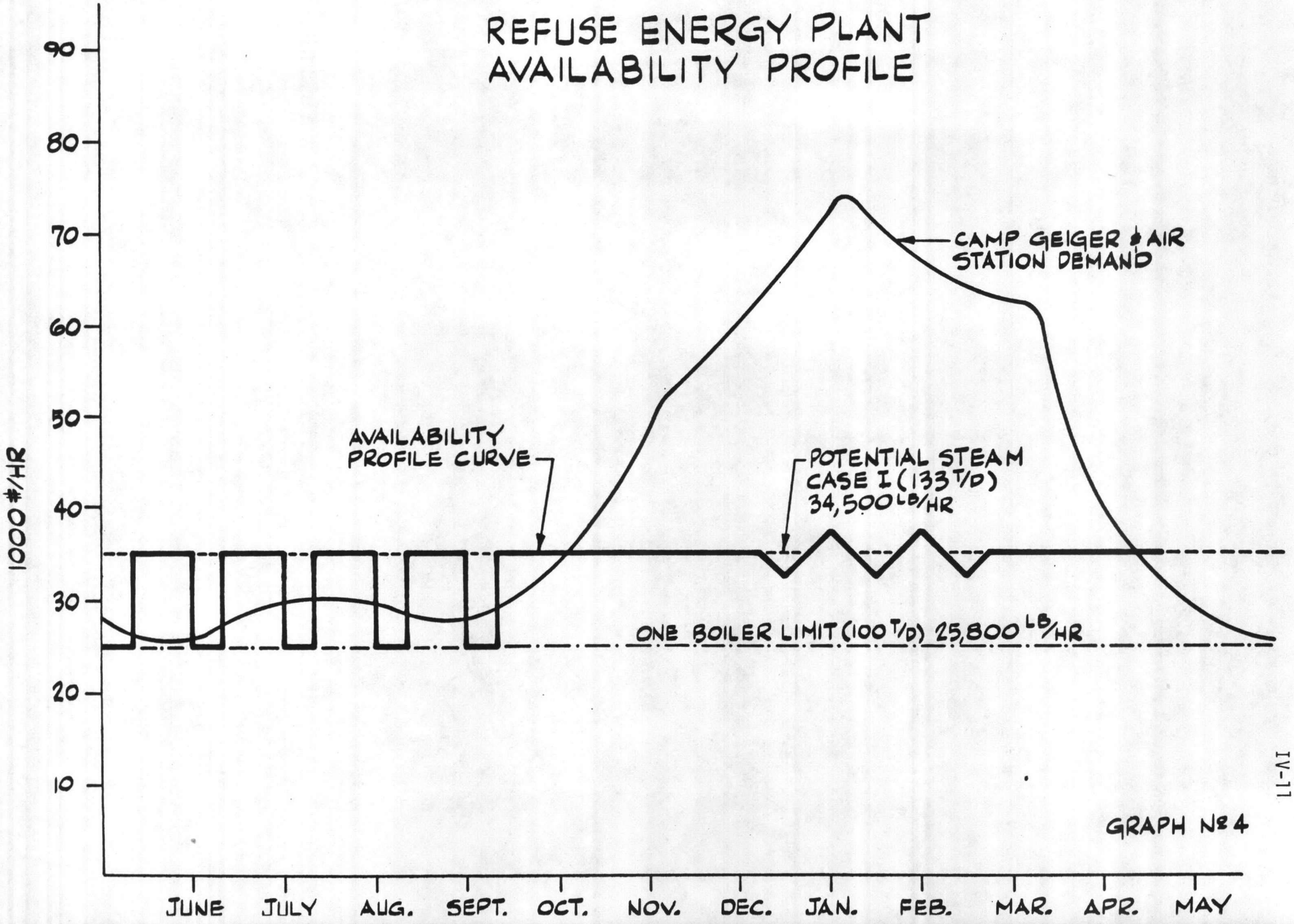
- 31,600 lb/hr equates to 122 T/D for five months with no venting of steam. The seven winter months were assumed to be at 133 T/D. (122 x 5) + (133 x 7)/12 = 128 T/D annual burn rate. This is 96% of potential. (See Table 5).
- The design analysis will use the maximum potential hours for equivalent oil plant operation, 8760. However, the availability penalty (4%) will be taken in the tons/day actually burned. Graph 4 depicts the expected steam production plotted with historial record of the combined Camp Geiger and Air Station plants.
- The cost of the displaced No. 6 Fuel Oil is $5.92 per MMBTU (1982 dollars).

TABLE 5
TONS BURNED PER DAY

	Maximum available tons	5 month summer average *	Annual average daily capacity **	Unburned tons to landfill
1987	133	122	128	5
	134	123	129	5
	136	124	131	5
1990	137	125	132	5
	139	126	134	5
	140	127	135	5
	142	128	136	6
	143	129	137	6
1995	144	130	138	6
	146	131	140	6
	147	132	141	6
	149	133	142	7
	150	133	143	7
2000	151	134	144	7
	153	135	145	8
	154	136	146	8
	156	137	148	8
	157	138	149	8
2005	158	139	150	8
	160	140	152	8
	161	141	153	8
	163	142	154	9
	164	143	155	9
	166	144	157	9
2011	167	145	158	9

* 10 days at 100 tons/day
20 days at maximum availability

** $\frac{(\text{summer av. x 5}) + (\text{max. x 7})}{12}$


REFUSE ENERGY PLANT
AVAILABILITY PROFILE
90
80
70
60
50
40
30
20
10
1000 #/HR
CAMP GEIGER & AIR STATION DEMAND
AVAILABILITY PROFILE CURVE
POTENTIAL STEAM CASE I (133 T/D) 34,500 LB/HR
ONE BOILER LIMIT (100 T/D) 25,800 LB/HR
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
GRAPH Nº 4

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SECTION V

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SECTION V

V. CASE I - REFUSE PLANT FOR STEAM

Plant Description

The plant configuration for this case would be as described in the general plant description. The boilers would operate at a nominal pressure of 200 PSIG saturated steam conditions. Each boiler would have an approximate maximum steam capacity of 25,800 lb/hr. This maximum output would be a function of the heat content of the refuse being fired. All numbers used for economic analysis in this report are based on 4500 Btu/lb. Ranges of higher heat values of refuse can be from 4000-6000 Btu/lb.

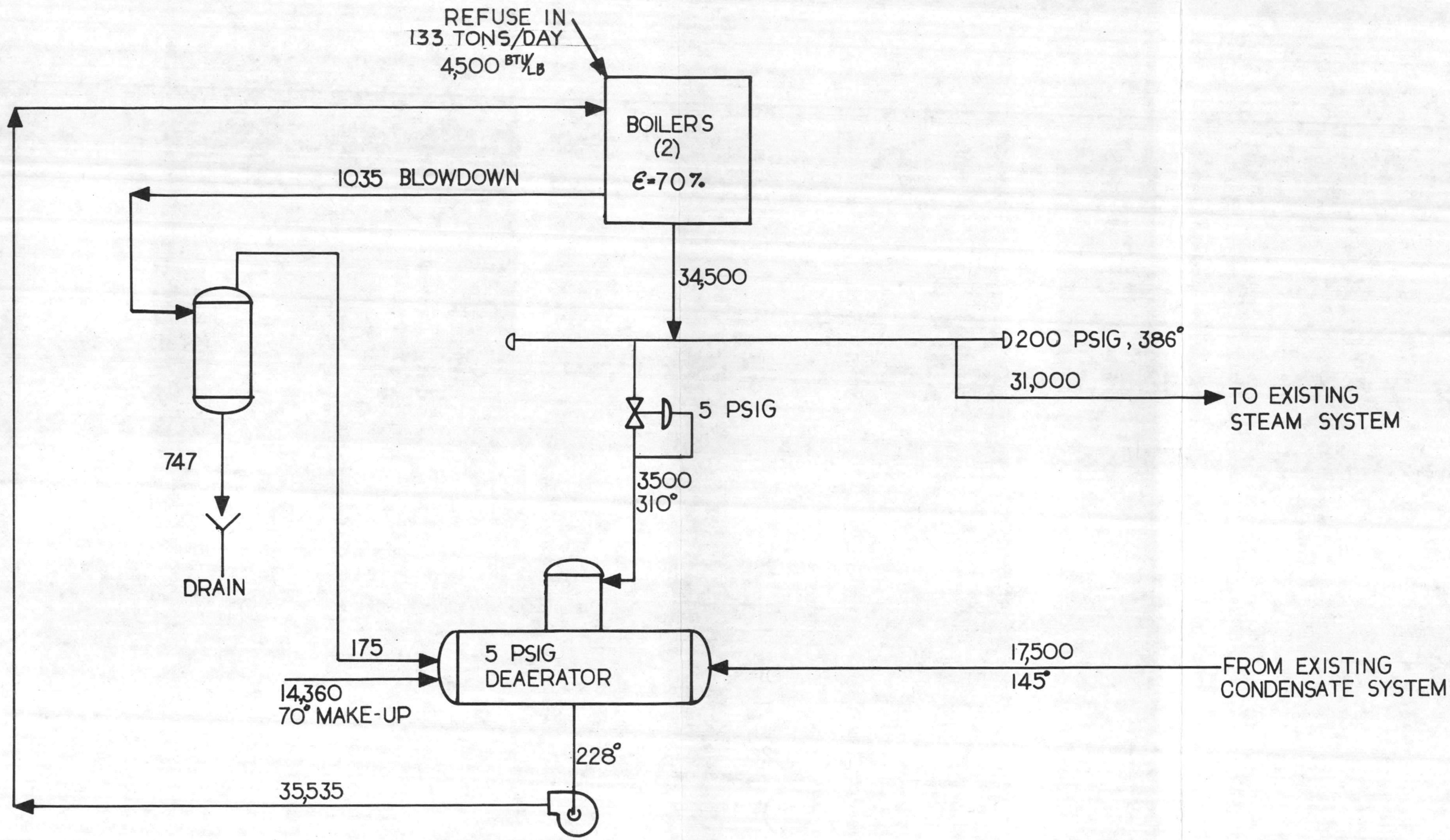
During initial operation of 133 tons per day of refuse delivered, 34,500 lb/hr of steam could be generated. This is based on a 70% boiler efficiency. The details of this cycle are shown on Drawings MX1 and MF1.

Steam lines would be run approximately 2100 feet to the Camp Geiger steam plant and 6500 feet to the Air Station steam plant. Pressure control valves would be used at each respective location to provide steam conditions compatible with the existing systems.

A suggested mode of operation would be to have the Camp Geiger steam needs satisfied at all times by the refuse energy complex and the excess sent to the Air Station. This is suggested since the Geiger plant is the older site and has the larger steam load.

The average steam usages are shown in Tables 3 and 4 and Graphs 1, 2, and 3. As can be seen from Graph 3, during September through April, the oil boilers would have to be on line at the Air Station. During the months of December and January, an oil boiler would be required at Camp Geiger.

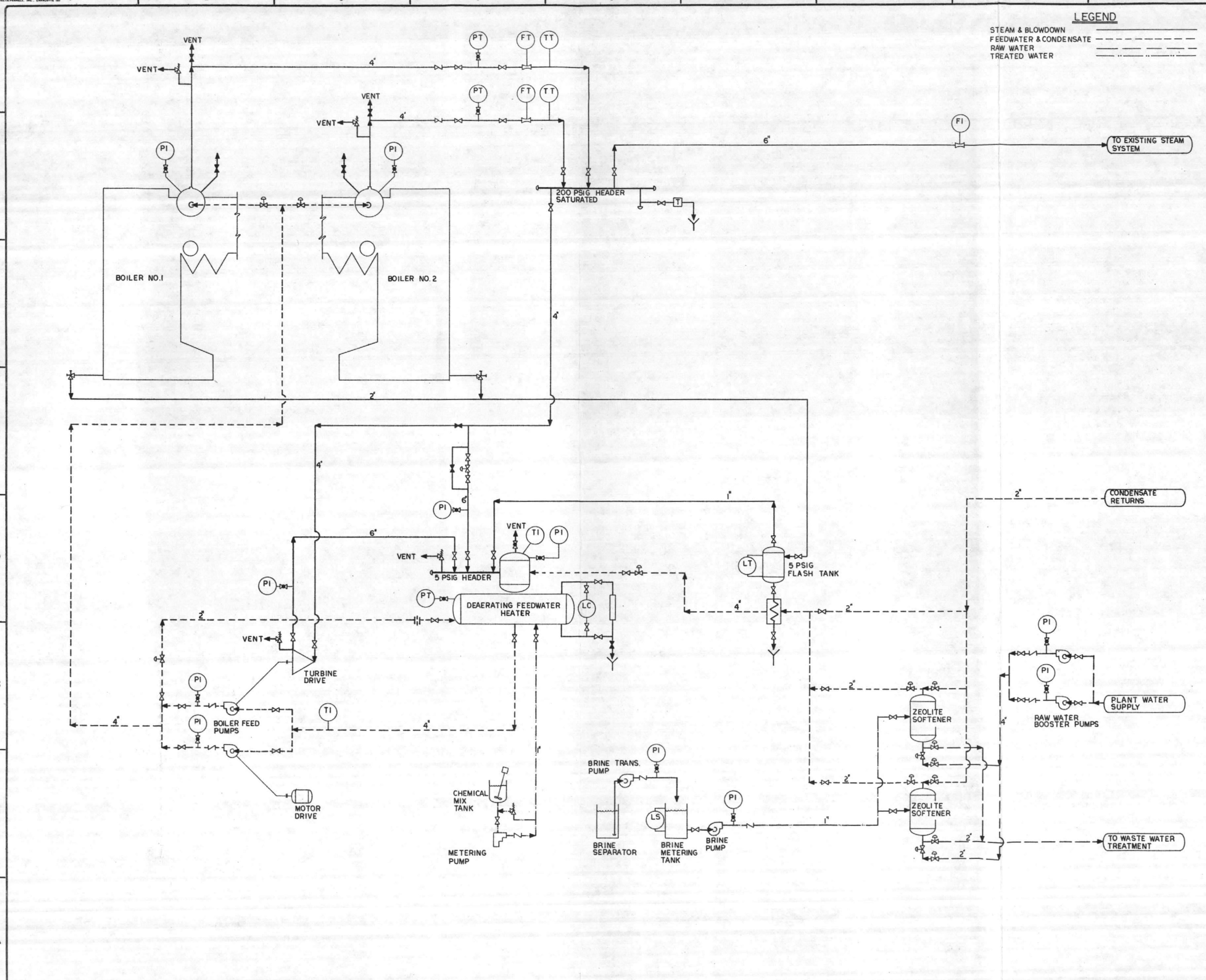
Condensate returns would be as they are at the present time. A new pump would be installed at each site and condensate lines would be run from the respective steam plants to a collecting tank in the refuse energy plant.



ALL FLOWS IN LB/HR

CASE 1

0	ISSUED FOR REPORT	3-15-82	HEAT BALANCE	DR. R. ROBINSON
			J. E. SIRRINE COMPANY — ARCHITECTS ENGINEERS PLANNERS	CH. W. KOOS
			RALEIGH, NORTH CAROLINA	SCALE NONE
				DATE
				FILE NO.
			R-1628-MX1	



NOTES
1. FOR FLOWS, REFER TO HEAT BALANCES.

REV. NO.	CODE	CIRCLES	REV. BY	DATE	DESCRIPTION
0			W.A.K.	8/3/87	ISSUED FOR REPORT

NOTE: CIRCLE ALL REVISIONS, IDENTIFY WITH DIAMOND, NUMBER AND ARROW. REMOVE ONLY CIRCLE AND ARROW BEFORE NEXT REVISION.

ISSUE CODE		
A PRELIMINARY	C MAT'L T.O.	F CONST'N
B DESIGN	D MAT'L PURC.	
	E BIDS	

SEAL

J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN. W. KOOS — SCALE NONE
DR. R. ROBINSON — DATE
CK. W. KOOS — SIRRINE FILE NUMBER 40-3
APPV. H. STIKES

DRAWING TITLE
PIPING & INST. DIAGRAM CASE 1
SOLID WASTE FUEL - COGENERATION STUDY
NAVFAC
CAMP LEJEUNE, N.C.

CLIENT DRAWING NUMBER
-

SIRRINE DRAWING NUMBER
R-1628-MF1

Cost Estimate

DEPARTMENT DIRECT COST SUMMARY

CASE I - STEAM ONLY

Equipment	$ 6,321,000	
Equipment Erection	124,100	
Equipment Foundations and Other Costs	243,900	
Buidings & Structures	3,400,000	
Electrical Installation Cost	338,000	
Instrumentation Installation Cost	200,000	
Piping Cost	2,116,000	
Area Cost	380,000	
SUBTOTAL CONSTRUCTION COST		$ 13,123,000
SIOH @ 5.5% (Supervision, inspection & overhead)		722,000
Contingency @ 10%		1,384,000
TOTAL CONSTRUCTION COST		$ 15,229,000

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE I

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
1. Boiler, 100 T/D Maximum Input 250 PSIG Design Pressure Unit No. 1		1,625,500	w/Equipment	w/Bldg. Cost
2. F.D. Fan		Incl.	w/Equipment	4,000
Coupling		Incl.	w/Equipment	
Controls		Incl.	w/Equipment	
Motor	50	Incl.	w/Equipment	
Intake Silencer		Incl.	w/Equipment	
3. Combustion Controls		Incl.	w/Equipment	
4. Boiler Breeching		Incl.	w/Equipment	w/Bldg.
5. Economizer		Incl.	w/Equipment	w/Bldg.
6. Stoker	10	Incl.	w/Equipment	w/Boiler
7. I.D. Fan		Incl.	w/Equipment	7,000
Coupling		Incl.	w/Equipment	
Fluid Drive		Incl.	w/Equipment	
Motor	75	Incl.	w/Equipment	
8. Precipitator No. 1		600,000	w/Equip. Cost	20,000
9. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
10. Expansion Joints		12,000	2,000	N/A
11. Isolation Damper	5	28,000	2,000	Incl.
12. Boiler, 100 T/D Maximum Input 250 PSIG Design Pressure Unit No. 2		1,625,500	w/Equip. Cost	w/Bldg.
13. F.D. Fan		Incl.	Incl.	4,000
Coupling		Incl.	Incl.	Incl.
Controls		Incl.	Incl.	Incl.
Motor	50	Incl.	Incl.	Incl.
Intake Silencer		Incl.	Incl.	Incl.

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE I

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
14. Combustion Controls		Incl.	Incl.	
15. Boiler Breeching		Incl.	Incl.	w/Bldg.
16. Economizer		Incl.	Incl.	w/Bldg.
17. Stoker	10	Incl.	Incl.	w/Boiler
18. I.D. Fan		Incl.	Incl.	7,000
Coupling		Incl.	Incl.	
Fluid Drive		Incl.	Incl.	
Motor	75	Incl.	Incl.	
19. Precipitator No. 2		600,000	Incl.	20,000
20. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
21. Expansion Joints		12,000	2,000	N/A
22. Isolation Damper	5	28,000	2,000	N/A
23. Ash Handling System	80 (Total)	575,000	Incl.	w/Bldg.
24. Overhead Crane - 5 Ton		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
25. Spare Crane		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
26. Deaerator		30,000	2,000	1,300
27. Blow-Off Tank		5,000	1,000	100

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE I

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
28. Continuous Blowdown System		16,500	2,500	500
Flash Tank		Incl.	Incl.	
Heat Exchanger		Incl.	Incl.	
Valves		Incl.	Incl.	
29. Condensate Tank		15,000	1,000	100
30. Condensate Transfer				
Pump		3,000	500	200
Motor	10	Incl.	500	200
31. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
32. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
33. Air Dryer		3,000	200	100
34. Stack - Dual Wall 150' x 9'-0" Dia.		155,000	Incl.	45,000
35. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.	Incl.	Incl.
36. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.		
37. Feedwater Treatment Equipment	30 Total	35,000	2,000	1,000
38. Boiler Feed Pump		5,000	500	500
Motor	50	Incl.	Incl.	Incl.
39. Boiler Feed Pump		5,000	500	500
Turbine		8,000	Incl.	Incl.
40. Chemical Feed Equipment	2 @ 5	5,000	800	300

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE I

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
41. Camp Geiger Condensate Transfer				
Pump		7,000	500	100
Motor	30	Incl.	200	Incl.
42. Air Station Condensate Transfer				
Pump		7,000	500	100
Motor	50	Incl.	200	Incl.
43. Condensate Collection Tank		15,000	500	200
Pump		3,000	200	100
Motor	10	Incl.	Incl.	Incl.
44. No. 2 Oil Storage Tank 10,000 Gallon		25,000	500	500
45. HVAC Equipment	20	15,000	Incl.	500
TOTAL, Equipment		$6,321,000	$124,100	$243,900

ITEMIZED CONSTRUCTION COST ESTIMATE

CASE I

46. Buildings and Structures	
Structural Steel	$ 800,000
Excavation and Backfill	445,000
Refuse Pit and Basement	690,000
Mat	313,000
Piling	66,000
Roof Deck and Roofing	179,000
Walls and Siding	242,500
Intermediate Floors	68,500
Stairs, Doors and Drains	110,000
Miscellaneous Steel and Grating	115,000
Support Steel and Miscellaneous	371,000
TOTAL, Building and Structures	$ 3,400,000
47. Electrical	
Building Lighting	$ 63,000
Electrical Equipment & Wiring	275,000
TOTAL, Electrical	$ 338,000
48. Instrumentation	$ 200,000
49. Piping	
Boiler Plant	$ 740,000
Export Steam & Condensate Return Lines	1,376,000
TOTAL, Piping	$ 2,116,000
50. Area	
Area	$ 130,000
Road Paving	250,000
TOTAL, Area	$ 380,000

CASE 1

DESIGN ANALYSIS COMPUTATIONS

JANUARY 1982

(Present Value = 1987 Dollars)

ALTERNATIVE A - Refuse-Burning Plant

1. Investment Cost

a. Refuse-Burning Plant Capital Costs (from equipment list)

Construction	$ 13,123,000
SIOH @ 5.5%	722,000
Contingency @ 10%	1,384,000
Total Unescalated Construction	$ 15,229,000

Total Construction escalated to April 1985

$\$\ 15,229,000 \times \frac{2384}{1922} = \$\ 18,890,000$

10% Discount (2% differential)	1.1198	
Present Value Construction Cost		$ 21,153,022

Engineering @ 6% = $ 914,000

Engineering escalated to April 1984

$\$\ 914,000 \times \frac{2253}{1922} = \$\ 1,071,000$

10% Discount (2% differential)	1.2071	
Present Value Engineering		$ 1,293,478

Total Present Value Construction & Engineering $ 22,446,500

b. Capital Costs for Ash Disposal

Investment for truck ($70,000) and 5 disposal containers ($26,000)
$96,000 in years 1, 9, 17

Escalated to Oct. 1987
$\$96,000 \times \frac{2684}{1922} = \$134,060$

10% Discount (2% differential) year 1	.963	
Present Value		$129,100
10% Discount (2% differential) year 9	.526	
Present Value		$ 70,516
10% Discount (2% differential) year 17	.288	
Present Value		$ 38,609
Total Present Value Ash Disposal Investment		$238,225

2. Recurring Costs

a. Annual Boiler Plant Labor Costs

4 Crane Operators (WG-8) @ $9.98/hr. (incl. benefits)
4 Boiler Operators (WG-7) @ $9.43/hr. (incl. benefits)
4 Boiler Mechanics (WG-10) @ $11.09/hr. (incl. benefits)
3 Supervisors (WS-7) @ $12.78/hr. (incl. benefits)

Unescalated Labor Cost

(4 x 9.98 x 2080) + (4 x 9.43 x 2080) + (4 x 11.09 x 2080) + (3 x 12.78 x 2080) = $333,508

Labor escalated to Oct. 1987

	Fy 82		Fy 83		Fy 84		Fy 85		Fy 86		Fy 87	
$333,508 x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	= $462,476

10% Discount (0% differential) 9.524

Present Value Labor Cost $4,404,621

b. Annual Boiler Maintenance Cost

ITEM	INSTALLED COST ($ X 10^3)	MAINT. FACTOR	COST ($ X 10^3)
Boilers & Fans	3,250	0.025	81.25
Precipitators	1,200	0.015	18.00
Ducts & Stack	245	0.010	2.45
Ash Handling	575	0.025	14.38
Pumps	33	0.015	0.50
Water Treatment	37	0.020	.74
Building	3,400	0.005	17.00
Internal Piping	740	0.005	3.70
Export Piping	1,376	0.010	13.76
Cranes	850	0.020	17.00
Electrical Instrumentation	538	0.020	10.76
Total Unescalated Maintenance			179.54

Maintenance escalated to Oct. 1987

	Fy 82		Fy 83		Fy 84		Fy 85		Fy 86		Fy 87	
$179,540 x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	= $248,969

10% Discount (0% differential) 9.524

Present Value Maintenance Costs $2,371,178

c. Annual Incremental Electrical Costs

SERVICE	POWER (KW)	USE FACTOR	EFFECTIVE POWER
Pumping Power*	60	0.8	48
Crane Operation	30	1.0	30
Precipitators	400	0.8	320
Ash Handling	60	0.8	48
		TOTAL	446 KW

* NOTE: Feedwater pumping is not included since a reduction in existing feedwater pumping will be realized.

Annual Demand Cost Increase
446 KW x $73.598/KW = $32,825/yr.

Annual KWH Increase
446 KW X 7000 hrs/yr. = 3,122,000 KWh/yr.

Annual Dollar Increase per Kwh
3,122,000 KWH/hr. X $ .02726/KWh = $ 85,106/yr.

Total Annual Increase Electrical Cost
$32,825 + $85,106 = $117,931

Escalated to Oct. 1987

	FY82	FY83	FY84	FY85	FY86	FY87	
$117,931	X 1.13	X 1.13	X 1.13	X 1.13	X 1.13	X 1.13	= $245,527

10% Discount (7% differential) 18.049

Present Value Incremental Electrical Cost $4,431,517

d. Annual Trash Transfer Cost from Cherry Point to Lejeune

$10/ton (1977) escalated to Oct. 1987

$\$10 \times \frac{2684}{1355} = \$19.81$

	Yr. of Op.	Tons/yr.	$/yr.	10% Discount (0% differential)	Present Value
1987	1	15,538	$ 307,808	.954	$ 293,649
	2	15,793	312,859	.867	271,249
	3	16,048	317,911	.788	250,514
1990	4	16,303	322,962	.717	231,564
	5	16,558	328,014	.652	213,865
	6	16,813	333,066	.592	197,175
	7	17,068	338,117	.538	181,907
	8	17,323	343,169	.489	167,809
	9	17,578	348,220	.445	154,958
	10	17,833	353,272	.405	143,075
	11	18,088	358,323	.368	131,863
	12	18,343	363,375	.334	121,367
	13	18,598	368,426	.304	112,002
2000	14	18,853	373,478	.276	103,080
	15	19,108	378,529	.251	95,011
	16	19,363	383,581	.228	87,456
	17	19,618	388,632	.208	80,836
	18	19,873	393,684	.189	74,406
	19	20,128	398,763	.172	68,582
	20	20,383	403,787	.156	62,991
	21	20,638	408,839	.142	58,055
	22	20,893	413,890	.129	53,392
	23	21,148	418,942	.117	49,016
	24	21,403	423,993	.107	45,367
2011	25	21,658	429,045	.097	41,617

Total Present Value Transfer Cost $3,290,806

e. Annual Ash Disposal Cost

	Yr. of Op.	1982 $*	1987 $*	10% Discount (0% differential)	Present Value
1987	1	$ 13,702	$ 19,134	.954	$ 18,254
	2	13,756	19,210	.867	16,655
	3	13,862	19,358	.788	15,254
1990	4	13,916	19,433	.717	13,933
	5	14,022	19,581	.652	12,767
	6	14,075	19,655	.592	11,636
	7	14,128	19,729	.538	10,614
	8	14,950	20,877	.489	10,209
	9	15,003	20,951	.445	9,323
	10	15,110	21,101	.405	8,586
	11	15,163	21,175	.368	7,792
	12	15,216	21,249	.334	7,097
	13	15,269	21,323	.304	6,482
2000	14	15,323	21,398	.276	5,906
	15	15,376	21,472	.251	5,389
	16	15,429	21,546	.228	4,912
	17	15,535	21,694	.208	4,512
	18	15,588	21,768	.189	4,114
	19	15,642	21,843	.172	3,757
	20	15,748	21,991	.156	3,431
	21	15,802	22,067	.142	3,134
	22	15,855	22,141	.129	2,856
	23	15,908	22,215	.117	2,599
	24	16,014	22,363	.107	2,393
2011	25	16,067	22,437	.097	2,176

Total Present Value Ash Disposal Cost $ 193,781

* Escalation from 1982 to 1987 = $\frac{2684}{1922}$ = 1.3965

Ash - 80 lbs/cf, 30% moisture

Ash Disposal - 5 days per week

Summary Sheet Alternative A - Total Present Value

Investment Cost	
Boiler Plant	$ 22,446,500
Ash Disposal	238,225
Recurring Costs	
Labor	4,404,621
Maintenance	2,371,178
Incremental Electrical	4,431,517
Trash Transfer	3,290,806
Ash Disposal	193,781
Total Present Value Alternative A	$ 37,376,628
Discount Factor 9.524	
Uniform Annual Cost	$ 3,924,467

ALTERNATIVE B - Incremental Cost of Refuse Landfills at Cherry Point and Camp Lejeune

1. Investment Costs

a. Incremental Cost of Landfill - Cherry Point

Capital Cost
$298,704 (1977) in year 5

Escalated to Oct. 1987
$\$298,704 \times \frac{2684}{1355} = \$591,676$

10% Discount (2% differential) year 5	.712	
Present Value Capital Cost		$421,274

Capital Cost
$36,000 (1977) in years 8, 16, 23

Escalated to Oct. 1987
$\$36,000 \times \frac{2684}{1355} = \$71,309$

10% Discount (2% differential) year 8	.568	
Present Value Capital Cost		$ 40,504
10% Discount (2% differential) year 16	.310	
Present Value Capital Cost		$ 22,106
10% Discount (2% differential) year 23	.183	
Present Value Capital Cost		$ 13,050
Total Present Value Capital Costs - Cherry Point		$496,934

b. Existing Boiler Plant Replacement/Upgrading Cost

Camp Geiger Capital Cost
$2,000,000 (1982$) in 1989

Escalated to Oct. 1987
$\$2,000,000 \times \frac{2684}{1922} = \$2,792,924$

10% Discount (2% differential) year 2	.893
Present Value Capital Cost	$2,494,081

Air Station Capital Cost
$2,000,000 (1982) in 1996

Escalated to Oct. 1987
$\$2,000,000 \times \frac{2684}{1922} = \$2,792,924$

10% Discount (2% differential) year 10	.488
Present Value Capital Cost	$1,362,947
Total Present Value Replacement Costs	$3,857,028

2. Recurring Costs

a. Annual Incremental Landfill Development Cost - Cherry Point

Year	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	53,312	105,600	0.963	$ 101,693
	2	54,208	107,375	0.893	95,886
	3	55,104	109,150	0.828	90,376
1990	4	56,000	110,925	0.768	85,190
	5	56,896	112,700	0.712	80,242
	6	57,792	114,474	0.660	75,553
	7	60,438	119,716	0.612	73,266
	8	61,334	121,490	0.568	69,006
	9	62,230	123,265	0.526	64,837
	10	63,126	125,040	0.488	61,020
	11	64,022	126,815	0.453	57,447
	12	64,918	128,590	0.420	54,008
	13	65,814	130,364	0.389	50,712
2000	14	66,710	132,139	0.361	47,702
	15	67,606	133,914	0.335	44,861
	16	68,502	135,689	0.310	42,064
	17	69,398	137,464	0.288	39,590
	18	70,294	139,238	0.267	37,177
	19	71,190	141,013	0.247	34,830
	20	72,086	142,788	0.229	32,698
	21	72,982	144,563	0.213	30,744
	22	73,878	146,338	0.197	28,829
	23	74,774	148,112	0.183	27,105
	24	75,670	149,887	0.170	25,481
2011	25	76,566	151,662	0.157	23,811

Total Present Value Development Cost - Cherry Point $ 1,374,128

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

b. Annual Incremental Landfill Development Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	$ 215,809	$ 427,477	.963	$ 411,660
	2	217,609	431,042	.893	384,921
	3	219,157	434,109	.828	359,442
1990	4	220,956	437,672	.768	336,132
	5	222,505	440,741	.712	313,808
	6	224,304	444,304	.660	293,241
	7	223,732	443,171	.612	271,221
	8	225,532	446,736	.568	253,746
	9	227,331	450,300	.526	236,858
	10	228,879	453,366	.488	221,243
	11	230,679	456,932	.453	206,990
	12	230,107	455,799	.420	191,436
	13	231,906	459,362	.389	178,692
2000	14	233,706	462,928	.361	167,117
	15	233,134	461,795	.335	154,701
	16	234,933	465,358	.310	144,261
	17	236,481	468,424	.288	134,906
	18	238,281	471,990	.267	126,021
	19	240,080	475,553	.247	117,462
	20	241,629	478,622	.229	109,604
	21	243,428	482,185	.213	102,705
	22	242,856	481,052	.197	94,767
	23	244,655	484,616	.183	88,685
	24	246,204	487,684	.170	82,906
2011	25	248,003	491,247	.157	71,126

Total Present Value Development Costs - Camp Lejeune $ 5,053,651

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

c. Annual Incremental Landfill Maintenance Cost - Cherry Point

Year	Yr. of Op.	1977$*	1987$*	10% Discount (0% differential)	Present Value
1987	1	$ 9,520	$ 18,857	.954	$ 17,990
	2	9,680	19,174	.867	16,624
	3	9,840	19,491	.788	15,359
1990	4	10,000	19,808	.717	14,202
	5	10,160	20,125	.652	13,122
	6	10,230	20,442	.592	11.914
	7	10,480	20,759	.538	11,168
	8	10,640	21,076	.489	10,306
	9	10,800	21,393	.445	9,520
	10	10,960	21,710	.405	8,793
	11	11,120	22,027	.368	8,106
	12	11,280	22,343	.334	7,463
	13	11,440	22,660	.304	6,889
2000	14	11,600	22,977	.276	6,342
	15	11,760	23,294	.251	5,847
	16	11,920	23,611	.228	5,383
	17	12,080	23,928	.208	4,977
	18	12,240	24,245	.189	4,583
	19	12,400	24,562	.172	4,225
	20	12,560	24,879	.156	3,881
	21	12,720	25,196	.142	3,579
	22	12,880	25,513	.129	3,292
	23	13,040	25,830	.117	3,022
	24	13,200	26,147	.107	1,412
2011	25	13,360	26,463	.097	1,296

Total Present Value Maintenance Costs - Cherry Point $ 199,295

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

d. Annual Incremental Landfill Maintenance Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (0% differential)	Present Value
1987	1	$ 16,460	$ 32,604	.954	$ 31,104
	2	16,597	32,876	.867	28,503
	3	16,715	33,109	.788	26,090
1990	4	16,853	33,383	.717	23,936
	5	16,971	33,616	.652	21,918
	6	17,108	33,888	.592	20,062
	7	17,064	33,801	.538	18,185
	8	17,202	34,074	.489	16,662
	9	17,339	34,345	.445	15,284
	10	17,457	34,579	.405	14,004
	11	17,594	34,850	.368	12,825
	12	17,551	34,765	.334	11,612
	13	17,688	35,037	.304	10,651
2000	14	17,825	35,308	.276	9,745
	15	17,781	35,221	.251	8,840
	16	17,919	35,494	.228	8,093
	17	18,037	35,728	.208	7,431
	18	18,174	35,999	.189	6,804
	19	18,311	36,271	.172	6,239
	20	18,429	36,504	.156	5,695
	21	18,567	36,778	.142	5,222
	22	18,523	36,691	.129	4,733
	23	18,660	36,962	.117	4,325
	24	18,778	37,196	.107	3,980
2011	25	18,915	37,467	.097	3,634

Total Present Value Maintenance Costs - Camp Lejeune $ 325,577

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

e. Annual Incremental Cost of #6 Fuel Oil at Camp Geiger and New River Plants

av. tons/day trash burned	- 24 hours/day	= tons/hr trash
tons/hr trash	X 6227 lbs steam/ton trash	= lbs steam/hr
lbs steam/hr	X 1086 Btu/lb*	= MMBtu/hr
MMBtu/hr	X $12.99/MMBtu**	= $/hr
$/hr	X 8760 hrs/yr	= $/yr
$/yr	X discount factor	= present value

	Year	tons/day	tons/hr.	lbs steam/hr.	MMBtu/hr.	$/hr.	$/yr.	10% Discount (8% differential)	Present Value
1987	1	128	5.33	33,211	36.07	$ 468.51	$ 4,104,167	.991	$ 4,067,229
	2	129	5.38	33,470	36.35	472.17	4,136,189	.973	4,024,512
	3	131	5.46	33,989	36.91	479.49	4,200,316	.955	4,011,302
1990	4	132	5.50	34,248	37.19	483.15	4,232,380	.938	3,969,972
	5	134	5.58	34,767	37.76	490.47	4,296,507	.921	3,957,083
	6	135	5.62	35,027	38.04	494.13	4,328,570	.904	3,913,027
	7	136	5.67	35,286	38.32	497.79	4,360,633	.888	3,872,242
	8	137	5.71	35,546	38.60	501.45	4,392,697	.871	3,826,039
	9	138	5.75	35,805	38.88	505.11	4,424,761	.856	3,787,595
	10	140	5.83	36,324	39.45	512.43	4,488,888	.840	3,770,666
	11	141	5.88	36,584	39.73	516.09	4,520,951	.825	3,729,784
	12	142	5.92	36,843	40.01	519.75	4,553,014	.810	3,687,942
	13	143	5.96	37,102	40.29	523.41	4,585,078	.795	3,645,137
2000	14	144	6.00	37,362	40.58	527.07	4,617,142	.781	3,605,988
	15	145	6.04	37,621	40.86	530.73	4,649,205	.766	3,561,291
	16	146	6.08	37,881	41.14	534.39	4,681,268	.752	3,520,314
	17	148	6.17	38,400	41.71	341.71	4,745,395	.739	3,506,847
	18	149	6.21	38,659	41.98	545.37	4,777,459	.725	3,463,658
	19	150	6.25	38,919	42.26	549.03	4,809,522	.712	3,424,380
	20	152	6.33	39,438	42.83	556.35	4,873,649	.699	3,406,668
	21	153	6.38	39,697	43.11	560.01	4,905,713	.687	3,370,225
	22	154	6.42	39,956	43.39	563.67	4,937,776	.674	3,328,061
	23	155	6.46	40,216	43.67	567.33	4,969,840	.662	3,290,034
	24	157	6.54	40,735	44.24	574.65	5,033,967	.650	3,272,078
2011	25	158	6.58	40,994	44.52	578.31	5,066,030	.638	3,232,127
							Total Present Value Fuel Oil Cost		$ 91,244,201

* Includes Camp Geiger Plant Efficiency

** $5.92 (Jan. 82) escalated to Oct. 87

	Fy82		Fy83		Fy84		Fy85		Fy86		Fy87	
$5.92 X	1.14	X	1.14	X	1.14	X	1.14	X	1.14	X	1.14	= $12.99

Summary Sheet Alternative B - Total Present Value

Investment Costs		
Cherry Point Capital Costs		$ 496,934
Boiler Plant - Replacement Costs		3,857,028
Recurring Costs		
Cherry Point Development		1,374,128
Camp Lejeune Development		5,053,651
Cherry Point Maintenance		199,295
Camp Lejeune Maintenance		325,577
Fuel Oil		91,244,201
Total Present Value Alternative A		$102,550,814
Discount Factor	9.524	
Uniform Annual Cost		$ 10,767,620

ECONOMIC ANALYSIS OF SHORE FACILITY

DATE
March 1982

ACTIVITY *(Name and Location)*
Refuse Plant, Camp Lejeune, N. C.

PROJECT TITLE
Design Analysis (Fy 87)

P NO.

DESCRIPTION OF ALTERNATIVES

Case I
A. Refuse Plant - Steam Only
B. Landfill and Oil-fired Boilers

PROJECT COST PROJECTIONS BY ALTERNATIVES

ALTERNATIVE A Refuse Plant — ECONOMIC LIFE 25 YRS.

DESCRIPTION AND YEAR	COSTS ($) ONE TIME	RECURRING	DISCOUNT FACTOR	PRESENT VALUE ($)
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE A - $ 37,376,628 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $3,924,467

ALTERNATIVE B Landfill and Oil-fired Boiler — ECONOMIC LIFE 2 YRS.

DESCRIPTION AND YEAR	COSTS ($) ONE TIME	RECURRING	DISCOUNT FACTOR	PRESENT VALUE ($)
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE B - $ 102,550,814 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $10,767,620

REMARKS

Encl 7

(Attach separate sheet showing derivation of cost entries)

Analysis

	Total Present Value	Uniform Annual Cost
Case 1A - Refuse Plant	$ 37,376,628	$ 3,924,467
Case 1B - Landfill & Oil	102,550,814	10,767,620
Difference	65,174,194	6,843,153

According to the present value analysis of the project over the 25-year plant life, the refuse plant would cost $65,174,194 less than operating the existing landfills and oil plants at maximum capacity. This converts to a $6,843,153 annual savings. The oil represents approximately 89% of the cost of Case 1B. The effect of the landfill costs on this alternative is small. The uniform annual cost of the refuse plant is less than the first year cost of oil. Even though, the price of oil is generally dropping at present, the price would have to be cut to half its present level before the least cost alternative in this case would change.

TAB PLACEMENT HERE

DESCRIPTION:

SECTION VI

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SECTION VI

VI. CASE 2 - ELECTRICITY WITH BACK PRESSURE TURBINE

Plant Description

Boilers

The plant would be as in the general description except the steam would be generated at 600 PSIG, 725°F. These steam conditions are the highest desirable to limit chloride corrosion in the boiler tubes. The boilers would be the same as Case 1A except for the inclusion of a superheater.

Turbine

All of the steam generated by the boilers (30,200 lb/hr) would be expanded through a turbine. The exhaust pressure would be 150 PSIG. A small amount of steam would be reduced for use in a deaerating feedwater heater. The rest would be desuperheated and sent to the respective steam distribution systems.

The turbine would operate at high speed and would drive a generator through a reduction gear. During initial operation approximately 725 KW would be produced.

The turbine-generator and electrical switchgear would be in a room adjacent to the boilers.

Electrical

The generator would be sized to match the turbine and would generate 1175 KVA power at the system voltage of 12.47 KV.

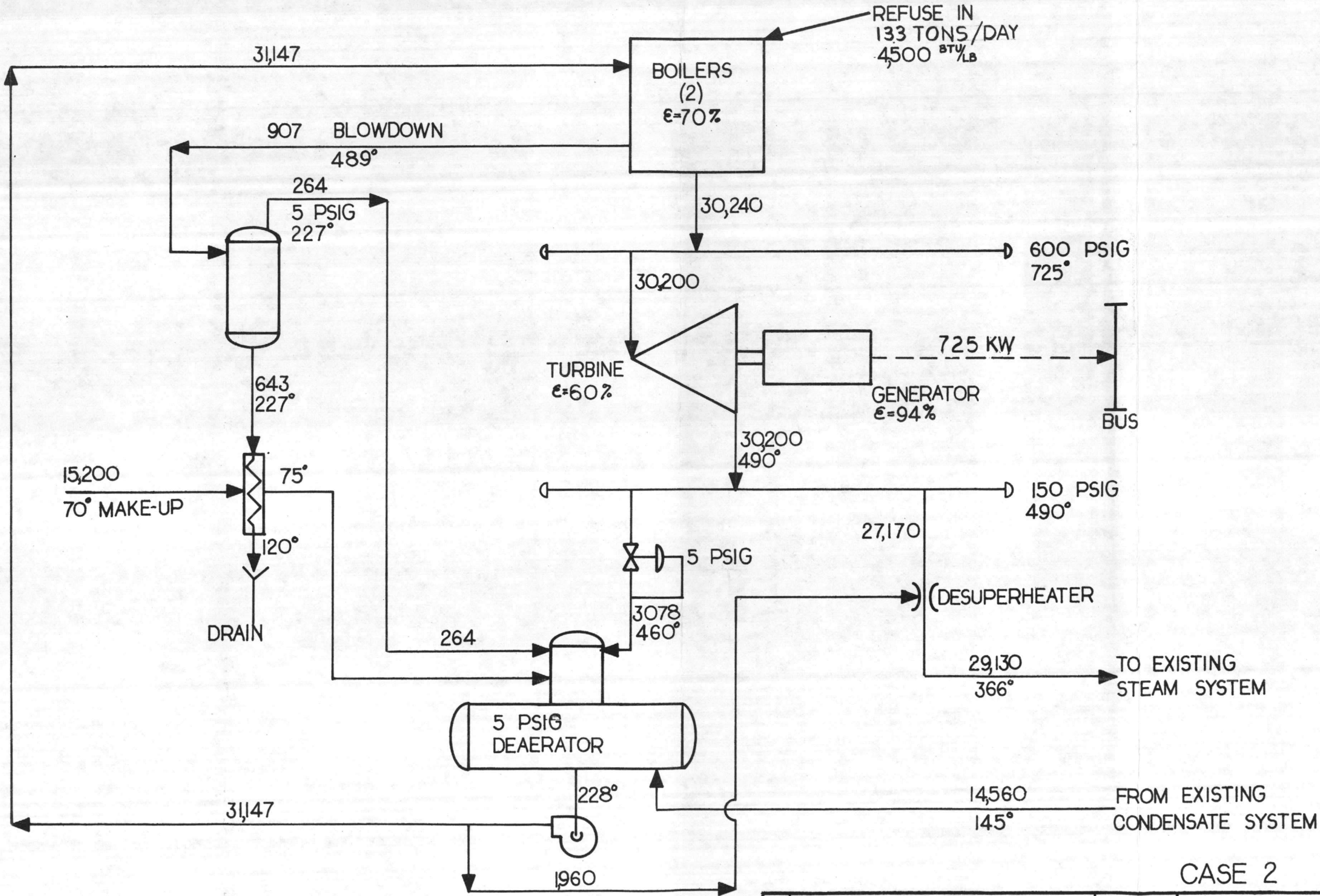
A switchgear line-up would be provided containing a 125 VDC air-operated or vacuum circuit breaker and auxiliary compartment, necessary relaying to protect the generator, switchgear and outgoing

line. The necessary controls to allow for synchronizing to the present electrical system would be provided.

The generator would be connected to the switchgear using 15 KV shielded cable. The outgoing line would be connected to the switchgear using 15 KV shielded cable.

Tie-in to the electrical system would be on the nearby 12.47 KV transmission line. Metering and recorders to account for the amount of power produced would be included.

The conceptual heat balance is shown on Drawing MX2. The flow sheet for the steam and water systems are on Drawing MF2.



CASE 2

ALL FLOWS IN LB/HR

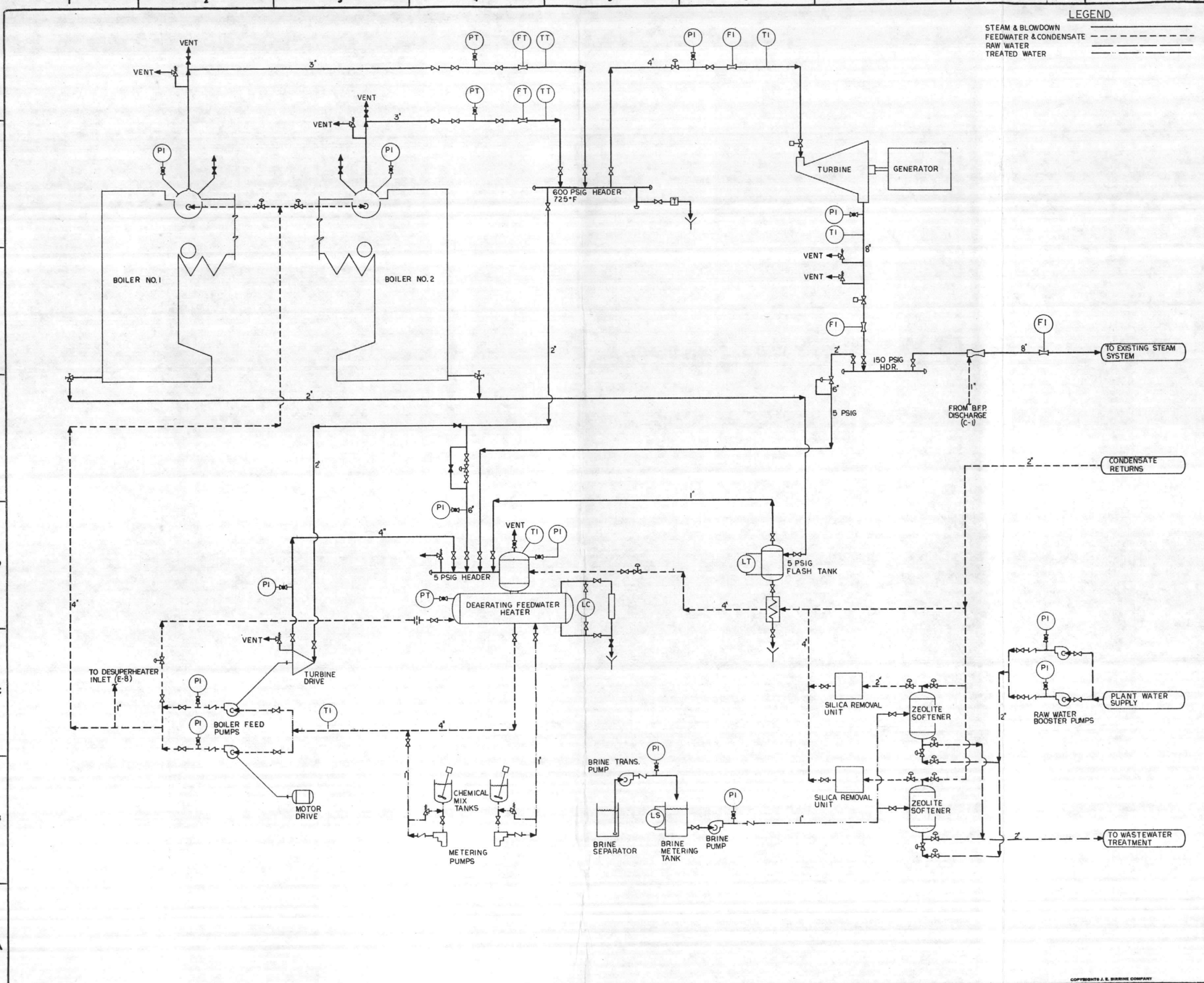
0	ISSUED FOR REPORT	3-15-82

HEAT BALANCE

J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
RALEIGH, NORTH CAROLINA

DR. R. ROBINSON
CH. W. KOOS
SCALE NONE
DATE
FILE NO.

R-1628-MX2



NOTES
1. FOR FLOWS, REFER TO HEAT BALANCES.

REV. NO.	REV. BY	CODE	CIRCLES	DATE	DESCRIPTION
0	W.A.K.				ISSUED FOR REPORT

NOTE: CIRCLE ALL REVISIONS, IDENTIFY WITH DIAMOND, NUMBER AND ARROW. REMOVE ONLY CIRCLE AND ARROW BEFORE NEXT REVISION.

ISSUE CODE		
A PRELIMINARY	C MAT'L. T.O.	F CONST'N
B DESIGN	D MAT'L. PURC.	
	E BIDS	

SEAL

J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN. W. KOOS	SCALE NONE		
DR. R. ROBINSON	DATE		
CK. W. KOOS	SIRRINE FILE NUMBER	40-3	
APPV. H. STIKES			

DRAWING TITLE
PIPING & INST. DIAGRAM
CASE 2
SOLID WASTE FUEL - COGENERATION STUDY
NAVFAC
CAMP LEJEUNE, N.C.

CLIENT DRAWING NUMBER

SIRRINE DRAWING NUMBER
FR1628-MF2

Cost Estimate

DEPARTMENT DIRECT COST SUMMARY

CASE 2 - BACK PRESSURE TURBINE

Equipment	$ 8,821,000	
Equipment Erection	170,100	
Equipment Foundations and Other Costs	248,900	
Buidings & Structures	3,700,000	
Electrical Installation Cost	463,000	
Instrumentation Installation Cost	250,000	
Piping Cost	2,246,000	
Area Cost	380,000	
SUBTOTAL CONSTRUCTION COST		$ 16,279,000
SIOH @ 5.5% (Supervision, inspection & overhead)		895,000
Contingency @ 10%		1,717,000
TOTAL CONSTRUCTION COST		$ 18,891,000

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 2

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
1. Boiler, 100 T/D Maximum Input 600 PSIG 725°F Unit No. 1		2,750,000	w/Equipment	w/Bldg. Cost
2. F.D. Fan		Incl.	w/Equipment	4,000
Coupling		Incl.	w/Equipment	
Controls		Incl.	w/Equipment	
Motor	50	Incl.	w/Equipment	
Intake Silencer		Incl.	w/Equipment	
3. Combustion Controls		Incl.	w/Equipment	
4. Boiler Breeching		Incl.	w/Equipment	w/Bldg.
5. Economizer		Incl.	w/Equipment	w/Bldg.
6. Stoker	10	Incl.	w/Equipment	w/Boiler
7. I.D. Fan		Incl.	w/Equipment	7,000
Coupling		Incl.	w/Equipment	
Fluid Drive		Incl.	w/Equipment	
Motor	75	Incl.	w/Equipment	
8. Precipitator No. 1		600,000	w/Equip. Cost	20,000
9. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
10. Expansion Joints		12,000	2,000	N/A
11. Isolation Damper	5	28,000	2,000	Incl.
12. Boiler, 100 T/D Maximum Input 600 PSIG 725°F Unit No. 2		2,750,000	w/Equip. Cost	w/Bldg.
13. F.D. Fan		Incl.	Incl.	4,000
Coupling		Incl.	Incl.	Incl.
Controls		Incl.	Incl.	Incl.
Motor	50	Incl.	Incl.	Incl.
Intake Silencer		Incl.	Incl.	Incl.

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 2

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
14. Combustion Controls		Incl.	Incl.	
15. Boiler Breeching		Incl.	Incl.	w/Bldg.
16. Economizer		Incl.	Incl.	w/Bldg.
17. Stoker	10	Incl.	Incl.	w/Boiler
18. I.D. Fan		Incl.	Incl.	7,000
Coupling		Incl.	Incl.	
Fluid Drive		Incl.	Incl.	
Motor	75	Incl.	Incl.	
19. Precipitator No. 2		600,000	Incl.	20,000
20. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
21. Expansion Joints		12,000	2,000	N/A
22. Isolation Damper	5	28,000	2,000	N/A
23. Ash Handling System	80 (Total)	575,000	Incl.	w/Bldg.
24. Overhead Crane - 5 Ton		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
25. Spare Crane		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
26. Deaerator		30,000	2,000	1,500
27. Blow-Off Tank		5,000	1,000	100

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 2

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
28. Continuous Blowdown System		17,000	2,500	500
Flash Tank		Incl.	Incl.	
Heat Exchanger		Incl.	Incl.	
Valves		Incl.	Incl.	
29. Condensate Tank		15,000	1,000	100
30. Condensate Transfer				
Pump		3,000	500	200
Motor	10	Incl.	500	200
31. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
32. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
33. Air Dryer		3,000	200	100
34. Stack - Dual Wall 150' x 9'-0" Dia.		155,000	Incl.	45,000
35. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.	Incl.	Incl.
36. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.		
37. Feedwater Treatment Equipment	30 Total	70,000	8,000	1,000
38. Boiler Feed Pump		8,000	500	500
Motor	75	Incl.	Incl.	Incl.
39. Boiler Feed Pump		8,000	500	500
Turbine		12,000	Incl.	Incl.
40. Chemical Feed Equipment	2 @ 5	10,000	800	300

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 2

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
41. Camp Geiger Condensate Transfer				
Pump		7,000	500	100
Motor	30	Incl.	200	Incl.
42. Air Station Condensate Transfer				
Pump		7,000	500	100
Motor	50	Incl.	200	Incl.
43. Condensate Collection Tank		15,000	500	200
Pump		3,000	200	100
Motor	10	Incl.	Incl.	Incl.
44. No. 2 Oil Storage Tank & Pump	5			
10,000 Gallon		25,000	500	500
45. HVAC Equipment	20	15,000	Incl.	500
46. Turbine Generator 900 KW Nominal Output 12,470 Volt Generator 1175 KVA Rating		200,000	40,000	4,800
TOTAL, Equipment		$8,821,000	$170,100	$248,900

ITEMIZED CONSTRUCTION COST ESTIMATE

CASE 2

47. Buildings and Structures	
Structural Steel	$ 880,000
Excavation and Backfill	445,000
Refuse Pit and Basement	690,000
Mat	365,000
Piling	86,000
Roof Deck and Roofing	190,000
Walls and Siding	270,000
Intermediate Floors	89,000
Stairs, Doors and Drains	160,000
Miscellaneous Steel and Grating	135,000
Support Steel and Miscellaneous	390,000
TOTAL, Building and Structures	$ 3,700,000
48. Electrical	
Building Lighting	63,000
Electrical Equipment & Wiring	400,000
TOTAL, Electrical	$ 463,000
49. Instrumentation	$ 250,000
50. Piping	
Boiler Plant	870,000
Export Steam & Condensate Return Lines	1,376,000
TOTAL, Piping	$ 2,246,000
51. Area	
Area	$ 130,000
Road Paving	250,000
TOTAL, Area	$ 380,000

CASE 2

DESIGN ANALYSIS COMPUTATIONS

JANUARY 1982

(Present Value = 1987 Dollars)

ALTERNATIVE A - Refuse-Burning Plant

1. Investment Cost

a. Refuse-Burning Plant Capital Costs (from equipment list)

Construction	$ 16,279,000
SIOH @ 5.5%	895,000
Contingency @ 10%	1,717,000
Total Unescalated Construction	$ 18,891,000

Total Construction escalated to April 1985

$\$ 18,891,000 \times \frac{2384}{1922} = \$ 23,432,000$

10% Discount (2% differential)	1.1198	
Present Value Construction Cost		$ 26,239,059

Engineering @ 6% = $ 1,133,000

Engineering escalated to April 1984

$\$ 1,133,000 \times \frac{2253}{1922} = \$ 1,328,000$

10% Discount (2% differential)	1.2071	
Present Value Engineering		$ 1,603,029

Total Present Value Construction & Engineering $ 27,842,088

b. Capital Costs for Ash Disposal

Investment for truck ($70,000) and disposal containers ($26,000) $96,000 in years 1, 9, 17

Escalated to Oct. 1987

$$\$96,000 \times \frac{2684}{1922} = \$134,060$$

10% Discount (2% differential) year 1	.963	
Present Value		$129,100
10% Discount (2% differential) year 9	.526	
Present Value		$ 70,516
10% Discount (2% differential) year 17	.288	
Present Value		$ 38,609
Total Present Value Ash Disposal Investment		$238,225

2. Recurring Costs

a. Annual Boiler Plant Labor Costs

4 Crane Operators (WG-8) @ $9.98/hr. (incl. benefits)
4 Boiler Operators (WG-7) @ $9.43/hr. (incl. benefits)
4 Boiler Mechanics (WG-10) @ $11.09/hr. (incl. benefits)
3 Supervisors (WS-7) @ $12.78/hr. (incl. benefits)

Unescalated Labor Cost

(4 x 9.98 x 2080) + (4 x 9.43 x 2080) + (4 x 11.09 x 2080) + (3 x 12.78 x 2080) = $333,508

Labor escalated to Oct. 1987

	Fy 82	Fy 83	Fy 84	Fy 85	Fy 86	Fy 87
$333,508 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056 =

= $462,476

10% Discount (0% differential) 9.524

Present Value Labor Cost $4,404,621

b. Annual Boiler Maintenance Cost

ITEM	INSTALLED COST ($ X 10^3)	MAINT. FACTOR	COST ($ X 10^3)
Boilers & Fans	3,250	0.025	81.25
Precipitators	1,200	0.015	18.00
Ducts & Stack	245	0.010	2.45
Ash Handling	575	0.025	14.38
Pumps	33	0.015	0.50
Water Treatment	37	0.020	.74
Building	3,400	0.005	17.00
Internal Piping	740	0.005	3.70
Export Piping	1,376	0.010	13.76
Cranes	850	0.020	17.00
Electrical Instrumentation	538	0.020	10.76
Turbine Generator	200	0.020	4.00
Total Unescalated Maintenance			183.54

Maintenance escalated to Oct. 1987

	Fy 82	Fy 83	Fy 84	Fy 85	Fy 86	Fy 87	
\$183,540 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056	= \$254,515

10% Discount (0% differential) 9.524

Present Value Maintenance Costs \$2,424,005

c. Plant Overhaul

$ 50,000 every 5 years

Escalated to Oct. 1987

	Fy 82		Fy 83		Fy 84		Fy 85		Fy 86		Fy 87		
$ 50,000	x 1.056		x 1.056		x 1.056		x 1.056		x 1.056		x 1.056	=	$ 69,335

10% Discount (0% differential) year 5	.652	
Present Value Overhaul Cost		$ 45,206
10% Discount (0% differential) year 10	.405	
Present Value Overhaul Cost		$ 28,081
10% Discount (0% differential) year 15	.251	
Present Value Overhaul Cost		$ 17,403
10% Discount (0% differential) year 20	.156	
Present Value Overhaul Cost		$ 10,816
Total Present Value Overhaul Costs		$ 101,506

d. Annual Incremental Electrical Costs

SERVICE	POWER (KW)	USE FACTOR	EFFECTIVE POWER
Pumping Power*	110	0.8	88
Crane Operation	30	1.0	30
Precipitators	400	0.8	320
Ash Handling	60	0.8	48
		TOTAL	486 KW

* NOTE: Feedwater pumping is not included since a reduction in existing feedwater pumping will be realized. Adjustment is made for higher pressure feedwater.

Annual Demand Cost Increase
486 KW X $ 73.598/KW = $ 35,769/yr.

Annual KWH Increase
486 KW X 7000 hrs/yr. = 3,402,000 KWh/yr.

Annual Dollar Increase per KWH
3,402,000 KWh/hr. X $ .02726/KWh = $ 92,738/yr.

Total Annual Increase Electrical Cost
$ 35,769 + $ 92,738 = $ 128,507

Escalated to Oct. 1987

	FY82		FY83		FY84		FY85		FY86		FY87		
$128,507 X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	=	$267,545

10% Discount (7% differential) 18.049

Present Value Incremental Electrical Cost $4,828,920

e. Annual Trash Transfer Cost from Cherry Point to Lejeune

$10/ton (1977) escalated to Oct. 1987

$$\$10 \times \frac{2684}{1355} = \$19.81$$

	Yr. of Op.	Tons/yr.	$/yr.	10% Discount (0% differential)	Present Value
1987	1	15,538	$ 307,808	.954	$ 293,649
	2	15,793	312,859	.867	271,249
	3	16,048	317,911	.788	250,514
1990	4	16,303	322,962	.717	231,564
	5	16,558	328,014	.652	213,865
	6	16,813	333,066	.592	197,175
	7	17,068	338,117	.538	181,907
	8	17,323	343,169	.489	167,809
	9	17,578	348,220	.445	154,958
	10	17,833	353,272	.405	143,075
	11	18,088	358,323	.368	131,863
	12	18,343	363,375	.334	121,367
	13	18,598	368,426	.304	112,002
2000	14	18,853	373,478	.276	103,080
	15	19,108	378,529	.251	95,011
	16	19,363	383,581	.228	87,456
	17	19,618	388,632	.208	80,836
	18	19,873	393,684	.189	74,406
	19	20,128	398,763	.172	68,582
	20	20,383	403,787	.156	62,991
	21	20,638	408,839	.142	58,055
	22	20,893	413,890	.129	53,392
	23	21,148	418,942	.117	49,016
	24	21,403	423,993	.107	45,367
2011	25	21,658	429,045	.097	41,617

Total Present Value Transfer Cost $3,290,806

f. Annual Ash Disposal Cost

	Yr. of Op.	1982 $*	1987 $*	10% Discount (0% differential)	Present Value
1987	1	$ 13,702	$ 19,134	.954	$ 18,254
	2	13,756	19,210	.867	16,655
	3	13,862	19,358	.788	15,254
1990	4	13,916	19,433	.717	13,933
	5	14,022	19,581	.652	12,767
	6	14,075	19,655	.592	11,636
	7	14,128	19,729	.538	10,614
	8	14,950	20,877	.489	10,209
	9	15,003	20,951	.445	9,323
	10	15,110	21,101	.405	8,586
	11	15,163	21,175	.368	7,792
	12	15,216	21,249	.334	7,097
	13	15,269	21,323	.304	6,482
2000	14	15,323	21,398	.276	5,906
	15	15,376	21,472	.251	5,389
	16	15,429	21,546	.228	4,912
	17	15,535	21,694	.208	4,512
	18	15,588	21,768	.189	4,114
	19	15,642	21,843	.172	3,757
	20	15,748	21,991	.156	3,431
	21	15,802	22,067	.142	3,134
	22	15,855	22,141	.129	2,856
	23	15,908	22,215	.117	2,599
	24	16,014	22,363	.107	2,393
2011	25	16,067	22,437	.097	2,176
Total Present Value Ash Disposal Cost					$ 193,781

* Escalation from 1982 to 1987 = $\frac{2684}{1922}$ = 1.3965

Ash - 80 lbs/cf. 30% moisture

Ash Disposal - 5 days per week

3. Benefits

Generated electricity sold to CP&L - 725 KW

Net Revenues from CP&L - $ 183,724/yr.

Escalated to Oct. 1987

	Fy82		Fy83		Fy84		Fy85		Fy86		Fy87	
$ 183,724 X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	= $ 382,504

10% Discount (7% differential) 18.049

Present Value Electricity Revenues $ 6,903,823

Source: CP&L Schedule CSP-2A, Variable Annual Rate

Summary Sheet Alternative A - Total Present Value

Investment Cost	
Boiler Plant	$ 27,842,088
Ash Disposal	238,225
Recurring Costs	
Labor	4,404,621
Maintenance	2,424,005
Plant Overhaul	101,506
Incremental Electrical	4,828,920
Trash Transfer	3,290,806
Ash Disposal	193,781
Total Present Value Cost	$ 43,323,952
Less Present Value Benefits Sale of Electricity	$ 6,903,823
Net Present Value Alternative A	$ 36,420,129
Discount Factor 9.524	
Uniform Annual Cost	$ 3,824,037

ALTERNATIVE B - Incremental Cost of Refuse Landfills at Cherry Point and Camp Lejeune

1. Investment Costs

a. Incremental Cost of Landfill - Cherry Point

Capital Cost
$298,704 (1977) in year 5

Escalated to Oct. 87
$\$298{,}704 \times \frac{2684}{1355} = \$591{,}676$

10% Discount (2% differential) year 5	.712	
Present Value Capital Cost		$421,274

Capital Cost
$36,000 (1977) in years 8, 16, 23

Escalated to Oct. 1987
$\$36{,}000 \times \frac{2684}{1355} = \$71{,}309$

10% Discount (2% differential) year 8	.568	
Present Value Capital Cost		$ 40,504
10% Discount (2% differential) year 16	.310	
Present Value Capital Cost		$ 22,106
10% Discount (2% differential) in year 23	.183	
Present Value Capital Cost		$ 13,050
Total Present Value Capital Costs - Cherry Point		$496,934

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b. Existing Boiler Plant Replacement/Upgrading Cost

Camp Geiger Capital Cost
$2,000,000 (1982$) in 1989

Escalated to Oct. 1987
$\$2{,}000{,}000 \times \frac{2684}{1922} = \$2{,}792{,}924$

10% Discount (2% differential) year 2	.893
Present Value Capital Cost	$2,494,081

Air Station Capital Cost
$2,000,000 (1982) in 1996

Escalated to Oct. 1987
$\$2{,}000{,}000 \times \frac{2684}{1922} = \$2{,}792{,}924$

10% Discount (2% differential) year 10	.488
Present Value Capital Cost	$1,362,947
Total Present Value Replacement Costs	$3,857,028

2. Recurring Costs

a. Annual Incremental Landfill Development Cost - Cherry Point

Year	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	53,312	105,600	0.963	$ 101,693
	2	54,208	107,375	0.893	95,886
	3	55,104	109,150	0.828	90,376
1990	4	56,000	110,925	0.768	85,190
	5	56,896	112,700	0.712	80,242
	6	57,792	114,474	0.660	75,553
	7	60,438	119,716	0.612	73,266
	8	61,334	121,490	0.568	69,006
	9	62,230	123,265	0.526	64,837
	10	63,126	125,040	0.488	61,020
	11	64,022	126,815	0.453	57,447
	12	64,918	128,590	0.420	54,008
	13	65,814	130,364	0.389	50,712
2000	14	66,710	132,139	0.361	47,702
	15	67,606	133,914	0.335	44,861
	16	68,502	135,689	0.310	42,064
	17	69,398	137,464	0.288	39,590
	18	70,294	139,238	0.267	37,177
	19	71,190	141,013	0.247	34,830
	20	72,086	142,788	0.229	32,698
	21	72,982	144,563	0.213	30,744
	22	73,878	146,338	0.197	28,829
	23	74,774	148,112	0.183	27,105
	24	75,670	149,887	0.170	25,481
2011	25	76,566	151,662	0.157	23,811

Total Present Value Development Cost - Cherry Point $ 1,374,128

* Escalation from 1977 to 1987 $= \frac{2684}{1355} = 1.9808$

b. Annual Incremental Landfill Development Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	$ 215,809	$ 427,477	.963	$ 411,660
	2	217,609	431,042	.893	384,921
	3	219,157	434,109	.828	359,442
1990	4	220,956	437,672	.768	336,132
	5	222,505	440,741	.712	313,808
	6	224,304	444,304	.660	293,241
	7	223,732	443,171	.612	271,221
	8	225,532	446,736	.568	253,746
	9	227,331	450,300	.526	236,858
	10	228,879	453,366	.488	221,243
	11	230,679	456,932	.453	206,990
	12	230,107	455,799	.420	191,436
	13	231,906	459,362	.389	178,692
2000	14	233,706	462,928	.361	167,117
	15	233,134	461,795	.335	154,701
	16	234,933	465,358	.310	144,261
	17	236,481	468,424	.288	134,906
	18	238,281	471,990	.267	126,021
	19	240,080	475,553	.247	117,462
	20	241,629	478,622	.229	109,604
	21	243,428	482,185	.213	102,705
	22	242,856	481,052	.197	94,767
	23	244,655	484,616	.183	88,685
	24	246,204	487,684	.170	82,906
2011	25	248,003	491,247	.157	71,126

Total Present Value Development Costs - Camp Lejeune $ 5,053,651

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

d. Annual Incremental Landfill Maintenance Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (0% differential)	Present Value
1987	1	$ 16,460	$ 32,604	.954	$ 31,104
	2	16,597	32,876	.867	28,503
	3	16,715	33,109	.788	26,090
1990	4	16,853	33,383	.717	23,936
	5	16,971	33,616	.652	21,918
	6	17,108	33,888	.592	20,062
	7	17,064	33,801	.538	18,185
	8	17,202	34,074	.489	16,662
	9	17,339	34,345	.445	15,284
	10	17,457	34,579	.405	14,004
	11	17,594	34,850	.368	12,825
	12	17,551	34,765	.334	11,612
	13	17,688	35,037	.304	10,651
2000	14	17,825	35,308	.276	9,745
	15	17,781	35,221	.251	8,840
	16	17,919	35,494	.228	8,093
	17	18,037	35,728	.208	7,431
	18	18,174	35,999	.189	6,804
	19	18,311	36,271	.172	6,239
	20	18,429	36,504	.156	5,695
	21	18,567	36,778	.142	5,222
	22	18,523	36,691	.129	4,733
	23	18,660	36,962	.117	4,325
	24	18,778	37,196	.107	3,980
2011	25	18,915	37,467	.097	3,634

Total Present Value Maintenance Costs - Camp Lejeune $ 325,577

* Escalation from 1977 to 1987 = $\frac{2684}{1355}$ = 1.9808

e. Annual Incremental Cost of #6 Fuel Oil at Camp Geiger and New River Plants

av. tons/day trash burned	- 24 hours/day	= tons/hr trash
tons/hr trash	X 5410 lb. steam/ton trash	= lbs steam/hr
lbs steam/hr	X 1086 Btu/lb*	= MMBtu/hr
MMBtu/hr	X $12.99/MMBtu**	= $/hr
$/hr	X 8760 hrs/yr	= $/yr
$/yr	X discount factor	= present value

	Year	tons/day	tons/hr.	lbs steam/hr.	MMBtu/hr.	$/hr.	$/yr.	10% Discount (8% differential)	Present Value
1987	1	128	5.33	28,853	31.33	$ 407.04	$ 3,565,653	.991	$ 3,533,562
	2	129	5.38	29,079	31.58	410.22	3,593,510	.973	3,496,485
	3	131	5.46	29,530	32.07	416.58	3,649,223	.955	3,485,008
1990	4	132	5.50	29,755	32.31	419.76	3,677,080	.938	3,449,101
	5	134	5.58	30,206	32.80	426.12	3,732,793	.921	3,437,902
	6	135	5.62	30,431	33.05	429.30	3,760,650	.904	3,399,627
	7	136	5.67	30,657	33.29	432.48	3,788,506	.888	3,364,193
	8	137	5.71	30,882	33.54	435.66	3,816,363	.871	3,324,052
	9	138	5.75	31,108	33.78	438.84	3,844,220	.856	3,290,652
	10	140	5.83	31,558	34.27	445.20	3,899,933	.840	3,275,944
	11	141	5.88	31,784	34.52	448.38	3,927,790	.825	3,240,426
	12	142	5.92	32,009	34.76	451.56	3,955,646	.810	3,204,073
	13	143	5.96	32,234	35.01	454.74	3,983,503	.795	3,166,885
2000	14	144	6.00	32,460	35.25	457.92	4,011,360	.781	3,132,872
	15	145	6.04	32,685	35.50	461.10	4,039,216	.766	3,094,039
	16	146	6.08	32,911	35.74	464.28	4,067,073	.752	3,058,439
	17	148	6.17	33,362	36.23	470.64	4,122,786	.739	3,046,739
	18	149	6.21	33,587	36.48	473.82	4,150,643	.725	3,009,216
	19	150	6.25	33,812	36.72	477.00	4,178,500	.712	2,975,092
	20	152	6.33	34,263	37.21	483.36	4,234,213	.699	2,959,715
	21	153	6.38	34,489	37.45	486.54	4,262,069	.687	2,928,042
	22	154	6.42	34,714	37.70	489.72	4,289,926	.674	2,891,410
	23	155	6.46	34,940	37.94	492.90	4,317,783	.662	2,858,372
	24	157	6.54	35,390	38.43	499.26	4,373,496	.650	2,842,772
2011	25	158	6.58	35,616	38.68	502.44	4,401,353	.638	2,808,063
						Total Present Value Fuel Oil Cost			$ 79,272,681

* Includes Camp Geiger Plant Efficiency

** $5.92 (Jan. 82) escalated to Oct. 87

	Fy82	Fy83	Fy84	Fy85	Fy86	Fy87	
$5.92	X 1.14	X 1.14	X 1.14	X 1.14	X 1.14	X 1.14	= $12.99

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Summary Sheet Alternative B - Total Present Value

Investment Costs		
Cherry Point Capital Costs		$ 496,934
Boiler Plant Replacement Cost		3,857,028
Recurring Costs		
Cherry Point Development		1,374,128
Camp Lejeune Development		5,053,651
Cherry Point Maintenance		199,295
Camp Lejeune Maintenance		325,577
Fuel Oil		79,272,681
Total Present Value Alternative A		$ 90,579,294
Discount Factor	9.524	
Uniform Annual Cost		$ 9,510,636

ECONOMIC ANALYSIS OF SHORE FACILITY

DATE: March 1982

ACTIVITY (Name and Location)
Refuse Plant - Camp Lejeune, N. C.

PROJECT TITLE
Design Analysis (Fy 87)

P NO.

DESCRIPTION OF ALTERNATIVES

Case 2

A. Refuse Plant - Elecricity with Back Pressure Turbine

B. Landfill - Oil-fired Boiler

PROJECT COST PROJECTIONS BY ALTERNATIVES

ALTERNATIVE A Refuse Plant - Electricity W/Back Pressure Turbine ECONOMIC LIFE 25 YRS.

DESCRIPTION AND YEAR	COSTS ($)		DISCOUNT FACTOR	PRESENT VALUE ($)
	ONE TIME	RECURRING		
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE A - $ 36,420,129 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $3,824,037

ALTERNATIVE B Landfill - Oil-fired Boiler ECONOMIC LIFE 25 YRS.

DESCRIPTION AND YEAR	COSTS ($)		DISCOUNT FACTOR	PRESENT VALUE ($)
	ONE TIME	RECURRING		
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE B - $ 90,579,294 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $9,510,636

REMARKS

Encl 7

(Attach separate sheet showing derivation of cost entries)

Analysis

	Total Present Value	Uniform Annual Cost
Case 2A	$36,420,129	$3,824,037
Case 2B	90,579,294	9,510,636
Difference	54,159,165	5,686,599

The refuse plant is again the least expensive alternative to disposing of burnable trash in landfills and burning oil at Camp Geiger and the Air Station. The total present value of the refuse plant is $54,159,165 less than the landfill and oil alternative. This converts to a $5,686,599 annual savings (or difference in cost). Although this is a substantial savings, it is smaller than $6.8 million potential annual savings in Case 1. The major costs in this case are different from those in Case 1 because there are added capital costs for the turbine and less oil-fired steam being replaced. However, the revenues paid to the Navy by CP&L for the electricity represent a benefit. To summarize, the benefit from electricity revenues is not high enough to offset the additional capital costs and the decreased oil savings.

TAB PLACEMENT HERE

DESCRIPTION:

SECTION VII

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SECTION VII

VII. CASE 3 - ELECTRICITY WITH CONDENSING TURBINE

Plant Description

Boilers

The boiler configuration would be the same as described in Case 2A.

Turbine

All of the steam generated, 30,200 lb/hr at 130 T/D, would be sent to a turbine. Approximatey 2,750 lb/hr would be extracted at 5 PSIG for feedwater heating and deaerating. The remainder would be sent to a condenser and pumped from there to the deaerator.

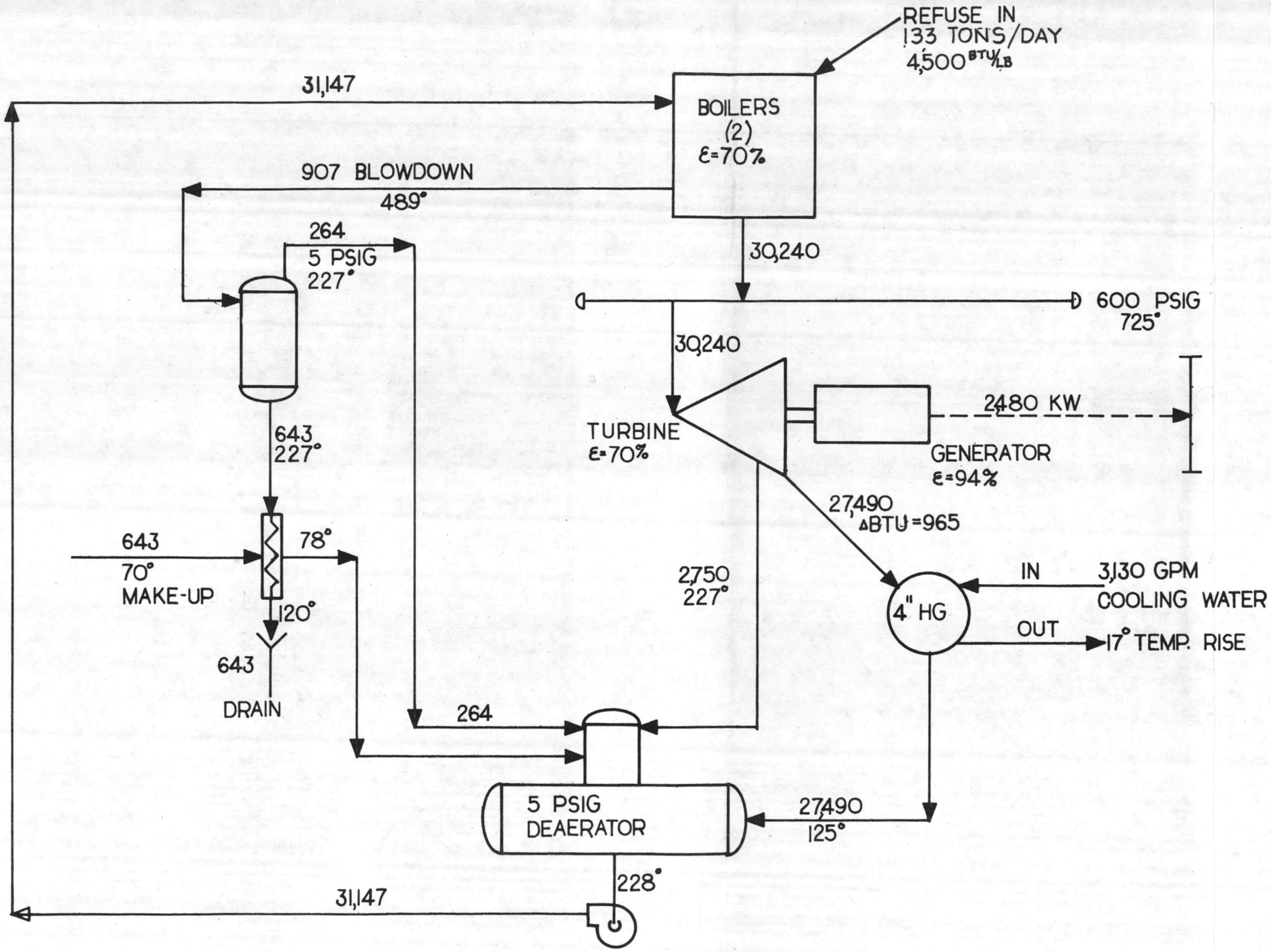
Cooling Tower

A mechanical draft cooling tower with a design capacity of 3300 GPM would supply a closed loop cooling system for the condenser. A 2-speed fan would be included to supply the cooling draft.

Electrical

The generator would be sized for a capacity of 3775 KVA and would generate power at 12.47 KV. All other electrical items would be as in Case 2A.

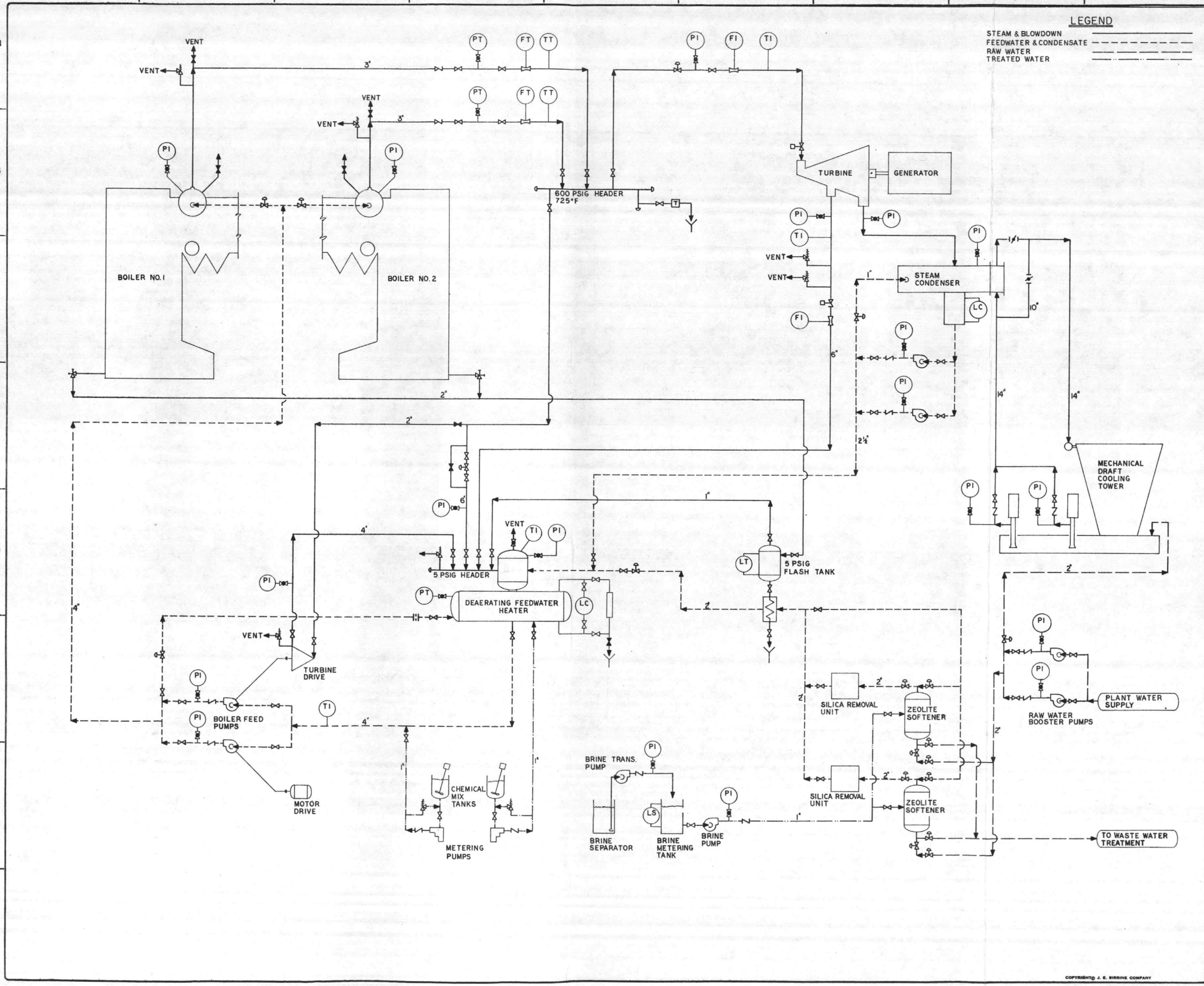
The conceptual heat balance is shown on Drawing MX3. The flow sheet for steam and water systems is on Drawing MF3.



CASE 3

0	ISSUED FOR REPORT	3-15-82	HEAT BALANCE	DR. R. ROBINSON
			J. E. SIRRINE COMPANY ARCHITECTS ENGINEERS PLANNERS	CH. W. KOOS
				SCALE NONE
			RALEIGH, NORTH CAROLINA	DATE
				FILE NO.
			R-1628-MX3	

ALL FLOWS IN LB/HR



NOTES

1. FOR FLOWS, REFER TO HEAT BALANCES.

REV. NO.	BY	CODE	CIRCLES	DATE	DESCRIPTION
0	W.A.K.				ISSUED FOR REPORT

NOTE: CIRCLE ALL REVISIONS, IDENTIFY WITH DIAMOND, NUMBER AND ARROW. REMOVE ONLY CIRCLE AND ARROW BEFORE NEXT REVISION.

ISSUE CODE: A PRELIMINARY; B DESIGN; C MAT'L T.O.; D MAT'L PURC.; E BIDS; F CONST'N

SEAL

J. E. SIRRINE COMPANY
ARCHITECTS ENGINEERS PLANNERS
NORTH CAROLINA DIVISION
RALEIGH, NORTH CAROLINA

DSGN. W. KOOS	SCALE NONE
DR. T. STABLES	DATE
CK. W. KOOS	SIRRINE FILE NUMBER 40-3
APPV. H. STIKES	

DRAWING TITLE
PIPING & INST. DIAGRAM
CASE 3

SOLID WASTE FUEL - COGENERATION STUDY

NAVFAC
CAMP LEJEUNE, N.C.

CLIENT DRAWING NUMBER

SIRRINE DRAWING NUMBER
R1628-MF3

Cost Estimate

DEPARTMENT DIRECT COST SUMMARY

CASE 3 - ELECTRICITY WITH CONDENSING TURBINE

Equipment	$ 9,199,000	
Equipment Erection	227,000	
Equipment Foundations and Other Cost	256,600	
Buildings & Structures	3,700,000	
Electrical Installation Cost	513,000	
Instrumentation Installation Cost	260,000	
Piping Cost	920,000	
Area Cost	380,000	
SUBTOTAL CONSTRUCTION COST		$ 15,455,600
SIOH @ 5.5% (Supervision, inspection & overhead)		850,000
Contingency @ 10%		1,630,600
TOTAL CONSTRUCTION COST		$ 17,936,200

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 3

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
1. Boiler, 100 T/D Maximum Input 600 PSIG 725°F Unit No. 1		2,750,000	w/Equipment	w/Bldg. Cost
2. F.D. Fan		Incl.	w/Equipment	4,000
Coupling		Incl.	w/Equipment	
Controls		Incl.	w/Equipment	
Motor	50	Incl.	w/Equipment	
Intake Silencer		Incl.	w/Equipment	
3. Combustion Controls		Incl.	w/Equipment	
4. Boiler Breeching		Incl.	w/Equipment	w/Bldg.
5. Economizer		Incl.	w/Equipment	w/Bldg.
6. Stoker	10	Incl.	w/Equipment	w/Boiler
7. I.D. Fan		Incl.	w/Equipment	7,000
Coupling		Incl.	w/Equipment	
Fluid Drive		Incl.	w/Equipment	
Motor	75	Incl.	w/Equipment	
8. Precipitator No. 1		600,000	w/Equip. Cost	20,000
9. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
10. Expansion Joints		12,000	2,000	N/A
11. Isolation Damper	5	28,000	2,000	Incl.
12. Boiler, 100 T/D Maximum Input 600 PSIG 725°F Unit No. 2		2,750,000	w/Equip. Cost	w/Bldg.
13. F.D. Fan		Incl.	Incl.	4,000
Coupling		Incl.	Incl.	Incl.
Controls		Incl.	Incl.	Incl.
Motor	50	Incl.	Incl.	Incl.
Intake Silencer		Incl.	Incl.	Incl.

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 3

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
14. Combustion Controls		Incl.	Incl.	
15. Boiler Breeching		Incl.	Incl.	w/Bldg.
16. Economizer		Incl.	Incl.	w/Bldg.
17. Stoker	10	Incl.	Incl.	w/Boiler
18. I.D. Fan		Incl.	Incl.	7,000
Coupling		Incl.	Incl.	
Fluid Drive		Incl.	Incl.	
Motor	75	Incl.	Incl.	
19. Precipitator No. 2		600,000	Incl.	20,000
20. Ductwork - To Precip., Fan, Stack w/Insulation		45,000	D&E	65,000
21. Expansion Joints		12,000	2,000	N/A
22. Isolation Damper	5	28,000	2,000	N/A
23. Ash Handling System	80 (Total)	575,000	Incl.	w/Bldg.
24. Overhead Crane - 5 Ton		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
25. Spare Crane		375,000	50,000	w/Bldg.
Control Cab		Incl.		
Grapple		Incl.		
Bridge Motor	15	Incl.		
Trolley Motor	10	Incl.		
Hoist Motors (2)	10 (Ea)	Incl.		
26. Deaerator		30,000	2,000	1,500
27. Blow-Off Tank		5,000	1,000	100

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 3

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
28. Continuous Blowdown System		17,000	2,500	500
Flash Tank		Incl.	Incl.	
Heat Exchanger		Incl.	Incl.	
Valves		Incl.	Incl.	
29. Condensate Tank		15,000	1,000	100
30. Condensate Transfer				
Pump		3,000	500	200
Motor	10	Incl.	500	200
31. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
32. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
33. Air Dryer		3,000	200	100
34. Stack - Dual Wall 150' x 9'-0" Dia.		155,000	Incl.	45,000
35. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.	Incl.	Incl.
36. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.		
37. Feedwater Treatment Equipment	30 Total	70,000	8,000	1,000
38. Boiler Feed Pump		8,000	500	500
Motor	75	Incl.	Incl.	Incl.
39. Boiler Feed Pump		8,000	500	500
Turbine		12,000	Incl.	Incl.
40. Chemical Feed Equipment	2 @ 5	10,000	800	300

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
CASE 3

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
41. No. 2 Oil Storage Tank & Pump	5			
10,000 Gallon		25,000	500	500
42. HVAC Equipment	20	15,000	Incl.	500
43. Turbine Generator				
3700 KW Nominal Output		350,000	80,000	8,000
12,470 Volt Generator				
4350 KVA Rating				
44. Condenser		75,000	5,000	1,000
45. Hotwell Pump		5,500	500	500
Motor	10	Incl.	Incl.	Incl.
46. Hotwell Pump		5,500	500	500
Motor	10	Incl.	Incl.	Incl.
47. Cooling Tower		150,000	10,000	1,500
Fan (2)		Incl.	Incl.	Incl.
Motor (2)	100 Total	Incl.	Incl.	Incl.
48. Circulating Water Pump (2)				
Motor(2)	300 Total	24,000 Incl.	3,000 Incl.	1,500 Incl.
TOTAL, Equipment		$9,199,000	$227,000	$ 256,600

ITEMIZED CONSTRUCTION COST ESTIMATE

CASE 3

49. Buildings and Structures	
Structural Steel	$ 880,000
Excavation and Backfill	445,000
Refuse Pit and Basement	690,000
Mat	365,000
Piling	86,000
Roof Deck and Roofing	190,000
Walls and Siding	270,000
Intermediate Floors	89,000
Stairs, Doors and Drains	160,000
Miscellaneous Steel and Grating	135,000
Support Steel and Miscellaneous	390,000
TOTAL, Buildings and Structures	$ 3,700,000
50. Electrical	
Building Lighting	63,000
Electrical Equipment & Wiring	450,000
TOTAL, Electrical	$ 513,000
51. Instrumentation	$ 260,000
52. Piping	
Boiler Plant	920,000
53. Area	
Area	$ 130,000
Road Paving	250,000
TOTAL, Area	$ 380,000

CASE 3

DESIGN ANALYSIS COMPUTATIONS

JANUARY 1982

(Present Value = 1987 Dollars)

ALTERNATIVE A - Refuse-Burning Plant

1. Investment Cost

a. Refuse-Burning Plant Capital Costs (from equipment list)

Construction	$ 15,455,600
SIOH @ 5.5%	850,000
Contingency @ 10%	1,630,600
Total Unescalated Construction	$ 17,936,200

Total Construction escalated to April 1985

$\$\ 17{,}936{,}200 \times \frac{2384}{1922} = \$\ 22{,}247{,}606$

10% Discount (2% differential)	1.1198	
Present Value Construction Cost		$ 24,912,869

Engineering @ 6% = $ 1,076,000

Engineering escalated to April 1984

$\$\ 1{,}076{,}000 \times \frac{2253}{1922} = \$\ 1{,}261{,}305$

10% Discount (2% differential)	1.2071	
Present Value Engineering		$ 1,522,521

Total Present Value Construction & Engineering $ 26,435,390

b. Capital Costs for Ash Disposal

Investment for truck ($70,000) and disposal containers ($26,000) $96,000 in years 1, 9, 17

Escalated to Oct. 1987

$\$96,000 \times \frac{2684}{1922} = \$134,060$

10% Discount (2% differential) year 1	.963	
Present Value		$129,100
10% Discount (2% differential) year 9	.526	
Present Value		$ 70,516
10% Discount (2% differential) year 17	.288	
Present Value		$ 38,609
Total Present Value Ash Disposal Investment		$238,225

2. Recurring Costs

a. Annual Boiler Plant Labor Costs

4 Crane Operators (WG-8) @ $9.98/hr. (incl. benefits)
4 Boiler Operators (WG-7) @ $9.43/hr. (incl. benefits)
4 Boiler Mechanics (WG-10) @ $11.09/hr. (incl. benefits)
3 Supervisors (WS-7) @ $12.78/hr. (incl. benefits)

Unescalated Labor Cost

(4 x 9.98 x 2080) + (4 x 9.43 x 2080) + (4 x 11.09 x 2080)
+ (3 x 12.78 x 2080) = $333,508

Labor escalated to Oct. 1987

	Fy 82	Fy 83	Fy 84	Fy 85	Fy 86	Fy 87
$333,508 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056 x	1.056 =
						$462,476

10% Discount (0% differential)	9.524
Present Value Labor Cost	$4,404,621

b. Annual Boiler Maintenance Cost

ITEM	INSTALLED COST ($ X 10^3)	MAINT. FACTOR	COST ($ X 10^3)
Boilers & Fans	3,250	0.025	81.25
Precipitators	1,200	0.015	18.00
Ducts & Stack	245	0.010	2.45
Ash Handling	575	0.025	14.38
Pumps	68	0.015	1.02
Water Treatment	37	0.020	.74
Building	3,400	0.005	17.00
Internal Piping	740	0.005	3.70
Export Piping	1,376	0.010	13.76
Cranes	850	0.020	17.00
Electrical Instrumentation	538	0.020	10.76
Turbine Generator	200	0.020	4.00
Condenser	75	0.010	.75
Cooling Tower	166	0.015	2.49
Total Unescalated Maintenance			187.30

Maintenance escalated to Oct. 1987

	Fy 82		Fy 83		Fy 84		Fy 85		Fy 86		Fy 87	
$187,300 x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	= $259,729

10% Discount (0% differential) 9.524

Present Value Maintenance Costs $2,473,663

c. Plant Overhaul

$ 50,000 every 5 years

Escalated to Oct. 1987

	Fy 82		Fy 83		Fy 84		Fy 85		Fy 86		Fy 87	
$ 50,000	x	1.056	x	1.056	x	1.056	x	1.056	x	1.056	x	1.056 = $ 69,335

10% Discount (0% differential) year 5	.652	
Present Value Overhaul Cost		$ 45,206
10% Discount (0% differential) year 10	.405	
Present Value Overhaul Cost		$ 28,081
10% Discount (0% differential) year 15	.251	
Present Value Overhaul Cost		$ 17,403
10% Discount (0% differential) year 20	.156	
Present Value Overhaul Cost		$ 10,816
Total Present Value Overhaul Costs		$ 101,506

d. Annual Incremental Electrical Costs

SERVICE	POWER (KW)	USE FACTOR	EFFECTIVE POWER
Pumping Power*	110	0.8	88
Crane Operation	30	1.0	30
Precipitators	400	0.8	320
Ash Handling	60	0.8	48
Hot Well Pump	75	0.8	6
Cooling Tower	75	0.8	60
Circulating Water Pumps	150	0.8	120
		TOTAL	672 KW

* NOTE: Feedwater pumping is not included since a reduction in existing feedwater pumping will be realized. Adjustment is made for higher pressure feedwater.

Annual Demand Cost Increase
672 KW X \$ 73.598/KW = \$ 49,458/yr.

Annual KWH Increase
672 KW X 7000 hrs/yr. = 4,704,000 KWh/yr.

Annual Dollar Increase per KWH
4,704,000 KWh/hr. X \$ .02726/KWh = \$128,231/yr.

Total Annual Increase Electrical Cost
\$ 49,458 + \$128,231 = \$ 177,689

Escalated to Oct. 1987

	FY82		FY83		FY84		FY85		FY86		FY87	
\$177,689 X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	X	1.13	= \$369,940

10% Discount (7% differential) 18.049

Present Value Incremental Electrical Cost \$6,677,047

e. Annual Trash Transfer Cost from Cherry Point to Lejeune

$10/ton (1977) escalated to Oct. 1987

$$\$10 \times \frac{2684}{1355} = \$19.81$$

	Yr. of Op.	Tons/yr.	$/yr.	10% Discount (0% differential)	Present Value
1987	1	15,538	$ 307,808	.954	$ 293,649
	2	15,793	312,859	.867	271,249
	3	16,048	317,911	.788	250,514
1990	4	16,303	322,962	.717	231,564
	5	16,558	328,014	.652	213,865
	6	16,813	333,066	.592	197,175
	7	17,068	338,117	.538	181,907
	8	17,323	343,169	.489	167,809
	9	17,578	348,220	.445	154,958
	10	17,833	353,272	.405	143,075
	11	18,088	358,323	.368	131,863
	12	18,343	363,375	.334	121,367
	13	18,598	368,426	.304	112,002
2000	14	18,853	373,478	.276	103,080
	15	19,108	378,529	.251	95,011
	16	19,363	383,581	.228	87,456
	17	19,618	388,632	.208	80,836
	18	19,873	393,684	.189	74,406
	19	20,128	398,763	.172	68,582
	20	20,383	403,787	.156	62,991
	21	20,638	408,839	.142	58,055
	22	20,893	413,890	.129	53,392
	23	21,148	418,942	.117	49,016
	24	21,403	423,993	.107	45,367
2011	25	21,658	429,045	.097	41,617

Total Present Value Transfer Cost $3,290,806

f. Annual Ash Disposal Cost

	Yr. of Op.	1982 $*	1987 $*	10% Discount (0% differential)	Present Value
1987	1	$ 13,702	$ 19,134	.954	$ 18,254
	2	13,756	19,210	.867	16,655
	3	13,862	19,358	.788	15,254
1990	4	13,916	19,433	.717	13,933
	5	14,022	19,581	.652	12,767
	6	14,075	19,655	.592	11,636
	7	14,128	19,729	.538	10,614
	8	14,950	20,877	.489	10,209
	9	15,003	20,951	.445	9,323
	10	15,110	21,101	.405	8,586
	11	15,163	21,175	.368	7,792
	12	15,216	21,249	.334	7,097
	13	15,269	21,323	.304	6,482
2000	14	15,323	21,398	.276	5,906
	15	15,376	21,472	.251	5,389
	16	15,429	21,546	.228	4,912
	17	15,535	21,694	.208	4,512
	18	15,588	21,768	.189	4,114
	19	15,642	21,843	.172	3,757
	20	15,748	21,991	.156	3,431
	21	15,802	22,067	.142	3,134
	22	15,855	22,141	.129	2,856
	23	15,908	22,215	.117	2,599
	24	16,014	22,363	.107	2,393
2011	25	16,067	22,437	.097	2,176

Total Present Value Ash Disposal Cost $ 193,781

* Escalation from 1982 to 1987 = $\frac{2684}{1922}$ = 1.3965

Ash - 80 lbs/cf. 30% moisture

Ash Disposal - 5 days per week

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3. Benefits

Generated electricity sold to CP&L - 2480 KW

Net Revenues from CP&L - $ 640,610/yr.

Escalated to Oct. 1987

	Fy82	Fy83	Fy84	Fy85	Fy86	Fy87	
$ 640,610 X	1.13 X	1.13 X	1.13 X	1.13 X	1.13 X	1.13	= $ 1,333,719

10% Discount (7% differential) 18.049

Present Value Electricity Revenues $ 24,072,294

Source: CP&L Schedule CSP-2A, Variable Annual Rate
See Appendix

Summary Sheet Alternative A - Total Present Value

Investment Cost	
Boiler Plant	$ 26,435,390
Ash Disposal	238,225
Recurring Costs	
Labor	4,404,621
Maintenance	2,473,663
Plant Overhaul	101,506
Incremental Electrical	6,677,047
Trash Transfer	3,290,806
Ash Disposal	193,781
Total Present Value Cost	$ 43,815,039
Less Present Value Benefits Sale of Electricity	$ 24,072,294
Net Present Value Alternative A	$ 19,742,745
Discount Factor 9.524	
Uniform Annual Cost	$ 2,072,947

ALTERNATIVE B - Incremental Cost of Refuse Landfills at Cherry Point and Camp Lejeune

1. Investment Costs

a. Incremental Cost of Landfill - Cherry Point

Capital Cost
$298,704 (1977) in year 5

Escalated to Oct. 87
$\$298,704 \times \frac{2684}{1355} = \$591,676$

10% Discount (2% differential) year 5	.712	
Present Value Capital Cost		$421,274

Capital Cost
$36,000 (1977) in years 8, 16, 23

Escalated to Oct. 1987
$\$36,000 \times \frac{2684}{1355} = \$71,309$

10% Discount (2% differential) year 8	.568	
Present Value Capital Cost		$ 40,504
10% Discount (2% differential) year 16	.310	
Present Value Capital Cost		$ 22,106
10% Discount (2% differential) in year 23	.183	
Present Value Capital Cost		$ 13,050
Total Present Value Capital Costs - Cherry Point		$496,934

b. Existing Boiler Plant Replacement/Upgrading Cost

Camp Geiger Capital Cost
$2,000,000 (1982$) in 1989

Escalated to Oct. 1987
$\$2,000,000 \times \frac{2684}{1922} = \$2,792,924$

10% Discount (2% differential) year 2	.893
Present Value Capital Cost	$2,494,081

Air Station Capital Cost
$2,000,000 (1982) in 1996

Escalated to Oct. 1987
$\$2,000,000 \times \frac{2684}{1922} = \$2,792,924$

10% Discount (2% differential) year 10	.488
Present Value Capital Cost	$1,362,947
Total Present Value Replacement Costs	$3,857,028

2. Recurring Costs

a. Annual Incremental Landfill Development Cost - Cherry Point

Year	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	53,312	105,600	0.963	$ 101,693
	2	54,208	107,375	0.893	95,886
	3	55,104	109,150	0.828	90,376
1990	4	56,000	110,925	0.768	85,190
	5	56,896	112,700	0.712	80,242
	6	57,792	114,474	0.660	75,553
	7	60,438	119,716	0.612	73,266
	8	61,334	121,490	0.568	69,006
	9	62,230	123,265	0.526	64,837
	10	63,126	125,040	0.488	61,020
	11	64,022	126,815	0.453	57,447
	12	64,918	128,590	0.420	54,008
	13	65,814	130,364	0.389	50,712
2000	14	66,710	132,139	0.361	47,702
	15	67,606	133,914	0.335	44,861
	16	68,502	135,689	0.310	42,064
	17	69,398	137,464	0.288	39,590
	18	70,294	139,238	0.267	37,177
	19	71,190	141,013	0.247	34,830
	20	72,086	142,788	0.229	32,698
	21	72,982	144,563	0.213	30,744
	22	73,878	146,338	0.197	28,829
	23	74,774	148,112	0.183	27,105
	24	75,670	149,887	0.170	25,481
2011	25	76,566	151,662	0.157	23,811

Total Present Value Development Cost - Cherry Point $ 1,374,128

* Escalation from 1977 to 1987 $= \frac{2684}{1355} = 1.9808$

b. Annual Incremental Landfill Development Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (2% differential)	Present Value
1987	1	$ 215,809	$ 427,477	.963	$ 411,660
	2	217,609	431,042	.893	384,921
	3	219,157	434,109	.828	359,442
1990	4	220,956	437,672	.768	336,132
	5	222,505	440,741	.712	313,808
	6	224,304	444,304	.660	293,241
	7	223,732	443,171	.612	271,221
	8	225,532	446,736	.568	253,746
	9	227,331	450,300	.526	236,858
	10	228,879	453,366	.488	221,243
	11	230,679	456,932	.453	206,990
	12	230,107	455,799	.420	191,436
	13	231,906	459,362	.389	178,692
2000	14	233,706	462,928	.361	167,117
	15	233,134	461,795	.335	154,701
	16	234,933	465,358	.310	144,261
	17	236,481	468,424	.288	134,906
	18	238,281	471,990	.267	126,021
	19	240,080	475,553	.247	117,462
	20	241,629	478,622	.229	109,604
	21	243,428	482,185	.213	102,705
	22	242,856	481,052	.197	94,767
	23	244,655	484,616	.183	88,685
	24	246,204	487,684	.170	82,906
2011	25	248,003	491,247	.157	71,126

Total Present Value Development Costs - Camp Lejeune $ 5,053,651

* Escalation from 1977 to 1987 $= \frac{2684}{1355} = 1.9808$

c. Annual Incremental Landfill Maintenance Cost - Cherry Point

Year	Yr. of Op.	1977$*	1987$*	10% Discount (0% differential)	Present Value
1987	1	$ 9,520	$ 18,857	0.954	$ 17,990
	2	9,680	19,174	0.867	16,624
	3	9,840	19,491	0.788	15,359
1990	4	10,000	19,808	0.717	14,202
	5	10,160	20,125	0.652	13,122
	6	10,230	20,442	0.592	11.914
	7	10,480	20,759	0.538	11,168
	8	10,640	21,076	0.489	10,306
	9	10,800	21,393	0.445	9,520
	10	10,960	21,710	0.405	8,793
	11	11,120	22,027	0.368	8,106
	12	11,280	22,343	0.334	7,463
	13	11,440	22,660	0.304	6,889
2000	14	11,600	22,977	0.276	6,342
	15	11,760	23,294	0.251	5,847
	16	11,920	23,611	0.228	5,383
	17	12,080	23,928	0.208	4,977
	18	12,240	24,245	0.189	4,583
	19	12,400	24,562	0.172	4,225
	20	12,560	24,879	0.156	3,881
	21	12,720	25,196	0.142	3,579
	22	12,880	25,513	0.129	3,292
	23	13,040	25,830	0.117	3,022
	24	13,200	26,147	0.107	1,412
2011	25	13,360	26,463	0.097	1,296

Total Present Value Maintenance Costs - Cherry Point $ 199,295

* Escalation from 1977 to 1987 $= \frac{2684}{1355} = 1.9808$

d. Annual Incremental Landfill Maintenance Cost - Camp Lejeune

	Yr. of Op.	1977$*	1987$*	10% Discount (0% differential)	Present Value
1987	1	$ 16,460	$ 32,604	.954	$ 31,104
	2	16,597	32,876	.867	28,503
	3	16,715	33,109	.788	26,090
1990	4	16,853	33,383	.717	23,936
	5	16,971	33,616	.652	21,918
	6	17,108	33,888	.592	20,062
	7	17,064	33,801	.538	18,185
	8	17,202	34,074	.489	16,662
	9	17,339	34,345	.445	15,284
	10	17,457	34,579	.405	14,004
	11	17,594	34,850	.368	12,825
	12	17,551	34,765	.334	11,612
	13	17,688	35,037	.304	10,651
2000	14	17,825	35,308	.276	9,745
	15	17,781	35,221	.251	8,840
	16	17,919	35,494	.228	8,093
	17	18,037	35,728	.208	7,431
	18	18,174	35,999	.189	6,804
	19	18,311	36,271	.172	6,239
	20	18,429	36,504	.156	5,695
	21	18,567	36,778	.142	5,222
	22	18,523	36,691	.129	4,733
	23	18,660	36,962	.117	4,325
	24	18,778	37,196	.107	3,980
2011	25	18,915	37,467	.097	3,634

Total Present Value Maintenance Costs - Camp Lejeune $ 325,577

* Escalation from 1977 to 1987 $= \frac{2684}{1355} = 1.9808$

Summary Sheet Alternative B - Total Present Value

Investment Costs		
Cherry Point Capital Costs	$	496,934
Boiler Plant Replacement Cost		3,857,028
Recurring Costs		
Cherry Point Development		1,374,128
Camp Lejeune Development		5,053,651
Cherry Point Maintenance		199,295
Camp Lejeune Maintenance		325,577
Fuel Oil		
Total Present Value Alternative A	$	11,306,613
Discount Factor 9.524		
Uniform Annual Cost	$	1,187,171

ECONOMIC ANALYSIS OF SHORE FACILITY

DATE: March 1982

ACTIVITY (Name and Location): Refuse Plant, Camp Lejeune, N. C.

PROJECT TITLE: Design Analysis (Fy 87)

P NO.:

DESCRIPTION OF ALTERNATIVES

Case 3

A. Refuse Plant - Electricity with Condensing Turbine

B. Landfill

PROJECT COST PROJECTIONS BY ALTERNATIVES

ALTERNATIVE A: Refuse Plant - Electricity w/Condensing Turbine — ECONOMIC LIFE: 25 YRS.

DESCRIPTION AND YEAR	COSTS ($) ONE TIME	COSTS ($) RECURRING	DISCOUNT FACTOR	PRESENT VALUE ($)
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE A - $ 19,742,745 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $2,072,947

ALTERNATIVE B: Landfill — ECONOMIC LIFE: 25 YRS.

DESCRIPTION AND YEAR	COSTS ($) ONE TIME	COSTS ($) RECURRING	DISCOUNT FACTOR	PRESENT VALUE ($)
INVESTMENT				
OPERATIONS				
MAINTENANCE				
PERSONNEL				
TERMINAL VALUE				
OTHER:				

TOTAL PRESENT VALUE ALTERNATIVE B - $ 11,306,613 ÷ DISCOUNT FACTOR 9.524 = UNIFORM ANNUAL COST $1,187,171

REMARKS

Encl 7

(Attach separate sheet showing derivation of cost entries)

Analysis

	Total Present Value	Uniform Annual Cost
Case 3A	$19,742,745	$2,072,947
Case 3B	11,306,613	1,187,171
Difference	8,436,132	885,776

This is the only one of three cases where the least expensive alternative is to continue with existing operations rather than build the refuse plant. The present value cost difference is $8,436,132 or $885,776 per year. The major reason for this difference is that no oil-generated steam is replaced by the refuse plant. The steam in this case is used solely to generate electricity and the revenues from the sale of electricity are not high enough to pay back the additional capital costs and offset the price of oil used to generate steam.

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SECTION VIII

VIII. WOOD-FIRED BOILER PLANT

Phase I of this study investigated the possibility of combining wood and refuse to produce steam and/or electricity. Phase I also investigated the details of wood availability and cost, including manpower, chipping, handling and transportation. However, after close consideration there appeared to be little advantage for the Navy in combining the fuels. Equipment compatibility problems are the major reason.

The equipment compatibility problems in combining wood and refuse arise in the boiler feed and burning systems. A boiler designed to use wood as the primary fuel and refuse as the secondary fuel would have a traveling grate. The refuse would have to be prepared by shreading, magnetic separation and air classification. This treated solid waste would be mixed with the wood and fed to the boiler by a screw feeder. Due to high electrical cost, and frequent maintenance required by the shredding equipment, this type of system was not considered for this project.

The boilers proposed for the refuse energy plant are mass burning incinerator-type stokers. The mix of wood and refuse would be very critical. The crane operator would have to insure an adequate mix of wood/refuse. Too much wood fired on the grate would create hot spots, which would increase maintenance and decrease the system availability. Also, the wood fuel would have to be hogged to a maximum size of less than 4 inches.

Another reason that wood was considered as a separate fuel is because of the policy problems that arise in procurement. The Navy

requested that only federal land (Marine bases and Croatan National Forest) be considered to determine the availability of wood for fuel. Although there was a sufficient amount of wood available (see Phase I, Interim Report) the cost of this fuel could be high because of restrictive forest management practices.

The forest management practices on federal land are so that wildlife and recreation are given a high priority. Logging residues which are the major source of wood fuel, are often used in windrows for wildlife habitats. Also, selective thinnings are preferred over clear cuts. If wood is harvested for fuel, the number of tons harvested per hour must be high, because the cost per ton must be low to compete with other fuels. If small, wastewood trees are selectively thinned, this high productivity cannot be obtained. The price of wood would increase to pay for higher per ton harvesting costs and would no longer be competitive as fuel.

If wood fuel was purchased on the open market, it could be obtained at a reasonable price. Most contract loggers obtain wood fuel from private timber owners who manage their land for the highest dollar return and not for wildlife and recreation. Since these lands are clearcut, a high number of tons per hour can be harvested, and the price can be low. But if the Navy purchases on the open market they would be defeating the objective of using trees from federal property.

Another policy problem in procurement could arise in Naval interdepartmental accounting procedures. How the costs of the wood fuel would be allocated between the forestry and utility departments could be a problem.

For instance, the reason federal forests were targeted for wood fuel use was so that a stumpage fee could be avoided. However, the base foresters use the stumpage fee for revenues to pay much of their operating costs and would hope to continue to receive those revenues. If the Utilities Department must add the cost of stumpage to the fuel they buy from federal lands, then fuel from the open market might be a better buy because production costs are lower.

None of these problems is impossible to overcome. However, to determine the most reliable and cost-effective installation for this study it was elected to handle the fuels in separate systems. Since disposing of the refuse is a major consideration of this study, and its cost is considerably less than wood, it was given priority as the primary fuel. Therefore, a wood-fired boiler installation, for the purpose of this study, was treated as a "battery limit" type concept.

Plant Description

Fuel Feed

Since the wood fired boiler installation was treated as a "battery limit" type concept, equipment required outside of the boiler system limits was not included. On the fuel feed system, nothing ahead of the boiler feed hoppers was estimated. It was assumed that no wood chips larger than 3 to 4 inches would be fed to the hoppers. It should be noted that the material handling equipment could become a major expense item, depending on what form the wood is received in, how it is stored, and the sophistication of the feed system design.

Boiler

Two boilers, each rated at 30,000 lb/hr maximum output, would be installed for burning wood having a moisture content of 45-55% and a heating value of 4500 Btu/lb as fired. The fuel would be fed by a pneumatic spreader to a stationary grate stoker. The power plant concept would be identical to that shown on Drawing MF1.

Pollution Control

It is expected that the particulate matter pollution limit would be met through use of a mechanical-type dust collector on each boiler. A primary and secondary collector would be installed upstream of the induced draft fan. The primary collector would collect the larger particles and the secondary collecter would capture the smaller ones. Particles that are removed from the gas stream would drop out into a hopper, through a rotary air lock valve, to the ash discharge system.

Ash Handling

The ash handling concept would be similar to that for the refuse fired plant. However, the ash content of wood is much lower than that of refuse fuel. A maximum range of 3 -5% is anticipated. The equipment sizing would be smaller than depicted in the refuse firing plant.

Cost Estimate

DEPARTMENT DIRECT COST SUMMARY

WOOD FIRING

Equipment	$ 2,443,500	
Equipment Erection	62,000	
Equipment Foundations and Other Cost	167,600	
Buidings & Structures	920,000	
Electrical Installation Cost	240,000	
Instrumentation Installation Cost	200,000	
Piping Cost	740,000	
Area Cost	130,000	
SUBTOTAL CONSTRUCTION COST		$ 4,903,100
SIOH @ 5.5% (Supervision, inspection & overhead)		270,000
Contingency @ 10%		517,300
TOTAL CONSTRUCTION COST		$ 5,690,400

NOTE: This estimate does not include equipment for fuel preparation and handling or any site specific type cost items.

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
WOOD PLANT

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
1. Boiler, 30,000 Lb/Hr Capacity 250 psig Design Pressure Unit No. 1		750,000	w/Equipment	w/Bldg. Cost
2. F.D. Fan		Incl.	w/Equipment	4,000
Coupling		Incl.	w/Equipment	
Controls		Incl.	w/Equipment	
Motor	50	Incl.	w/Equipment	
Intake Silencer		Incl.	w/Equipment	
3. Combustion Controls		Incl.	w/Equipment	
4. Boiler Breeching		Incl.	w/Equipment	w/Bldg.
5. Economizer		Incl.	w/Equipment	w/Bldg.
6. Stoker		Incl.	w/Equipment	w/Boiler
7. I.D. Fan		Incl.	w/Equipment	7,000
Coupling		Incl.	w/Equipment	
Fluid Drive		Incl.	w/Equipment	
Motor	75	Incl.	w/Equipment	
8. Mechanical Dust Collector		75,000	20,000	7,000
9. Ductwork - To Dust Collector, Fan, Stack w/Insulation		35,000	D&E	40,000
10. Expansion Joints		12,000	2,000	N/A
11. Isolation Damper	5	28,000	2,000	Incl.
12. Boiler, 30,000 Lb/Hr Capacity 250 psig Design Pressure Unit No. 2		750,000	w/Equip. Cost	w/Bldg.
13. F.D. Fan		Incl.	Incl.	4,000
Coupling		Incl.	Incl.	Incl.
Controls		Incl.	Incl.	Incl.
Motor	50	Incl.	Incl.	Incl.
Intake Silencer		Incl.	Incl.	Incl.

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
WOOD PLANT

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
14. Combustion Controls		Incl.	Incl.	
15. Boiler Breeching		Incl.	Incl.	w/Bldg.
16. Economizer		Incl.	Incl.	w/Bldg.
17. Stoker		Incl.	Incl.	w/Boiler
18. I.D. Fan		Incl.	Incl.	7,000
Coupling		Incl.	Incl.	
Fluid Drive		Incl.	Incl.	
Motor	75	Incl.	Incl.	
19. Mechanical Dust Collector		75,000	20,000	7,000
20. Ductwork - To Dust Collector, Fan, Stack w/Insulation		35,000	D&E	40,000
21. Expansion Joints		12,000	2,000	N/A
22. Isolation Damper	5	28,000	2,000	N/A
23. Ash Handling System	50 (Total)	300,000	Incl.	w/Bldg.
24. Deaerator		30,000	2,000	1,500
25. Blow-Off Tank		5,000	1,000	100
26. Continuous Blowdown System		16,500	2,500	500
Flash Tank		Incl.	Incl.	
Heat Exchanger		Incl.	Incl.	
Valves		Incl.	Incl.	
27. Condensate Tank		15,000	1,000	100
28. Condensate Transfer				
Pump		3,000	500	200
Motor	10	Incl.	500	200
29. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		

ITEMIZED CONSTRUCTION COST ESTIMATE

EQUIPMENT LIST
WOOD PLANT

Item Description	Motor HP-RPM	Equipment $	Equipment Erection $	Equip. Supports Platforms and Other Costs $
30. Air Compressor	25	6,000	500	200
Air Receiver		Incl.		
31. Air Dryer		3,000	200	100
32. Stack - Dual Wall 150' x 9'-0" Dia.		155,000	Incl.	45,000
33. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.	Incl.	Incl.
34. Raw Water Booster Pump		3,000	500	100
Motor	20	Incl.		
35. Feedwater Treatment Equipment	30 Total	35,000	2,000	1,000
36. Boiler Feed Pump		5,000	500	500
Motor	50	Incl.	Incl.	Incl.
37. Boiler Feed Pump		5,000	500	500
Turbine		8,000	Incl.	Incl.
38. Chemical Feed Equipment	2 @ 5	5,000	800	300
39. No. 2 Oil Storage Tank 10,000 Gallon		25,000	500	500
40. HVAC Equipment	20	15,000	Incl.	500
TOTAL, Equipment		$ 2,443,500	$ 62,000	$ 167,600

ITEMIZED CONSTRUCTION COST ESTIMATE

WOOD PLANT

41. Buildings and Structures

Structural Steel		300,000
Mat		150,000
Piping		50,000
Roof Deck and Roofing		90,000
Walls and Siding		100,000
Intermediate Floors		30,000
Stairs, Doors and Drains		50,000
Miscellaneous Steel and Grating		50,000
Support Steel and Miscellaneous		100,000
TOTAL, Buildings and Structures	$	920,000

42. Electrical

Building Lighting	$	40,000
Electrical Equipment & Wiring		200,000
TOTAL, Electrical	$	240,000

43. Instrumentation	$	200,000
44. Piping		
Boiler Plant	$	740,000
45. Area	$	130,000

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SECTION XI

IX. CONCLUSIONS AND RECOMMENDATIONS

Case Comparisons

Table 6 summarizes the capital costs, present values, and uniform annual costs of the three refuse plant case options. The table also points out the total and annual savings that could be realized if the refuse plant in that case is constructed. The largest savings over existing operations could be realized in the case where the refuse plant is designed to provide steam only. The reason is that the largest amount of oil-generated steam could be replaced in this scenario. If electricity is generated, as in Cases 2 and 3, a smaller amount of steam would be available because of the higher pressure and temperature required to generate electricity. The revenues from the electricity in Case 2A would not be enough to offset the price of oil that could be replaced. Case 3A would use all the steam generated to produce electricity. Because there would be no incremental oil cost to avoid, there would be no net savings to be realized by building a refuse plant of this type. Again there would not be enough electric revenues, to make this case worthwhile economically.

It should be pointed out that although Case 2A has a higher capital cost than Case 1A, the total project present value is lower in Case 2A, due to the revenues the Navy would receive from selling electricity to CP&L. However, since generating electricity provides less steam that could otherwise replace oil-fired steam, the potential total and annual savings in Case 2, are slightly lower than those of Case 1.

Sensitivites to Critical Costs

Price of oil - At $5.92 per MMBtu, this price equates to

TABLE 6
COST SUMMARY
DESIGN ANALYSIS (FY87)

	Construction Costs (1982 $)	Total Project Cost Present Value	Total Refuse Plant Savings	Uniform Annual Cost	Annual Refuse Plant Savings
Case 1A - Refuse-fired plant producing steam only	15,229,000	37,376,628	65,174,194	3,924,467	6,843,153
Case 1B - Incremental cost of landfill for refuse and oil for steam	--	102,550,814	--	10,767,620	--
Case 2A - Refuse-fired plant producing steam and electricity with a backpressure turbine	18,891,000	36,420,129	54,159,165	3,824,037	5,686,599
Case 2B - Incremental cost of landfill for refuse and oil for steam	--	90,579,294	--	9,510,636	--
Case 3A - Refuse-fired plant producing electricity with a condensing turbine	17,936,200	19,742,745	--	2,072,947	--
Case 3B - Incremental cost of of a landfill	--	11,306,613	<8,436,132>	1,187,171	<885,776>

approximately $.88 per gallon of No. 6 fuel oil. In recent weeks the price of oil has been dropping. Since this is the major factor in determining the amount of the savings for the refuse plant, the price was set at $.50 per gallon ($3.38/MMBtu) and incorporated in the design analysis to see its effect on total project feasibility. This change brought the total project present value of Case 1B down to roughly $57 million. This would still enable the Navy to realize a total project savings of approximately $20 million, or an annual savings of approximately $2 million.

Revenues from electricity - The rate schedule that CP&L uses to pay avoided costs to small power producers is reestablished every 2 years. It is due to be updated and approved by the N. C. Utilities Commission in June, 1982. This rate is expected to increase approximately 20-30%. To establish the effect of increased electricity revenues on the feasibility of Case 2A, the rate was assumed to increase 20%. This decreases the total present value of Case 2A roughly $1.4 million, not enough to make the savings higher for this Case than for Case 1A.

Construction costs - This is the largest single cost within each Case A. To determine if a substantial increase in this cost would affect project feasibility, it was increased by 20% for Case 1A. This would decrease the total present value savings only approximately $4.5 mill or approximately $500,000 per year.

Plant availability - The assumed plant availability for this report is 80%. Because of the double system (2 boilers, 2 precipitators and spare crane) it is felt this availability is

attainable. Of the 20% outage, 15% is scheduled and 5% is unscheduled. Because of the 3-day storage capacity at the garbage pit, and the extra capacity of the boiler, up to 10% unscheduled outage could be handled without effecting the potential savings of the system.

Recommendation

It is recommended that the Navy install a refuse energy plant to furnish steam to Camp Geiger and the Air Station as described in Case 1. This case offers both the lowest construction costs and the highest potential savings versus existing operations. This recommendation does not change even if the major cost factors were to change as shown by the sensitivity analyses performed.

The concept recommended in Case 1 has been put into practice in a refuse-to-steam plant located in Hampton, Virginia. The Hampton plant is a 200-ton per day facility similar in design to the plant in Case 1. This plant was completed in 1980 at a cost of $10.4 million. Its only steam customer is NASA's Langley Research Center. The original operation charged a tipping fee of $4.69 per ton, paid by the city of Hampton, and sold steam to NASA for $8.07 per thousand pounds. In July of 1982, the tipping fee will be eliminated and the plant will be self-sustaining on steam sales alone.

Several factors which cannot be shown in the economic analysis but may have a positive influence on the proposed installation are:

- The plant would have excess capacity available and a market for excess steam output in the winter. During this period a mutually beneficial agreement could be negotiated with the surrounding civilian community for additional trash to burn.

- The project estimate is a conservative one and no value engineering or systems optimization has been attempted. Detailed design may produce a lower total installed cost.
- Cherry Point's landfill situation may be approaching a capacity crisis. The refuse energy plant would relieve the potential problem.

A factor which would have a negative influence on the recommendation is:

- Any successful steam and condensate conservation program would diminish the benefits derived from this case.

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SECTION X

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SECTION X

Carolina Power & Light Company
(North Carolina Only)

COGENERATION AND SMALL POWER PRODUCER

SCHEDULE CSP-2A

AVAILABILITY

This Schedule is available for electrical energy and capacity supplied by Seller to Company if Seller is a Qualifying Facility as defined by the Federal Energy Regulatory Commission's (FERC) Order No. 70 under Docket No. RM79-54.

This Schedule is not available for electric service supplied by Company to Seller or for Seller who has negotiated rate credits or conditions which are different from those below. If Seller requires supplemental, standby, or interruptible services, Seller shall enter into a separate service agreement with Company in accordance with Company's applicable electric rates, riders, and Service Regulations on file with and authorized by the state regulatory agency having jurisdiction.

APPLICABILITY

This Schedule is applicable to all electric energy and capacity supplied by Seller to Company at one point of delivery through Company's metering facilities.

CONTRACT CAPACITY

The Contract Capacity shall be the maximum capacity of the qualifying facility.

MONTHLY RATE

Payment

For Qualifying Facilities classified as New Capacity in accordance with FERC Order No. 69 under Docket No. RM79-55, Company will pay Seller a monthly credit equal to the sum of the Energy and Capacity Credits reduced by both the Customer Charge and any applicable Interconnection Cost. For Qualifying Facilities classified as other than New Capacity in accordance with the above FERC Regulations, Company will pay Seller a monthly credit equal to the Energy Credit reduced by both the Customer Charge and any applicable Interconnection Cost.

Energy Credit

Company shall pay Seller an Energy Credit for all energy delivered to Company's System as registered or computed from Company's metering facilities. This Energy Credit will be in accordance with the length of rate term for energy sales so established in the Purchase Agreement. The Energy Credit shall be:

	Variable Annual	Fixed Long-Term Rates		
	Rate	5 yr.	10 yr.	15 yr.
On-Peak kWh (¢/kWh)	3.12*	3.69	4.40	5.55
Off-Peak kWh (¢/kWh)	2.31*	2.83	3.31	4.04

*Fuel Cost Adjustment Factors will only apply to the Variable Annual Rate Energy Credits.

Capacity Credit

Company shall pay Seller a Capacity Credit based on the on-peak kWh supplied by Seller.

	Variable Annual	Fixed Long-Term Rates		
	Rate	5 yr.	10 yr.	15 yr.
On-Peak kWh (¢/kWh)-Summer	1.49	1.49	1.49	2.39**
On-Peak kWh (¢/kWh)-Non-summer	1.29	1.29	1.29	2.08**

**Applies to Purchase Agreements of 15 years or longer.

Summer months are defined as the calendar months of June through September. Non-summer months are defined as all other months.

Customer Charge

Seller shall pay to Company a Customer Charge outlined below in accordance with the Contract Capacity:

	Contract Capacity		
	0 to 100 kW	101 to 999 kW	1000 kW and above
Monthly Customer Charge	$5	$65	$193

RATE UPDATES

The Variable Annual and Fixed Long-Term Energy Credits and Capacity Credits of this Schedule will be updated every two years. Customers who have contracted for the Long-Term Rates will not be affected by these updates until their rate term expires.

DETERMINATION OF ON-PEAK AND OFF-PEAK HOURS

A. On-Peak Hours

(1) For calendar months of April through September; the on-peak hours are the hours between 10:00 a.m. and 10:00 p.m., Monday through Friday.

(2) For calendar months of October through March, the on-peak hours are the hours between 6:00 a.m. and 1:00 p.m. and the hours between 4:00 p.m. and 9:00 p.m., Monday through Friday.

B. Off-Peak Hours

The off-peak hours in any billing month are defined as all hours not specified as on-peak hours.

INTERCONNECTION COSTS

The installed costs to Seller for all facilities constructed or installed by Company to interconnect and safely operate in parallel with Seller's equipment shall be determined in accordance with Company's Terms and Conditions For The Purchase of Electric Power.

EARLY CONTRACT TERMINATION OR CHANGE IN CONTRACT CAPACITY

If Seller terminates the Agreement or reduces the Contract Capacity prior to the expiration of the initial (or extended) term of the Purchase Agreement, the following payment shall be made to Company by Seller:

Early Contract Termination - Variable Annual Rate

Payment shall be the summation of all Monthly Capacity Credits paid by Company to Seller times the number of months remaining in the Contract Period divided by the total number of months in the Contract Period. Payment for additional facilities shall be in accordance with the Purchase Agreement.

Early Contract Termination - Fixed Long-Term Rate

Seller shall pay to Company the total Energy and Capacity credits received in excess of what would have been received under the variable Annual Rate, plus interest. The interest should be the weighted average rate for new debt issued by the Company in the calendar year previous to that in which the Contract was commenced.

Reduction In Contract Capacity

Payment shall be a quantity equal to the amount as calculated under the applicable Early Contract Termination clause multiplied by the ratio of the capacity reduction to existing Contract Capacity.

Increase In Contract Capacity

Seller may apply to Company to increase the Contract Capacity during the Contract Period and, upon approval by Company, future Monthly Delivered Capacities shall not exceed the revised Contract Capacity. If such increase in Contract Capacity results in additional costs associated with redesign or a resizing of Company's facilities, such additional costs to Seller shall be determined in accordance with Company's Terms and Conditions For The Purchase of Electric Power.

APPROVED FUEL CHARGE

The increase or decrease in the Approved Fuel Charge applicable to retail service and adjusted to time-of-day shall apply to all Energy Credits under the Variable Annual Rate provision of this Schedule.

CONTRACT PERIOD

The Contract Period for all Qualifying Facilities shall be at least five years with minimum one-year renewal periods. Qualifying Facilities classified as New Capacity may choose different lengths for Energy Credits and Capacity Credits, except that the Rate Term of the Capacity Credit shall not be shorter than the Rate Term of the Energy Credit.

Effective December 1, 1981

CUC Docket No. E-100, Sub 41

CASE 7

725 kw Oct - April
633 kw May - Sept.
730 hrs. / mo.

	JAN	FEB.	MARCH	APRIL	[MAY
TOTAL Output	529,250	529,250	529,250	529,250	462,090
PEAK hrs (kwh) 35%	185,238	185,238	185,238	185,238	161,732
OFF-PEAK HRS (kwh) 65%	344,012	344,012	344,012	344,012	300,358
ANNUAL RATES					
PEAK ENERGY ¢/Kwh	3.12	3.12	3.12	3.12	3.12
PEAK Capacity ¢/Kwh	1.29	1.29	1.29	1.29	1.29
TOTAL PEAK ¢/Kwh	4.41	4.41	4.41	4.41	4.41
OFF PEAK ¢/Kwh	2.31	2.31	2.31	2.31	2.31
Revenues $					
PEAK	$ 8,169	$ 8,169	$ 8,169	$ 8,169	$ 7,132
OFF-PEAK	7,947	7,947	7,947	7,947	6,938
TOTAL	$ 16,116	16,116	16,116	16,116	14,070
LESS CUSTOMER CHARGE	65	65	65	65	65
Net Revenue	$ 16,051	$ 16,051	$ 16,051	$ 16,051	$ 14,005

	JUNE	July	August	Sept.]	Oct	Nov	DEC	TOTAL
TOTAL Output	462,090	462,090	462,090	462,090	529,250	529,250	529,250	
PEAK hrs (kwh) 35%	161,732	161,732	161,732	161,732	185,238	185,238	185,238	
OFF-PEAK HRS (kwh) 65%	300,358	300,358	309,358	300,358	344,012	344,012	344,012	
ANNUAL RATES								
PEAK ENERGY ¢/Kwh	3.12	3.12	3.12	3.12	3.12	3.12	3.12	
PEAK Capacity ¢/Kwh	1.29	1.49	1.49	1.49	1.49	1.29	1.29	
TOTAL PEAK ¢/Kwh	4.41	4.61	4.61	4.61	4.61	4.41	4.41	
OFF PEAK ¢/Kwh	2.31	2.31	2.31	2.31	2.31	2.31	2.31	
Revenues $								
PEAK	$ 7,132	$ 7,456	$ 7,456	$ 7,456	$ 8,539	$ 8,169	$ 8,169	
OFF-PEAK	6,938	6,938	6,938	6,938	7,947	7,947	7,947	
TOTAL	14,070	14,394	14,394	14,394	16,486	16,116	16,116	
LESS CUSTOMER CHARGE	65	65	65	65	65	65	65	
Net Revenue	$ 14,005	$ 14,329	$ 14,329	$ 14,329	$ 16,421	$ 16,051	$ 16,051	$ 183,724

CASE 3

2480 kw Oct - April
2270 kw May - Sept.
730 hrs / mo.

	JAN	FEB	MARCH	April	MAY	JUNE	July	August	Sept	Oct.	Nov	Dec	TOTAL
TOTAL OUTPUT	1,810,400	1,810,400	1,810,400	1,810,400	1,657,100	1,657,100	1,657,100	1,657,100	1,657,100	1,810,400	1,810,400	1,810,400	
Peak hrs kwh (35%)	633,640	633,640	633,640	633,640	579,985	579,985	579,985	579,985	579,985	633,640	633,640	633,640	
Off Peak hrs kwh (65%)	1,176,760	1,176,760	1,176,760	1,176,760	1,077,115	1,077,115	1,077,115	1,077,115	1,077,115	1,176,760	1,176,760	1,176,760	
ANNUAL RATES													
Peak Energy ¢/kwh	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	
Peak Capacity ¢/kwh	1.29	1.29	1.29	1.29	1.29	1.29	1.49	1.49	1.49	1.49	1.29	1.29	
Total Peak ¢/kwh	4.41	4.41	4.41	4.41	4.41	4.41	4.61	4.61	4.61	4.61	4.41	4.41	
OFF PEAK ¢/kwh	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	
Revenues $													
Peak	27,944	27,944	27,944	27,944	25,577	25,577	26,737	26,737	26,737	29,211	27,944	27,944	
Off Peak	27,183	27,183	27,183	27,183	24,881	24,881	24,881	24,881	24,881	27,183	27,183	27,183	
	55,127	55,127	55,127	55,127	50,458	50,458	51,618	51,618	51,618	56,394	55,127	55,127	
Total													
Less Customer Charge	$193	193	193	193	193	193	193	193	193	193	193	193	
Net Revenue	$54,934	54,934	54,934	54,934	50,265	50,265	51,425	51,425	51,425	56,201	54,934	54,934	640,610