ENERGY ENGINEERING ANALYSIS PROGRAM

472-02

FINAL

Seneca Army Depot
NEW YORK

FEASIBILITY STUDY CENTRAL COAL-FIRED HEATING PLANTS

APPENDIX - Volume 1

INCREMENT E

Contract No. DACA 65-80-C-0003
NORFOLK DISTRICT
CORPS OF ENGINEERS

REYNOLDS, SMITH AND HILLS
Architects-Engineers-Planners, Incorporated

ENERGY ENGINEERING ANALYSIS

FORT DEVENS

SENECA ARMY DEPOT

LETTERKENNY ARMY DEPOT

CONTRACT NO. DACA65-80-C-0003

FEASIBILITY STUDY

INCREMENT E

CENTRAL COAL-FIRED HEATING PLANTS

APPENDIX - VOLUME 1

SENECA ARMY DEPOT

February 1982

Reynolds, Smith and Hills

Architects-Engineers-Planners,

Incorporated

FINAL SUBMITTAL

TABLE OF CONTENTS

6.0 APPENDIX

VOLUME I

SECTION I-1

CAPITAL COST ESTIMATE

BASE CASE

BASE CASE - SENECA NORTH

1/2/81

1. ANTICIPATED MIDPOINT OF CONSTRUCTION

   DOES NOT APPLY TO BASE CASE – SYSTEMS ARE ALL PRESENTLY INSTALLED & OPERABLE

2. BENEFICIAL OCCUPANCY DATE

   SAME AS #1, ABOVE

3. ECONOMIC LIFE

BLDG 718	30 YRS	replacement costs are reflected in item #7, below
PIPING SYSTEMS	25 YRS	
OTHER BLDG'S	20 YRS	

4. DATE OF ESTIMATE

   DECEMBER 1980

5. INITIAL COSTS

   DOES NOT APPLY, see #1 above

6. ANNUAL MAINTENANCE COSTS

   MAINTENANCE COST → $ 12,500
   OPERATING COST → $ 128,340

   TOTAL $ 140,840

7. CYCLICAL MAINTENANCE COSTS

THESE COSTS ARE THOSE REQUIRED TO REPLACE THE EQUIPMENT AS IT WEARS OUT

1986	$ 295,780
1996	$ 411,114
2016	$ 340,647
2021	$ 366,249

8. ANNUAL FUEL COST

#6 FUEL OIL 177400 GAL/YR $ 90972

#2 FUEL OIL 40823 GAL/YR $ 39495

9. ANNUAL ELECTRICAL CONSUMPTION

137,887 KWH

10. ELECTRICAL DEMAND RATE

34 KW

REPLACEMENT REQUIRED IN 1986

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: | ESTIMATOR: S Cowen | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BLDG 718 Boilers, Feed Pumps, Deaerator, AND Associated Equipment				41850		174500	216350
LABOR BURDEN	22%			9207		-	9207
SALES TAX	5%			-		8725	8725
SUBTOTAL							234282
OVERHEAD & PROFIT	25%						58570
BOND	1%						2928
TOTAL REPLACEMENT COST IN DEC 1980 $ →							$295,780

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1980 O—516188

REPLACEMENT REQUIRED IN 1996

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.:

ESTIMATOR: S Cowen

CHECKED BY:

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
PIPING SYSTEMS				76648		187226	263874
BLDG 729				915		1533	2448
Tennis Bubble				1000		8300	9300
BlDG 802				915		1533	2448
BlDG 805				915		1533	2448
BlDG 810				1375		6700	8075
BlDG 812				1375		6700	8075
Sub-TOTAL				83143		213525	296668
LABOR BURDEN	22%			18291		-	18291
SALES TAX	5%			-		10676	10676
Sub-TOTAL							325635
OVERHEAD & PROFIT	25%						81409
BOND	1%						4070
TOTAL REPLACEMENT COST IN DEC 1980 $ →							$411,114

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1959 O-518188

REPLACEMENT REQ'D IN 2016

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: | ESTIMATOR: S Lowas | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BLDG 718 - Complete				41850		174500	216350
BLDG 729				915		1533	2448
TENNIS Bubble				1000		8300	9300
BLDG 802				915		1533	2448
BLDG 805				915		1533	2448
BLDG 810				1375		6700	8075
BLDG 812				1375		6700	8075
SUB-TOTAL				48345		200799	249144
Labor BURDEN	22%			10636		—	10636
Sales TAX	5%			—		10040	10040
SUB-TOTAL							269820
OVERHEAD & PROFIT	25%						67455
BOND	1%						3372
TOTAL REPLACEMENT COST IN DEC 1980 $ →							$340,647

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE

REPLACEMENT OF EXISTING PIPING ~ 2021

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT – NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: S Cowen

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	18.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SALES TAX	5%			—		9361	9361
SUBTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 1984 DOLLARS)							$ 366,249

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

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INCORPORATED

SUBJECT SEAD - NORTH BASE
BASE CASE
DESIGNER S. Corwen
CHECKER

AEP NO 80122-000
SHEET .... OF ....
DATE
DATE

BUILDING: 718 DESCRIPTION: STEAM PLANT

1.	EQUIPMENT NAME	(3) Kewanee Compact Boiler	DEAERATOR (1)	Boiler Feed (3) Pumps	
2.	DESCRIPTION	50 psig - 310 Hp per boiler - Todd burners NB-15517 Design 125 psig	Graver Co. oper @ 5 psig	MULTI-STAGE Flow = 40 GPM HD = 200 Ft Hp = 5	
3.	CONDITION AS OF OCT. 1980	1 blr was opened up - 1 was being fired & 1 on standby	good	fair - good	
4.	CURRENT AGE	Built 1955 25 yrs	25 yrs	25 yrs	
5.	LIFE EXPECTENCY	30 yrs	30 Yrs	30 yrs	
6.	Replacement Cost (Dec '80 $)	$181,350	$20,000	$15,000 TOTAL	

7. ANNUAL OPERATING COST, (DEC. '80 $) $128,340

8. ANNUAL FUEL COST, (DEC. '80 $) $94,000

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $10,800

10. ANNUAL ELECTRICAL CONSUMPTION 128737 Kwh

11. ELECTRICAL DEMAND RATE 34 KW

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SUBJECT SEAD - NORTH BASE
AEP NO 80122-000
SHEET ____ OF ____
DESIGNER S COWEN
DATE
CHECKER
DATE

(BLDG # 718)

ANNUAL OPERATING COST

OPERATING PERSONNEL	# REQ'D	DEC '80 SALARY INCLUDING FRINGES	TOTAL ANNUAL COST
1. Boiler Plant Oper. Leader	1	$ 23,150	$ 23,150
2. Boiler Plant Operators	4	$ 21,038	$ 84,152
3. Heating Equip. Mechanic	1	$ 21,038	$ 21,038
		TOTAL =	$ 128,340

NOTE: Dec '80 Salary = March '80 hourly rate x 2080 hrs + 10.3% fringes + 7% escalation

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 233,200 GAL/YR #6 F.O.

SETBACK SAVINGS = 8370 MBTU

$$\text{ANNUAL FUEL USE} = 233{,}200 \text{ GPY} - \frac{8{,}370{,}000{,}000 \text{ BTU}}{150{,}000 \text{ BTU/GAL}} = 177400 \text{ GPY}$$

ANNUAL FUEL COST = 177400 GPY x $.5128/GAL = $ $94000 / yr
+$3028 (No. #2 F.O.)

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF TOTAL REPLACEMENT COST

.05 x $ 216350 = $ 10,800 / YEAR

*ANNUAL FUEL USE - AMMO FACILITY

4500 GPY #2 F.O.   SETBACK = 190 MBTU

$$4500 - \frac{190{,}000{,}000}{138{,}700} = 3130 \text{ GPY} \times \$.9675 = \$\,3028$$

BLDG # 718, CONT.

310 Hp Boilers (3)

FD FAN ~ 10 Hp EACH
OIL Pump ~ 1/2 Hp "
AIR ATOM Comp. ~ 3 Hp "
AIR ATOM Oil Pump ~ 1/2 Hp "
BFP's ~ 5 Hp "
COND PUMPS ~ 1 Hp "
MISC. ~ 5 Hp "

25 Hp ÷ 1.341 Hp/Kw = 18.6 Kw/BOILER

Assume (1) 310 Hp Boiler uses 18.6Kw at full load; from 0-25% load (1) 310 Hp Boiler uses 67% x 18.6 = 12.5 Kw; at 25-50% load, 80% x 18.6 = 14.9 Kw; Above 50% load, the boiler uses 18.6 Kw/Boiler

MONTH	AVG HOURLY STEAM DEMAND	% LOAD (310 Hp BLRS)	Kw	Kwh
JAN	5583	53.2	18.6	13838
FEB	6326	60.2	18.6	12499
MAR	4767	45.2	14.9	11086
APRIL	4116	39.2	14.9	10728
MAY	2844	27.1	14.9	11086
JUNE	1286	12.2	12.5	9000
JULY	1165	11.1	12.5	9300
AUG	1196	11.4	12.5	9300
SEPT	1831	17.4	12.5	9000
OCT	2905	27.7	14.9	11086
NOV	4404	41.9	14.9	10728
DEC	5237	49.9	14.9	11086
			TOTAL	128737 Kwh

BLDG # 718, CONT.

ELECTRIC DEMAND RATE

PEAK DEMAND = 12,980 lb/HR

(2) 310 Hp Boilers req'd at peak, one at 90% load AND ONE AT 33% LOAD ⇒ KW REQ'D WOULD EQUAL

18.6 KW + 14.9 KW = 33.5 KW

ElECTRIC DEMAND RATE = 34 KW

BOILER REPLACEMENT COST

KEWANEE "SCOTCH MARINE" TYPE, OIL-FIRED, FIRETUBE BOILER, RATED AT 310 Hp, 50 PSIG, UNIT # 300, Complete : $ 46,500 EACH

ADD 20% for installation of new boilers $ 9300

Add 10% for demolition of existing boilers $ 4650

TOTAL INSTALLED COST for (1) new 310 Hp Boiler = $ 60,450

TOTAL COST for	(3) Boilers @ 60,450	=	181,350
	(1) Deaerator @ 20,000	=	20,000
	(3) BFP's @ 5,000	=	15,000
			$ 216,350

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SUBJECT SEAD-NORTH BASE
"OPTION 2" Elec. CONSUMPTION
DESIGNER S COWEN
CHECKER

AEP NO
SHEET OF
DATE
DATE

	AVG HOURLY SYSTEM DEMAND lb/HR (1)	TOTAL AVG HOURLY SYST. DEMAND - #718 lb/HR (2)	TOTAL AVG HOURLY SYST DEMAND - New Coal Plant lb/HR (3)
JAN	4505	5583	6707
FEB	5104	6326	7599
MAR	3846	4767	5726
APRIL	3321	4116	4945
MAY	2295	2844	3417
JUNE	1038	1286	1545
JULY	940	1165	1400
AUG	965	1196	1437
SEPT	1477	1831	2200
OCT	2344	2905	3489
NOV	3553	4404	5291
DEC	4225	5237	6291
PEAK =	10473		

(1) BASED ON Bldg #718 Fuel Records, Excluding Bldg 714, Ammo Facility, New Barracks, Tennis bubble, AND the exclusion Area Addition

(2) EXISTING SYSTEM (718) plus Allowance for 714, Ammo Facility, New BARRACKS, & TENNIS Bubble BASED ON RATIO of New BLDG PEAK (2507 lb/hr) TO EXISTING SYSTEM PEAK (10473 #/HR) = 0.2394

(3) EXISTING SYSTEM (718) plus 714, AMMO FACILITY, New BARRACK, TENNIS Bubble & exclusion Area Bldgs (729, 803, 805, 810, 812) Based on Ratio of Excl. Area PEAK (1958 lb/HR) plus Central Plant load (655 lb/HR) TO existing + 718 peak (12980 lb/hr) = 0.2013

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SUBJECT SEAD - NORTH BASE
BASE CASE
DESIGNER S Loven
CHECKER

AEP NO 80122-000
SHEET ____ OF ____
DATE
DATE

BUILDING: TENNIS BUBBLE DESCRIPTION: ______

1.	EQUIPMENT NAME	Heating only			
2.	DESCRIPTION	Applied Air [illegible] 02-LIF-[illegible] 1x10⁶ BTU/HR [illegible] BTU/HR			
3.	CONDITION AS OF OCT. 1980	EXCELLENT			
4.	CURRENT AGE	[illegible] yrs			
5.	LIFE EXPECTENCY	20 YRS.			
6.	REPLACEMENT COST (DEC '80 $)	$ 9300 QUOTE FROM Applied Air [illegible]			

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 8900

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 465

10. ANNUAL ELECTRICAL CONSUMPTION 1831 Kwh

11. ELECTRICAL DEMAND RATE -0-

TENNIS BUBBLE

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 12,300 GAL/YR #2 F.O.

SETBACK SAVINGS = 430 MBTU

$$\text{Annual Fuel Use} = 12{,}300 \frac{GAL}{YR} - \frac{430\,000\,000 \text{ BTU/YR}}{138{,}700 \text{ BTU/GAL}}$$

$$= 9200 \text{ GAL/YR}$$

ANNUAL FUEL COST = 9200 GPY x $.9675/GAL = $8900/YR

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF REPLACEMENT COST

.05 x $9300 = $465/YR

ANNUAL ELECTRICAL CONSUMPTION

ASSUME 1/2 HP BLOWER

$$\frac{1/2 \text{ HP}}{1.341 \text{ HP/KW}} = 0.373 \text{ KWH} \times 4910 \frac{\text{HRS}}{\text{YR}} = 1831 \text{ KWH/YR}$$

ELECTRICAL DEMAND RATE

0 KW

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SUBJECT SEAD ~ NORTH BASE
BASE CASE
DESIGNER Slovers
CHECKER

AEP NO 80122-000
SHEET ______ OF ______
DATE ______
DATE ______

BUILDING: 729 DESCRIPTION: ______

1. EQUIPMENT NAME	STEAM BOILER			
2. DESCRIPTION	WEIL-McLAIN			
3. CONDITION AS OF OCT. 1980	Blr located in [illegible] locked [illegible] - it appears to be in excellent shape			
4. CURRENT AGE	5 yrs			
5. LIFE EXPECTENCY	[illegible] yrs			
6. Replacement Cost (Dec '80 $)	$ 2418			

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 3164

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 122

10. ANNUAL ELECTRICAL CONSUMPTION 1219 Kwh

11. ELECTRICAL DEMAND RATE — 0 —

BLDG 729

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 5000 GAL/HR #2 F.O.

SETBACK SAVINGS = 240 M BTU

$$\text{ANNUAL FUEL USE} = 5000 \text{ GPY} - \frac{240{,}000{,}000 \text{ BTU}}{138{,}700 \text{ BTU/GAL}} = 3270 \text{ GPY}$$

ANNUAL FUEL COST = 3270 GPY x \$.9675/GAL = \$3164

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF REPLACEMENT COST

.05 x \$2448 = \$122/YR

ANNUAL ELECTRICAL CONSUMPTION

1/3 Hp BLOWER

$$\frac{1/3}{1.341 \text{ Hp/Kw}} = 0.248 \text{ Kwh} \times 4910 \frac{\text{hrs}}{\text{YEAR}} = 1219 \text{ Kwh/YR}$$

ELECTRICAL DEMAND RATE

0 KW

BUILDING: 802 DESCRIPTION: ____

1. EQUIPMENT NAME	steam Boiler			
2. DESCRIPTION	Assume Well-maint. 250 # Hhr			
3. CONDITION AS OF OCT. 1980	–			
4. CURRENT AGE	Assume 5 yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$ 2448			

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 2050

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 122

10. ANNUAL ELECTRICAL CONSUMPTION 1219 Kwh/YR

11. ELECTRICAL DEMAND RATE – 0 –

BLDG 802

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 3200 GAL/YR #2 F.O.

SETBACK SAVINGS = 150 M BTU

$$\text{ANNUAL FUEL USE} = 3200 \text{ GPY} - \frac{150{,}000{,}000 \text{ BTU}}{138{,}700 \text{ BTU/GAL}} = 2119 \text{ GPY}$$

ANNUAL FUEL COST = 2119 GPY × $.9675/GAL = $2050

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF REPLACEMENT COST

.05 × $2448 = $122

ANNUAL ELECTRICAL CONSUMPTION

1/3 Hp Blower (see Bldg #729)

1219 Kwh/YR

ELECTRICAL DEMAND RATE

0 KW

BUILDING: 805 DESCRIPTION:

1. EQUIPMENT NAME	steam boiler			
2. DESCRIPTION	assume Weil-McLain 250 #/HR			
3. CONDITION AS OF OCT. 1980	—			
4. CURRENT AGE	Assume 5yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$ 2448			

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 2394

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 122

10. ANNUAL ELECTRICAL CONSUMPTION 1219 Kwh/hr

11. ELECTRICAL DEMAND RATE -0-

BLDG 805

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 3700 GAL/YR #2 F.O.

SETBACK SAVINGS = 170 MBTU

$$\text{ANNUAL FUEL USE} = 3700 \text{ GPY} - \frac{170{,}000{,}000 \text{ BTU}}{138{,}700 \text{ BTU/GAL}} = 2474 \text{ GPY}$$

ANNUAL FUEL COST = 2474 GPY x $.9675/GAL = $2394

ANNUAL MAINTENANCE COST

Assume as 5% of replacement cost

.05 x $2448 = $122/YR

ANNUAL ELECTRICAL CONSUMPTION

1/3 Hp Blower (See Bldg #729)

1219 Kwh/YR

ELECTRICAL DEMAND RATE

0 KW

BUILDING: 810 DESCRIPTION:

1. EQUIPMENT NAME	Steam Boiler			
2. DESCRIPTION	Assume Wall-mt/min 1000#/HR			
3. CONDITION AS OF OCT. 1980	—			
4. CURRENT AGE	Assume 5 yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$8075			

7. ANNUAL OPERATING COST, (DEC. '80 $) $0
8. ANNUAL FUEL COST, (DEC. '80 $) $11362
9. ANNUAL MAINTENANCE COST, (DEC '80 $) $404
10. ANNUAL ELECTRICAL CONSUMPTION 1831 Kwh/YR
11. ELECTRICAL DEMAND RATE -0-

BLDG 810

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 17,800 GAL/YR #2 F.O.

SETBACK SAVINGS = 840 MBTU

ANNUAL FUEL USE = $17800 \text{ GPY} - \frac{840{,}000{,}000 \text{ BTU}}{138{,}700 \text{ BTU/GAL}} = 11744 \text{ GPY}$

ANNUAL FUEL COST = 11744 GPY x $.9675/GAL = $11362

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF REPLACEMENT COST

.05 x $8075 = $404

ANNUAL ELECTRICAL CONSUMPTION

1/2 HP BLOWER

$\frac{1/2 \text{ HP}}{1.341 \text{ HP/KW}} = 0.373 \text{ KWH} \times 4910 \frac{\text{HRS}}{\text{YR}} = 1831 \text{ KWH/YR}$

ELECTRICAL DEMAND RATE

0 KW

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SUBJECT SEAD - NORTH BASE
BASE CASE
DESIGNER S Cowen
CHECKER

AEP NO 80122-000
SHEET OF
DATE
DATE

BUILDING: 812 DESCRIPTION:

1. EQUIPMENT NAME	Steam Boiler			
2. DESCRIPTION	Assume well-maintain 1000 #/HR			
3. CONDITION AS OF OCT. 1980	—			
4. CURRENT AGE	Assume 5yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$ 8075			

7. ANNUAL OPERATING COST, (DEC. '80 $) $0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 8597

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 404

10. ANNUAL ElECTRICAL CONSUMPTION 1831 Kwh/YR

11. ElECTRICAL DEMAND RATE — 0 —

BLDG 812

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 13,500 GAL/YR #2 F.O.

SETBACK SAVINGS = 640 MBTU

ANNUAL FUEL USE = $13500 \text{ GPY} - \frac{640{,}000{,}000 \text{ BTU}}{138{,}700 \text{ BTU/GAL}} = 8886 \text{ GPY}$

ANNUAL FUEL COST = 8886 GPY x $.9675/GAL = $8597

ANNUAL MAINTENANCE COST

ASSUME AS 5% OF REPLACEMENT COST

.05 x $8075 = $404

ANNUAL ELECTRICAL CONSUMPTION

1/2 HP BLOWER (See Bldg # 810)

1831 Kwh/yr

ELECTRICAL DEMAND RATE

0 KW

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-000

(Local) L.D. ____ (Placed) Rec'd ____ Date 31 DEC 80

J. McMILLIN Conversed with BOB MEYERS

Of R.M. Meyers Regarding Weil - McLain Boiler
904-387-2743

Asked for life expectancy, electrical requirements and cost for Weil-McLain boilers of 250 lb/hr and 1000 lb/hr size. Fuel is no 2 fuel oil, 15 psi pressure, cast iron.

Life expectancy of cast iron boilers is 15-20 years.

A 1000 lb/hr. boiler, model PL-686-SF, would cost $6700 has 1/2 hp blower motor.

A 250 lb/hr. boiler, model P-766, would cost $1533, has less than 1/3 hp blower motor.

Distribution:

RS&H FORM 102 11/72

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: | ESTIMATOR: Slowen | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
WEIL-McLAIN Boilers							
15 PSI - CAST IRON - #2 F.O.							
250#/HR labor	40	HR	22.87	915	–	–	915
MAT	1	–	–	–	1533	1533	1533
TOTAL							$2448
1000#/HR labor	60	HR	22.87	1375	–	–	1375
MAT	1	–	–	–	6700	6700	6700
TOTAL							$8075

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

Applied Air Systems, Inc. 31 DEC 80

612-646-9631
St. Paul, Minn.
#2 Fuel oil
Model 02-LIF-100 V
1980 cost
Electrical requirements

RL Stone Co,
Syracuse
315-4686221

404-394-7199
Lincoln Assoc.
ATLANTA

Alan Graff

~~#6300~~ [illegible]
+
#15000 [illegible]

#8300
+#1000 labor

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ____ (L.D.) ____ (Placed) ____ Rec'd ____ Date 2 JAN 80

J. McMILLIN ____ Conversed with ____

Of KEWANEE BOILER CORP Regarding Budget costs for Kewanee Boilers 309-853-3541

Compact Type "C" boiler, model #7L285,
199 hp, 15 psig working pressure.
$32,000 complete
Scotch Marine Type, Size 300, 310 hp,
50 psig pressure, $46,500 complete

Distribution:

Savings Due to Setback Control
for Buildings Independent of Boiler Plants

Bldg #	Est. Annual Fuel Use (gal)	Savings (%)	Savings (MBtu)	ADEQUATE controls?	AUTH TEMP
101	8000	0.15 [a]	170	Y	65
103	9200	–	–	–	65
104	7600	–	–	–	65
106	17,100	–	–	–	70
113	17,100	0.56	1330	N	60
114	7,000	0.25	240	Y	50/65
116	4700	0.34	220	Y	65
S-142	16,200	0.65	1460	N	65
710	3400	0.34	160	Y	65
729	5000	0.34	240	Y	65
802	3200	0.34	150	Y	65
~~804~~					~~65~~
805	3700	0.34	170	Y	65
806	4200	0.34	200	Y	65
807	4,300	0.34	200	Y	65
810	17,800	0.34	840	Y	60/65
812	13,500	0.34	640	Y	65
813	7,900	0.34	370	Y	65
814	3,500	0.30	150	Y	60
815]					65
816]	25,200	0.34	1190	Y	65
817	3,200	0.34	150	Y	60/65
819	10,300	0.34	490	Y	65
825	1,800	0.20	50	Y	50
TENNIS BUBBLE	12,300	0.25	430		

continued

Savings Due to Setback - Boiler Plant # 718

Bldg #	Est. Annual #6 Fuel Use (gal)	Savings (%)	Savings (MBtu)	Adequate Controls?	AUTH TEMP SET
701	13,100	0.52[a]	1020	N	65
702	18,700	—	—	N	65
704	27,700	—	-	N	65
705	5,000	0.26	200	N	65
706	5,900	0.65	580	N	65
707	14,800	0.26	580	N	65
708	27,700	—	-	N	65
714	7,300	0.20	220	Y	65
718	10,100	—	—	—	—
719	1,900	0.65	190	N	50
720	9,600	0.30[b]	430	N	50/65
~~721~~	~~1,100~~	~~0.50~~	~~80~~		
722	7,100	0.59	630	N	50/65
723	41,200	0.54	3340	N	60/65
724	12,600	0.52	980	N	65
731	1,100	—	—	Y	65
732	2,600	0.52	200	N	65
NEW BKS	25,900	—	—	—	65
TOTALS	233,200		8370		

[a] Calculated, remainder were extrapolated from calculation results on similar buildings

[b] partitioning required

Savings Due to Setback for Bldgs.
Independent of Central Boiler Plants (Cont.)

Bldg #	Est Annual Fuel Use (#2 gal)	Savings (%)	Savings (MBtu)	AOQ. CONT.?	AUTH TEMP
Ammo MAINT.	4,500	30	190	Y	60
Vehicle MAINT.	2,500	30	100	Y	60
SUBTOTAL 2	7,000		290		
TOTAL	213,200		9140		

OPTION 2 SENECA NORTH

CENTRAL COAL-FIRED STEAM PLANT

ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

BENEFICIAL OCCUPANCY DATE JAN '85

ECONOMIC LIFE 25 YEARS

DATE OF ESTIMATE DEC '80 $

INITIAL COST $ 3,168,037

ANNUAL MAINTENANCE COSTS

OPERATIONS (labor) $ 170,416
MAINTENANCE MATERIAL $ 83,954
} TOTAL = $ 254,370

CYCLICAL MAINTENANCE COSTS

1) EXISTING PIPING WILL BE REPLACED IN 1996 & 2021 AT A COST OF $ 366,249 IN DEC '80 $

2) SYSTEMS WILL BE REPLACED AFTER 25 YRS (2010) AT A TOTAL REPLACEMENT COST OF $ 2,442,396 IN DEC '80 $

ANNUAL FUEL COST

COAL → 1295 TONS @ $ 54/TON = $ 69,930

ANNUAL ELECTRICAL CONSUMPTION 516,264 Kwh

ELECTRICAL DEMAND RATE 69 KW

SECTION I-2

CAPITAL COST ESTIMATE

OPTION TWO

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: Slaven

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280,478	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
ROAD WORK & CIVIL SITE PREP				—		27500	27,500
BLDG COND RETURN SYSTEMS				3660		16185	19,845
STM PLANT COND COLL. SYST.				1292		4385	5677
MAKEUP WATER SOFTENERS				366		1600	1966
FOUNDATIONS				—		166100	166,100
ELECTRICAL				123,000		123,000	246,000
INSTR. & CONTROL (MISC.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				421033		682350	1103383
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		34118	34118
SUB-TOTAL							1230128
OVERHEAD & PROFIT	25%						307532
BOND	1%						15377
SUB-TOTAL							1553037
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1615000
~~ENGINEERING & DESIGN~~	~~6%~~						~~140082~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~$3358119~~

$3,168,037

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD-NORTH BASE "OPTION 2" Elec. CONSUMPTION
AEP NO 50122-000
SHEET ____ OF ____
DESIGNER SCOWEN
DATE ____
CHECKER ____
DATE ____

	AVG HOURLY SYSTEM DEMAND lb/HR (1)	TOTAL AVG HOURLY SYST. DEMAND - #718 lb/HR (2)	TOTAL AVG HOURLY SYST DEMAND - New Coal Plant lb/HR (3)
JAN	4505	5583	6707
FEB	5104	6326	7599
MAR	3846	4767	5726
APRIL	3321	4116	4945
MAY	2295	2844	3417
JUNE	1038	1286	1545
JULY	940	1165	1400
AUG	965	1196	1437
SEPT	1477	1831	2200
OCT	2344	2905	3489
NOV	3553	4404	5291
DEC	4225	5237	6291
PEAK =	10473		

(1) BASED ON Bldg # 718 Fuel Records, Excluding Bldg 714, Ammo Facility, New Barracks, Tennis bubble, AND the exclusion Area Addition

(2) EXISTING SYSTEM (718) plus Allowance for 714, Ammo Facility, NEW BARRACKS, & TENNIS Bubble BASED ON RATIO of NEW BLDG PEAK (2507 lb/HR) TO EXISTING SYSTEM PEAK (10473 #/HR) = 0.2394

(3) EXISTING SYSTEM (718) plus 714, AMMO FACILITY, NEW BARRACK, TENNIS Bubble & exclusion Area Bldgs (729, 802, 805, 810, 812) Based on Ratio of EXCL. AREA PEAK (1958 lb/HR) plus CENTRAL Plant load (655 lb/HR) TO existing + 718 peak (12980 lb/HR) = 0.2013

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SENECA - CENTRAL COAL PLANT
AEP NO 80122.000.
SHEET ____ OF ____
DESIGNER J. McMILLIN
DATE
CHECKER S [signature]
DATE

NORTHBASE

ELECTRICAL CONSUMPTION (1) 8500 lb/hr boiler uses 68.6 kW electricity at full load. From 0-25% load, assume boiler uses 67% of full load electrical. 25-50% load → 80%. Above 50% load, assume 100%.

	AVG. HOURLY STEAM DEMAND (lb/hr)	BOILER SIZE (lb/hr)	KW	KWH
JAN	6707	(1) 8500	69	51,336
FEB	7599	"	69	46,368
MARCH	5726	"	69	51,336
APRIL	4945	"	69	49680
MAY	3417	"	55	40920
JUNE	1545	"	46	33,120
JULY	1400	"	46	34,224
AUG	1437	"	46	34,224
SEPT	2200	"	46	33,120
OCT	3489	"	55	40920
NOV	5291	"	69	49,680
DEC	6291	"	69	51,336
			TOTAL	516,264 kwh

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA- CENTRAL COAL PLANT
AEP NO 80122-003
SHEET ___ OF ___
DESIGNER: J. McMILLIN
DATE ___
CHECKER: S. Cowen
DATE ___

YEARLY FUEL COST

NORTHBASE

BLDG	#2 FUEL OIL (GAL)	#6 F.O. (GAL)	FUEL USAGE BEFORE SETBACK (MBtu)	SETBACK SAVINGS (MBtu)	FUEL USAGE AFTER SETBACK (MBtu)
718	—	200,000	30,000	8150	21850
729	5000	—	694	240	454
802	3200	—	444	150	294
805	3700	—	513	170	343
810	17,800	—	2469	840	1629
812	13,500	—	1872	640	1232
714	—	7300	1095	220	875
AMMO	4500	—	624	100	524
TENNIS	12,300	—	1706	430	1276
NEW BKS		25900	3885	—	3885
				TOTAL	32362 MBtu/yr

OR #6 F.O. 26610 MBtu

& #2 F.O. 5752 MBtu

COAL USAGE

$$\frac{32362\ (10^6)}{12,500\ (2000)} = 1295 \text{ tons/yr}$$

@ \$54/ton = \$69930 DEC 1980 COST

SUBJECT SEAD ~ NORTH BASE | AEP NO 80122-000

REYNOLDS SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SHEET ___ OF ___

DESIGNER S COWEN | DATE

CHECKER | DATE

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$ 23,150
2. BOILER PLANT OPERATOR	4	$ 21,038	$ 84,152
3. COAL EQUIPMENT OPERATOR	1	$ 21,038	$ 21,038
4. HEATING EQUIPMENT MECHANIC	2	$ 21,038	$ 42,076

TOTAL = $ 170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC'80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 83954
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 254370

REPLACEMENT COST AFTER 25 YEARS

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: Slowen

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280,478	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
Bldg Cond Return Systems				3660		16,185	19,845
Stm Plant Cond Coll. Syst.				1292		4385	5677
Makeup Water Softeners				366		1600	1966
Electrical				123,000		123000	246000
Instr. & Control (misc.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				421033		488750	909783
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		24438	24438
SUB-TOTAL							1026848
OVERHEAD & PROFIT	25%						256712
BOND	1%						12836
SUB-TOTAL							1296396
Boilers, Auxiliaries, Fuel Handling Equip., etc	(Lump Sum Installed)						1146000
ENGINEERING & DESIGN	6%						
TOTAL ESTIMATED 25TH YEAR REPLACEMENT COST (DEC 1980 $)							$2,442,396

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 19__

REPLACEMENT OF EXISTING PIPING ~ 1996 & 2021

CONSTRUCTION COST ESTIMATE

DATE PREPARED	SHEET OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS	BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)
LOCATION: SENECA ARMY DEPOT – NORTH BASE	
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.	
DRAWING NO.: EXISTING PIPING REPLACEMENT	ESTIMATOR: S Cowen; CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SAles TAX	5%			—		9361	9361
SubTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 1984 DOLLARS)							$ 366,249

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE 1959 O—510168

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

OVERHEAD PIPING

				ADD 20% FOR LOOPS	ADD 10% FOR FITTINGS	TOTA
6"	S	210'	210'	40	25	27
2½"	C	210'+40'+20'+50'	320'	60	40	42
1¼"		40'+50'+80'	170'	35	20	22
4"		260'+110'	370'	75	45	49
2"		260'+110'+80'	450'	90	60	60
3"		130'+110'	240'	50	30	32
1½"		130'+110'	240'	50	30	32

BURIED PIPING

8"	300'+200'+210'	710'	140	90	9
4"	300'+200'+30'+210'+280'+170'	1190'	240	150	15
2"	30'+280'+170'	480'	100	60	6
6"	540'+250'+290'+100'	1180'	240	150	[illegible]
2½"	540'+250'+120'+290'+30'+100'	1330'	270	160	17
1¼"	120'+30'	150'	30	20	2
3"	80'	80'	20	10	11
1½"	80'	80'	20	10	11

ASSUMPTIONS

1. Material Cost per attached sheet, same for buried or overhead
2. Labor Cost per attached sheet for installation
3. Labor Cost for demolition of existing piping = 60% x labor cost for installation

Cost for 1¼" same as for 1½"

PIPE SIZE/SCH	PIPE COST ($/20')	INSULATION COST ($/20')	LABOR COST			TOTAL COST			
			WELDING	FITTING (Per 20')		Per 20'		Per Ft	
			Per Joint	Overhead	In Trench	Overhead	In Trench	Overhead	In Trench
1/80	36.38	121.00	24.01	15.44	13.40	196.83	194.79	9.84	9.74
1½/80	54.39	127.60	26.30	17.42	15.13	225.71	223.42	11.29	11.17
2/40	44.68	141.20	28.59	19.41	16.86	233.88	231.33	11.69	11.57
2½/40	57.68	182.60	75.47	21.88	19.03	337.63	334.78	16.88	16.74
3/40	72.80	237.40	82.33	24.86	21.62	417.39	414.15	20.87	20.71
4/40	103.48	277.80	105.20	29.84	25.94	516.32	512.42	25.82	25.62
6/40	178.33	442.40	144.08	41.77	36.32	806.58	801.13	40.33	40.06
8/40	257.99	558.00	178.39	52.22	47.13	1046.60	1041.51	52.33	52.08
10/40	356.54	656.00	214.98	70.14	60.97	1297.66	1288.49	64.88	64.42

NOTES

1. Cost does not include
   a) Pipe Rack or Trench
   b) Fittings and Valves
   c) Contingency, bond or sales tax
   d) Protective Conduit
2. Cost of Labor to Owner
   a) Pipefitter 21.62 $/hr
   b) Welder 22.87 $/hr

3. Insulation Cost includes

SOURCES

1. Pipe Cost – Manufacturer quote *
2. Insulation Cost – 1979 Richardson's
3. Pipe fitting and Welding – Man-hours from 1979 Richardson's
   a) 1" thru 2" Sockotweld and 2½" up Buttweld
   b) 1" and 1½ are A-106
   2" and up are A-53

SENECA NORTH BASE

1. **McBURNEY CORP.** THREE (3) B&W FM TYPE STEAM GENERATORS, EACH RATED AT 8,500 lb/HR AND FIRED ON STOKER SIZE (1¼x0) 12,500-13,000 BTU/lb EASTERN BITUMINUOUS COAL, AT 50 psig, SAT.; complete with: boilers, boiler trim, combustion controls, deaerator, boiler feed pumps (3), Ash removal system, baghouse, stacks, fuel handling equipment including three (3) 25-TON Storage silo's, in-ground truck unloading hopper with a screw feeder, bucket elevator, insulated prefabricated building and enclosure. $1,650,000

ADD TO McBURNEY QUOTE

80' Long Drag chain conveyor & two 12"x12" gate valves $31,650

TOTAL McBURNEY COST $1,681,650

2. **HURST BOILER CO.** Three (3) HRT STEAM GENERATORS RATED AT 8625 lb/HR EACH to be fired on stoker size 12,500-13,000 BTU/lb Eastern Bituminous Coal at 50 PSIG, SAT.; complete with: boilers, boiler trim, stokers, feed hoppers, combustion & pollution control equipment, cond. return system, boiler feed pumps. Does not include coal unloading & handling equipment, structural steel, deaerator, or the boiler enclosure $970,000

ADD TO HURST QUOTE

DEAERATOR: $12,500
material handling equipment: $98,600
structural & bldg enclosure: $469,000

TOTAL HURST COST $1,550,100

McBURNEY COST: $ 1,681,650

HURST COST: $ 1,550,100

Average $ 1,615,875

USE $ 1,615,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT
INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION
SEAD-NORTH BASE

ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR Slower

CHECKED BY

MATERIAL HANDLING ~~EQUIPMENT~~ SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
25 Ton Storage Bunker	3	EA	2143	6429	7175	21525	27954
Gate Valves 12" x 12"	2	EA	45	90	780	1560	1650
Drag Chain Conveyor	80	Ft	50	4000	325	26000	30,000
Bucket Elevator	85	Ft	50	4250	250	21250	25,500
Screw Feeder	10	Ft	50	500	200	2000	2,500
Truck Unloading Hopper	1	EA	—	—	11000	11,000	11,000
							$ 98604
SUB-TOTAL							
Equipment Req'd for Firing Supplemental Fuel							
5 Ton Storage Bunkers	2	EA	720	1440	2409	4818	6258
Gate Values 12" x 12"	2	EA	45	90	780	1560	1650
Diverting Valves	2	EA	90	180	1460	2920	3100
Sub-TOTAL							

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

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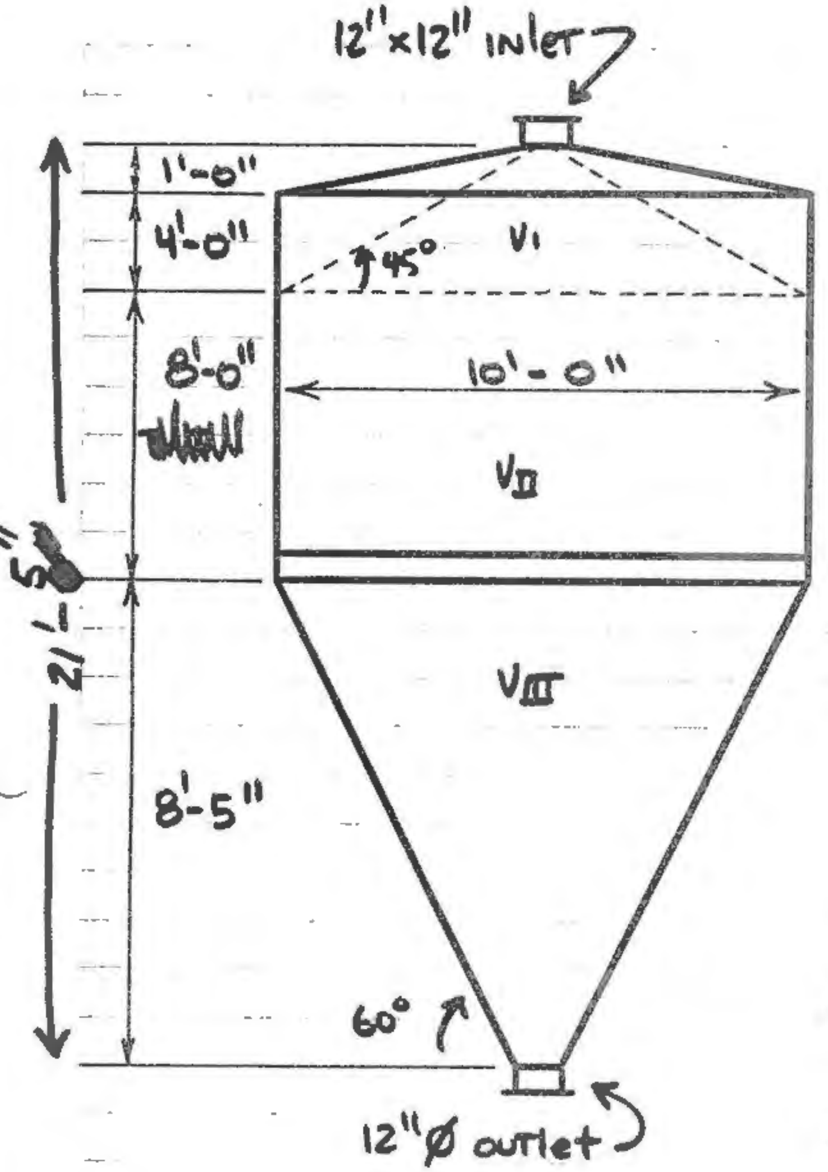
NORTH BASE 25 TON BUNKERS



$$\frac{25\ \text{Tons}}{50\#/\text{Ft}^3} = 1000\ \text{Ft}^3$$

$$V_I + V_{II} + V_{III} = 1000\ \text{Ft}^3$$

$$V_I = \frac{1}{3}\pi R^2 h = \frac{\pi}{3}(5)^2(5)$$

$$V_I = 130.9\ \text{FT}^3$$

$$V_{III} = \frac{\pi}{3} h (R_1^2 + R_2^2 + R_1 R_2)$$

$$= \frac{\pi}{3} \times 8.417 \left(25 + (.5)^2 + .5 \times 5\right)$$

$$V_{III} = 244.6\ \text{Ft}^3$$

$$V_{II} = 1000 - 244.6 - 130.9$$

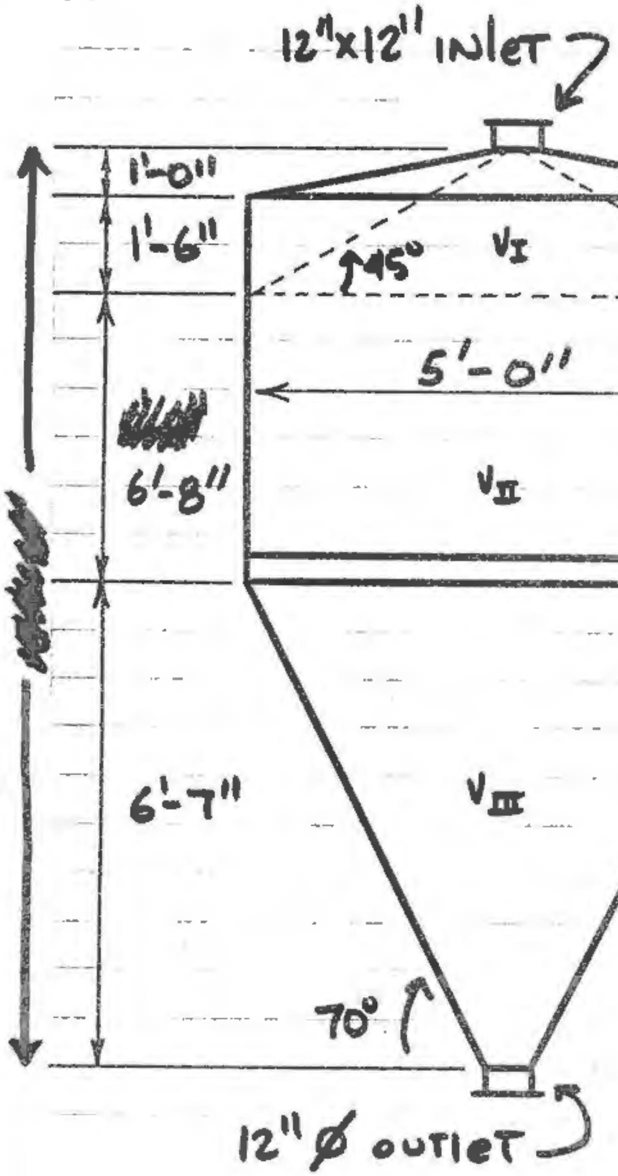
$$= 624.5\ \text{Ft}^3$$

$$h_{II} = \frac{624.5}{\pi \frac{(10)^2}{4}} = 7.95 = 8'\text{-}0"$$

surface AREA = 609 Ft^2
ρ = 15.3 $\#/\text{Ft}^2$ weight = 9318 lbs

material cost = \$.77/lb = \$ 7175
labor cost = \$.23/lb = \$ 2143

NORTH BASE
5 TON BUNKERS



$$\frac{5 \text{ TONS}}{50 \ \#/Ft^3} = 200 \ Ft^3$$

$$V_I + V_{II} + V_{III} = 200 \ Ft^3$$

$$V_I = \frac{1}{3}\pi \frac{D^2}{4}h = \frac{\pi}{3} \times \frac{5 \times 5}{4} \times 2.5 = 16.4 \ Ft^3$$

$$V_{III} = \frac{1}{3}\pi h \left(R_1^2 + R_2^2 + R_1 R_2\right)$$

$$= \frac{\pi}{3} \times 6.58 \left(2.5^2 + .5^2 + 2.5 \times .5\right)$$

$$= 53.4 \ Ft^3$$

$$V_{II} = 200 - 53.4 - 16.4 = 130.2 \ Ft^3$$

$$h_{II} = \frac{130.2}{\frac{\pi (25)}{4}} = 6.63 = 6'\text{-}8''$$

Surface Area = 204.5 Ft^2

ρ = 15.3 $\#/Ft^2$ WEIGHT = 3129 lbs

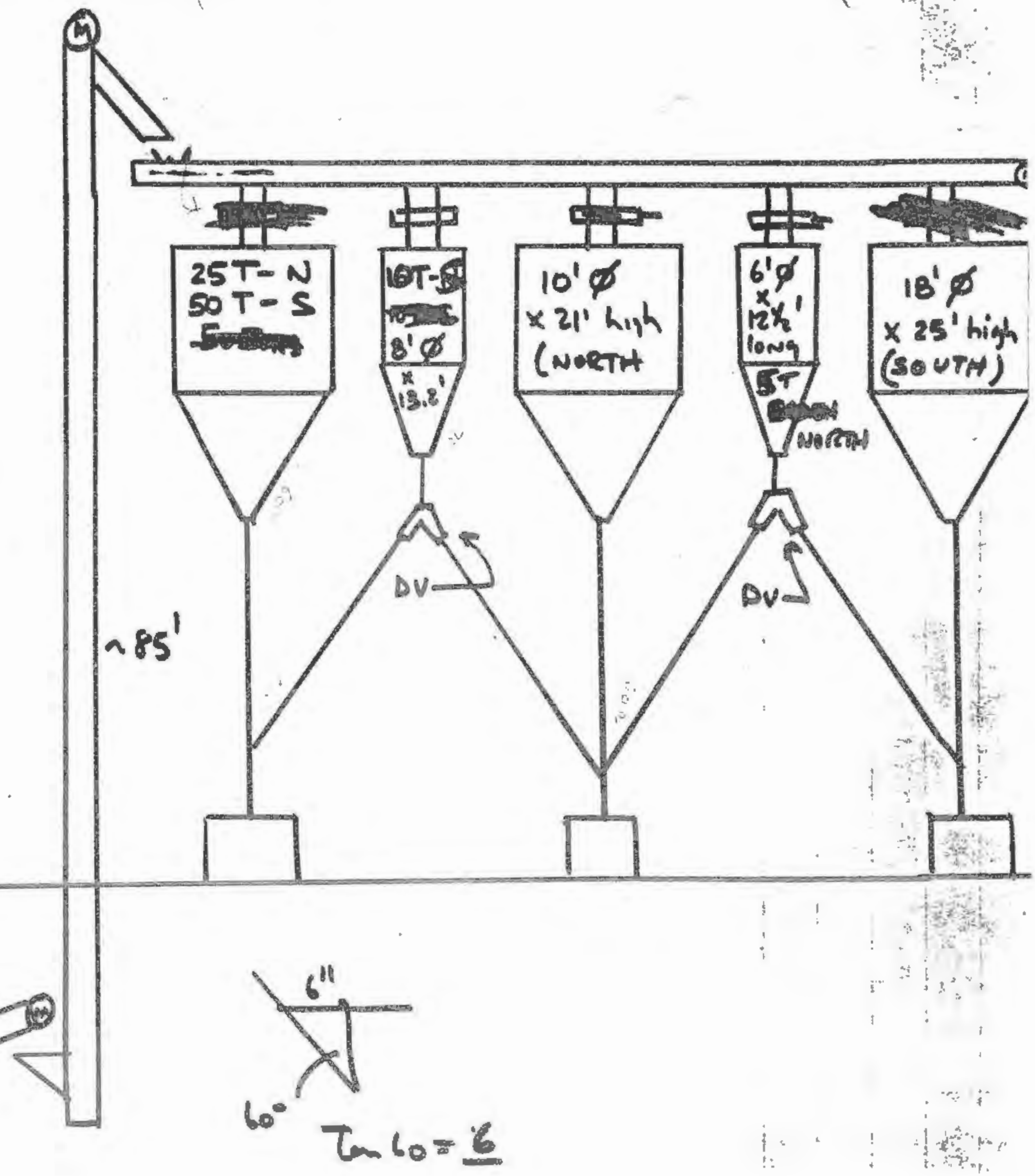
material cost = \$.77/lb = \$2409

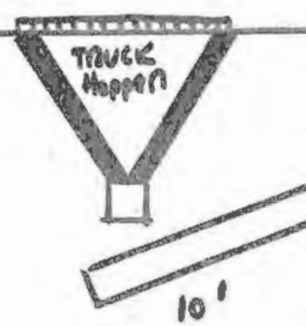
labor cost = \$.23/lb = \$720

North Base 8 TPD
South Base 17 TPD

Budgetary Cost
: Bucket Elevator # 250/Ft
Screw Conveyor # 200/Ft
: Drag Chain # 325/Ft

rag Chain 80' x #325/Ft = #26,000
ucket 85' x 250/Ft = # 21,250
rew 10' x 200/Ft = # 2,000
ite Values
uck hopper





REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD-NORTH BASE AEP NO 80122-000
SHEET 1 OF 4
DESIGNER S COWEN DATE
CHECKER DATE

APPROXIMATE the sizes of the motors ASSOCIATED with THE BOILER PLANT

BOILER CAPACITY – 8,500 #/HR

Fuel to be burned – Eastern Bituminous, 12,500-13000 BTU/lb, Vol. Matter ~ 30-35%

Theoretical Air Req'd – Approx 7.6 #/10,000 BTU's Fuel

At 50 PSIG, SAT., Steam OUTPUT & 5 PSIG, SAT., Feedwater INPUT, $\Delta h = 982.83$ Btu/lb

$$\text{Fuel Req'd} = \frac{8{,}500\ \#/\text{HR} \times 982.83\ \text{BTU/lb}}{.70\ (\text{Efficiency})} = 11.93 \times 10^6\ \text{BTU/HR}$$

$$\text{Theoretical Air Req'd} = 7.6\ \#/10^4\ \text{BTU} \times 11.93 \times 10^6\ \text{BTU/HR} = 9070\ \#/\text{HR}$$

ASSUME 30% EXCESS AIR

TOTAL AIR REQ'D = 9070 × 1.3 = 11,800 lb/HR

ASSUME OFA FAN PROVIDES 15% = 1770 lb/HR
FD FAN PROVIDES 85% = 10,030 lb/HR
ID FAN Handles 100% = 11,800 lb/HR

OFA FAN Assume 60 F Temp in boiler house ⇒ $\rho = .0764\ \#/\text{Ft}^3$
$\Delta P = 15''$

$$\text{Flow} = \frac{1770\ \text{lb/HR}}{.0764\ \text{lb/Ft}^3 \times 60\ \text{MIN/HR}} \times 1.2\ (\text{Safety Factor}) = 463.4\ \text{CFM}$$

Hp REQ'D = $\frac{0.0158 \times 463.4 \times 15}{67.5}$ = 1.63 × 1.15 (SERVICE FACTOR) = 1.87

USE 2 Hp MOTOR ✓

FD FAN

Flow = $\frac{10030}{.0764 \times 60}$ × 1.2 = 2625.7 CFM

Hp = $\frac{.0158 \times 2625.7 \times 15}{67.5}$ = 9.21 × 1.15 = 10.6

USE 15 Hp MOTOR ✓

ID FAN

T = 350 F ρ = .049 #/ft³ ΔP = 20"

Flow = $\frac{11800}{.049 \times 60}$ × 1.2 = 4816 CFM

Hp = $\frac{.0158 \times 4816 \times 20}{67.5}$ = 22.5 × 1.15 = 25.9 Hp

USE 30 Hp MOTOR ✓

BOILER FEED PUMPS

Size each pump for max peak demand = 15593 lb/HR = 31 GPM

HEAD REQ'D = (50 psig - 5 psig) x 2.448 + 20' = 130.2'

$$\text{Hp REQ'D} = \frac{31 \times \frac{130.2}{2.448}}{1714 \times .65} = 1.48 \times 1.15 = 1.7 \text{ Hp}$$

USE 2 Hp MOTORS ✓

CONDENSATE TRANSFER PUMPS

Size each pump for max peak demand = 31 GPM

Head REQ'D = 5 psig x 2.395 + 20' = 32'

$$\text{Hp REQ'D} = \frac{31 \times \frac{32}{2.395}}{1714 \times .65} = 0.37 \times 1.15 = 0.43 \text{ Hp}$$

USE 1/2 Hp Motors ✓

MATERIAL HANDLING EQUIPMENT

SCREW FEEDER AT TRUCK UNLOADING HOPPER	~ 5 Hp
BUCKET ELEVATOR	~ 15 Hp
DRAG CHAIN CONVEYOR	~ 10 Hp
Coal Screw Feeder ~ 1 per boiler	~ 7½ Hp
Ash Screw Feeder ~ 1 per boiler	~ 5 Hp

SUMMARY

THREE (3) 8,500 #/HR BOILERS

		TOTAL IN BOILER PLANT
OFA FAN (1 per boiler)	2 Hp	6 Hp
FD FAN (1 per boiler)	15 Hp	45 Hp
ID FAN (1 per boiler)	30 Hp	90 Hp
BOILER FEED PUMPS (3)	2 Hp	6 Hp
COND. TRANS. PUMPS (2)	½ Hp	1 Hp
COAL SCREW FEEDER (1 per boiler)	7½ Hp	22½ Hp
ASH SCREW FEEDER (1 per boiler)	5 Hp	15 Hp
SCREW FEEDER AT HOPPER (1)	5 Hp	5 Hp
BUCKET ELEVATOR (1)	15 Hp	15 Hp
DRAG CHAIN CONVEYOR (1)	10 Hp	10 Hp

REYNOLDS, SMITH AND HILLS
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INCORPORATED

SUBJECT SEAD-NORTH BASE AEP NO 80/22-000
SHEET ____ OF ____
DESIGNER SCOWEN DATE ____
CHECKER ____ DATE ____

ELECTRICAL REQUIREMENTS

CASE	MAXIMUM [(3) 8,500 lb/HR]	PEAK [(2) 8,500 lb/HR]	AVG Hourly [(1) 8,500 lb/HR]
OFA FAN	6 Hp	4	2
FD FAN	45	30	15
ID FAN	90	60	30
BFP'S	6	4	2
COND. TR. PUMP	1	1/2	1/2
COAL SCREW FDR	22 1/2	15	7 1/2
ASH SCREW FDR	15	5	5
HOPPER SCREW	5	5	5
BUCKET ELEV.	15	15	15
DRAG CHAIN CONV.	10	10	10
TOTAL Hp	215.5	148.5	92
TOTAL Kw	160.7	110.7	68.6

misc.
lighting

USE 69 Kw
AVG LOADING

SENECA ARMY DEPOT - SOUTH BASE & NORTH BASE

BOILER FOUNDATION (80X100 BLDG)

EXCAVATION : 1110 cy @ $4.24 = $4700

BACKFILL : 850 cy @ $6.36 = $5400

Concrete : 640 cy @ $243.80 = $156,000

TOTAL $166,100

Boiler Enclosure & Structural Steel

STRUCTURAL STEEL : 180 Tons @ $1500/TON = $270,000

GRATING : 4000 Ft² @ $4.24 = $16960

stairs : 100 riser @ $116 = $11,600

handrail : 400 ft @ $15.90 = $6360

TOTAL = $304,920

Say $305,000

ARCHITECTURAL ENCLOSURE $164,000 - 8,000 Ft² @ 20.5/Ft²

TOTAL $469,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [X] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: Slover

CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SITE IMPROVEMENTS							
GRADING	1.6	AC.			3125	5,000	5000
PAVING	1500	SY			15	22,500	22,500
TOTAL						27,500	27,500

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE 1959 O-516160

REYNOLDS, SMITH AND HILLS
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SUBJECT SENECA - CENTRAL COAL PLANT
DESIGNER J. MCMILLIN
CHECKER Slowen

AEP NO 80122-000
SHEET 1 OF
DATE 19 DEC 80
DATE

PLANT BATHROOM FACILITIES

Bathroom to include 2 water closets, 2 showers, 3 lavatories and a drinking fountain

EST. COST

LABOR $4500
MATL. 3500
$8000 TOTAL

ADD $ 750 material
$ 250 labor
} for Roomsize A/C & ventilator for control room

HVAC & PLUMBING

labor $ 4750
material $ 4250

TOTAL $ 9,000

SENECA - NORTH BASE

AVERAGE Hourly DEMAND = 7051 lb/HR

HEAT INPUT REQ'D = $\frac{7051 \frac{lb}{HR} \times 982.8 \frac{BTU}{lb}}{.70}$ = 9,899,604

ASSUME 13,000 BTU/lb COAL

Coal REQ'D = $\frac{9899604}{13,000 \times 2000}$ = 0.38 TONS/HR

DAILY COAL REQ'D = 24 X .38 = 9.1 TONS/DAY

* PROVIDE ON-SITE STORAGE FOR 14 DAYS = 127 TONS

Volume REQ'D = $\frac{127 \times 2000}{50}$ = 5096 Ft^3 {EASILY STORED IN A SILO OR BUNKER}

* PROVIDE ON-SITE STORAGE FOR 30 DAYS = 273 TONS

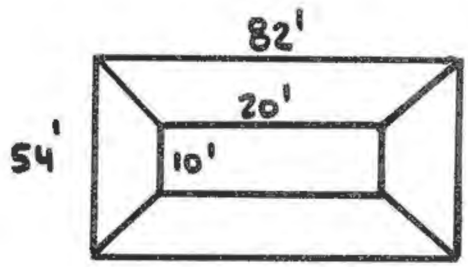
Volume Req'D = $\frac{273 \times 2000}{50}$ = 10,920 Ft^3 {Possibly could be stored in a silo - better on-ground WITH RECLAIM}

Assume Pile is Frustrum of Pyramid :

max slope on sides = 15°

max height = 6'

$\tan 15 = \frac{6}{x} \Rightarrow x = 22'$



$$V = \frac{1}{3} \times 6 \left[10 \times 20 + 54 \times 82 + \sqrt{10 \times 20 \times 54 \times 82} \right]$$

$$V = 2 \left[200 + 4428 + 941 \right] = 11{,}138 \text{ Ft}^3$$

(NOMINAL 280 TONS)

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: Slowey

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
TRUCK SCALES							
60x10/60 TON/4 SECTION TRUCK SCALE complete WITH: 90-7300/3100 DIGITAL INSTR. AND DOT MATRIX PRINTER, 2-MANHOLES RINGS & COVERS, TYPE REGISTER BEAM, SHORT IRON & PILLAR, SURGE VOLTAGE PROTECTION						#21026	#21026
INSTALLATION, INCLUDING PIT				#11,074			#11,074
TOTAL							# 32,100

ENG FORM 150
1 AUG 59

(ER 1110-345-730)

PREVIOUS EDITION MAY BE USED

(TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

SUBJECT SENECA NORTH BASE AEP NO 00122-000

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DESIGNER SCowen
CHECKER
SHEET ___ OF ___
DATE
DATE

VALUES, SPECIALTIES, ETC

TRAP STATIONS: Assume 1 station per 500' of steam line run plus 1 station per Building

	PIPING	BLDG'S
BLDG 812	1	1
802	1	1
729	4	1
810	1	1
805	1	1
718	1	1
	9	6

15 TRAP STATIONS x \$479.70 = \$7196 MATERIAL
x \$530.58 = \$7959 labor

\$15,155

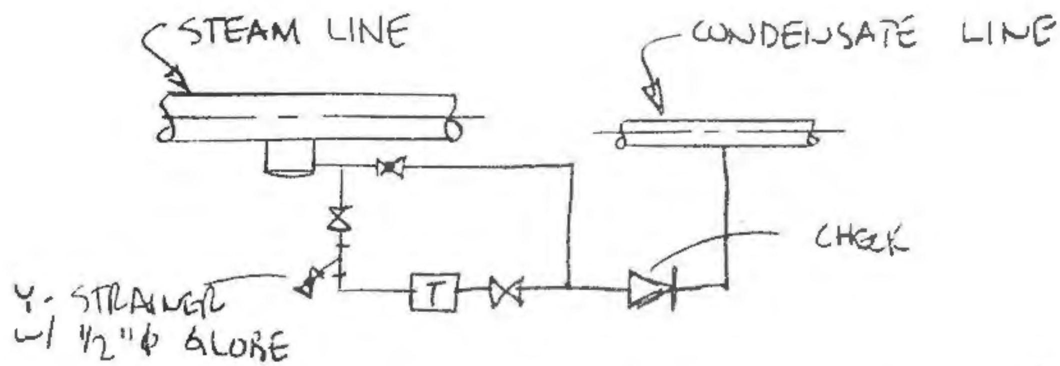
PRESSURE REDUCING STATIONS:

BLDG	TYPE 500 lb/HR	TYPE 6000 lb/HR
812	✓	-
810	✓	-
805	✓	- ~~6 PRC Station~~
802	✓	-
729	✓	-
Tennis Bubble	✓	-

6 PR Stations x \$402.50 = \$2415 labor
\$1280 = \$7680 material

\$10,095

TYPICAL TRAP STATION



All valves and piping 3/4"ϕ except as noted

	LABOR (MH.) EACH	MATL (EACH)
3/4" INV. BUCKET TRAP (1)	1.6	155.40
3/4" Y-STRAINER	0.5	5.70
3/4 GLOBE	1.7	51.70
3/4 GATE	1.7	39.50
3/4 CHECK	1.3	47.00
3/4" A-106 SCH 80 PIPE	12.6/100 ft.	142.60/100 ft.
1/2" GLOBE	1.2	44.20
3/4" ELBOW	1.2	4.60
3/4" TEE	1.8	5.80

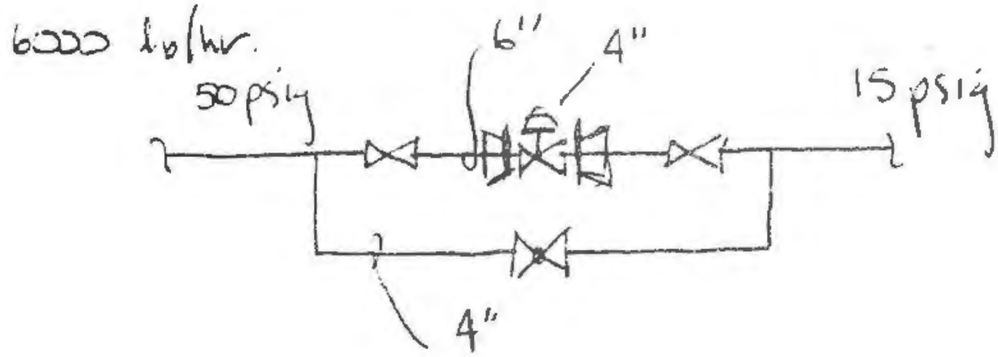
	MH	MATL
(1) 3/4" INV. BUCKET TRAP	1.6	155.40
(1) 3/4" Y-STRAINER	0.5	5.70
(1) 3/4" GLOBE	1.7	51.70
(2) 3/4" GATE	3.4	79.00
(1) 3/4" CHECK	1.3	47.00
(1) 1/2" GLOBE	1.2	44.20
(3) ELBOWS	3.6	13.80
(2) TEES	3.6	11.60
50' PIPE	6.3	71.30
SUBTOTALS =	23.2 MH	$ 479.70

$$\left(\frac{23.2\,MH}{1}\right)\left(\frac{\$22.87}{MH}\right) = \$530.58$$

I-58

TOTAL COST / STATION = 479.70 + 530.58 = $1010.28

PRESSURE REDUCING STATION



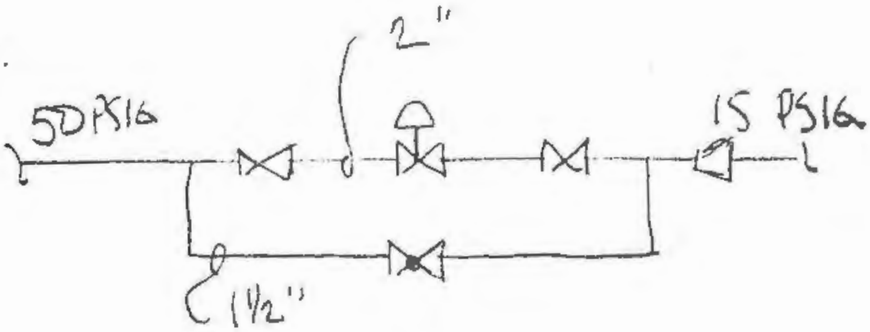
Assume 10' 6" ϕ sch 40 pipe
10' 4" ϕ sch 40 pipe

	LABOR	MATL.
(1) 4" PRV	4	1100
(2) 6" GATE	2(2,7) = 5,4	1750
(1) 4" GLOBE	2,1	659
10' 6" PIPE	10/100 (35,0) = 3,5	65
10' 4" PIPE	10/100 (25,0) = 2,5	38
(2) 4" ELLS	2(3,8) = 7,6	14,40
(2) 6" TEES	2(7,5) = 15,00	82,10
(2) 4" FLANGES	3,8	31,60
(2) 6"x4" REDUCERS	9,4	28,9
	49,3 MH.	$3769

49,3(22,87) = $1127
\+ 3769
$4896 → SAY $4900

TYPICAL PRESSURE REDUCING STATION:

500 lb/hr.



Assume 10' 2" φ sch 80 pipe
10' 1½" φ sch 80 pipe

	LABOR	MATL.
(1) 2" PRV	2	630
(2) 2" GATE	2(1.7) = 3.4	2(216) = 432
(1) 1½" GLOBE	1.6	140.00
10' 2" SCH 80 PIPE	$\frac{10}{100}(17.2) = 1.7$	10.00
10' 1½" SCH 80 PIPE	$\frac{10}{100}(16.0) = 1.6$	10.00
(2) 1½" ELLS	2(1.40) = 2.8	24.00
(2) 2" TEES	2(2.25) = 4.5	34.00
	17.6 MH	1280.

$$\left(\frac{17.6\ MH}{}\right)\left(\frac{\$22.87}{MH}\right) = 402.50$$

1280.

TOTAL = $1683 → SAY **$1700**

MAKEUP WATER SOFTENERS

Size Softeners for 20% of maximum boiler capacity

25,500 lb/HR = 51 GPM x .2 = 10.2 GPM

USE DUPLEX AUTOMATIC UNIT

EQUIPMENT COST: $ 1600

labor to install = 16 hrs @ 22.87 = $ 365.92

Condensate Transfer Pumps

Size for 50 % of total Boiler Capacity

25,500 lb/HR = 51 GPM × .5 = 25.5 GPM

Capacity = 30 GPM
Head = 32' (5 PSIG + 20')

$$\text{motor Hp} = \frac{30 \times \frac{32}{2.395}}{1714 \times .7} = 0.33$$

S.F. = 1.15   Hp = .33 × 1.15 = 0.38 Hp

USE ½ Hp MOTOR

TOTAL COST, PUMP & MOTOR : $ 1250

labor for installation : 16 hrs @ 22.87 = $ 366

TOTAL STM PLANT COND. COLLECT SYSTEM

	MAT	LABOR
PUMPS (2)	2500	732
TANK	1885	560
	$ 4385	$ 1292

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SENECA - NORTH   AEP NO 80122-000
SHEET ___ OF ___
DESIGNER Slowey   DATE
CHECKER   DATE

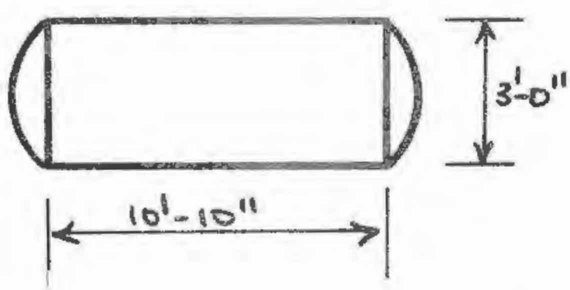
CONDENSATE COLLECTION TANK

Size tank to hold minimum of 20 minute capacity of all three (3) boilers, at mid-level of tank:

$$25500 \text{ lb/HR} = 51 \frac{\text{GAL}}{\text{MIN}} \times 20 \text{ MIN} = 1020 \text{ Gallons}$$

USE 4' Ø TANK

$$\text{LENGTH} = \frac{1020 \text{ Gallon}}{7.48 \frac{\text{GAL}}{\text{FT}^3} \times \frac{\pi (4)^2}{4}} = 10.85'$$



Assume 3/8" PL   Surface Area = πDL + Heads
= 136 + heads
say 160 Ft²

ρ = 15.3 lb/ft²   weight = 2448 lbs

for budgetary cost, Carbon Steel; use $1.00/lb installed
($.77 mat, $.23 labor)

material: 2448 × .77 = $1885

labor: 2448 × .23 = $ 560

CONDENSATE RETURN SYSTEMS

Material Prices: QUOTED BY AURORA PUMP CO.

Labor Prices: Assume 16 hrs at $22.87/HR to install Pumps, Tanks, valves, vent, local piping, etc. (Double labor in exclusion area)

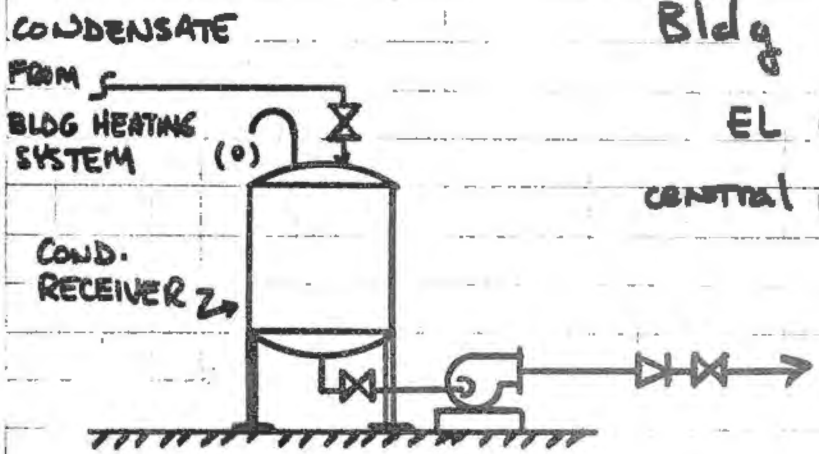
	MATERIAL	LABOR
BLDG 810	$2317	$732
805	2317	732
729	2317	366
812	2317	732
802	2317	732
718	4600	366
TOTALS	$16185	$3660

CONDENSATE RETURN SYSTEMS

Bldg 810

EL 650'

central plant EL 630'



CONDENSATE RETURN TO CENTRAL COAL PLANT
2340'

Flow = 1½ GPM (5 GPM Pump)

Assume Δh = 2'/100 Ft

friction head = 47'

Head req'd At Central Plant = 15' + 5 psig × 2.395 = 27'

Pump TDH = 47' + 27' + (630 − 650) = 54' (say 60')

$$\text{Motor Hp} = \frac{5\,\text{GPM} \times \frac{60}{2.395}}{1714 \times .7} = 0.104\ \text{Hp}$$

× 1.15 S.F. = .12 Hp (¼ Hp motor)

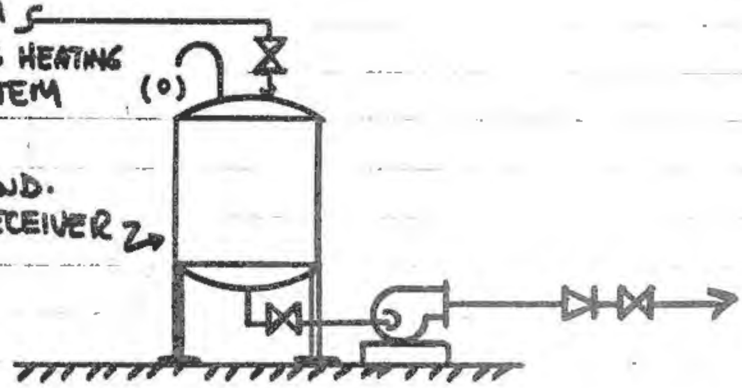
Aurora E9T-1.5
30 gal TK
2317

CONDENSATE RETURN SYSTEMS

Bldg 805
EL ~~825'~~ 650'

CONDENSATE FROM BLDG HEATING SYSTEM (0)

COND. RECEIVER



CONDENSATE RETURN TO CENTRAL COAL PLANT
2540'

flow = 0.3 GPM (5 GPM PUMP)

Assume 2'/100' Δh

friction head = 51'

Head @ central plant = 27'

Pump TDH = 51' + 27' + (630 − 650) = 58' say 60'

1/4 Hp motor

AURORA E4T-1.5
30 gal TK
#2317

REYNOLDS, SMITH AND HILLS
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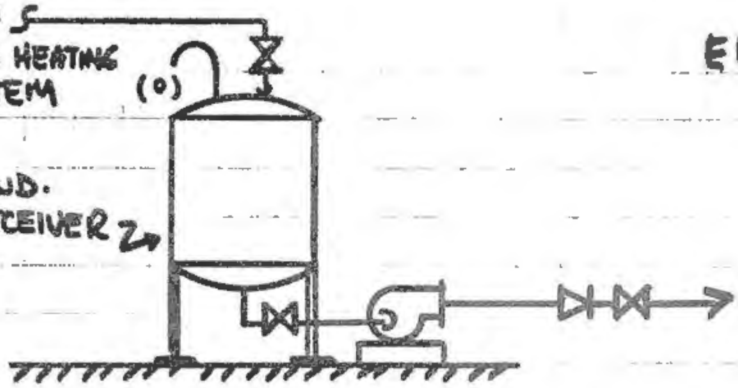
INCORPORATED

SUBJECT: SENECA ARMY DEPOT — AEP NO 80122-000
SHEET ____ OF ____
DESIGNER: Slowey — DATE ____
CHECKER ____ — DATE ____

CONDENSATE RETURN SYSTEMS

BLDG 729

EL 650'



1540'

Flow = 1/2 GPM (5 GPM Pump)

Assume Δh = 2'/100'

friction head = 31'

Hd @ Central Plant = 27'

Pump TDH = 31' + 27' + (630-650) = 38' (say 40')

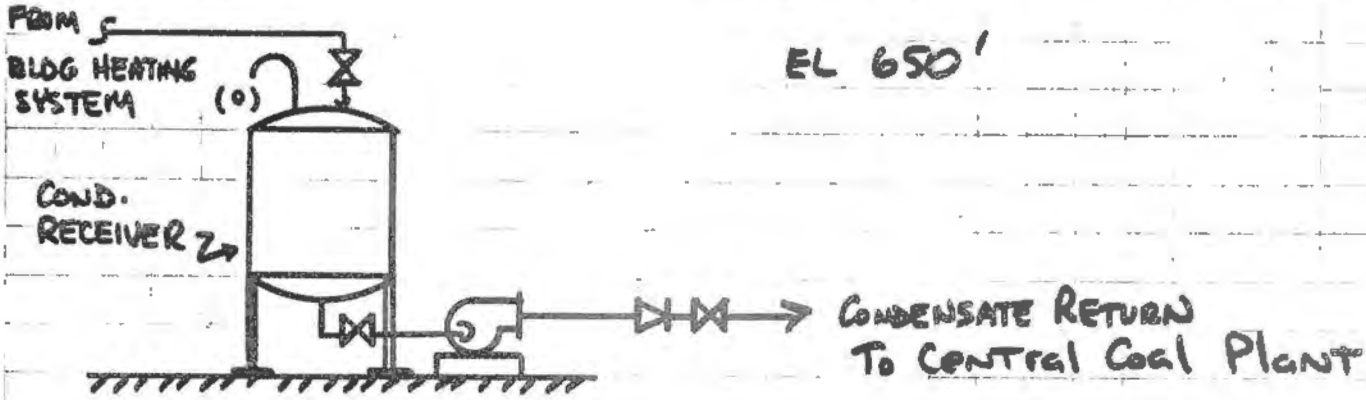
1/4 Hp motor

Aurora E4T-1.5
30 gal TK
2317

CONDENSATE RETURN SYSTEMS

BLDG 812

EL 650'



Flow = 1 1/2 GPM (5 GPM Pump) [redacted] 2480'

Assume Δh = 2'/100'

Friction head = 50'

Hp @ central plant = 27'

Pump TDH = 50' + 27' + (630 - 650) = 57' say 60'

1/4 Hp MOTOR

AURORA E4T-1.5
30 gal TK

#2317

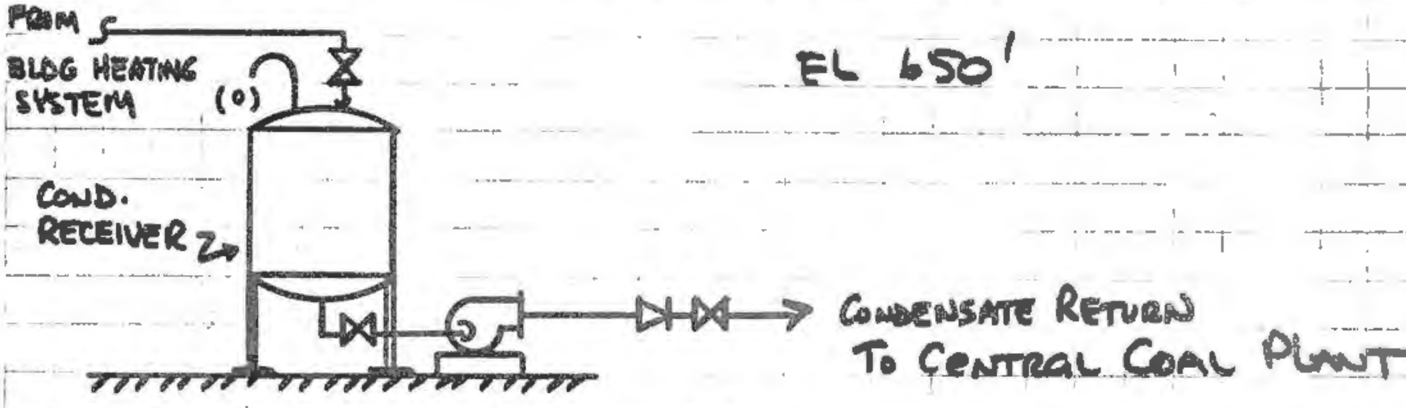
REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SENECA ARMY DEPOT NORTH BASE
DESIGNER Sloven
CHECKER
AEP NO 80122-000
SHEET ... OF ...
DATE
DATE

CONDENSATE RETURN SYSTEMS

BLDG 802

EL 650'



flow = 1/4 GPM (5 GPM PUMP)   2860'

Assume Δh = 2'/100 Ft

Friction head = 45'

HD at central plant = 27'

Pump TDH = 45' + 27' + (630-650) = 52' say 60'

1/4 Hp motor

Aurora E4T-1.5
30 gal TK
#2317

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

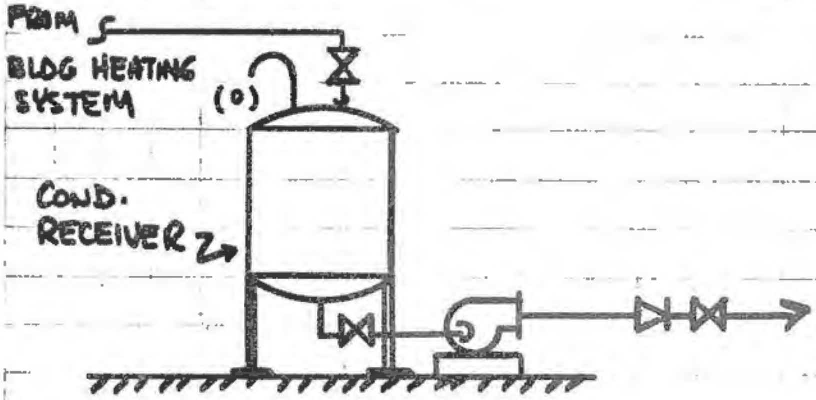
SUBJECT SENECA ARMY DEPOT
NORTH BASE
DESIGNER Slowey
CHECKER

AEP NO. 80122-000
SHEET ____ OF ____
DATE
DATE

CONDENSATE RETURN SYSTEMS

BLDG 718

EL 630'



Flow = 26 GPM (30 GPM Pump) 300'

Assume Δh = 2'/100'

Friction head = 6'

Hd at central plant = 27'

Pump TDH = 6' + 27' + (630 − 630) = 33' say 40'

$$Hp = \frac{\frac{40 \times 30}{2.395}}{1714 \times .7} = 0.42\ Hp$$

× 1.15 SF = 0.48 Hp

1/2 Hp Motor

Aurora L5-7.5
250 gal TK
#4600

INSTRUMENTATION & CONTROL

NOTE: Most of the I&C devices will be provided with the boiler package, those not expected to be included ARE:

	LABOR	MATERIAL
1) Pump Control Panels (1)	200	1100
2) Flow elements & recorders (3)	700	9000
3) Pressure Regulators & gauges (3)	200	1500
4) Temperature gauges (5)	200	500
SUB-TOTAL	# 1300	# 12100
ADD 50% for UNKNOWNS	650	6050
	# 1950	# 18150

SENECA ARMY DEPOT - NORTH BASE

BOILERS, AUXILIARIES, FUEL HANDLING EQUIPMENT, ENCLOSURE, ETC.	$ 1,615,000
BREAKOUT COST FOR BOILERS (50%)	$ 807,000
BREAKOUT COST FOR STRUCTURAL & ENCLOSURE	$ 469,000
SUBTOTAL	$ 339,000
ADD FOR: STEAM PLANT COND SYSTEM	$ 5677
WATER SOFTENERS	$ 1966
MISC. INSTR. & CONTROLS	$ 20,100
MECHANICAL EQUIP. TOTAL	= $ 366,743

Rule of Thumb → Electrical Installation Cost Approximately 67% of cost of MECH EQUIPMENT, 50/50 labor/material

USE: ELECTRICAL LABOR = $ 123,000
" MATERIAL = $ 123,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

LOCATION: COST ESTIMATE - MAIN STEAM & CONDENSATE PIPING - CENTRAL PLANT TO BUILDING 805 (No 816)

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: | ESTIMATOR: Slowey | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OUTSIDE OF EXCLUSION AREA							
4" buried conduit (sch 40)	2696	Ft	14.82	39955	30.00	80880	120835
1½" buried conduit (sch 80)	2546	Ft	12.12	30858	20.25	51557	82415
4" elbows	42	EA	148.20	6224	210.00	8820	15044
1½" elbows	30	EA	121.20	3636	110.00	3300	6936
EXCAVATION & BACKFILL	2696	Ft	6.32	17039	—	—	17039
INSIDE EXCLUSION AREA							
4" sch 40 buried conduit	524	Ft	29.64	15531	30.00	15720	31251
2" sch 40 buried conduit	338	Ft	25.84	8734	19.50	6591	15325
2" elbows	12	EA	258.40	3101	134.00	1608	4709
1½" sch 80 buried conduit	150	Ft	24.24	3636	20.25	3038	6674
1" sch 80 buried conduit	688	Ft	24.24	16677	18.00	12384	29061
1" elbows	16	EA	242.40	3878	104.00	1664	5542
EXCAVATION & backfill	862	Ft	12.64	10896	—	—	10896
SUB-TOTAL				160165		185562	345727
LINE TO BLDG 729	SEE APPL. SHEETS ↓	↓	↓	4815		5492	10307
LINE TO BLDG 802				9630		5492	15122
LINE TO BLDG 812				41483		27542	69025
LINE TO BLDG 810				9902		5553	15455
SUB-TOTAL				225995		229641	455636
LINE TO TENNIS Bubble				14522		18008	32530
LINE TO BLDG 718				16850		32829	49679
TOTAL				257367		280478	537845

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

CONSTRUCTION COST ESTIMATE

DATE PREPARED	SHEET	OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: STEAM & CONDENSATE SUPPLY TO TENNIS BUBBLE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: Slorven

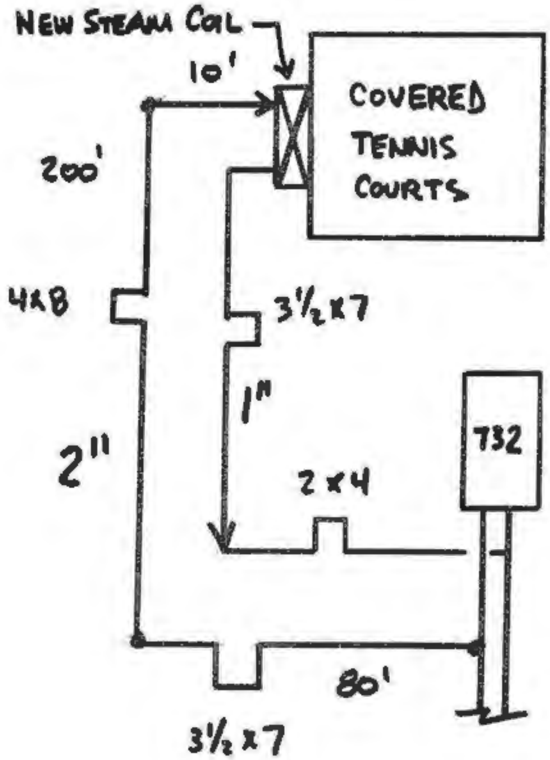
CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
2" CONDUIT	320	Ft	12.92	4134	19.50	6240	
2" elbows	14	EA	129.20	1809	134.00	1876	
1" CONDUIT	302	Ft	12.12	3660	18.00	5436	
1" elbows	14	EA	121.20	1697	104.00	1456	
EXCAVATION & BACKFILL	320	Ft	6.32	2022	—	—	
STEAM COIL	1	EA	1200	1200	3000	3000	
Sub-TOTAL				14522		18008	32530

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE



2" PIPE 290' + 1 Lp @ 14 + 1 Lp @ 16 = 320'
2" elbows 4 x Lp + 6 = 14

1" PIPE 290' + 1 Lp @ 14 + 1 Lp @ 8 = 302'
1" elbows 4 x Lp + 6 = 14

EXCAVATION & BACKFILL = 320'

ASSUME $ 3,000 for Steam Coil material
$ 1,200 for " " labor

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COAL PLANT CONNECTION TO BLDG 718

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

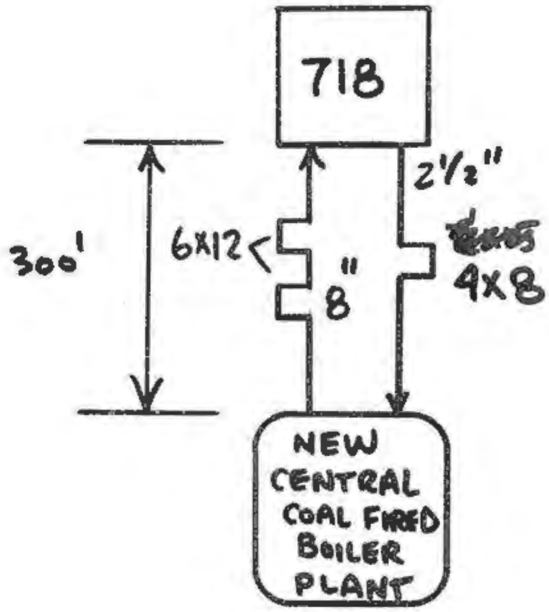
DRAWING NO.

ESTIMATOR: Slover

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
8" CONDUIT	348	Ft	19.62	6828	55.50	19314	
8" elbows	12	EA	196.20	2354	327.00	3924	
2½" conduit	316	Ft	13.81	4364	26.25	8295	
2½" elbows	8	EA	138.10	1105	162.00	1296	
EXCAVATION & BACKFILL	348	Ft	6.32	2199	—	—	
SUBTOTAL				16850		32829	49679

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)



8" CONDUIT 300' + 2 Lp @ 24 = 348'
8" elbows 4 x Lp + 4 = 12

2½" CONDUIT 300' + 1 Lp @ 16 = 316'
2½" elbows 4 x Lp + 4 = 8

EXCAVATION & BACKFILL 348'

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COST ESTIMATE - ANCILLARY BUILDINGS NEAR EXCLUSION AREA (OR INSIDE E-A)

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: Slowey

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BUILDING 729							
1½" sch 80 Conduit	110	Ft	12.12	1333	20.25	2228	3561
1½" elbows	6	EA	121.20	727	110.00	660	1387
1" sch 80 Conduit	110	Ft	12.12	1333	18.00	1980	3313
1" elbows	6	EA	121.20	727	104.00	624	1351
EXCAVATION & BACKFILL	110	Ft	6.32	695	—	—	695
* TOTAL				4815		5492	10307
BUILDING 802							
1½" sch 80 CONDUIT	110	Ft	24.24	2666	20.25	2228	4894
1½" elbows	6	EA	242.40	1454	110.00	660	2114
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & BACKFILL	110	Ft	12.64	1390	—	—	1390
* TOTAL				9630		5492	15122
BUILDING 810							
2" sch 40 Conduit	110	Ft	25.84	2842	19.50	2145	4987
2" elbows	6	EA	258.40	1550	134.00	804	2354
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & backfill	110	Ft	12.64	1390	—	—	1390
* TOTAL				9902		5553	15455

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COST ESTIMATE - ANCILLARY BUILDINGS IN EXCLUSION AREA

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: Slowey

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BUILDING 812							
2½" sch 40 CONDUIT	568	Ft	27.62	15688	26.25	14910	30598
2½" elbows	10	EA	276.20	2762	162.00	1620	4382
1" sch 80 Conduit	554	Ft	24.24	13429	18.00	9972	23401
1" elbows	10	EA	242.40	2424	104.00	1040	3464
EXCAVATION & backfill	568	Ft	12.64	7180	—	—	7180
* TOTAL				41483		27542	69025
BUILDING 805							
2" sch 40 Conduit	110	Ft	25.84	2842	19.50	2145	4987
2" elbows	6	EA	258.40	1550	134.00	804	2354
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & backfill	110	Ft	12.64	1390	—	—	1390
* TOTAL				9902		5553	15455

LABOR COSTS

ASSUME PRODUCTIVITY IN EXCLUSION AREA = 1/2 OF NORMAL level of productivity

6" buried conduit ; normal labor = 0.774 MAN-HRS/FT

4" buried conduit ; normal labor = 0.648 MAN-HRS/Ft

2" buried conduit ; normal labor = 0.565 MAN-HRS/FT

1½" buried conduit ; normal labor = 0.53 MAN-HRS/FT

1" buried conduit ; normal labor = 0.153 MAN-HRS/Ft

2½" buried conduit ; Normal labor = 0.604 MAN HRS/FT

LABOR RATE = $ 22.87 /HR

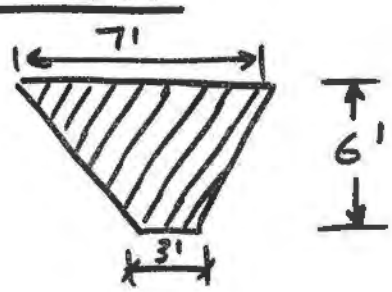
6" CONDUIT :	INSIDE EXCLUSION AREA	$ 35.40/Ft
	OUTSIDE AREA	$ 17.70/Ft
4" CONDUIT :	INSIDE AREA	$ 29.64/Ft
	OUTSIDE AREA	$ 14.82/Ft
1½" OR 1" CONDUIT :	INSIDE AREA	$ 24.24/Ft
	OUTSIDE AREA	$ 12.12/Ft
2" CONDUIT :	INSIDE AREA	$ 25.84/Ft
	OUTSIDE AREA	$ 12.92/Ft
2½" CONDUIT :	INSIDE AREA	$ 27.62
	OUTSIDE AREA	$ 13.81

Assume labor req'd for elbows equal to 10 ft of same size pipe

6" elbows	Inside exclusion area	# 354.00
	Outside area	# 177.00
4" elbows	Inside area	# 296.40
	Outside area	# 148.20
2½" elbows	Inside area #276.20	
	Outside area #138.10	
1½" elbows } 1" elbows	Inside area	# 242.40
	Outside area	# 121.20
2" elbows	Inside area	# 258.40
	Outside area	# 129.20

Excavation & Backfill

Trench req'd



Normal labor = 0.039 man-hrs/ft

Cost = #162/man-hour

Inside exclusion area # 12.64/ft
Outside area # 6.32/ft

Project No. 80122

Telephone Call Confirmation

reynolds, smith and hills

Local X L.D. ____ Placed ✓ Rec'd ____ Date 2/12/80

[illegible] Conversed with WES [illegible]

Of [illegible] Regarding [illegible]

PRICES FOR BLACK STEEL FOR SENECA

Ø	COST / FT
8	[illegible].50
6	45
4	30
3	27.75
2½	26.25
2	19.50
1½	20.25
1	18.00

(ADD 5% FOR GALVANIZED STEEL)

90° ELS

Ø	COST / Ø
8	327
6	260
4	210
3	178
2½	162
2	134
1½	110
1	104

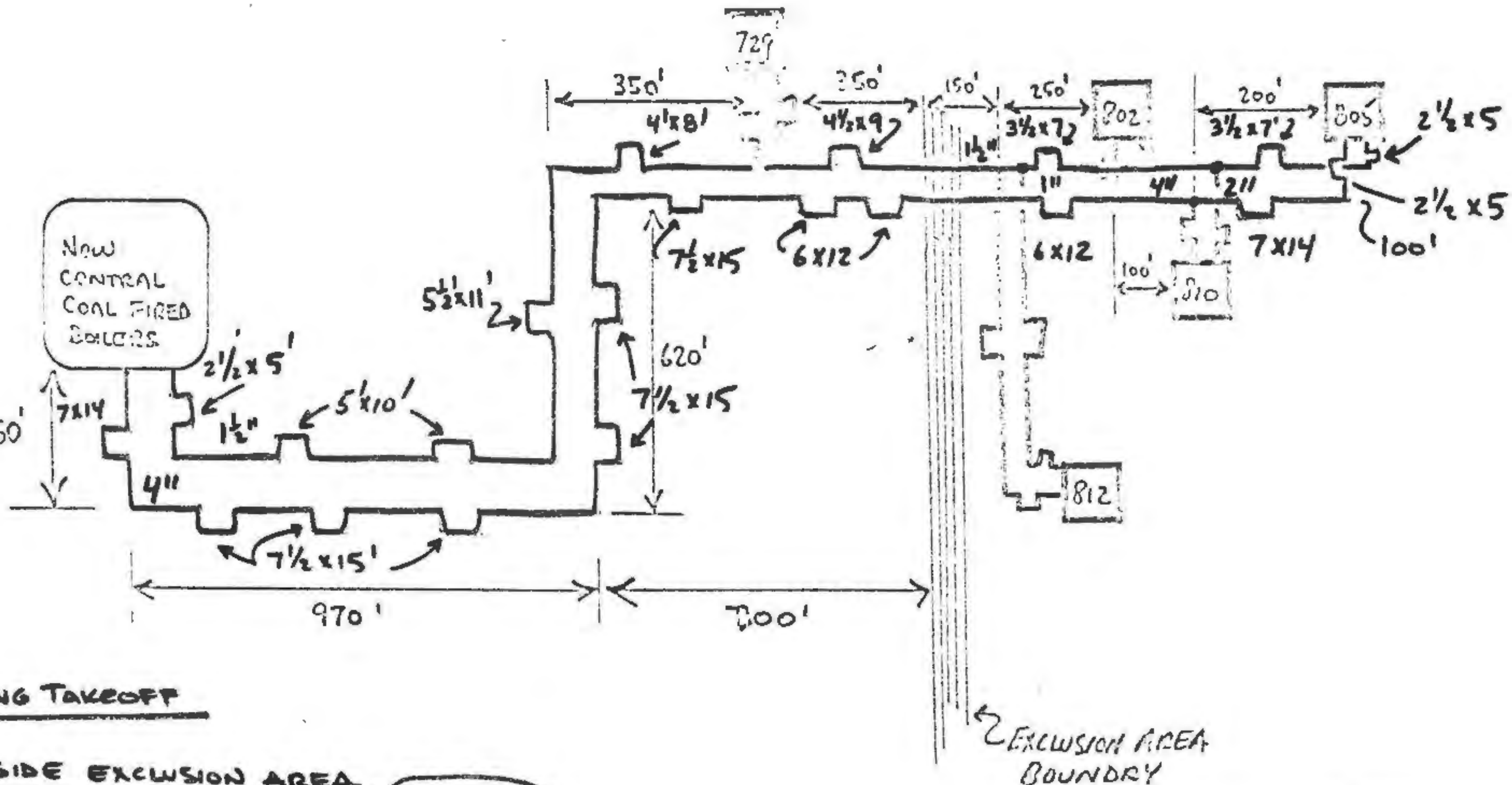
[illegible]

[illegible]

Distribution:

I-82

RS&H FORM 102 11/72



H-83

PIPING TAKEOFF

OUTSIDE EXCLUSION AREA

4" PIPE 2440' PLUS 1 Lp @ 28, 6 Lp @ 30, 2 Lp @ 24 } 256'

4" PIPE = 2696'

1½" PIPE 2440' plus 1 Lp @ 10, 2 Lp @ 20, 1 Lp @ 22, 1 Lp @ 16, 1 Lp @ 18 } 106'

1½" PIPE = 2546'

4" elbows 4 x Lp + 6 = 42

1½" elbows = 30

INSIDE EXCLUSION AREA

4" PIPE 500' plus 1 Lp @ 24

4" PIPE 524'

* 2" PIPE 300' plus 1 Lp @ 28, 1 Lp @ 10 } 38'

2" PIPE 338'

1½" PIPE 150'

1" PIPE 650' plus 2 Lp @ 14, 1 Lp @ 10 } 38'

1" PIPE 688'

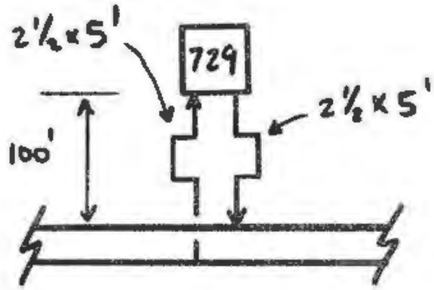
4" elbows = 0

2" elbows = 4 x Lp + 4 = 12

1½" elbows = 0

1" elbows = 4 x Lp + 4 = 16

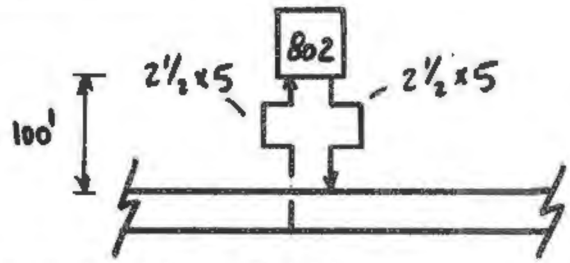
BUILDING 729



STEAM 1½" sch 80 6 Elbows 110'

COND 1" sch 80 6 Elbows 110'

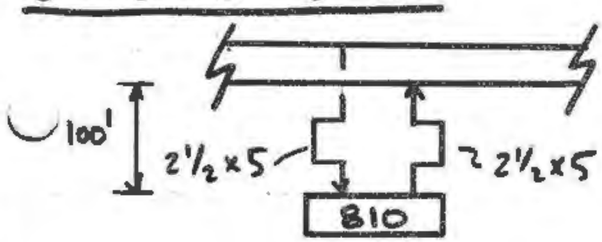
BUILDING 802



STEAM 1½" sch 80 6 elbows 110'

COND 1" sch 80 6 elbows 110'

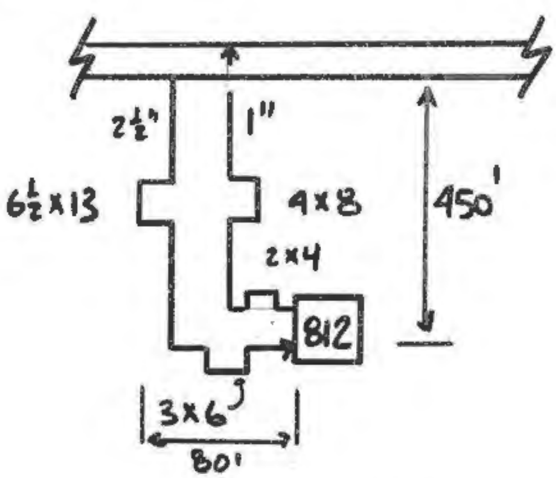
BUILDING 810



STEAM 2" sch 40 6 elbows 110'

COND 1" sch 80 6 elbows 110'

BUILDING 812



STEAM 2½" sch 40 10 elbows 568'

COND 1" sch 80 10 Elbows 554'

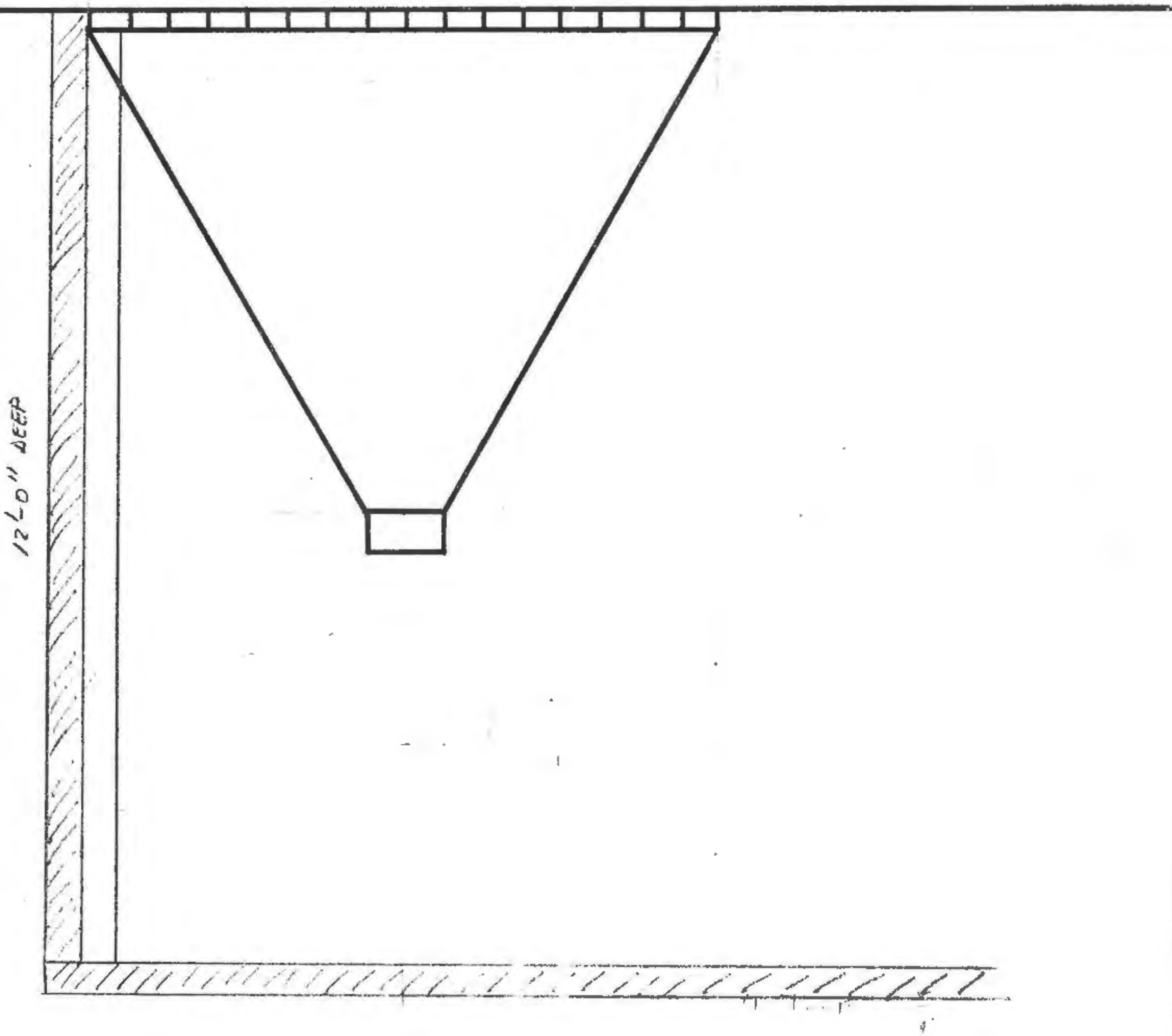
BUILDING 805

SAME AS BLDG 810

STEAM 2" sch 40 6 elbows 110'

COND 1" sch 80 6 elbows 110'

TRUCK UNLOADING HOPPER



106 x 4.24 =

$450 12' Deep x 15' long x 8' WIDE = 1440 Ft³ = 53 yds x 2 (hole

$7314 CONCRETE = (2 x 12 x 15 + 2 x 12 x 8.) x 1' = 792 Ft³ = 30 yds x $243.8

$1928 steel plate (3/8") S = ½ x (4x1 + 4x8) x 7 = 126 Ft² x 15.3#/Ft² = 1928# @ $1.00/#

$1454 CONTINGENCY (15%)

$11,146 TOTAL

say $11,000

SECTION I-3

CAPITAL COST ESTIMATE

OPTION THREE

OPTION D
AFBC PLANT

SENECA NORTH

1. ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

2. BENEFICIAL OCCUPANCY DATE JAN '85

3. ECONOMIC LIFE 25 YEARS

4. DATE OF ESTIMATE DEC '80 $

5. INITIAL COST ~~$ 4,091,492~~ $ 3,859,898

6. ANNUAL MAINTENANCE COSTS

OPERATIONS (labor) $ 170416
MAINTENANCE MATERIAL $ 102287
} TOTAL = $ 272,703

7. CYCLICAL MAINTENANCE COSTS

1) EXISTING PIPING WILL BE REPLACED IN 1996 & 2021 AT A COST OF $ 366,249 IN DEC '80 $

2) AFBC SYSTEMS WILL BE REPLACED AFTER 25 YRS (2010) AT A TOTAL REPLACEMENT COST OF $ 2,981,539 IN DEC '80 $

8. ANNUAL FUEL COST

COAL → 1133 TONS @ $ 54/TON = $ 61182
LIMESTONE → 283 TONS @ $ 13^{35}/TON = $ 3778
} TOTAL = $ 64,960

9. ANNUAL ELECTRICAL CONSUMPTION 889,103 Kwh

10. ELECTRICAL DEMAND RATE 200 KW

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)

DRAWING NO.: "OPTION 3" CENTRAL COAL FIRED AFBC STEAM PLANT

ESTIMATOR: [signature]

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
NORTH AFBC Steam Plant - Complete				550,889		2,271,676	2,822,565
LABOR BURDEN	22%			121196		—	121196
Sales TAX	5%			—		113584	113584
SUB-TOTAL							3057345
OVERHEAD & PROFIT	25%						764336
BOND	1%						38217
~~SUBTOTAL~~						$	3859898
~~ENGINEERING & DESIGN~~	~~6%~~						~~231,594~~
~~TOTAL~~						$	~~4,091,492~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE : 1990 O—515150

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify) ____

DRAWING NO.: "OPTION 3" CENTRAL COAL FIRED AFBC Steam PLANT

ESTIMATOR: Slovan

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING	LOT			257367		280478	537845
VALVES, SPECIALTIES, ETC.	LOT			10374		14876	25250
TRUCK SCALE	1	EA		11074		21026	32100
HVAC, PLUMBING, ETC	LOT			4750		4250	9000
ROADWORK & CIVIL SITE PREP	–	–		–		27500	27500
BLDG COND RETURN SYSTEMS	LOT	–		3660		16185	19845
STM PLANT COND COLL. SYST.	LOT	–		1292		4385	5677
MAKEUP WATER SOFTENERS	LOT	–		366		1600	1966
FOUNDATIONS	–	–		–		166100	166100
ELECTRICAL	–	–		122000		122000	244000
MISC INSTR. & CONTROLS	LOT	–	1950	1950	18150	18150	20100
FIRE PROTECTION	–	–	7200	7200	4800	4800	12000
DEAERATOR	1	EA	1830	1830	12500	12500	14330
BOILER FEED PUMPS	3	EA	458 33	1375	5000	15000	16375
FUEL HANDLING EQUIP.	1	EA	34908	34908	161651	161651	196559
ASH REMOVAL SYSTEM	LOT		–	–	100000	100000	100000
ASH HOPPER - 25 TON	1	EA	2143	2143	7175	7175	9318
STRUCTURAL STEEL	LOT	–	–	–	305000	305000	305000
ENCLOSURE	–	–	–	–	164000	164000	164000
SUB-TOTAL				460289		1,446,676	1,906,965
10,000 #/HR AFBC STEAM GENERATOR	3	EA	30,200	90,600	275000	825000	915,600
TOTAL W/O MARKUPS				550,889		2,271,676	2,822,565

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

LOCATION: SEAD - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: "OPTION 3" AFBC PLANT REPLACEMENT COST

ESTIMATOR: [signature]

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257367		280478	537845
values, specialties, etc				10374		14876	25250
truck scale				11074		21026	32100
HVAC, Plumbing, etc				4750		4250	9000
Bldg Cond Return Systems				3660		16185	19845
STEAM Plant Cond Coll. System				1292		4385	5677
makeup water softeners				366		1600	1966
Electrical				122000		122000	244000
Misc. Instr & Controls				1950		18150	20100
Fire Protection				7200		4800	12000
Deaerator				1830		12500	14330
Boiler Feed Pumps				1375		15000	16375
Fuel Handling Equipment				34908		161651	196559
Ash Removal system				—		100000	100000
Ash Hopper - 25 Ton				2143		7175	9318
10,000 #/H AFBC Boilers				90600		825000	915600
SUBTOTAL				550889		1609076	2159965
Labor Burden	22%			121196		—	121196
Sales Tax	5%			—		80454	80454
SUBTOTAL							2361615
overhead & Profit	25%						590404
Bond	1%						29520
TOTAL REPLACEMENT COST AFTER 25 YRS → IN DEC '80 $							$2,981,539

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT – NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: Slawen

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SAlES TAX	5%			—		9361	9361
SubTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 1980 DOLLARS)							$366,249

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

DESIGNER J. McMILLIN
CHECKER Slovey

SHEET ____ OF ____
DATE ____
DATE ____

YEARLY FUEL COST

NORTHBASE

BLDG	#2 FUEL OIL (GAL)	#6 F.O. (GAL)	FUEL USAGE BEFORE SETBACK (MBtu)	SETBACK SAVINGS (MBtu)	FUEL USAGE AFTER SETBACK (MBtu)
718	—	200,000	30,000	8150	21850
729	5000	—	694	240	454
802	3200	—	444	150	294
805	3700	—	513	170	343
810	17,800	—	2469	840	1629
812	13,500	—	1872	640	1232
714	—	7300	1095	220	875
AMMO	4500	—	624	100	524
TENNIS	12,300	—	1706	430	1276
New BKS		25900	3885	—	3885
				TOTAL	32362 MBtu/yr.

OR #6 F.O. 26610 MBtu

& #2 F.O. 5752 MBtu

COAL USAGE

$$\frac{32362\,(10^6)}{12,500\,(2000)} = 1295 \text{ tons/yr}$$

@ $54/ton = $69930 DEC 1980 COST

I-91

NOTE AFBC Boiler ($\frac{80\%}{70\%}$) more efficient than conventional coal fired Boilers in this size range ⇒ Annual Fuel Consumption = 7/8 × 1295 = 1133 TONS/YR

ANNUAL LIMESTONE CONSUMPTION

Annual Coal Usage = 1133 TONS

LIMESTONE USAGE = 1/4 COAL USAGE = 283 Tons /YR

Cost for Limestone = 283 TONS x \$13.35/TON

= \$ 3778

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: OPTION THREE - MATERIAL HANDLING

ESTIMATOR: Slowey

CHECKED BY:

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
25 Ton Coal Bunker	3	EA	2143	6429	7175	21525	27954
10 Ton Limestone Bunker	3	EA	1283	3849	3952	11856	15705
Gate Values 12"x12"	4	EA	45	180	780	3120	3300
Drag Chain Conveyor	2	EA	4000	8000	26000	52000	60000
Bucket elevator	2	EA	4250	8500	21250	42500	51000
Screw Feeder	1	EA	500	500	2000	2000	2500
Truck Unloading Hopper	1	EA	—	—	11000	11000	11000
Limestone Storage - 50 Ton	1	EA	6200	6200	12650	12650	18850
Screw Feeder - 25'	1	EA	1250	1250	5000	5000	6250
Sub-TOTAL				34908		161651	196559

ENG FORM 150
1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-000

Local ______ L.D. X Placed X Rec'd ______ Date 12-9-80

Steve Cowen Conversed with John WALLISH

Of Johnston Boiler Co. Regarding FBC PACKAGE Boilers

Requested budgetary cost information regarding the Johnson Boiler Co. Atmospheric Fluidized Bed Package Boilers, with the following noted:

1) STEAMING RATE : 8500 lb/HR & 15,000 lb/HR
2) EASTERN BITUMINOUS - 13,000 BTU/lb
   3.5% Sulphur (potential)
3) Design Pressure : Our system 50 psig, SAT
   their boiler 150 psig, SAT

For the 8500 lb/HR Boiler, they will provide A 10,000 lb/HR Packaged FBC unit complete with:
FD & ID FANS, STEAM BOILER TRIM, COMBUSTION CONTROLS & PANEL, COAL METERING SYSTEM, LIMESTONE METERING SYSTEM, MECH COLLECTORS, standby GAS/OIL Firing, etc → Their scope of supply would start at the outlet of the coal & limestone feed bunkers AND end at the GAS outlet of the mechanical collectors. Cost $275,000. TO ADD A BAGHOUSE collector, complete with controls, insulation, rotary airlock, etc. Add $80,000.
* Does Not include installation, ash or spent bed removal

For the 15,000 lb/HR UNIT, the price would be $325,000 plus $100,000 for the baghouse collector

Note: ① Installation of FBC Compared to conventional coal fired unit is minimal labor – unit is fired at factory and arrives on site ready to be hooked into utilities & started up!

② Turndown Ratio on this unit is About 6:1 10,000 lb/HR unit 1666 lb/HR min fire, 15,000 lb/HR UNIT 2500 lb/HR MIN.

Distribution: J. McMillin

1-616-842-5050

RS&H FORM 102 11/72

1)

Johnson Boiler Co.
Bob Shedd

Package
2500# – 50,000#
FIRETUBE CONVECTION SECTION
AFBC

(1) IN plant 3 years 10,000 lb/HR → Auger feeders
(1) IN Ohio 3 mos. 40,000 lb/HR overbed feed NO LIME
ROTARY FEEDER 150–200 PSIG, SAT.

2) Charlotte, N.C. 20,000 lb/HR (SOON) Gas/Oil/Future Coal
3) Brazil 25,000 lb/HR (SOON) will be tested IN their SHOP IN THE NEXT COUPLE OF WEEKS
↳ Alcohol pilot 50% ASH COAL

* Call them WITH AS much lead time as possible to set up plant visit after we are short-listed on ANL JOB

---

2) General Resources Corp. MINNEAPOLIS, MINN.
612-9337474
out to lunch!
left word for someone to call back → THIS COMPANY DOES NOT MFG Boilers – Strictly pneumatic Feeders

---

3) Keeler; Williamsport; PA. PFBC for Curtis-Wright
NOT IN AFBC BUSINESS Dorr-Oliver

---

4) ZURN ERIE CITY; ERIE CITY, PA
814-4526421 Bob SEIBEL
Not presently in this business but would be most interested in participating – They have done a lot of work on paper

---

5) FLUIDYNE, MINNEAPOLIS, MINN.
612-5442721
ERVIN LENTZ
(1) 40,000 lb/HR UNIT ON order for delivery IN MID '81
(1) 18 Ft² unit IN plant set up as Airheater
(2) 2¼ Ft² FBC's IN Lab → doing test work for TVA

FLUIDYNE, CONTD. They are teamed up with FLUOR POWER SERVICES, INC ON the ANL Job – would be happy TO WORK WITH US IF we get THE JOB

They would have International Boiler Works (IBW) do the steam side of the unit – they are capable of producing FBC's in the 50-75 MM BTU input range (@ 200 PSIG, SAT, $\eta \approx$ .82-84%, MCR = 40-60,000 lb/HR)

(6) DELTAK CORP., ACTIVE WITH [Copeland Associates]

vertical inbed surface – deep bed { 5-6 FPS velocity, 5-6 Ft Bed }

[(BROS BOILER Co.) → people came from there]

[Steve Smithson]

SENECA NORTH BASE

JOHNSTON BOILER COMPANY THREE Johnston MULTI-FUEL FLUIDIZED BED COMBUSTION PACKAGED BOILERS, RATED AT 10,000 lb/HR EACH, TO BE FIRED ON EASTERN BITUMINOUS COAL, 12,500-13,000 BTU/lb, MAX Sulphur 3.5%, Vol. Matter 30-35%, SIZE: UP TO 1¼", complete WITH FD & ID FANS, BOILER TRIM, COMBUSTION CONTROLS & PANEL, COAL METERING SYSTEM, LIMESTONE METERING SYSTEM, MECH. Collectors, standby gas or oil firing system. Their scope of supply would begin At the outlet of the coal & limestone feedbunkers AND end At the gas outlet of the mechanical collectors. Their cost does not include deaerator, boiler feed pumps, coal & limestone handling equipment, Ash removal system, Ash hopper, structural steel, foundations, building or enclosure, truckunloading hopper, bucket elevator.

Cost for Three FBC UNITS $825,000

ADD TO JOHNSTON QUOTE

DEAERATOR: $12,500

Boiler Feed Pumps: $15,000

COAL HANDLING EQUIPMENT: }
LIMESTONE HANDLING EQUIPMENT: } $196,600

Ash REMOVAL SYSTEM: $100,000

Ash hopper (25 TON): $9318

structural steel : $305,000

~~Bldg~~ Enclosure: $164,000

TOTAL FBC COST $1,482,100 (NO INSTALLATION)

DEAERATOR INSTALLATION

Assume 80 hrs Req'd
@ $22.87 / HR = $ 1830

Boiler Feed Pumps Installation

Assume 20 hrs per pump
x 3 pumps = 60 hrs
@ $22.87/HR = $ 1375

AFBC STEAM GEN. INSTALLATION

Conv. Coal Fired Package Boiler System -
installation about 4,000 manhours
Johnston Blr Co. quotes approximately 67% savings on installation due to shop fabrication feature of their unit, with minimal field hook up
4000 hrs x .67 = 2680 hrs saved per boiler

4000-2680 = 1320 hrs @ $ 22.87 = $ 30,200 per Boiler

MECHANICAL EQUIPMENT:

STEAM PLANT COND SYSTEM	# 5677
water softeners	1966
MISC. INSTR & CONTROLS	20100
Deaerator	14330
Boiler Feed Pumps	16375
Fuel Handling Equip.	196559
Ash Removal System	100000
Ash Hopper	9318

TOTAL # 364,325

Rule of Thumb → Electrical Installation Cost approximately 2/3 that of mech equipment, broken up as 50/50 lab & material

USE: Electrical labor = # 122,000
" material = # 122,000

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD-NORTH BASE
AFBC-OPTION 3
DESIGNER SCOWEN
CHECKER

AEP NO 80122-000
SHEET ___ OF ___
DATE
DATE

ELECTRICAL REQUIREMENTS

	AVG HOURLY (1) 10,000	PEAK (2) 10,000	MAXIMUM (3) 10,000
FD FANS (3/BLR, 7½ Hp EA)	22½	45	67½
COAL FEEDERS (3/BLR, ¾ Hp EA)	2¼	4½	6¾
Lime FEEDERS (3/BLR, ¼ Hp EA)	¾	1½	2¼
ID FAN (1/BLR, 50 Hp EA)	50	100	150
Boiler Feed Pumps (3@ 2Hp EA)	2	4	6
Cond Trans Pumps (2@ ½ Hp EA)	½	½	1
Hopper Screw Feeder (2@ 5Hp)	10	10	10
Bucket Elevator (2@ 15 Hp)	30	30	30
Drag Chain Conveyor (2@ 10Hp)	20	20	20
Bottom Ash Pneumatic Blower (3@ 25Hp EA)	25	50	75
TOTAL Hp =	163	265.5	368.5
Kw =	121.6	198.0	274.8

Assume 121.6 Kw for AVG LOADING WITH (1) 10,000 lb/HR Boiler IN operation; At 0-25% Boiler load, Kw = .67 × 121.6 = 81 Kw ; At 25-50% load, Kw = .80 × 121.6 = 97 Kw ; Above 50% load, Kw = 121.6 Kw

MONTH	AVG Hourly Steam Demand	Boiler SIZE	% Boiler LOAD	Kw REQ'D	Electric Consumption Monthly - Kwh
JAN	6707 lb/HR	10,000 lb/HR	67.1	121.6	90,470
FEB	7599 "	↓	76.0	121.6	81,715
MAR	5726 "		57.3	121.6	87,552
APR	4945 "		49.5	97.0	69,840
MAY	3417 "		34.2	97.0	72,168
JUNE	1545 "		15.5	81.0	58,320
JULY	1400 "		14.0	81.0	60,264
AUG	1437 "		14.4	81.0	60,264
SEPT	2200 "		22.0	81.0	58,320
OCT	3489 "		34.9	97.0	72,168
NOV	5291 "		52.9	121.6	87,552
DEC	6291 "	↓	62.9	121.6	90,470

TOTAL CONSUMED 889,103 Kwh

ANNUAL OPERATION AND MAINTENANCE COST (DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$23,150
2. BOILER PLANT OPERATOR	4	$21,038	$84,152
3. COAL EQUIPMENT OPERATOR	1	$21,038	$21,038
4. HEATING EQUIPMENT MECHANIC	2	$21,038	$42,076

TOTAL = $170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs +10.3% FRINGES +7% ESCALATION

TOTAL ANNUAL LABOR COST = $ 170416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 102287
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 272703

SECTION I-4

CAPITAL COST ESTIMATE

OPTION 2 + RDF
OPTION 2 + WOOD

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - NORTH BASE - SOLID WASTE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: McMullin

CHECKED BY: Stevens

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
FRONT END LOADER	1	EA	—	—	12,000	12,000	12,000
TROMMEL SCREEN	1	EA	10,000	10,000	30,000	30,000	40,000
SHREDDER	1	EA	21,000	21,000	78,300	78,300	99,300
MAGNETIC SEPARATOR	1	EA	2000	2000	6000	6000	8000
STORAGE BIN	1	EA	3400	3400	11,500	11,500	14,900
SH. FEED CONVEYOR	1	EA	1500	1500	9750	9750	11,250
SH DISCH. CONVEYOR	1	EA	750	750	4875	4875	5625
M.S. CONVEYOR	1	EA	1000	1000	6500	6500	7500
GLASS CONVEYOR	1	EA	1000	1000	6500	6500	7500
T.S. DISCH. CONVEYOR	1	EA	1500	1500	9750	9750	11,250
WASTE BINS	2	EA	—	—	1000	2000	2000
SUB TOTAL PROCESS				42,150		177,175	219,325
ADDITIONAL BLDG	4000	FT²	8.80	35,200	13.20	52,800	88,000
ELECTRICAL	L.S.	—	—	68,785	—	68,785	137,570
FOUNDATIONS	LS	—	-	—	—	55,000	55,000
SUBTOTALS				146,135		353,760	499,895
LABOR BURDEN	22%			32,150		—	32,150
SALES TAX	5%			—		17,688	17,688
SUBTOTAL							549,733
OVERHEAD & PROFIT	25%						137,433
BOND	1%						6872
~~SUBTOTAL~~							~~$694,038~~
~~ENGINEERING & DESIGN~~	~~6%~~						~~41,642~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~$735,680~~ $694,038

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE

25 YEAR REPLACEMENT COST

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - NORTH BASE - SOLID WASTE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR: McMillin

CHECKED BY: Flowers

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
FRONT END LOADER	1	EA	—	—	12,000	12,000	12,000
TROMMEL SCREEN	1	EA	10,000	10,000	30,000	30,000	40,000
SHREDDER	1	EA	21,000	21,000	78,300	78,300	99,300
MAGNETIC SEPARATOR	1	EA	2000	2000	6000	6000	8000
STORAGE BIN	1	EA	3400	3400	11,500	11,500	14,900
SH. FEED CONVEYOR	1	EA	1500	1500	9750	9750	11,250
SH DISCH. CONVEYOR	1	EA	750	750	4875	4875	5625
M.S CONVEYOR	1	EA	1000	1000	6500	6500	7500
GLASS CONVEYOR	1	EA	1000	1000	6500	6500	7500
T.S. DISCH. CONVEYOR	1	EA	1500	1500	9750	9750	11,250
WASTE BINS	2	EA	—	—	1000	2000	2000
SUB TOTAL PROCESS				42,150		177,175	219,325
ELECTRICAL	L.S.	—	—	68,785	—	68,785	137,570
SUBTOTALS				110,935		245,960	356,895
LABOR BURDEN	22%			24,406		—	24,406
SALES TAX	5%			—		12,298	12,298
SUBTOTAL							393,599
OVERHEAD & PROFIT	25%						98,400
BOND	1%						4920
SUBTOTAL							$496,919
ENGINEERING & DESIGN	6%						
TOTAL ESTIMATED 25TH YEAR REPLACEMENT (DEC 1987 $)							$496,919

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) U.S. GOVERNMENT PRINTING OFFICE

LANDFILL SAVINGS

LANDFILL COSTS WITHOUT INCINERATION ARE $7800/YR

Assume 30% of the TOTAL RFD BURNED still has to be hauled off to the landfill, the TOTAL ANNUAL SAVINGS IS:

SAVINGS = ½ x $7800 x 70% = $2730/YEAR

Annual Maintenance Costs

Assume same as for coal plant; 2½% of capital cost

(.025)($735680) = $18,392

Assume no additional operators are required

Annual Electrical Consumption

20,530 Kwh

ELECTRICAL DEMAND = 132 Kw for solid waste system

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD - North Base
Solid Waste
DESIGNER S Cowen
CHECKER

AEP NO 80122-000
SHEET OF
DATE
DATE

ANNUAL FUEL COST

Coal REQ'D = 1130 TONS/YR x \$54/TON
= \$61020/YR

landfill cost savings = \$2730/YR

NET FUEL COST = \$58290/YR

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SEAD - NORTH BASE — AEP NO. 80122-000
SHEET ____ OF ____
DESIGNER: S. COWEN — DATE ____
CHECKER ____ — DATE ____

* ASSUME RFD CAN BE BURNED AS 25% OF TOTAL FUEL INPUT

MONTH	AVG HOURLY STM DEMAND lb/HR	HEAT INPUT REQ'D MBTU/HR	MAX HEAT INPUT BY RFD = 25% FULL LOAD MBTU/HR	RFD FIRING RATE/TONS PER HOUR/ 4500 BTU/lb	RFD FIRING RATE - TONS/DAY	① HOURS REQ'D TO BURN RFD DELIVERY
JAN	6707	9.42	2.36	0.262	6.29	33.6
FEB	7599	10.67	2.67	0.297	7.13	29.6
MARCH	5726	8.04	2.01	0.223	5.35	39.5
APRIL	4945	6.94	1.74	0.193	4.63	45.6
MAY	3417	4.80	1.20	0.133	3.19	66.2
JUNE	1545	2.17	0.54	0.060	1.44	146.7
JULY	1400	1.97	0.49	0.054	1.30	163.0
AUG	1437	2.02	0.51	0.057	1.37	154.4
SEPT	2200	3.09	0.77	0.086	2.06	102.3
OCT	3489	4.90	1.23	0.137	3.29	64.2
NOV	5291	7.43	1.86	0.207	4.97	42.5
DEC	6291	8.83	2.21	0.246	5.90	35.8

ASSUME THAT
① RFD IS DELIVERED TWICE A WEEK AT A RATE OF 17.6 TONS/WK
ASSUME EACH DELIVERY = 8.8 TONS

Based on the above information, RFD will only be fired in the boilers for those months in which the total load can be disposed of within 48 hours, limiting the firing of RFD to JAN, FEB, MARCH, APRIL, NOV & DEC

TOTAL RFD UTILIZED PER YEAR = 26 WEEKS $\times \frac{17.6 \text{ TONS}}{\text{WEEK}}$

= 457.6 TONS

TOTAL Heat INPUT by RFD = $457.6 \frac{\text{Tons}}{\text{YR}} \times 4500 \text{ BTU/lb} \times 2000 \text{ lbs/ton}$

= 4118.4 MBTU/YR

COAL REQ'D = $1295 \text{ TONS} - \frac{4118400000}{12500 \times 2000}$ = 1130 Tons/YR

T - 10(

SOLID WASTE PROCESSING EQUIPMENT -

Electrical consumption

Equipment sized to handle waste in 3 hours, 2 days per week.

Equipment horsepower

Shredder feed conveyor	10 hp.
Shredder	150 hp
Shredder discharge conveyor	5 hp.
Magnetic separator conveyor	2 hp
Glass conveyor	2 hp.
Trommel screen	7½ hp.

Total connected hp = 176.5 hp.

$$\left(\frac{176.5\ hp}{1}\right)\left(\frac{kw}{1.341\ hp}\right) = 131.6\ kw$$

Therefore, DEMAND = 132 KW

$$\text{CONSUMPTION} = \left(\frac{131.6\ kw}{1}\right)\left(\frac{6\ hr}{week}\right)\left(\frac{26\ weeks}{yr}\right) = 20{,}530\ \frac{kwh}{yr}$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD - NORTH BASE - SOLID WASTE

AEP NO 80122-000

SHEET 1 OF

DESIGNER McMullen

DATE

CHECKER Sloan

DATE

SOLID WASTE CAPITAL COST ESTIMATE

CONVEYOR

Assume all conveyor are drag-link type @ $50/foot labor & $325/foot matl.

SHREDDER FEED CONVEYOR - Assume 30 ft. long

LABOR = $50/ft (30 ft) = $1500

MATL = $325/ft (30 ft) = $9750

SHREDDER DISCHARGE CONVEYOR Assume 15 ft. long

LABOR = 50 (15) = $750

MATL = 325 (15) $4875

MAGNETIC SEPARATOR CONVEYOR - Assume 20 ft.

LABOR = 50 (20) = $1000

MATL = 325 (20) = $6500

GLASS CONVEYOR - Assume 20 ft

LABOR = 50 (20) = $1000

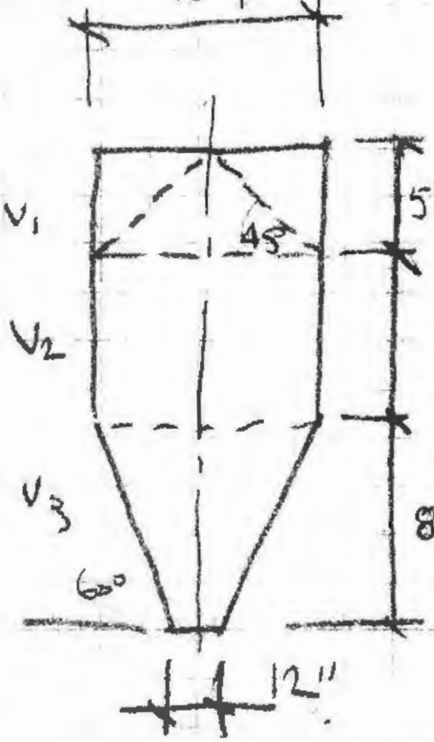
MATL = 325 (20) = $6500

TROMMEL SCREEN DISCHARGE CONVEYOR - Assume 30 ft -

LABOR = 50 (30) = $1500

MATL = 325 (30) = $9750

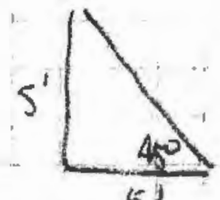
STORAGE BIN – Assume 9 Tons Storage,
10 lb/ft³

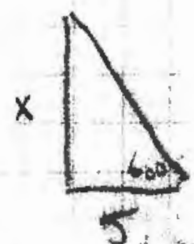


$$9 \text{ ton}\left(\frac{ft^3}{10 lb}\right)\left(\frac{2000 lb}{ton}\right)$$

$= 1800 ft^3$

STORAGE REQ'D.





$\tan 60° = \frac{x}{5}$

$x = 8.66 ft$

$V_1 + V_2 + V_3 = 1800 ft^3$

$V_1 = \frac{1}{3}\pi(5)^2(5) = 131 ft^3$

$V_3 = \frac{1}{3}\pi(5)^2(8.66) = 227 ft^3$

$V_2 = 1800 - 131 - 227 = 1442 ft^3 = \pi(5)^2 h$

$\therefore h = 18.4 ft$

$\rho = 15.3 lb/ft^2$

SURFACE AREA $= \pi(5)^2 + 23.4(\pi)(10) + \pi(5)\sqrt{5^2 + 8.66^2}$
$= 971 ft^2$

WT $= 15.3(971) = 14,856$ lb.

COST
LABOR = \$0.23 /lb (14,856 lb) = \$3417
MAT'L = \$0.77 /lb (14,856 lb) = \$11,439

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-020

Local ___ L.D. (circled) ___ Placed (circled) ___ Rec'd ___ Date 5 JAN 80

J. McMILLIN Conversed with MIKE LATIMOR

Of ERIEZ MANF. Co. Regarding Magnetic separator for SEAD SOLID WASTE SYSTEM 814-833-9881

Require magnetic separator for 18" wide conveyor - model 6-35-18 is $1600.

Distribution:

I - 110

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ___ (L.D.) ___ (Placed) ___ Rec'd ___ Date 5 JAN 80

J. McMILLIN Conversed with B. BURDA

Of SATURN MANF. CO. Regarding Shredder for SEAD Solid Waste System 503-682-3633

Require shredder for 3 TPH municipal solid waste, maximum particle size of 3" x 3". Shredder selected Model 52-40 (52" x 40" opening) good for 7.5 TPH, has 150 hp motor, costs $78,300.

Distribution:

I - 111

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ____ (L.D.) ____ (Placed) ____ Rec'd ____ Date 5 JAN 80

J. McMILLIN Conversed with KEN STERRETT

Of SPROUT-WALDRON Co. Regarding Trommell screen for

SEAD SOLID WASTE SYSTEM 717-546-8211

Require trommell screen with through put capacity of 3 TPH, 1/2"ϕ holes, located after shredder to eliminate glass, grit, etc. Shredder selected is 4 1/2'ϕ x 12' long with 7 1/2 hp motor, approximate cost = $30,000.

Distribution:

I-112

RS&H FORM 102 11/72

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: Slavens

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280,478	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11074		21,026	32100
HVAC, Plumbing, ETC.				4750		4250	9,000
ROAD WORK & CIVIL SITE PREP				—		27500	27,500
BLDG COND RETURN SYSTEMS				3660		16185	19,845
STM PLANT COND COLL. SYST.				1292		4385	5677
MAKEUP WATER SOFTENERS				360		1600	1960
FOUNDATIONS				—		166100	166100
ELECTRICAL				123,000		123,000	246,000
INSTR. & CONTROL (MISC.)				1950		18,150	20100
Fire Protection				7100		4900	12000
SUB-TOTAL				421033		682350	1103383
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		34118	34118
SUB-TOTAL							1230128
OVERHEAD & PROFIT	25%						307532
BOND	1%						15377
SUB-TOTAL							1553037
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1615000
~~ENGINEERING & DESIGN~~	~~6%~~						~~110082~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~[illegible]~~

$3,168,037

ENG FORM 150, 1 AUG 59 (EM 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$ 23,150
2. BOILER PLANT OPERATOR	4	$ 21,038	$ 84,152
3. COAL EQUIPMENT OPERATOR	1	$ 21,038	$ 21,038
4. HEATING EQUIPMENT MECHANIC	2	$ 21,038	$ 42,076

TOTAL = $ 170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALLATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 83954
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 254370

REPLACEMENT COST AFTER 25 YEARS

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: S[illegible]

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280,476	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, ETC.				4750		4250	9000
BLDG COND RETURN SYSTEMS				3660		16,185	19,845
STM PLANT COND COLL. SYST.				1292		4385	5677
MAKEUP WATER SOFTENERS				366		1600	1966
ELECTRICAL				123,000		123000	246000
INSTR. & CONTROL (MISC.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				421033		488750	909783
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		24438	24438
SUB-TOTAL							1026848
OVERHEAD & PROFIT	25%						256712
BOND	1%						12836
SUB-TOTAL							1296396
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1146000
~~ENGINEERING & DESIGN~~	~~6%~~						~~146544~~
TOTAL ESTIMATED 25TH YEAR REPLACEMENT COST (DEC 1980 $)							~~$2583940~~

$2,442,396

ENG FORM 1 AUG 59 150 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

REPLACEMENT OF EXISTING PIPING ~ 1996 & 2021

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT – NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: Corwin

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SALES TAX	5%			—		9361	9361
SUBTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 1930 DOLLARS)							# 366,249

ENG FORM 150
1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* [illegible] 20% [illegible] OF EXISTING PIPING

NORTHBASE

ELECTRICAL CONSUMPTION (1) 8500 lb/hr boiler uses 68.6 kw electricity at full load. From 0-25% load, assume boiler uses 67% of full load electrical. 25-50% load → 80%. Above 50% load, assume 100%.

	AVG. HOURLY STEAM DEMAND (lb/hr)	BOILER SIZE (lb/hr)	KW	KWH
JAN	6707	(1) 8500	69	51,336
FEB	7599	"	69	46,368
MARCH	5726	"	69	51,336
APRIL	4945	"	69	49680
MAY	3417	"	55	40920
JUNE	1545	"	46	33,120
JULY	1400	"	46	34,224
AUG	1437	"	46	34,224
SEPT	2200	"	46	33,120
OCT	3489	"	55	40920
NOV	5291	"	69	49,680
DEC	6291	"	69	51,336
			TOTAL	516,264 kwh

WOOD FIRING] SENECA NORTH

1. ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

2. BENEFICIAL OCCUPANCY DATE JAN '85

3. ECONOMIC LIFE 25 YEARS

4. DATE OF ESTIMATE DEC '80 $

5. INITIAL COST ~~$ 3,386,261~~ $ 3,194,586

6. ANNUAL MAINTENANCE COSTS

OPERATIONS (labor) $ 191,454
MAINTENANCE MATERIAL $ 84658
} $ 276,112 TOTAL

7. CYCLICAL MAINTENANCE COSTS

1) EXISTING PIPING will be replaced IN 1996 & 2021 AT A COST OF $ 366,249 IN DEC '80 $

2) INITIAL SYSTEM will be replaced after 25 yrs (2010) at a total replacement cost of $ 2,468,945 IN Dec '80 $

8. ANNUAL FUEL COST

1116 TONS OF WOOD @ $ 20/TON = $ 2232
1246 TONS OF COAL @ $ 54/TON = $ 67284
} TOTAL = $ 69516

9. ANNUAL ELECTRICAL CONSUMPTION

516264 Kwh

1. ELECTRICAL DEMAND RATE

125 KW

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: WOOD FIRING SUB-OPTION

ESTIMATOR: Slowey

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
10 Ton Storage Bunker	2	EA	1283	2566	3952	7904	10,470
Gate Values 12"x12"	4	EA	45	180	780	3120	3300
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
12" Ø feed chute	100	Ft	6 86	686	18 86	1886	2572
SUB TOTAL				3612		15830	19442
LABOR BURDEN	22%			795		—	795
SALES TAX	5%			—		792	792
SUBTOTAL							21029
OVERHEAD & PROFIT	25%						5257
BOND	1%						263
SUBTOTAL							26549
~~ENGINEERING & DESIGN~~	~~6%~~						~~1593~~
~~TOTAL~~							~~$ 28,112~~

Replacement Cost in 2010 & 2035

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD- NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: WOOD FIRING SUB-OPTION

ESTIMATOR: Slowen

CHECKED BY

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
10 Ton Storage Bunker	2	EA	1283	2566	3952	7904	10,470
Gate Valves 12"x12"	4	EA	45	180	780	3120	3300
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
12" Ø feed chute	100	Ft	6.86	686	18.86	1886	2572
SUBTOTAL				3612		15830	19442
LABOR BURDEN	22%			795		—	795
SALES TAX	5%			—		792	792
SUBTOTAL							21029
OVERHEAD & PROFIT	25%						5257
BOND	1%						263

TOTAL REPLACEMENT COST IN DEC 1980 $ ⟶ $ 26549

ENG FORM 1 AUG 59 150 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

ADDITIONAL EQUIPMENT REQUIRED FOR WOOD FIRING:

(2) WOOD SURGE BUNKERS, 10 TON CAPACITY, TO BE "TOPPED UP" by the existing coal reclaim hopper / BUCKET ELEVATOR/ DRAG CHAIN CONVEYOR SYSTEM - WOOD WOULD NOT BE STORED IN THESE SURGE BINS, BUT would BE FED TO THE BOILER THRU THESE BINS. Note! THESE BINS WOULD HAVE TO BE EQUIPPED WITH VIBRATORS TO KEEP THE WOOD FLOWING

(4) 12" Ø COAL CHUTES, 25' long EACH

(4) 12" x 12" slide gate valves

(2) 12X12"X12" DIVERTING VALVES

Note! WOOD IS TO BE FIRED ONLY AS A SUPPLEMENTAL FUEL, IT HAS BEEN ASSUMED THAT NO MORE THAN 10% of the TOTAL HEAT INPUT will BE PROVIDED BY THE WOOD.

PEAK load of steam GENERATOR = 15593 lb/HR

Steam Pressure = 80 psig, Temperature = SAT } h = 1179.1

Feedwater Temperature = 228 F } h = 196.27

Δh = 982.83 BTU/lb

Assume Boiler Efficiency = 70%
WOOD HHV = 5528 BTU/lb
MOISTURE = 37.5%

$$\text{MAX WOOD BURN RATE} = \frac{15593\ \text{lb/HR} \times 982.83\ \frac{\text{BTU}}{\text{lb}} \times 10\%}{.70 \times 5528\ \text{BTU/lb}} = 396\ \frac{\text{lbs}}{\text{HR}}$$

ADDITIONAL O&M COST ASSOCIATED WITH WOOD FIRING:

1) Assume that 1 additional operator will be required per shift that wood is being fired @ $ 21038 per year per operator (Assume 1-shift per day, 5 days per week)

Additional Annual Labor Cost = $ 21038

2) Assume that the maintenance costs will be the same % as with the central coal plant ($2\frac{1}{2}$% of initial cost)
(.025 x $ 28142) = $ 704/YR

FUEL COST FOR WOOD FIRING

MONTH	AVG HOURLY STEAM DEMAND lb/HR	Heat Input Req'd (MBTU) *	Heat Input Provided by Wood Firing **	Total Hrs/Mo Firing Wood 1-Shift/5 Days	Total Heat Input/Mo by Wood	Total Wood [illegible]
JAN	6707	9.42	0.942 MBTU	176.7	166.5 MBTU	15.1
FEB	7599	10.67	1.067 "	159.6	170.3 "	15.4
MAR	5726	8.04	0.804 "	176.7	142.1 "	12.9
APR	4945	6.94	0.694 "	171.0	118.7 "	10.7
MAY	3417	4.80	0.480 "	176.7	84.8 "	7.7
JUNE	1545	2.17	0.217 "	171.0	37.1 "	3.4
JULY	1400	1.97	0.197 "	176.7	34.8 "	3.1
AUG	1437	2.02	0.202 "	176.7	35.7 "	3.2
SEPT	2200	3.09	0.309 "	171.0	52.8 "	4.8
OCT	3489	4.90	0.490 "	176.7	86.6 "	7.8
NOV	5291	7.43	0.743 "	171.0	127.1 "	11.5
DEC	6291	8.83	0.883 "	176.7	156.0 "	16.0
				TOTALS =	1212.5 MBTU	111.6 TON

$$* \text{ HEAT INPUT} = \frac{\text{Steam Demand} \times 982.83 \frac{\text{BTU}}{\text{lb}}}{70\% \text{ efficiency}}$$

** Heat Input x .10

$$\text{TOTAL HRS} = \frac{\text{DAYS IN MONTH}}{365} \times 260 \times 8 \text{ hrs}$$

The cost of wood chips, delivered to the Seneca Army Depot, is assumed to be $20/ton. It should be noted, however, that there are no chipping or harvesting operations currently in progress in the area of the plant, and therefore, this cost could be much greater when such an operation is started up.

Annual wood fuel use = 111.6 tons x $20/ton = $2232

$$\text{Annual Coal Use} = 1295 \text{ TONS} - \frac{1212{,}500{,}000 \text{ BTU}}{12500 \frac{\text{BTU}}{\text{lb}} \times 2000 \frac{\text{lb}}{\text{TON}}} = 1246 \text{ TONS}$$

Annual Coal Cost = 1246 tons x $54/ton = $67284

TOTAL ANNUAL FUEL COST = $69516

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: [signature]

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280,478	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, ETC.				4750		4250	9000
ROAD WORK & CIVIL SITE PREP				—		27500	27,500
BLDG COND RETURN SYSTEMS				3660		16185	19,845
STM PLANT COND COLL. SYST.				1292		4385	5677
MAKEUP WATER SOFTENERS				366		1600	1966
FOUNDATIONS				—		166100	166,100
ELECTRICAL				123,000		123,000	246,000
INSTR. & CONTROL (MISC.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				421033		682350	1103383
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		34118	34118
SUB-TOTAL							1230128
OVERHEAD & PROFIT	25%						307532
BOND	1%						15377
SUB-TOTAL							1553037
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1615000
~~ENGINEERING & DESIGN~~	~~6%~~						~~190082~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~$3358119~~

$3,168,037

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$ 23,150
2. BOILER PLANT OPERATOR	4	$ 21,038	$ 84,152
3. COAL EQUIPMENT OPERATOR	1	$ 21,038	$ 21,038
4. HEATING EQUIPMENT MECHANIC	2	$ 21,038	$ 42,076

TOTAL = $ 170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC'80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALLATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 83954
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 254370

CONSTRUCTION COST ESTIMATE

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT- NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR: McMillin

CHECKED BY: Slowey

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				257,367		280478	537,845
Valves, specialties, etc.				10,374		14,876	25,250
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, ETC.				4750		4250	9000
Blog Cond Return Systems				3660		16,185	19,845
Stm Plant Cond Coll. Syst.				1292		4385	5677
Makeup Water Softeners				366		1600	1966
Electrical				123,000		123000	246000
Instr. & Control (misc.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				421033		488750	909783
LABOR BURDEN	22%			92627		—	92627
SALES TAX	5%			—		24438	24438
SUB-TOTAL							1026848
OVERHEAD & PROFIT	25%						256712
BOND	1%						12836
SUB-TOTAL							1296396
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1146000
~~ENGINEERING & DESIGN~~	~~6%~~						~~146544~~
TOTAL ESTIMATED 25TH YEAR REPLACEMENT COST (DEC 1980 $)							~~$2588940~~

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

$2,442,396

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS		BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)
LOCATION: SENECA ARMY DEPOT – NORTH BASE		
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO.: EXISTING PIPING REPLACEMENT	ESTIMATOR: Slawson	CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, insulated	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SAles TAX	5%			—		9361	9361
SubTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 1984 DOllARS)							$ 366,249

ENG FORM 150
1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1980 O—310180

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

NORTHBASE

ELECTRICAL CONSUMPTION (1) 8500 lb/hr boiler uses 68.6 kw electricity at full load. From 0-25% load, assume boiler uses 67% of full load electricity. 25-50% load → 80%. Above 50% load, assume 100%.

	AVG. HOURLY STEAM DEMAND (lb/hr)	BOILER SIZE (lb/hr)	KW	KWH
JAN	6707	(1) 8500	69	51,336
FEB	7599	"	69	46,368
MARCH	5726	"	69	51,336
APRIL	4945	"	69	49680
MAY	3417	"	55	40920
JUNE	1545	"	46	33,120
JULY	1400	"	46	34,224
AUG	1437	"	46	34,224
SEPT	2200	"	46	33,120
OCT	3489	"	55	40920
NOV	5291	"	69	49,680
DEC	6291	"	69	51,336
			TOTAL	516,264 kwh

SECTION I-5

CAPITAL COST ESTIMATE

HTW DISTRIBUTION SYSTEMS

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT SENECA ARMY DEPOT - NORTH BASE HTW SYSTEM
AEP NO. 80-122000
SHEET ___ OF ___
DESIGNER BLJ
DATE 1/5/81
CHECKER ___
DATE ___

1. ANTICIPATED MIDPOINT DATE OF CONSTRUCTION: 1/84

2. BENEFICIAL OCCUPANCY DATE : 1/85

3. ECONOMIC LIFE = 25 yrs ; PLANT LIFE = 25 yrs

4. PROJECT COST in Dec 1980 dollars.

5. INITIAL COST (including engineering) : ~~$ 3,523,806~~ $3,324,345

6. ANNUAL OPERATION AND MAINTENANCE COST : $258,517

7. CYCLICAL MAINTENANCE COST:
The exisiting distribution piping must be replaced in 1996 at a cost of $ 366,249 (Dec. '80 dollars)

8. ANNUAL FUEL COST = (1295 tons/yr)(.98) x $54/ton
= $ 68,531.

9. ANNUAL ELECTRIC ENERGY DEMAND = 661,768 KWH

10. KW FOR ENERGY DEMAND CHARGE = 118

CONSTRUCTION COST ESTIMATE	DATE PREPARED 5/1/81	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.:

ESTIMATOR: BLJ

CHECKED BY:

COMPLETE PROJ. SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
HTW PIPING				258,937		246,676	505,613
HTW CIRC PUMPS				1,320		11,686	13,006
HTW VALVES, I+C				3,790		13,082	16,872
TRUCK SCALE				11,074		21,026	32,100
HVAC, PLUMBING, ETC				4,750		4,250	9,000
ROAD WORK + CIVIL SITE				-		27,500	27,500
BLDG COND. PACKAGES				5,280		55,608	60,888
UNFIRED STEAM GEN'S.				12,650		250,000	262,650
MAKE-UP WTR SOFTENER				366		1,200	1,566
FOUNDATION				-		166,100	166,100
BOILER PLANT				88,000		592,222	680,222
MISC ELECTRICAL				40,000		40,000	80,000
SERVICE WTR + FIRE PRO				7,200		4,800	12,000
BOILER ENCLOSURE				-		164,000	164,000
BOILER STRUCT. STEEL				-		305,000	305,000
MAT. HNDLG EQPMT				15,269		83,335	98,604
SUB-TOTAL				448,636		1,986,485	2,435,121
LABOR BURDEN	22	%		98,700		-	98,700
SALES TAX	5	%		-		99,324	99,324
SUB-TOTAL							2,633,145
OVERHEAD + PROFIT	25	%					658,286
BOND	1	%					32,914
SUB-TOTAL							3,324,345
~~ENGINEERING + DESIGN~~	~~6~~	~~%~~					~~199,461~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980)							~~$ 3,523,806~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

$ 3,324,345

VIII (cont.)

CONSTRUCTION COST ESTIMATE	DATE PREPARED 12/30/80	SHEET OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS	BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)	
LOCATION: SENECA ARMY DEPOT - North Base		
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO.	ESTIMATOR: BLJ	CHECKED BY

BOILER PLANT SUMMARY - MECH. + ELEC	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BOILER (10,500 lb/hr)	3		SEE	BELOW	161,354	484,062	
EXPANSION TANKS	2			↓	24,604	49,208	
BOILER FEED PUMPS	2				11,476	22,952	
PIPING, VALVES + CONTROLS	1				15,000	15,000	
CONTROL PANEL	1				21,000	21,000	
MECH. AND ELECTRICAL INSTALLATION OF ABOVE	4,000	hrs	22	88,000			
				88,000		592,222	680,222

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE	DATE PREPARED 12/30/80	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

LOCATION: SENECA ARMY DEPOT - North Base

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.:

ESTIMATOR: BLJ

CHECKED BY:

HTW DISTRIB. SYS. SUMMARY PUMPS, VALVES, I+C	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
HTW CIRC. PUMPS:							
"A"	2	ea	330	660	3,530	7,060	7,720
"B"	2	ea	330	660	2,313	4,626	5,286
				1,320		11,686	13,006
VALVES:							
½" Globe	13	ea	40	520	45	585	
¾" Globe	10	ea	40	400	55	550	
1" Globe	1	ea	44	44	65	65	
½" Gate	26	ea	31	806	42	1092	
¾" Gate	20	ea	31	620	62	1240	
1" Gate	2	ea	40	80	82	164	
				2,470		3,696	6,166
INSTRUMENTATION AND CONTROLS:							
Temp. Transmitters	4	ea			459	1836	
Flow Meter (Includes Flanges)	2	ea	60	hrs total	402	804	
Flow Transmitter	2	ea	@	22 $/hr	809	1618	
Recorder	2	ea	=	1320	1814	3628	
Interface Controls	1	ea			1500.	1500	
				1320		9,386	10,706
SUB-TOTAL FOR VALVES AND I+C				3,790		13,082	16,872

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

CONSTRUCTION COST ESTIMATE

CONSTRUCTION COST ESTIMATE	DATE PREPARED 12/19/80	SHEET	OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS		BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)	
LOCATION: SENECA ARMY DEPOT - NORTH BASE			
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.			
DRAWING NO.	ESTIMATOR: BZJ	CHECKED BY	

HTW DISTRIBUTION SUMMARY PIPING	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
EXCLUSION AREA:							
1" SCH 80 + CONDUIT	938	ft	24.24	22,737	18.00	16,884.	39,621
1½" SCH 80 + CONDUIT	2,158	ft	24.24	52,310	20.25	43,700	96010.
2" SCH 40 + CONDUIT	316	ft	25.84	8,165	19.50	6,162	14,327.
1" ELL's + TEES	38	ea.	242.40	9,211	104.00	3,952	13,163.
1½" ELL's + TEES	54	ea.	242.40	13,090	110.00	5,940	19,030.
2" ELL's + TEES	8	ea.	258.40	2,067	134.00	1,072	3,139.
EXCAVATION + BACKFILL	1,706	ft	12.64	21,564	—	-	21,564.
OUTSIDE EXCLUSION AREA:							
1" SCH 80 + CONDUIT	712	ft	12.12	8,629	18.00	12,816	21,445
2" SCH 80 + CONDUIT	5,356	ft.	12.92	69,200	19.50	104,442	173,642
6" SCH 80 + CONDUIT	720	ft	17.70	12,744	45.00	32,400	45,144
1" ELL'S + TEE's	30	ea.	121.20	3,636	104.00	3,120	6,756
2" ELL's + TEE's	82	ea.	129.20	10,594	134.00	10,988	21,582
6" ELL's + TEE's	20	ea.	177.00	3,540	260.00	5,200	8,740
EXCAVATION + BACKFILL	3,394	ft	6.32	21,450	—	—	21,450
TOTALS			$	258,937		246,676	505,613

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE	DATE PREPARED 12/30/80	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - North Base

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: | ESTIMATOR: BZJ | CHECKED BY:

BUILDING SUMMARY HEATING SYSTEMS	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
UNFIRED STEAM GENERATORS							
250 lb steam/hr	6	ea	550	3,300	9,500	57,000	
500 lb/hr	7	ea	550	3,850	10,000	70,000	
1000 lb/hr	6	ea	550	3,300	12,000	72,000	
1500 lb/hr	3	ea	550	1,650	12,500	37,500	
3000 lb/hr	1	ea	550	550	13,500	13,500	
				12,650		250,000	262,650
CONDENSATE RECEIVER AND PUMP PACKAGE	24	ea	220	5,280	2,317	55,608	60,888

CONSTRUCTION COST ESTIMATE

DATE PREPARED: [illegible]/81 | SHEET ____ OF ____

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT – NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR:

CHECKED BY:

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify) [illegible]

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	7.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SALES TAX	5%			—		9361	9361
SUBTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 198[illegible] DOLLARS)							366,249

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD-NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

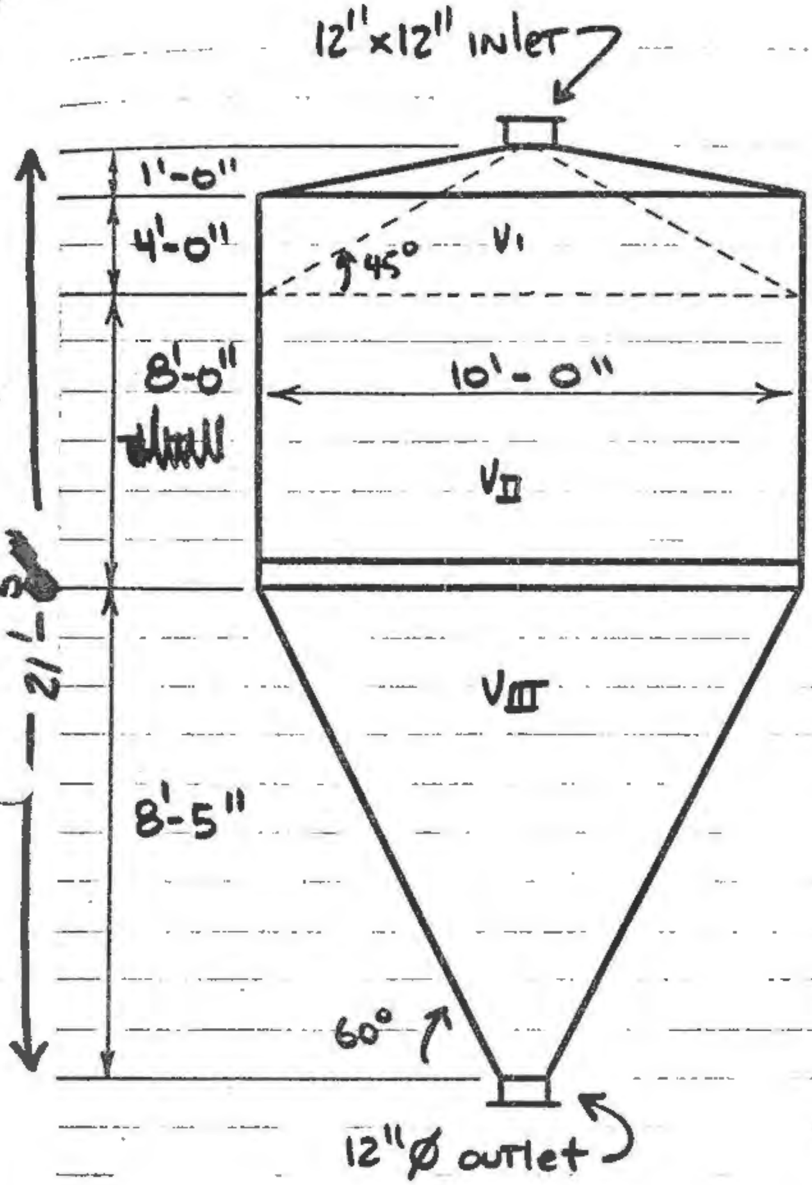
DRAWING NO. | ESTIMATOR | CHECKED BY

~~EQUIPMENT~~ MATERIAL HANDLING SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
25 TON STORAGE BUNKER	3	EA	2143	6429	7175	21525	27954
Gate Values 12"x12"	2	EA	45	90	780	1560	1650
DRAG CHAIN CONVEYOR	80	Ft	50	4000	325	26000	30,000
BUCKET ELEVATOR	85	Ft	50	4250	250	21250	25,500
Screw Feeder	10	Ft	50	500	200	2000	2,500
TRUCK UNLOADING HOPPER	1	EA	—	—	11000	11,000	11,000
				15,269		83,335	
							$ 98604
~~SUB~~-TOTAL							

EQUIPMENT REQ'D FOR FIRING SUPPLEMENTAL FUEL							
5 TON STORAGE BUNKERS	2	EA	720	1440	2409	4818	6258
Gate Values 12"x12"	2	EA	45	90	780	1560	1650
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
Sub-TOTAL							

ENG FORM 150
1 AUG 59
(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)
U.S. GOVERNMENT PRINTING OFFICE

NORTH BASE
25 TON BUNKERS



$\frac{25 \text{ Tons}}{50\#/\text{Ft}^3} = 1000 \text{ Ft}^3$

$V_I + V_{II} + V_{III} = 1000 \text{ Ft}^3$

$V_I = \frac{1}{3}\pi R^2 h = \frac{\pi}{3}(5)^2(5)$

$V_I = 130.9 \text{ FT}^3$

$V_{III} = \frac{\pi}{3} h (R_1^2 + R_2^2 + R_1 R_2)$

$= \frac{\pi}{3} \times 8.417 (25 + (.5)^2 + 5 \times .5)$

$V_{III} = 244.6 \text{ Ft}^3$

$V_{II} = 1000 - 244.6 - 130.9$

$= 624.5 \text{ Ft}^3$

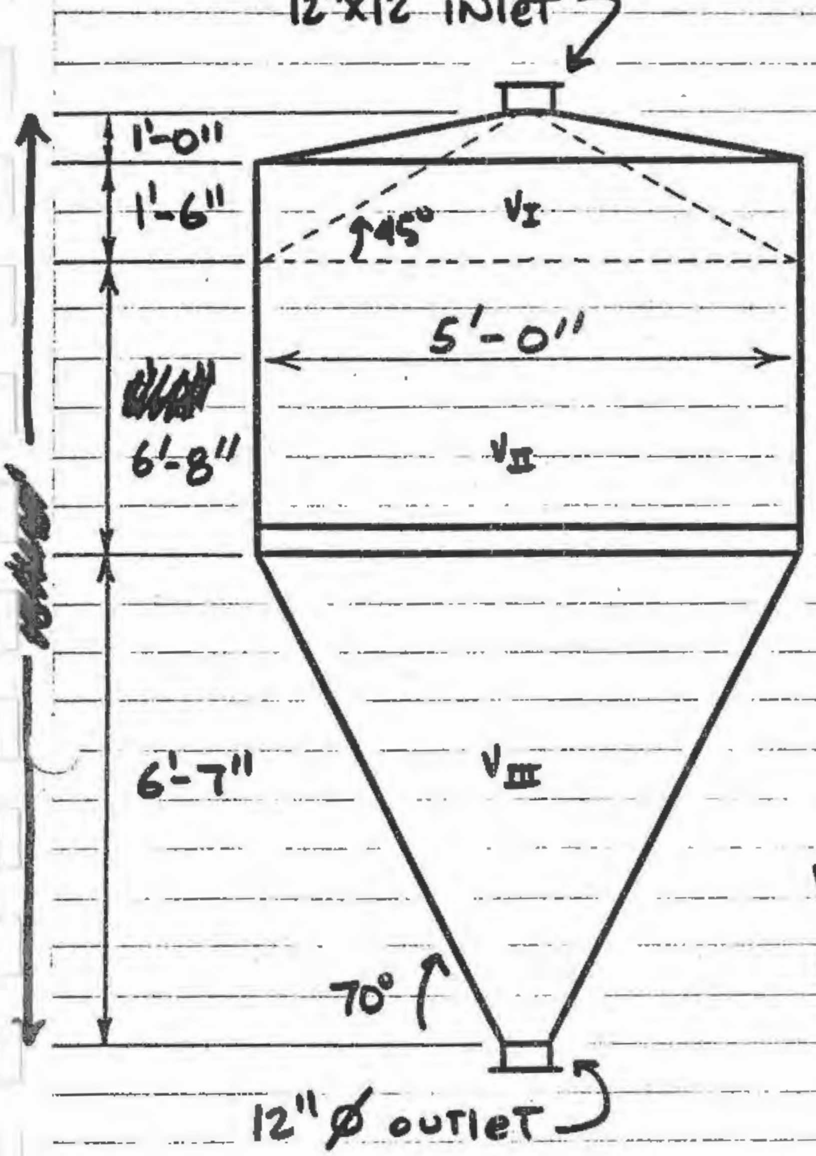
$h_{II} = \frac{624.5}{\pi \frac{(10)^2}{4}} = 7.95 = 8'\text{-}0''$

surface AREA = 609 Ft²

ρ = 15.3 #/Ft²   weight = 9318 lbs

material cost = $.77/lb = $ 7175

labor cost = $.23/lb = $ 2143



NORTH BASE
5 TON BUNKERS

$$\frac{5 \text{ TONS}}{50\ \#/Ft^3} = 200\ Ft^3$$

$$V_I + V_{II} + V_{III} = 200\ Ft^3$$

$$V_I = \frac{1}{3}\pi \frac{D^2}{4} h = \frac{\pi}{3} \times \frac{5 \times 5}{4} \times 2.5 = 16.4\ Ft^3$$

$$V_{III} = \frac{1}{3}\pi h\,(R_1^2 + R_2^2 + R_1 R_2)$$

$$= \frac{\pi}{3} \times 6.58\,(2.5^2 + .5^2 + 2.5 \times .5)$$

$$= 53.4\ Ft^3$$

$$V_{II} = 200 - 53.4 - 16.4 = 130.2\ Ft^3$$

$$h_{II} = \frac{130.2}{\frac{\pi (25)}{4}} = 6.63 = 6'\text{-}8"$$

Surface Area = 204.5 Ft^2

ρ = 15.3 $\#/Ft^2$ WEIGHT = 3129 lbs

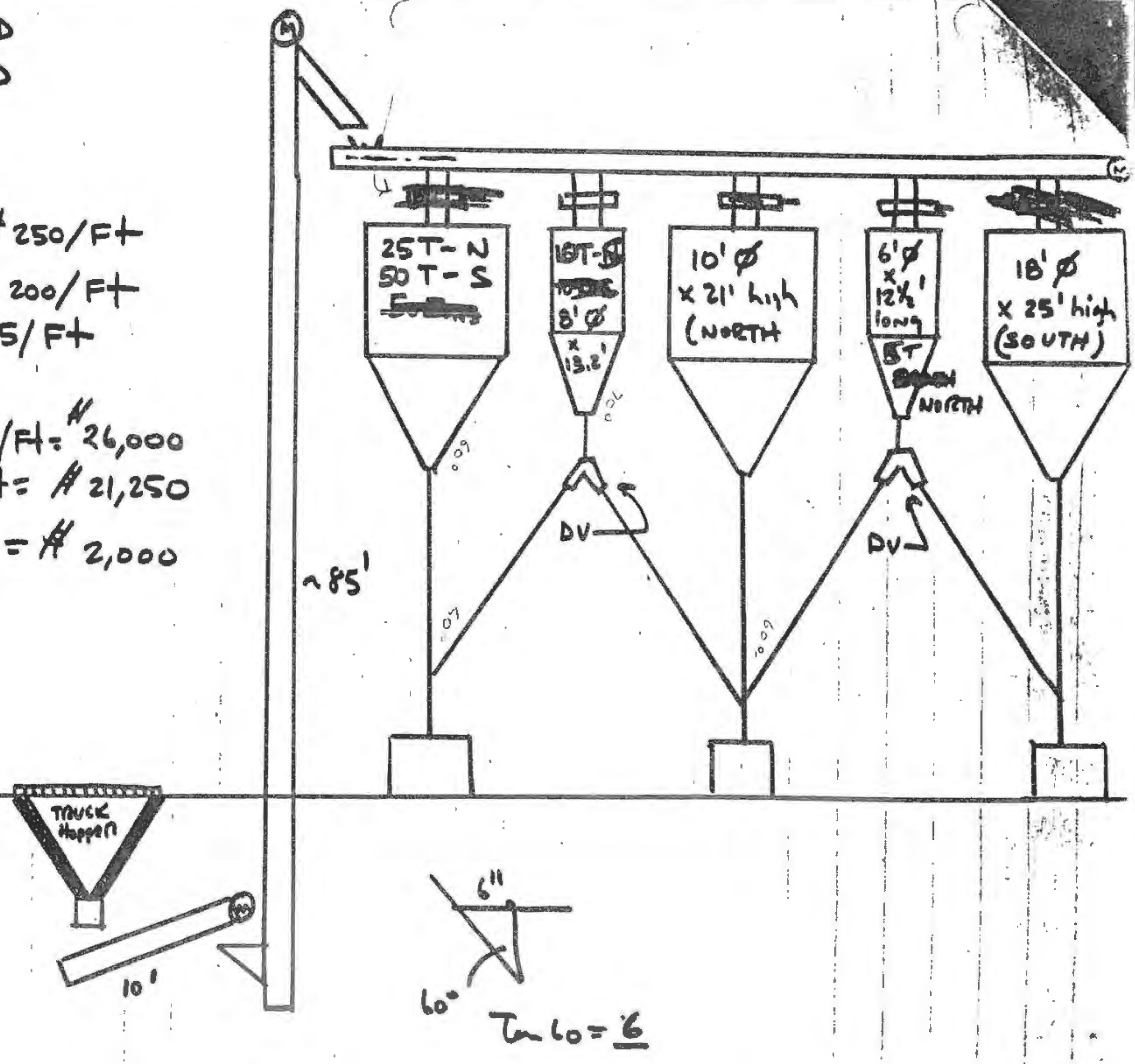
material cost = \$.77/lb = \$ 2409

labor cost = \$.23/lb = \$ 720

North Base 8 TPD
South Base 17 TPD

Budgetary Cost
Bucket Elevator # 250/Ft
Screw Conveyor # 200/Ft
: Drag Chain # 325/Ft

Drag Chain 80' x # 325/Ft = # 26,000
Bucket 85' x 250/Ft = # 21,250
Screw 10' x 200/Ft = # 2,000
Valves
Truck hopper



CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT
INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION
SENECA ARMY DEPOT - NORTH BASE

ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
TRUCK SCALES							
60x10/60 TON/4 SECTION TRUCK SCALE complete WITH: 90-7300/8100 DIGITAL INSTR. AND DOT MATRIX PRINTER, 2-MANHOLES RINGS & COVERS, TYPE REGISTER BEAM, SHORT IRON & PILLAR, SURGE VOLTAGE PROTECTION						$21026	$21026
INSTALLATION, INCLUDING PIT				$11,074			$11,074
TOTAL							$32,100

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SENECA - CENTRAL COAL PLANT
DESIGNER J MCMILLIN
CHECKER
AEP NO 00166-000
SHEET 1 OF
DATE 19 DEC 80
DATE

PLANT BATHROOM FACILITIES

Bathroom to include 2 water closets, 2 showers, 3 lavatories and a drinking fountain

EST. COST

LABOR $4500
MATL. 3500
$8000 TOTAL

ADD $ 750 material
$ 250 labor
} for Room size A/C & ventilator for control room

HVAC & PLUMBING

Labor $ 4750
material $ 4250

TOTAL $ 9,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SITE IMPROVEMENTS							
GRADING	1.6	AC.			3125	5,000	5000
PAVING	1500	SY			15	22,500	22,500
TOTAL						27,500	27,500

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) U.S. GOVERNMENT PRINTING OFFICE

SENECA [illegible]

NORTH BASE

BOILER FOUNDATION (80X100 BLDG)

EXCAVATION: 1110 cy @ $4.24 = $4700

BACKFILL: 850 cy @ $6.36 = $5400

Concrete: 640 cy @ $243.80 = $156,000

TOTAL $166,100

Boiler Enclosure & Structural Steel

STRUCTURAL STEEL: 180 Tons @ $1500/TON = $270,000

GRATING: 4000 Ft² @ $4.24 = $16960

stairs: 100 riser @ $116 = $11,600

handrail: 400 Ft @ $15.90 = $6360

TOTAL = $304,920

Say $305,000

ARCHITECTURAL ENCLOSURE $164,000

I-143

TOTAL $469,000

REPLACEMENT OF EXISTING PIPING ~ 1996

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT – NORTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR

CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
OVERHEAD PIPING							
6" sch 40, INSULATED	275	Ft	11.15*	3066	31.04	8536	11602
4" sch 40 "	490	Ft	8.12*	3979	19.06	9339	13318
3" sch 40 "	320	Ft	6.44*	2061	15.51	4963	7024
2½" sch 40 "	420	Ft	5.84*	2453	12.01	5044	7497
2" sch 40 "	600	Ft	2.88*	1728	9.29	5574	7302
1½" sch 80 "	320	Ft	2.63*	842	9.10	2912	3754
1¼" sch 80 "	225	Ft	2.63*	592	9.10	2048	2640
PIPING BURIED IN NEW TRENCH							
EXCAVATION & BACKFILL	2500	Ft	6.32	15800	–	–	22815
8" sch 40, INSULATED	940	Ft	11.28	10603	40.80	38352	48955
6" sch 40	1570	Ft	9.02	14161	31.04	48733	62894
4" sch 40	1580	Ft	6.56	10365	19.06	30115	40480
3" sch 40	110	Ft	5.20	572	15.51	1706	2278
2½" sch 40	1760	Ft	4.73	8325	12.01	21138	29463
2" sch 40	640	Ft	2.28	1459	9.29	5946	7405
1½" sch 80	110	Ft	2.07	228	9.10	1000	1228
1¼" sch 80	200	Ft	2.07	414	9.10	1820	2234
Sub-TOTAL				76648		187226	263874
LABOR BURDEN	22%			16863		—	16863
SALES TAX	5%			—		9361	9361
SUBTOTAL							290098
OVERHEAD & PROFIT	25%						72525
BOND	1%						3626
TOTAL REPLACEMENT COST (DEC 198_ DOLLARS)							$ 366,249

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* [illegible] 20% FOR DEMOLITION OF EXISTING PIPING

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$ 23,150
2. BOILER PLANT OPERATOR	4	$ 21,038	$ 84,152
3. COAL EQUIPMENT OPERATOR	1	$ 21,038	$ 21,038
4. HEATING EQUIPMENT MECHANIC	2	$ 21,038	$ 42,076

TOTAL = $ 170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 88,095.
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 258,511

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT
DESIGNER BLJ
CHECKER

AEP NO.
SHEET 31 OF
DATE
DATE

VIII COST ESTIMATE

A. Piping (New)

Piping will be enclosed in conduit and buried underground. Supply and return lines are enclosed in seperate conduits. Labor rates are doubled for piping runs located within the "Exclusion Area." Cost includes insulation.

Exclusion Area Pipe Runs	Pipe Size	Run Length* (ft)	Fittings* (Ells+Tees)
38 - 40 (Partial)	2"	316	8
40 - 41	1½"	1190	24
40 - 42	1½"	536	8
42 - 43	1"	226	14
42 - 44	1½"	206	8
44 - 45	1½"	226	14
44 - 46	1"	712	24

* Total for both supply and return lines

The above pipe runs in the Exclusion Area can be summarized as follows:

Exclusion Area Pipe Size	Run Length (ft)*	Fittings*
1"	938	38
1½"	2,158	54
2"	316	8

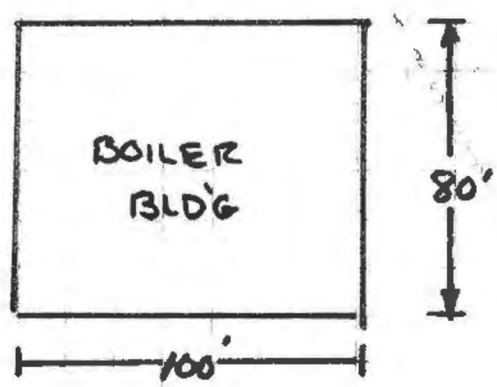
Subtracting the above pipe lengths and fittings from the applicable values in Table -3 will give the pipe and fitting totals for new piping laid outside of the Exclusion Area. (See Next Page)

VIII (cont.)

PIPING OUTSIDE OF EXCLUSION AREA (SIZE)	RUN LENGTH (FT)	FITTINGS (No)
1"	712	30
1½"	-	-
2"	5,356	82
6"	720	20

See Cost Estimate Summary Sheet for a tabulation of pipe + fitting material and labor costs.

B. Boiler Building Shell (Pre-fabricated type)



Building Shell Cost per Sq. Ft of Floor Area = $20.50

SHELL COST = (80 × 100) (20.50) = $164,000

VIII (cont.)

C. Distribution System Valves, Instrumentation and Controls. (Does not include Boiler Plant)

1. Valves:

Each unfired steam generator requires two (2) isolation gate valves and one (1) pressure balancing globe value: There are 24 unfired steam generators and the values required can be summorized as follows:

UNFIRED STM. GEN PATTERSON-KELLEY No.	VALVE* SIZE	No. of STM GEN	No of VALVES REQ'D GLOBE	GATE
H245 A	½"	6	13	26
H245 B	½"	7		
H 305	¾"	7	10	20
H 307	¾"	3		
H 369	1"	1	1	2

* Value size is taken as the same size as the feedwater inlet to the unfired steam generator. See Section V for steam generator listing.

2. Instrumentation and Controls

To control the flow of HTW to each unfired steam generator, each main pipeline leaving the Central Coal Fired Plant (cont.)

VIII C. 2. (cont.)

requires the following:

	Qty
Temperature Transmitter	2
Flow Meter (orifice type)	1
Flow Transmitter	1
Circular Recorder (2-function)	1

and one set of Boiler Plant / Distribution System interface controls are required to "marry" the above items to the Boiler Controls. The cost of the req'd interface controls is assumed to be $1500. Since the distribution pumps are not variable speed, three-way bypass values are required to control the flow of HTW to each unfired steam generator. The cost of these control values are included in the cost of the packaged steam generators.

See the Cost Estimate Summary Sheets for a tabulation of the Distribution System Valves, Instrumentation and Controls.

D. Individual Building Heating Systems

Each building requires the installation of one unfired steam generator and one condensate receiver / steam generator feed pump package to convert it from steam supply to HTW supply.

E. Water Softener

2 Boilers
1% Blowdown max
10,500 lb/hr Boilers

} ⇒ ½ GPM } Softener Cost ~ $1,200-per J. Gersten. Assume $366 for labor

REYNOLDS, SMITH AND HILLS ARCHITECTS · ENGINEERS · PLANNERS INCORPORATED	SUBJECT	AEP NO
		SHEET 35 OF
	DESIGNER BLT	DATE
	CHECKER	DATE

VIII (cont.)

F. Miscellaneous Electric

Assume that the cost for Miscellaneous Electrical installation is equal to 67% of the mechanical equipment cost. This mechanical equipment is that which requires electrical service and which is not already included in the Boiler cost estimate

HTW CIRCULATION PUMPS	$ 13,006
HTW VALVES	6,166
WATER SOFTENER	1,566
FUEL HANDLING EQUIPMENT	98,604
	$119,342

MISC. ELECTRICAL COST = (.67)(119,342)

= $80,000

Assume a 50-50 split betwean labor and material.

HURST BOILER AND WELDING CO., INC.

P. O. BOX 38 – HIGHWAY 319
COOLIDGE, GEORGIA 31738

PHONE AREA CODE
912–346–3443

BOILER and CONTROLS
STEAM PLANT EQUIPMENT
BURNERS and WELDING

December 18, 1980

Reynolds, Smith and Hills
4019 Boulevard Center Drive
P.O. Box 4850
Jacksonville, Fla. 32201

Dear Mr. Franco:

In reference to our phone conversation, as of Wednesday 12/17/80, in regards to cost estimates on coal fired boiler and component equipment, we are listing the following cost. These costs are prevailing at today's prices. You should include excalating cost in this equipment.

The estimated cost are as follows:

1- Three (3) each 9500 PPH, coal fired packaged boilers, at 2500 psig ASME coded. $153,670.00 each or a total of $461,010.00.
   These boilers will be equipped with chain grate stokers, safety valves, main stop valve, steam trim, combined I.D. Fan and grit arrestor, and grit disposal bin.

2- Two (2) 5' dia.x 15' long, ASME coded, 250 psi operating pressure, pressurized receiver tanks.
   $24,604.00 each or a total of $49,204.00.

These tanks will be mounted on a steel stand of nominal height based on NPSH required for the pumps, 2" fiberglass insulation with 24 ga. metal jacket, suction piping and valves, electric panel with starter, breaker, and alarm horn, and trim that includes the following:

A- Dual gauge glasses.
B- Thermometer.
C- High and low water alarms.
D- Steam pressure reducing valve.
E- Pressure gauge.
F- Relief valve.
G- Drain valve.

3- Two (2) pressurized pumps for the above 250 psi system.
   $11,476.00 each or a total of $22,952.00

If we can be of further service on this project, please contact us.

Enclosed is a descriptive folder on the above coal fired boiler.

Sincerely yours,

Barton C. Latner

Hurst Boiler and Welding Co., Inc.

HURST BOILER CO., INC.

P. O. Box 38, Hwy. 319 / Coolidge, Georgia 31738
(912) 346-3178

SPECIFICATIONS:

A. BOILER:

PRESSURE VESSEL DESIGN: The vessel is a firetube horizontal return t[illegible] as a HRT boiler. HURST'S HRT boilers are constructed in accordance with the ASME code and are available in capacities of 25 boiler horsepower (862 lbs. steam per hour) through 1500 boiler horsepower (51,750 lbs. steam per hour). The HRT's are available in design pressures of 15 PSIG through 300 PSIG and include manhole and handholes to facilitate cleaning and inspection.

HEATING SURFACE: The total fireside heating surface averages 6.5 square feet heating surface per boiler horsepower depending on the moisture content of the fuel.

BOILER TRIM: HURST insulates and provides "H" column supports for overhead suspension. The following valves and safety components are also included:

1. Steam relief valve.
2. Primary low water cut off-inclined gauge glass, tricocks, and handles.
3. Steam pressure gauge.
4. Slow and quick opening blowdown valves.
5. Water column blowdown valves.
6. Boiler mounted globe, swing check, and spring check valves.
7. Chemical feed valves-gate, and swing check.

B. STOKER:

The HURST stoker is a positive dump, over grate, mechanically driven stoker with spreader. The stoker system, pretested and factory assembled, includes:

1. Live bottom hopper.
2. Drive and motor.
4. Auger and housing.
5. Observation window.

C. CASING, INSULATION, REFRACTORY, AND TRIM:

The 3/8" metal casing includes stifners, overgrate doors, under grate doors, rear hopper, rear hopper cleanout door, refractory and insulation hangers on 24" horizontal centers and 18" vertical centers to give maximum refractory support. 2" of 750° insulation, 2" of 1900° "M" block, and 9" of 2700° refractory surround the firebox to give good combustion with no smoke.

D. COMBUSTION AIR AND POLLUTION EQUIPMENT:

The forced draft fan supplies air for both under grate and over fireair thus cutting down on electrical horsepower to operate the HURST HRT [illegible]. The rear hopper serves as a collection area for unburned carbon particles where they can be reinjected into the firebox for reburning before it reaches the atmosphere. HURST's multiclone collectors filter out particulate matter after it passes through the HRT cutting the emissions to .02 or less. The induced draft fan is centrifugal type designed for high temperature service. It is a paddle wheel radial blade type fan, easily accessible for cleaning and inspection. The pillow block bearings are located outside of the hot gas stream.

E. CONDENSATE RETURN SYSTEM:

HURST's duplex return system is included with all steam plant insulations. The duplex return system offers two feedwater pumps, one as a primary pump and one as a back-up or secondary pump to prevent low water incidents and expensive tube and boiler repairs. HURST's pumps are double suction regenerate turbine vane type, with bronze inpellers, renewable liners, stainless steel shafts, and heavy duty grease packed ball bearings. Receiver tanks, properly sized, are constructed of copper bearing steel plate, suction piping and valve. Perforated submerged steam water heater with or without temperature regulator can be supplied upon request to decrease boiler shock and increase tube life.

F. ELECTRICAL CONTROL PANEL:

The panel is factory wired, totally enclosed, and constructed of 12-gauge sheet steel. Flush mounted controls are in a hinged top front panel. Motor starters and circuit breakers are mounted one above the other, wired through a totally enclosed trough. Lights indicate primary and secondary pump opera- [illegible] operation [illegible]

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80-122-000

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 12/22/80

B. FRANCO Conversed with JEFF HUNDLEY

Of INGERSOLL-RAND Regarding HTW CIRC PUMPS
(1-404-455-6200)

JEFF GAVE ME BUDGET COSTS FOR THE FOLLOWING PUMPS:

35 GPM @ 55'

1½ x 1 x 8 HEC
1750 RPM
44% Eff
0.81 BHP @ DESIGN
1½ HP MOTOR
$ 2,236. for pump
$ 77. for MOTOR (Open Drip Proof)

225 GPM @ 40'

4 x 3 x 8 HEC
1750 RPM
66% Eff
2.96 BHP @ DESIGN
3 HP MOTOR
$ 3,441 for pump
$ 89 for MOTOR

BOTH PUMPS INCLUDE - S.S casing with Ductile Iron Internals, 300 lb flanges, mechanical seals and water cooled box.

B. Franco

Distribution:

I - 154

Telephone Call Confirmation

Project No. 80-122-000

reynolds, smith and hills

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 1/5/81

B. FRANCO Conversed with B. LATNER

Of HURST BOILER CO. Regarding HTW System Boilers

I told him that 10,500 lb/hr boilers were required now instead of the 9,500 lb/hr originally quoted. He said that the 9,500 lb/hr boiler fell in the 10,350 lb/hr range so that the increase in size is actually only from 10,350 to 10,500. - The cost increase is approx 5% on the boiler cost only.

He also gave me the following information in answer to my questions

- 50' x 50' foundation ample size for all 3 boilers
- Control Panel Cost is $21,000 for all 3 boilers
- Piping req'd to tie boilers in a lead-lag system will cost approx $15,000 and includes control valves.
- Approx 4,000 man-hours are required to set boilers, install piping, and controls

B. Franco

Distribution:

I-155

Project No. 80-122-000

Telephone Call Confirmation

reynolds, smith and hills

Local 398-5545 ✓ L.D. ____ Placed ✓ Rec'd ____ Date 12/30/80

B FRANCO Conversed with JERRY ADAMS

Of Foxboro Rep. Regarding HTW System Instrumentation

JERRY gave me budgetary costs for the following equipment (All electric signal)

RECORDER - Circular Chart (2 function) $1,814

300 # FLANGES (2 per set) $344

ORIFICE PLATE (6") $68

DP CELL E13-DM MODEL $809

THERMOCOUPLES AND ANALOG CONVERTER $459
E-93 Series 4-20 mA Transmitter

Bruce Franco

Distribution:

I-156

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80-122-000

Local ____ L.D. ✓ Placed ✓ Rec'd ____ Date 12/23/80

B. FRANCO Conversed with JIM DEEDS

Of CLEVELAND ARMSTRONG Regarding COAL VALVES

Jim gave me budgetary costs for the following coal valves:

12" Rolling Blade Diverter
TW-12-MHTE
60° offset
} $1,460. ea.

12" Slide Value
RS-12-RP
} $780 ea

B. Franco

Distribution:

I-157

Project No. 80-122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ✓ L.D. ______ Placed ✓ Rec'd ______ Date 12/16/80

B. FRANCO Conversed with DON FLETCHALL

Of INGLEWORTH ENGR CO. (SALES REP.) Regarding Paterson Kelley Steam Generators

DON GAVE ME BUDGETARY PRICES FOR THE FOLLOWING PATERSON-KELLEY UNFIRED HEAT EXCHANGERS. COME SKID MOUNTED [redacted] WITH INSTRUMENTATION AND [redacted] REQ'D SAFETY AND CONTROL VALVES. ASME STAMPED

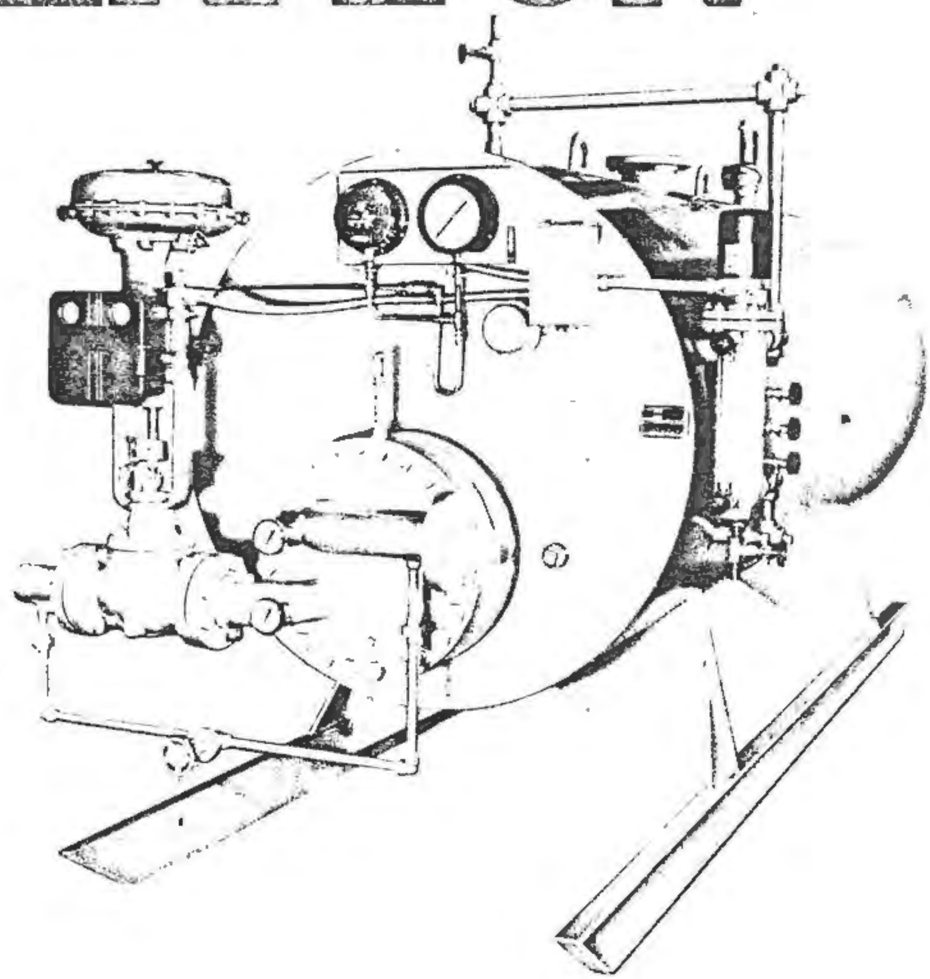
H-245A	$ 9,500	EACH
H-245B	10,000	
H-305	12,000	
H-307	12,500	
H-369	13,500	

B. Franco

Distribution:

I-158

PACKAGED UNFIRED STEAM GENERATOR



Use boiler steam or high-temperature water as a heat source ...supply clean steam safely, economically

Division of Taylor Wharton Co.-HARSCO Corporation
EAST STROUDSBURG, PENNSYLVANIA 18301

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STRAIGHTFORWARD SELECTION
Series 380 package data, standard construction and special materials

While P-K assembles Series 380 Unfired Steam Generators from standard components, the packages themselves are not stock items. Each unit is designed for a specific duty with provisions for its individual installation.

Yet selection and application are not difficult.

PACKAGE SIZE

Table 1 lists standard Series 380 sizes in terms of output steam capacities. Shell size, which determines package size, often works out the same over a wide range of output steam pressures. While a high pressure may require space inside the shell for a relatively large heat-transfer bundle, a lower pressure will mean more steam volume per pound, and ample disengaging area must be provided at the water surface to prevent entrainment.

Patterson-Kelley engineers recommend that Series 380 Unfired Steam Generators be applied with a reasonably large temperature differential across the heat transfer surfaces. The difference between temperature of incoming high-temperature water or steam and the saturation temperature of output steam influences package size. Units for smaller temperature differentials than those indicated by Table 2 or the graph on page 3 can certainly be designed and built. However, they require extra-large heat-transfer sections, and they usually must have larger shells than those listed in Table 1.

Only when a small temperature differential justifies a relatively high initial investment is this type of design advocated. Consult your Patterson-Kelley representative on these special Series 380 applications.

Principal dimensions of each standard Series 380 package are shown in Tables 3 and 4. They may need to be modified somewhat to meet individual requirements, but these standard dimensions should serve well for preliminary planning and allocation of space in building design.

The code significance of P-K's model numbers may be of interest. Series 380 packages are listed by shell size. The first pair of digits indicates nominal shell diameter in inches. The next digit or pair of digits gives nominal shell length in feet. Prefix letters S or H designate whether the heat source is steam or high-temperature water.

S	36	9	H	60	10
heat source, S for steam	shell diameter, inches	shell length, feet	heat source, H for H.T.W.	shell diameter, inches	shell length, feet

OPERATING DATA

In order to design the heat-transfer section and to select controls and auxiliary equipment, Patterson-Kelley engineers will need the following operating data for the application you have in mind:

STEAM-TO-STEAM

- Steam capacity, pounds per hour
- Output operating steam pressure, psig
- Steam supply pressure, psig and degrees of superheat, if any
- Available makeup water pressure, psig, min.
- Lowest feedwater or makeup water temperature, degrees F.

(Continued on Page 4)

I - 160

[illegible]	[illegible]	
	H.T.W.-to-Steam [illegible]	Steam-to-Steam [illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Table: [illegible] for Generating Steam Pressures from 10 to 100 psig (For 5 psig, select at next larger Model No.)

[illegible] FOR TABLE No. 1 OUTPUT RATINGS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	57	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	113	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

H.T.W.-TO-STEAM EXAMPLE:

With high-temperature water at 390°F, generate 6800 pounds per hour of steam at 75 psig from feedwater at 40°F.

Package size

From Table No. 1, opposite 7500 Lb./hr., select Series 380 size H4810.

Check Table No. 2 for minimum inlet water temperature. Opposite 75 psig see 380°F, so that 390°F is satisfactory.

H.T.W. requirements

See graph below for 40°F feedwater. For 75 psig and 390°F incoming water, read 20.0 Lb./hr. of H.T.W. per pound of steam generated. Multiplied by 6800, this indicates 136,000 Lb./hr. of H.T.W.

From Table No 4, a 4-inch connection will be required for the H.T.W. inlet and outlet.

Using the conversion graph on page 4, the factor for converting to gallons per hour at 390°F is 432. Dividing 136,000 by 432 yields 315 GPM at temperature.

STEAM-TO-STEAM EXAMPLE

With steam at 100 psig, generate 4000 pounds per hour of steam at 25 psig from feedwater at 180°F.

Package size

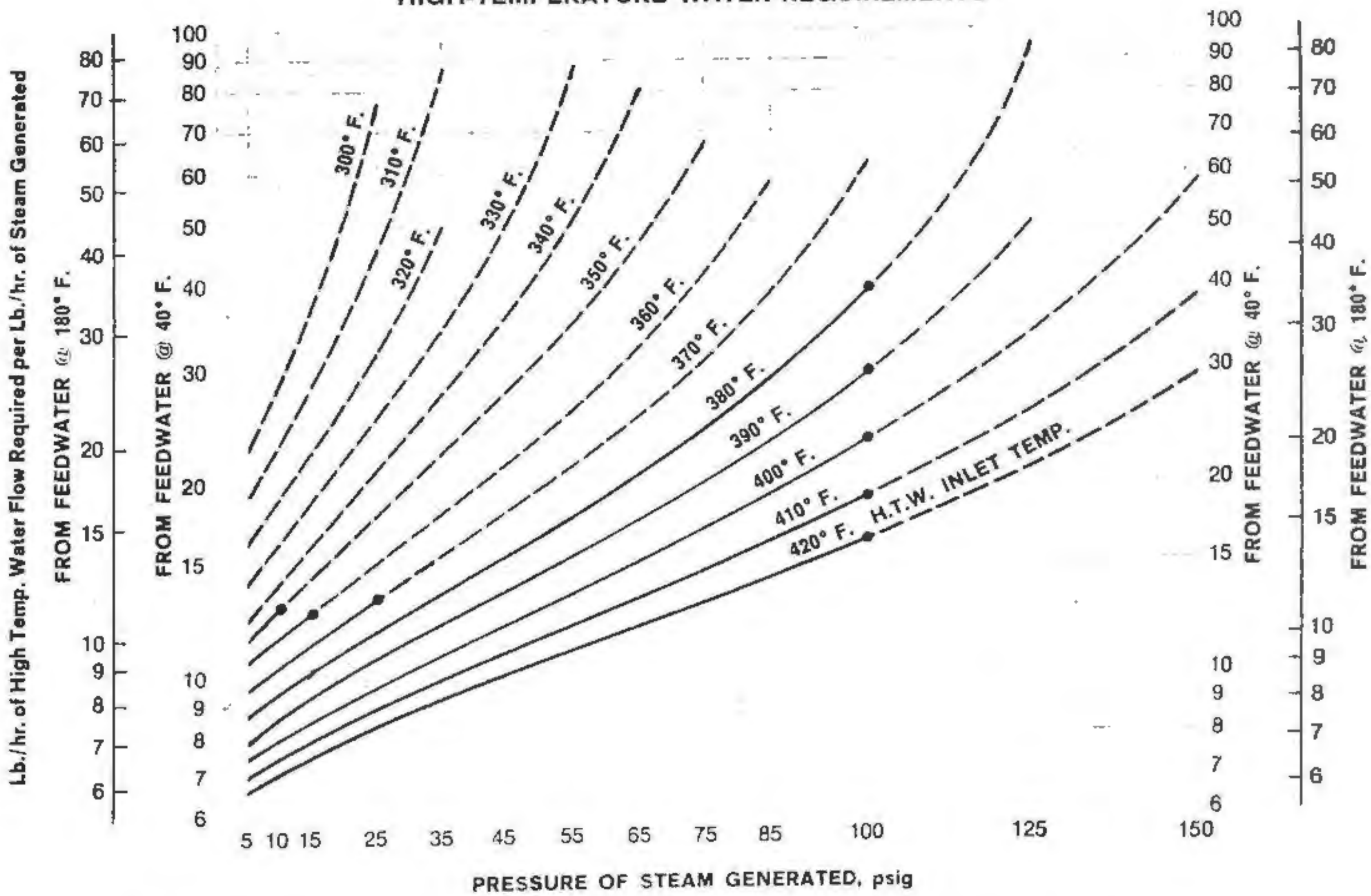
Referring to Table No. 1, opposite 4000 Lb./hr., select Series 380 size S3610.

Check on Table 2 and see that minimum source steam pressure for 25 psig is 72 psig. Therefore 100 psig is satisfactory.

Steam requirements

From Table No. 2, read opposite 25 psig, under 180°F, that it takes 1.140 Lb./hr. of steam to generate one Lb./hr. of steam. Multiplying 4000 by this factor yields a requirement of 4560 Lb./hr. of steam at 100 psig.

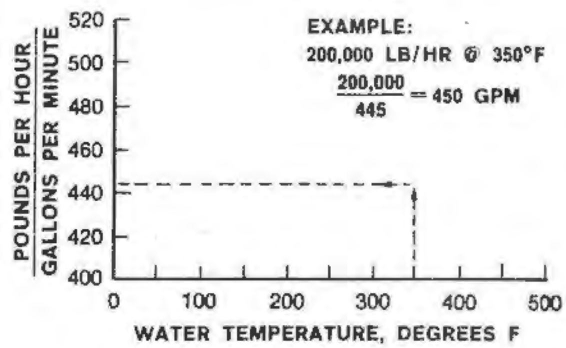
HIGH-TEMPERATURE WATER REQUIREMENTS



NOTE: Combinations of output steam pressure and H.T.W. inlet temperature that fall on solid portions of curves can be handled with standard Model 380 packages. Consult P-K for combinations that fall on dashed portions of curves.

T-161

CONVERSION HTW LB/HR TO GPM



- Percentage of makeup water to return condensate
- Analysis of makeup water
- Material requirements if they differ from steel shell and copper tubing — as an example, stainless steel for deionized steam or for special sterilizer service, etc.

HTW-TO-STEAM

- Steam capacity, pounds per hour
- Output operating steam pressure, psig
- Heat-source HTW water temperature, degrees F., Min.
- Pressure of HTW supply, psig, max.
- Available makeup water pressure, psig, min.
- Lowest feedwater or makeup water temperature, degrees F.
- Percentage of makeup water to return condensate
- Analysis of makeup water
- Material requirements if they differ from steel shell and 90/10 Cupro-nickel tubing — as an example, stainless steel for deionized steam or for special sterilizer service, etc.

HEAT EXCHANGER SECTION

Patterson-Kelley will select a standard tube bundle to deliver the capacity you specify under the operating conditions you anticipate.

An ample fouling allowance is used in computing the Series 380 tube bundle for your particular requirement. Please note that P-K asks for the percentage of makeup water compared with the quantity of return condensate if a return system is used. If no condensate is to be returned, indicate 100% makeup water. P-K engineering department also asks for an analysis of makeup water so that the fouling factor can be based on both percent makeup and its mineral content.

Series 380 Packaged Generators are supplied with ASME tandem blow-off valves. Regular periodic blowdown of any piece of steam-generating equipment must be performed to maintain its peak capacity. Frequency of blowdown will be dependent upon the percentage of raw makeup and its mineral content. Of course, if deionized or mineral-free water is fed to the Series 380, the blowdown requirements are minimal.

CONSTRUCTION MATERIALS

Standard shell construction is welded steel, SA 285 Grade C or SA 212 Grade B.

Standard bundle construction utilizes $^3/_4$-inch O.D. tubing, parallel roller-expanded with electronic control into close-fit, double serrated tube holes. Tubing is seamless with a minimum wall thickness of 18 BWG (.049 inch). Copper tubing is used in steam heated generators operating up to 150 psig (366°F) supply pressure. 90-10 Cupro-nickel tubing is used in HTW heated generators and for the higher steam supply pressures.

START-UP SERVICE

Patterson-Kelley offers start-up service as an option at extra cost. If specifed, we will provide a qualified engineer who will check over the installation of a Series 380, witness start-up, check the performance of all controls, make any needed adjustments and instruct those responsible for care and operation of the equipment.

SECTION I-6

LIFE CYCLE COST CALCULATIONS

BASE CASE, OPTION 2, OPTION 3, OPTION 2 + WOOD,
OPTION 2 + RDF, OPTION SENSITIVITY ANALYSIS

CALCULATION RATIONALE

Cost Estimate	12/80
Construction Midpoint	1/84
Beneficial Occupancy Date (BOD)	1/85
Midpoint of First Year of Facility Use	7/85

(1) Planning Date - Time Calculations

(a) Time from project cost estimate (12/80) to midpoint of first year of facility use (7/85) is five years - seven months (5.58 years).

(b) Time from anticipated midpoint of construction (1/84) to the project BOD (1/85) is 1 year.

(2) Initial Costs

Initial cost differential cost growth factor for this analysis is 1.0, as it is anticipated that its cost will grow at the same rate as that of general inflation. Therefore, the initial cost estimate dated 12/80 will be the same dollar value as the anticipated midpoint of construction date estimated for all alternates.

(3) Maintenance Costs

Maintenance cost differential cost growth factor is 1.0, for the same reason as the initial cost factor. Hence, the maintenance cost estimates dated 12/80 will be the same dollar value as the BOD year cost estimtaes for all alternates.

Seneca North
Base Case

25 Year Life
1970 - 80 Escalation Rates

<u>Initial</u> \$0

<u>Ann. Maintenance</u> (1/85) \$140,840

P.V. (B.O.D.) : \$140,840 x 9.524 = \$1,341,360

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= 1,341,360 x $\frac{1}{1.1}$
= \$1,219,418

<u>Cyclical Maintenance</u>

A) Bldg 718 \$295,780 x .867 = \$256,441

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= 256,441 x $\frac{1}{1.1}$ = \$233,128

B) Other Bldgs \$44,866 x .334 = \$14,985

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$14,985 x $\frac{1}{1.1}$ = \$13,623

C) Piping System \$366,249 x .334 = \$122,327

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$122,327 x $\frac{1}{1.1}$ = \$111,206

A)	\$233,128
B)	13,623
C)	111,206
	\$357,957

Seneca North, Base Case, 25 yr, 1970-80 Escalation Rates

Operating - #2 Fuel Oil — \$1,624,505

$\$39,495 \times 1.11^{4.58} = \$63,697$

$\$63,697 \times 28.054 = \$1,786,956$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$\$1,786,956 \times \frac{1}{1.1} = \$1,624,505$

Operating - #6 Fuel Oil — \$3,741,868

$\$90,972 \times 1.11^{4.58} = \$146,719$

$\$146,719 \times 28.054 = \$4,116,055$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$4,116,055 \times \frac{1}{1.1} = \$3,741,868$

Operating - Electricity — \$37,114

$\$3778 \times 1.01^{4.58} = \$3954$

$\$3954 \times 10.325 = \$40,825$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$40,825 \times \frac{1}{1.1} = \$37,114$

Seneca North, Base Case, 25 yr, 1970-80 Escalation Rates

Operating - Elect. Demand — $19,912

$\$1326 \times 1.042^{4.58} = \$1601$

$\$1601 \times 13.681 = \$21,903$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$21,903 \times \frac{1}{1.1} = \$19,912$

Total Life Cycle Cost — $7,000,774

SENECA NORTH
BASE CASE

40 YEAR LIFE
1970 - 1980 ESCALATION RATES

INITIAL (1/84): \$0 — \$ -0-

ANN MAINTENANCE (1/85): \$140,840

P.V. (B.O.D.): \$140,840 × 10.245 = \$1,442,906

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$1,442,906 × $\frac{1}{1.1}$ = \$1,311,733 — 1,311,733

CYCLICAL MAINTENANCE

A) BUILDING 718
\$295,780 (.867 + .013) = \$260,286

$F = N \times \frac{R}{P}$
= .050 × $\frac{8}{30}$ = .013

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$260,286 × $\frac{1}{1.1}$ = \$236,624 — 236,624

B) OTHER BUILDINGS
\$44,866 (.334 + .02) = \$15,883

$F = N \times \frac{R}{P}$
= .050 × $\frac{8}{20}$ = .020

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$15,883 × $\frac{1}{1.1}$ = \$14,439 — 14,439

C) PIPING SYSTEM
\$366,249 (.334 + .004) = \$123,792

$F = N \times \frac{R}{P}$
= .031 × $\frac{3}{25}$ = .004

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$123,792 × $\frac{1}{1.1}$ = \$112,538 — 112,538

SENECA NORTH, BASE, 40 YR., 1970-1980 ESC.

OPERATING - #2 FUEL OIL

$\$39,495 \times 1.11^{4.58} = \$63,697$

$\$63,697 \times 48.209 = \$3,070,769$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$3,070,769 \times \frac{1}{1.1} = \$2,791,608$

2,791,608

OPERATING - #6 FUEL OIL

$\$90,972 \times 1.11^{4.58} = \$146,719$

$\$146,719 \times 48.209 = \$7,073,176$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$7,073,176 \times \frac{1}{1.1} = \$6,430,160$

6,430,160

OPERATING - ELECTRICITY

$\$3,778 \times 1.01^{4.58} = \$3,954$

$\$3,954 \times 11.314 = \$44,736$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$44,736 \times \frac{1}{1.1} = \$40,669$

40,669

OPERATING - ELEC DEMAND

$\$1,326 \times 1.042^{4.58} = \$1,601$

$\$1,601 \times 16.329 = \$26,143$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$26,143 \times \frac{1}{1.1} = \$23,766$

23,766

SENECA NORTH, BASE 40 YR., 1970-1980 ESC.

TOTAL LIFE CYCLE COST	$10,961,537

SENECA NORTH
BASE CASE

25 YEAR LIFE
Army Escalation Rates

Initial $0 — $0

Ann. Maintenance (1/85) $140,840 — $1,219,418

P.V. (B.O.D.) : $140,840 x 9.524 = $1,341,360

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= 1,341,360 x $\frac{1}{1.1}$
= $1,219,418

Cyclical Maintenance — $357,957

A) Bldg 718 $295,780 x .867 = $256,441

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= 256,441 x $\frac{1}{1.1}$ = $233,128

B) Other Bldgs $44,866 x .334 = $14,985

P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= 14,985 x $\frac{1}{1.1}$ = $13,623

C) Piping System $366,249 x .334 = $122,327

P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $122,327 x $\frac{1}{1.1}$ = $111,206

A) $233,128
B) 13,623
C) 111,206
$357,957

SENECA North, Base Case, 25 yr, Army Esc.

Operating - #2 fuel oil

$\$39,495 \times 1.08^{4.58} = \$56,185$
$\$56,185 \times 20.050 = \$1,126,509$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1,126,509 \times \frac{1}{1.1} = \$1,024,099$

Operating - #6 fuel oil

$\$90,972 \times 1.08^{4.58} = \$129,416$
$\$129,416 \times 20.050 = \$2,594,791$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$2,594,791 \times \frac{1}{1.1} = \$2,358,901$

Operating - Electricity

$\$3778 \times 1.07^{4.58} = \$5150$
$5150 \times 18.048 = \$92,947$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$92,947 \times \frac{1}{1.1} = \$84,497$

$1,024,099
$2,358,901
$84,497

Seneca North, Base Case, 25 yr, Army Esc.

Operating - Elect. Demand

$\$1326 \times 1.07^{4.58} = \$1808$

$\$1808 \times 18.048 = \$32,631$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$32,631 \times \frac{1}{1.1} = \$29664$

	\$29,664

Total Life Cycle Cost — \$5,074,536

SENECA NORTH
BASE CASE

40 YEAR LIFE
ARMY ESC. RATES

Ann Maintenance (1/85): \$140,840 P.V. (BOD): \$140,840 × 10.245 = \$1,442,906 P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$1,442,906 × $\frac{1}{1.1}$ = \$1,311,733	\$1,311,733
Cyclical Maintenance A) Bldg 718 \$295,780 (.867 + .013) = \$260,286 — $F = N \times \frac{R}{P}$ = .050 × $\frac{8}{30}$ = .013 P.V. (1/84): \$260,286 ÷ 1.1 = \$236,624 B) Other Bldgs \$44,866 (.334 + .020) = \$15,883 — $F = N \times \frac{R}{P}$ = .050 × $\frac{8}{20}$ = .020 P.V. (1/84): \$15,883 ÷ 1.1 = \$14,439 C) Piping System \$366,249 (.334 + .004) = \$123,792 — $F = N \times \frac{R}{P}$ = .031 × $\frac{3}{25}$ = .004 P.V. (1/84): \$123,792 ÷ 1.1 = \$112,538	363,601
Operating - #2 Fuel Oil \$39,495 × $1.08^{4.58}$ = \$56,185 \$56,185 × 28.328 = \$1,591,609 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$1,591,609 × $\frac{1}{1.1}$ = \$1,446,917	1,446,917
Operating - #6 Fuel Oil \$90,972 × $1.08^{4.58}$ = \$129,416 \$129,416 × 28.328 = \$3,666,096	3,332,815

Seneca North; Base Case, 40 Yr, Army Esc

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$3,666,096 \times \frac{1}{1.1} = \$3,332,815$

Operating - Electricity
$\$3778 \times 1.07^{4.58} = \$5150$
$\$5150 \times 24.185 = \$124,553$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$124,553 \times \frac{1}{1.1} = \$113,230$

Operating - Electrical Demand
$\$1326 \times 1.07^{4.58} = \$1808$
$\$1808 \times 24.185 = \$43,726$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$43,726 \times \frac{1}{1.1} = \$39,751$

113,230

39,751

$6,608,047

SENECA NORTH
OPTION 2

25 Yr Life
1970 - 80 Escalation Rates

Initial (1/84): ~~\$3,358,119~~ \$3,168,037

Ann. Maintenance (1/85): \$254,370

P.V. (B.O.D.): \$254,370 × 9.524 = \$2,422,620

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$2,422,620 × $\frac{1}{1.1}$
= \$2,202,382

Cyclical Maintenance

\$366,249 × .174 = \$63,727

$F = 10 \times \frac{R}{P}$
$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$63,727 × $\frac{1}{1.1}$ = \$57,934

Operating - coal
\$69,930 × $1.10^{4.58}$ = \$108,204
\$108,204 × 25.000 = \$2,705,100

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$2,705,100 × $\frac{1}{1.1}$ = \$2,459,182

Seneca North, Opt. 2 25 Yr Life, 1970-80 Esc.

Operating - Electricity

$\$14,146 \times 1.01^{4.58} = \$14,806$

$\$14,806 \times 10.325 = \$152,872$

P.U. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$152,872 \times \frac{1}{1.1} = \$138,975$

Operating - Elect. Demand

$\$4,875 \times 1.042^{4.58} = \$5,886$

$\$5,886 \times 13.681 = \$80,526$

P.U. (1/8): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$80,526 \times \frac{1}{1.1} = \$73,205$

Total Life Cycle Cost

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing — AEP NO 60122 000 — SHEET 14 OF 46
DESIGNER A. Chambers — DATE 12/31/80
CHECKER S. Dunn — DATE

SENECA NORTH
OPTION 2

25 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~$3,358,119~~ $3,168037 — $3,168,037 ~~$3,358,119~~

ANN. MAINTENANCE (1/85): $254,370

P.V. (B.O.D.): $254,370 × 9.524 = $2,422,620

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $2,422,620 × $\frac{1}{1.1}$ = $2,202,382 — 2,202,382

CYCLICAL MAINTENANCE

$366,249 × .174 = $63,727

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $63,727 × $\frac{1}{1.1}$ = $57,934 — 57934

OPERATING – COAL

$69,930 × $1.05^{4.58}$ = $87,440

$87,440 × 14.776 = $1,292,013

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $1,292,013 × $\frac{1}{1.1}$ = $1,174,557 — 1,174,557

SENECA NORTH, OPT. 2, 25 YR., ARMY ESC.

OPERATING – ELECTRICITY — 316,415

$\$14,146 \times 1.07^{4.58} = \$19,285$

$\$19,285 \times 18.048 = \$348,056$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$348,056 \times \frac{1}{1.1} = \$316,415$

OPERATING – ELECT DEMAND — 109,043

$\$4,875 \times 1.07^{4.58} = \$6,646$

$\$6,646 \times 18.048 = \$119,947$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$119,947 \times \frac{1}{1.1} = \$109,043$

TOTAL LIFE CYCLE COST — \$7,028,368 ~~\$7,218,450~~

SENECA NORTH — 40 YR LIFE
OPTION 2 — Army ESCALATION RATES

Initial (1/84): ~~$3,358,119~~ $ 3,168,037

Ann. Maintenance (1/85): $254,370

P.V. (B.O.D.): $254,370 × 10.245 = $2,606,021

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $2,606,021 × $\frac{1}{1.1}$

= $2,369,110

Cyclical Maintenance

A) $2,442,396 (.049) = $119,677

$F = N \times \frac{R}{P}$

$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $119,677 $\left[\frac{1}{(1.1)}\right]$ = $108,798

B) $366,249 (.334 + .004) = $123,792

$F = N \times \frac{R}{P}$

$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $123,792 × $\frac{1}{1.1}$ = $112,538

Operating – coal

$69,930 × $1.05^{4.58}$ = $87,440

$87,440 × 18.136 = $1,585,812

$3,168,037
~~$3,358,119~~
2,369,110
108798
112,538
1,441,647

Seneca North, Opt 2, 40 yR, Army Esc.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1,585,812 \times \frac{1}{1.1} = \$1,441,647$

Operating - Electricity
$\$14,146 \times 1.07^{4.58} = \$19,285$
$\$19,285 \times 24.185 = \$466,408$ — 424,007

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$\$466,408 \times \frac{1}{1.1} = \$424,007$

Operating - Elect Demand
$\$4,875 \times 1.07^{4.58} = \$6646$
$\$6646 \times 24.185 = \$160,734$ — 146,122

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$160,734 \times \frac{1}{1.1} = \$146,122$

Total Life Cycle Cost — $7,770,259
~~$7,960,341~~

SENECA NORTH
OPTION 2

40 YEAR LIFE
1970-'80 ESCALATION RATES

Initial (1/84): ~~\$3,358,119~~ \$3,168,037 — \$3,168,037 (~~\$3,358,119~~)

Ann. Maintenance (1/85): \$254,370

P.V. (B.O.D): \$254,370 × 10.245 = \$2,606,021

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$2,606,021 × $\frac{1}{1.1}$
= \$2,369,110 — 2,369,110

Cyclical Maintenance

A) \$2,492,396 × (.049) = \$119,677

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$119,677 × $\frac{1}{1.1}$ = \$108,798 — 108,798

B) \$366,249 (.334 + .004) = \$123,792

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$123,792 × $\frac{1}{1.1}$ = \$112,538 — 112,538

Operating - coal

\$69,930 × $1.1^{4.58}$ = \$108,204

\$108,204 × 40.000 = \$4,328,160

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$4,328,160 × $\frac{1}{1.1}$ = \$3,934,691 — 3,934,691

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing
DESIGNER J. Steckloff
CHECKER

AEP NO 80122-000
SHEET 19 OF 96
DATE 12/30/80
DATE

Seneca North, Opt 2, 40 Yr, 1970-'80 Esc

Operating - Electricity	225,128
$\$14,146 \times (1.1)^{4.58} = \$21,888$	
$\$21,888 \times 11.314 = \$247,641$	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= \$247,641 \times \frac{1}{1.1} = \$225,128$	
Operating - Electrical Demand	87,375
$\$4,875 \times 1.042^{4.58} = \$5886$	
$\$5886 \times 16.329 = \$96,112$	
P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= \$96,112 \times \frac{1}{1.1} = \$87,375$	
Total Life Cycle Cost	\$10,005,677 ~~\$10,195,759~~

SENECA NORTH
COAL SENSITIVITY ANALYSIS

40 YEAR LIFE
1970 - '80 ESCAL

	Life Cycle Costs if Coal Increased: 9%	10%	11%
Option 2	$9,421,467	$10,195,759	$11,203,927
Option 2 - Wood Firing	9,527,776	10,272,733	11,242,769
Option 2 - RDF Firing	9,947,930	10,623,564	11,503,30[illegible]
Option 3	10,073,595	10,751,017	11,633,067
HTW	9,434,929	10,193,725	11,181,714

	9%	10%	11%
Option 2	9,231,385	10,005,677	11,203,927
Option 2 - Wood firing	9,336,101	10,081,058	11,242,769
Option 2 - RDF firing	9,716,206	10,391,840	11,503,308
Option 3	9,842,001	10,519,423	11,633,067
HTW	9,235,468	9,994,264	11,181,714

SENECA North HTW 40 YR LIFE 70-80 ESC. TOT

Operating Coal .1968 ↓.20

$\$68,531 \times 1.09^{4.58} = \$101,695$

$\$101,695 \times 33.501 = \$3,406,884 \times \frac{1}{1.1} = \$3,097,168$ 9,434,929

.2562 ↑.26

$\$68,531 \times 1.11^{4.58} = \$110,526$

$\$110,526 \times 48.209 = 5,328,348 \times \frac{1}{1.1} = \$4,843,953$ 11,181,714

SENECA North Opt. 2 Wood Firing Suboption 70-80 ESC

Operating Coal

$\$67,284 \times 1.09^{4.58} = \$99,845$

$\$99,845 \times 33.501 = \$3,344,907 \times \frac{1}{1.1} = \$3,040,825$ ↓.1968 9,527,776

$\$67,284 \times 1.11^{4.58} = \$108,515$

$\$108,515 \times 48.209 = 5,231,400 \times \frac{1}{1.1}$ 4,755,818 ↑.2562 11,242,769

SENECA North Opt. 2 RDF Firing Subopt. 40 YR 1970-80

Operating Coal

$\$61,020 \times 1.09^{4.58} = \$90,549$

$\$90,549 \times 33.501 = 3,033,482 \times \frac{1}{1.1} = \$2,757,711$ ↓.1968 9,947,930

$\$61,020 \times 1.11^{4.58} = \$98,413$

$\$98,413 \times 48.209 = \$4,744,392 \times \frac{1}{1.1} = \$4,313,084$ ↑.2562 11,503,303

SENECA North Opt. 3 40 YR LIFE 1970-80 ESC. TOT.

Operating Coal

\$61,182 x $1.09^{4.58}$ = \$90,790 ①

\$90,790 x 33.501 = \$3,041,556 ② x $\frac{1}{1.1}$ = \$2,765,081 ③ ↓.1968 10,073,595

\$61,182 x $1.11^{4.58}$ = \$98,674

\$98,674 x 48.209 = 4,756,975 x $\frac{1}{1.1}$ = \$4,324,523 ↑.2562 11,633,067

SENECA North Opt 2 40 YR Life 1970-80 ESC.

Operating Coal

\$69,930 x $1.09^{4.58}$ = \$103,771

\$103,771 x 33.501 = \$3,476,439 x $\frac{1}{1.1}$ = \$3,160,399 ↓.1968 9,421,467

\$69,930 x $1.11^{4.58}$ = \$112,783

\$112,783 x 48.209 = \$5,437,145 x $\frac{1}{1.1}$ = \$4,942,859 ↑.2562 11,203,927

SENECA North
Option 3

25 Year Life
1970-80 Esc. Rates

<u>Initial</u> (1/84): ~~$4,091,492~~ $3,859,898

<u>Ann Maintenance</u> (1/85): $272,703

P.V. (B.O.D.): $272,703 x 9.524 = $2,597,223

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= 2,597,223 x $\frac{1}{1.1}$ = $2,361,112

<u>Cyclical Maintenance</u>

Existing Piping
$366,249 x .174 = $63,727

$F = N \times \frac{R}{P}$
= .334 x $\frac{13}{25}$
= .174

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= 63,727 x $\frac{1}{1.1}$ = $57,934

<u>Operating - Coal</u>

$61,182 x $1.10^{4.58}$ = $94,668
$94,668 x 25 = $2,366,700

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,366,700 x $\frac{1}{1.1}$ = $2,151,546

Seneca North Option 3; 25 yr; 1970-80 Esc. Rates

Operating - Limestone

$\$3778 \times .988^{4.58} = \$3575$

$\$3575 \times 8.663 = \$30,970$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$30,970 \times \frac{1}{1.1} = \$28,155$ — \$28,155

Operating - Electricity

$\$24,361 \times 1.01^{4.58} = \$25,497$

$\$25,497 \times 10.325 = \$263,257$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$263,257 \times \frac{1}{1.1} = \$239,325$ — \$239,325

Operating - Elect. Demand

$\$7800 \times 1.042^{4.58} = \$9417$

$\$9417 \times 13.681 = \$128,834$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$128,834 \times \frac{1}{1.1} = \$117,122$ — \$117,122

\$8,815,092

Total Life Cycle Cost — \$9,046,686

SENECA NORTH
OPTION 3

25 YEAR LIFE
ARMY ESCAL RATES

Initial (1/84): ~~$4,091,492~~ $ 3,859,898	$ 3,859,898 ~~$4,091,492~~
Ann. Maintenance (1/85): $272,703 P.V. (1/85): $272,703 × 9.524 = $2,597,223 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $2,597,223 × $\frac{1}{1.1}$ = $2,361,112	2,361,112
Cyclical Maintenance A) Existing Piping $366,249 × .174 = $63,727 $F = N \times \frac{R}{P}$ = .334 × $\frac{13}{25}$ = .174 P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $63,727 × $\frac{1}{1.1}$ = $57,934	57,934
Operating - Coal $61,782 × $1.05^{4.52}$ = $76,278 $76,278 × 14.776 = $1,127,084 P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $1,127,084 × $\frac{1}{1.1}$ = $1,024,622	1,024,622
Operating - Limestone $3778 × $1.0^{4.58}$ = $3778 $3778 × 9.524 = $35,982 P.V. = $35,982 × $\frac{1}{1.1}$ = $32,711	32,711

Seneca North: Option 3; 25 YEAR Life; Army Escal

Operating - Electricity	544,885
$\$24,361 \times 1.07^{4.58} = \$33,210$	
$\$33,210 \times 18.048 = \$599,374$	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= \$599,374 \times \frac{1}{1.1} = \$544,885$	
Operating - Elect Demand	174,458
$\$7880 \times 1.07^{4.58} = \$10,633$	
$\$10,633 \times 18.048 = \$191,904$	
P.V (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= \$191,904 \times \frac{1}{1.1} = \$174,458$	
TOTAL LIFE CYCLE COST	\$8,055,620 ~~\$8,287,214~~

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing
DESIGNER J. Steckloff
CHECKER

AEP NO. 0UICC-ш
SHEET 27 OF 46
DATE 1/9/81
DATE

SENECA NORTH
OPTION 3

40 YEAR LIFE
ARMY Esc RATES

Initial (1/84): ~~$4,091,492~~ $3,859,898 | $3,859,898 ~~$4,091,492~~

Ann Maintenance (1/85): $272,703
P.V. (B.O.D): $272,703 × 10.245 = $2,793,842

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$
= $2,793,842 × 1/1.1 = $2,539,856 | 2,539,856

Cyclical Maintenance
A) Existing Piping
$366,249 × (.334 + .004) = $123,792 — F = N × R/P = .031 × 3/25 = .004 | 245,352

P.V. (1/84) = $P = s\left[\frac{1}{(1+i)^n}\right]$
= $123,792 × 1/1.1 = $112,538

B) AFBC Systems
$2,981,539 × .049 = $146,095 — F = N × R/P = .088 × 14/25 = .049

PV (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$
= $146,095 × 1/1.1 = $132,814

Operating - Coal
$61,182 × $1.05^{4.58}$ = $76,502 | 1,261,309
$76,502 × 18.136 = $1,387,440

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$
= $1,387,440 × 1/1.1 = $1,261,309

Seneca North; Option 3; 40 Y/R; Army Esc Rates

Operating – Limestone

$\$3778 \times 1.0^{4.58} = \$3778$

$\$3778 \times 10.245 = \$38,706$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$38,706 \times \frac{1}{1.1} = \$35,187$ — 35,187

Operating – Electricity

$\$24,361 \times 1.07^{4.58} = \$33,210$

$\$33,210 \times 24.185 = \$803,184$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$803,184 \times \frac{1}{1.1} = \$730,167$ — 730,167

Operating – Elect Demand

$\$7800 \times 1.07^{4.58} = \$10,633$

$\$10,633 \times 24.185 = \$257,159$

PV (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$257,159 \times \frac{1}{1.1} = \$233,781$ — 233,781

TOT LIFE CYCLE COST — $8,905,550

~~$9,137,144~~

SENECA NORTH
OPTION 3

40 YR LIFE
1970-'80 ESCAL

Initial (1/84): ~~\$4,091,492~~ \$3,859,898

Ann. Maintenance (1/85): \$272,703

P.V. (1/85): \$272,703 × 10.245 = \$2,793,842

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$

$= \$2,793,842 \times \frac{1}{1.1} = \$2,539,856$

Cyclical Maintenance

A) Existing Piping

\$366,249 (.334 + .004) = \$123,792

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$

$= \$123,792 \times \frac{1}{1.1} = \$112,538$

B) AFBC Systems

\$2,981,539 (.049) = \$146,095

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

PV (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$

$= \$146,095 \times \frac{1}{1.1} = \$132,814$

Operating - Coal

$\$61,182 \times 1.1^{4.58} = \$94,668$

\$94,668 × 40.0 = \$3,786,720

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$

$= \$3,786,720 \times \frac{1}{1.1} = \$3,442,473$

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SUBJECT: Life Cycle Costing | AEP NO: 80122-000 | SHEET 30 OF 46
DESIGNER: J. Steckloff | DATE: 1/8/81
CHECKER: | DATE:

Seneca North; Option 3; 40 Yr; 1970-'80 Escal

Operating - Limestone
$\$3778 \times .988^{4.58} = \$3575$
$\$3575 \times 9.171 = \$32,786$ | 29,805

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$32,786 \times \frac{1}{1.1} = \$29,805$

Operating - Electric
$\$24,361 \times 1.01^{4.58} = \$25,497$
$\$25,497 \times 11.314 = \$288,473$ | 262,248

PV (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$288,473 \times \frac{1}{1.1} = \$262,248$

Operating - Electric Demand
$\$7800 \times 1.042^{4.58} = \$9417$
$\$9417 \times 16.329 = \$153,770$ | 139,791

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$153,770 \times \frac{1}{1.1} = \$139,791$

TOT LIFE CYCLE COST | $10,519,423
~~$10,754,017~~

SENECA NORTH
OPTION 2 - RFD FIRING SUBOPTION

25 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~$4,093,799~~ $3,862,075 — $3,862,075 ~~$4,093,799~~

ANN. MAINTENANCE (1/85): $270,032

P. V. (B.O.D.): $270,032 × 9.524 = $2,571,786

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$2,571,785 \times \frac{1}{1.1} = \$2,337,986$ — 2,337,986

CYCLICAL MAINTENANCE

$366,249 × .174 = $63,727 — 57,934

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P. V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$63,727 \times \frac{1}{1.1} = \$57,734$

OPERATING - COAL — 1,024,904

$\$61,020 \times 1.05^{4.58} = \$76,299$

$\$76,299 \times 14.776 = \$1,127,394$

P. V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$1,127,394 \times \frac{1}{1.1} = \$1,024,904$

OPERATING - ELECTRICITY — 328,982

$\$14,708 \times 1.07^{4.58} = \$20,051$

$\$20,051 \times 18.048 = \$361,880$

SENECA NORTH OPT. 2, RFD FIRING SUBOPT., 25 YR, ARMY ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$361,880 \times \frac{1}{1.1} = \$328,982$

OPERATING – ELECT DEMAND

$\$10,023 \times 1.07^{4.58} = \$13,664$
$\$13,664 \times 18.048 = \$246,608$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$246,608 \times \frac{1}{1.1} = \$224,189$

224,189

TOTAL LIFE CYCLE COST

$7,836,070
~~$8,067,794~~

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SENECA NORTH
OPTION 2 - RFD FIRING SUBOPTION

25 YEAR LIFE
1970-'80 ESCALATION

INITIAL (1/84): ~~\$4,093,799~~ \$3,862,075 — \$3,862,075 ~~\$4,093,799~~

ANN. MAINTENANCE (1/85): \$270,032

P.V. (B.O.D.): \$270,032 × 9.524 = \$2,571,785

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,571,785 × $\frac{1}{1.1}$ = \$2,337,986 — 2,337,986

CYCLICAL MAINTENANCE

\$366,249 × .174 = \$63,727

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$63,727 × $\frac{1}{1.1}$ = \$57,934 — 57,934

OPERATING - COAL

\$61,020 × $1.10^{4.58}$ = \$94,417

\$94,417 × 25.00 = \$2,360,425

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,360,425 × $\frac{1}{1.1}$ = \$2,145,841 — 2,145,841

OPERATING - ELECTRICITY — 144,494

\$14,708 × $1.01^{4.58}$ = \$15,394

\$15,394 × 10.325 = \$158,943

SENECA NORTH, OPT. 2, RFD FIRING SUBOFT., 25 YR., 1970-'80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$158,943 \times \frac{1}{1.1} = \$144,494$

OPERATING – ELECT. DEMAND — 150,504

$\$10,023 \times 1.042^{4.58} = \$12,101$

$\$12,101 \times 13.681 = \$165,554$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$165,554 \times \frac{1}{1.1} = \$150,504$

TOTAL LIFE CYCLE COST — $8,698,834 ~~$8,930,558~~

SENECA NORTH — 40 YEAR LIFE
OPTION 2 - RDF FIRING SUBOPTION — ARMY ESCALATION RATES

INITIAL (1/84): ~~$4,093,799~~ $3,862,075 — $3,862,075 ~~$4,093,799~~

ANN. MAINTENANCE (1/85): $270,032

P.V. (B.O.D.): $270,032 × 10.245 = $2,766,478

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$2,766,478 \times \frac{1}{1.1} = \$2,514,980$ — 2,514,980

CYCLICAL MAINTENANCE

A) $366,249 (.334 + .004) = $123,792

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$123,792 \times \frac{1}{1.1} = \$112,538$ — 112,538

B) $2,939,315 × .049 = $144,026

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$144,026 \times \frac{1}{1.1} = \$130,933$ — 138,789

OPERATING - COAL

$61,020 × $1.05^{4.58}$ = $76,299

$76,299 × 18.136 = $1,383,759

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$1,383,759 \times \frac{1}{1.1} = \$1,257,963$ — 1,257,963

SENECA NORTH, OPT. 2, RFD FIRING SUPPORT., 40 YR., ARMY ESC.

OPERATING - ELECTRICITY

$\$14,708 \times 1.07^{4.58} = \$20,051$

$\$20,051 \times 24.185 = \$484,933$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$484,933 \times \frac{1}{1.1} = \$440,848$ — 440,848

OPERATING - ELECT. DEMAND

$\$10,023 \times 1.07^{4.58} = \$13,664$

$\$13,664 \times 24.185 = \$330,464$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$330,464 \times \frac{1}{1.1} = \$300,422$ — 300,422

TOTAL LIFE CYCLE COST — \$8,619,759 ~~\$8,851,483~~

SENECA NORTH — 40 YEAR LIFE
OPTION 2 – RDF FIRING SUBOPTION — 1970-'80 ESC. RATES

INITIAL (1/84): ~~$4,093,799~~ $3,862,075	$3,862,075 ~~$4,093,799~~
ANN. MAINTENANCE (1/85): $270,032 P.V. (E.O.D): $270,032 × 10.245 = $2,766,478 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $2,766,478 × $\frac{1}{1.1}$ = $2,514,980	2,514,980
CYCLICAL MAINTENANCE A) $366,249 (.334 + .004) = $123,792 — $F = N \times \frac{R}{P}$ = .031 × $\frac{3}{25}$ = .004 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $123,792 × $\frac{1}{1.1}$ = $112,538	112,538
B) $2,939,315 × .049 = $144,026 — $F = N \times \frac{R}{P}$ = .088 × $\frac{14}{25}$ = .049 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $144,026 × $\frac{1}{1.1}$ = $130,933	130,933
OPERATING – COAL $61,020 × $1.10^{4.58}$ = $94,417 $94,417 × 40.0 = $3,776,680 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $3,776,680 × $\frac{1}{1.1}$ = $3,433,345	3,433,345

SENECA NORTH, OPT. 2, RFD FIRING SUBOPT., 40 YR., 1970-'80 ESC.

OPERATING – ELECTRICITY — 158,335

$\$14,708 \times 1.01^{4.58} = \$15,394$

$\$15,394 \times 11.314 = \$174,168$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$174,168 \times \frac{1}{1.1} = \$158,335$

OPERATING – ELECT. DEMAND — 179,634

$\$10,023 \times 1.042^{4.58} = \$12,101$

$\$12,101 \times 16.329 = \$197,597$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$197,597 \times \frac{1}{1.1} = \$179,634$

TOTAL LIFE CYCLE COST — $10,391,840

~~$10,623,564~~

Seneca North
Option 2 - Wood Firing Suboption

25 yr Life
Army Esc. Rates

Initial (1/84): ~~\$3,386,261~~ \$3,194,586

Ann. Maintenance (1/85): \$276,112

P.V. (B.O.D.): \$276,112 × 9.524 = \$2,629,691

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,629,691 × $\frac{1}{1.1}$ = \$2,390,628

Cyclical Maintenance

Existing Piping

\$366,249 × .174 = \$63,727

$F = N \times \frac{R}{P}$
$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$63,727 × $\frac{1}{1.1}$ = \$57,934

Operating - Wood

\$2232 × $1.07^{4.58}$ = \$3043

\$3043 × 18.048 = \$54,920

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$54,920 × $\frac{1}{1.1}$ = \$49,927

Operating - Coal

\$67,284 × $1.05^{4.58}$ = \$84,132

\$84,132 × 14.776 = \$1,243,134

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$1,243,134 × $\frac{1}{1.1}$ = \$1,130,122

Seneca North; Opt. 2 - Wood Firing Suboption; 25 Yr. Life; Army Esc.

Operating - Electricity

$\$14,146 \times 1.07^{4.58} = \$19,285$

$\$19,285 \times 18.048 = \$348,056$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$348,056 \times \frac{1}{1.1} = \$316,415$

$316,415

Operating - Elect. Demand

$\$4875 \times 1.07^{4.58} = \$6646$

$\$6646 \times 18.048 = \$119,947$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$119,947 \times \frac{1}{1.1} = \$109,043$

$109,043

Total Life Cycle Cost

$7,248,655

~~$7,440,330~~

Seneca North
Option 2 - Wood Firing Suboption

25 yr. Life
1970-80 Escalation Rates

Initial (1/84): ~~\$3,386,261~~ \$3,194,586 — \$3,194,586 ~~\$3,386,261~~

Ann. Maintenance (1/85): \$276,112

P.V. (B.O.D.): \$276,112 x 9.524 = \$2,629,691

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,629,691 x $\frac{1}{1.1}$ = \$2,390,628 — \$2,390,628

Cyclical Maintenance

Existing Piping

\$366,249 x .174 = \$63,727

$F = N \times \frac{P}{P}$

= .334 x $\frac{13}{25}$ = .174

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

\$63,727 x $\frac{1}{1.1}$ = \$57,934 — \$57,934

Operating - Wood

\$2232 x $1.07^{4.58}$ = \$3043

\$3043 x 18.048 = \$54,920

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$54,920 x $\frac{1}{1.1}$ = \$49,927 — \$49,927

Seneca North; Opt. 2 - Wood Firing Suboption; 25 yr.; 1970-80 Esc.

Operating - Coal

$\$67,284 \times 1.10^{4.58} = \$104,109$

$\$104,109 \times 25 = \$2,602,725$

P.U. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$2,602,725 \times \frac{1}{1.1} = \$2,366,114$

Operating - Electricity

$\$14,146 \times 1.01^{4.58} = \$14,806$

$\$14,806 \times 10.325 = \$152,872$

P.U. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$152,872 \times \frac{1}{1.1} = \$138,975$

Operating - Elect. Demand

$\$4875 \times 1.042^{4.58} = \$5886$

$\$5886 \times 13.681 = \$80,526$

P.U. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$80,526 \times \frac{1}{1.1} = \$73,205$

Total Life Cycle Cost

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SUBJECT Life Cycle Costing
DESIGNER S. Dunn
CHECKER J Stecklaff

AEP NO [illegible]
SHEET 43 OF 46
DATE 1-9-81
DATE 1-12-81

Seneca North
Option 2 - Wood Firing Suboption

40 yr Life
1970-80 Escalation Rates

Initial (1/84) : ~~$3,386,261~~ $3,194,586 — $3,194,586 ~~$3,386,261~~

Ann. Maintenance (1/85) : $276,112

P.V. (B.O.D.) : $276,112 x 10.245 = $2,828,767

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= $2,828,767 x $\frac{1}{1.1}$ = $2,571,606 — $2,571,606

Cyclical Maintenance — $222,518

A) Existing Piping

$366,249 x (.334 + .004) = $123,792

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= $123,792 x $\frac{1}{1.1}$ = $112,538

B) Initial System

$2,468,945 x .049 = $120,978

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= $120,978 x $\frac{1}{1.1}$ = $109,980

Operating - Wood — $66,905

$2232 x $1.07^{4.58}$ = $3043

$3043 x 24.185 = $73,595

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= $73,595 x $\frac{1}{1.1}$ = $66,905

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SUBJECT Life Cycle Costing
DESIGNER S. Dunn
CHECKER J Steckloff

AEP NO. 50122-000

DATE 1-9-81
DATE 1/12/81

Seneca North; Opt. 2 - Wood Firing Suboption; 40 yr. Life; 1970-80 Esc.

Operating - Coal $\$67,284 \times 1.10^{4.58} = \$104,109$ $\$104,109 \times 40 = \$4,164,360$ P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ $= \$4,164,360 \times \frac{1}{1.1} = \$3,785,782$	$3,785,782
Operating - Electricity $\$14,146 \times 1.01^{4.58} = \$14,806$ $\$14,806 \times 11.314 = \$167,515$ P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ $= \$167,515 \times \frac{1}{1.1} = \$152,286$	$152,286
Operating - Elect. Demand $\$4875 \times 1.042^{4.58} = \$5886$ $\$5886 \times 16.329 = \$96,112$ P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ $= \$96,112 \times \frac{1}{1.1} = \$87,375$	$87,375
Total Life Cycle Cost	$10,081,058 ~~$10,272,733~~

Seneca North
Option 2 - Wood Firing Suboption

40 Yr Life
Army Esc. Rates

<u>Initial</u> (1/84) : ~~$3,386,261~~ $3,194,586 — $3,194,586 (~~$3,386,261~~)

<u>Ann. Maintenance</u> (1/85) : $276,112

P.V. (B.O.D.) : $276,112 x 10.245 = $2,828,767

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,828,767 x $\frac{1}{1.1}$ = $2,571,606 — $2,571,606

<u>Cyclical Maintenance</u>

A) Existing Piping
$366,249 x (.334 + .004) = $123,792 — $F = N \times \frac{R}{P}$ = .031 x $\frac{3}{25}$ = .004

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= $123,792 x $\frac{1}{1.1}$ = $112,538

B) Initial System
$2,468,945 x .049 = $120,978 — $F = N \times \frac{R}{P}$ = .088 x $\frac{14}{25}$ = .049

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$
= $120,978 x $\frac{1}{1.1}$ = $109,980

$222,518

Seneca North ; Opt. 2 - Wood Firing Suboption ; 40 yr. Life ; Army Esc.

Operating - Wood — $66,905

$\$2232 \times 1.07^{4.58} = \$3043$

$\$3043 \times 24.185 = \$73,595$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$73,595 \times \frac{1}{1.1} = \$66,905$

Operating - Coal — $1,387,107

$\$67,284 \times 1.05^{4.58} = \$84,132$

$\$84,132 \times 18.136 = \$1,525,818$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$1,525,818 \times \frac{1}{1.1} = \$1,387,107$

Operating - Electricity — $424,007

$\$14,146 \times 1.07^{4.58} = \$19,285$

$\$19,285 \times 24.185 = \$466,408$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$466,408 \times \frac{1}{1.1} = \$424,007$

Operating - Elect. Demand — $146,122

$\$4875 \times 1.07^{4.58} = \$6646$

$\$6646 \times 24.185 = \$160,734$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$160,734 \times \frac{1}{1.1} = \$146,122$

Total Life Cycle Cost — $8,012,851

~~$8,004,5[illegible]~~

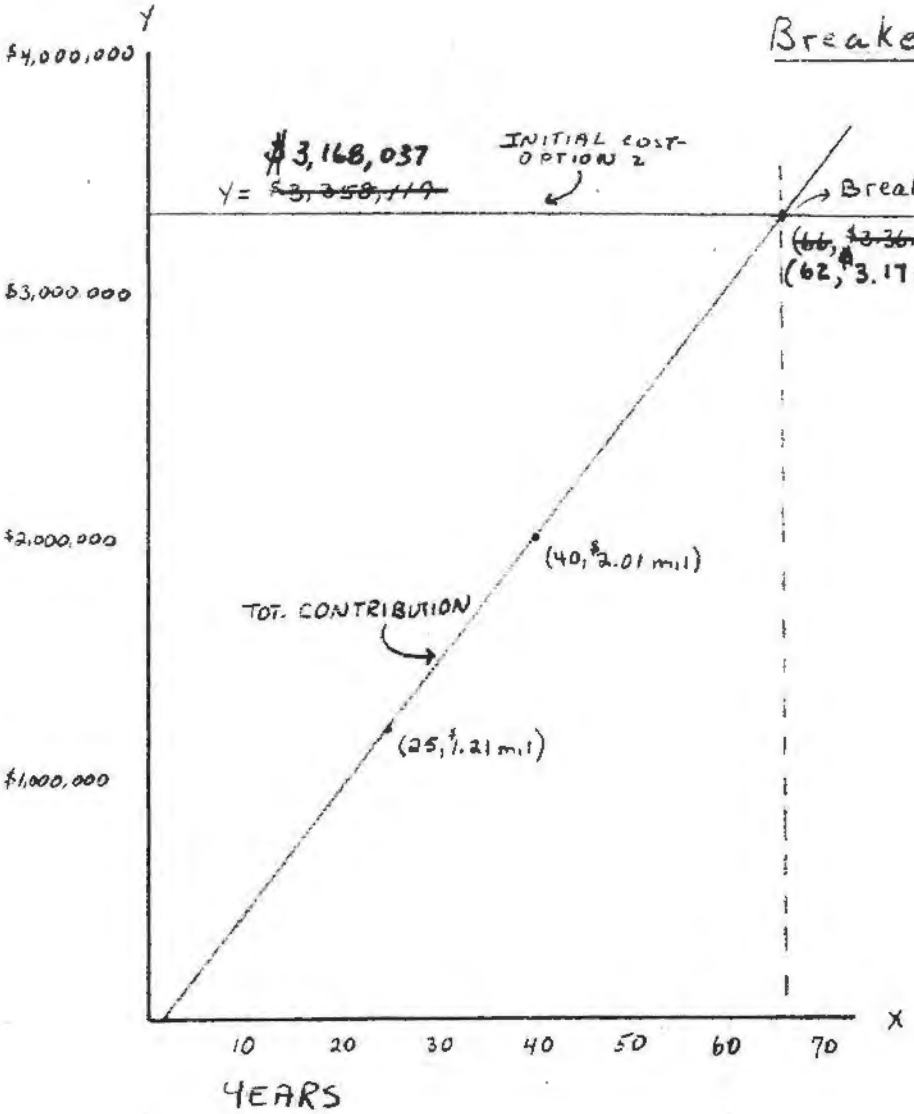
SECTION I-7

LIFE CYCLE COST CALCULATIONS

BREAKEVEN ANALYSIS

SENECA NORTH
BREAK-EVEN ANAL

OPTION 2 VS. BASE CASE
ARMY ESCALATION



Breakeven = ~~65.6~~ 61.5 years

The initial cost of
is represented by t
$3,168,037 Y = ~~$3,358,119.~~ Du
each year of exist
a net contributi
$3.17 → the ~~$3.36~~ million
cost will be gen
due to lower ann
costs (fuel, etc) a
with option 2. T
contribution is re
by the sloping li
62 → year ~~66~~, this co
ution will finally
to the initial cos
option 2 will
cost effective at
point.

Seneca North, Breakeven, Army Esc

Option 2 initial cost = $3,168,037 ~~$3,358,119~~

25 Year Point

Base ann costs = $5,074,536

Opt 2 ann costs = $7,218,450 – $3,358,119 = $3,860,331

Contrib = $5,074,536 – $3,860,331 = $1,214,205

40 Year Point

Base ann. costs = $6,608,047

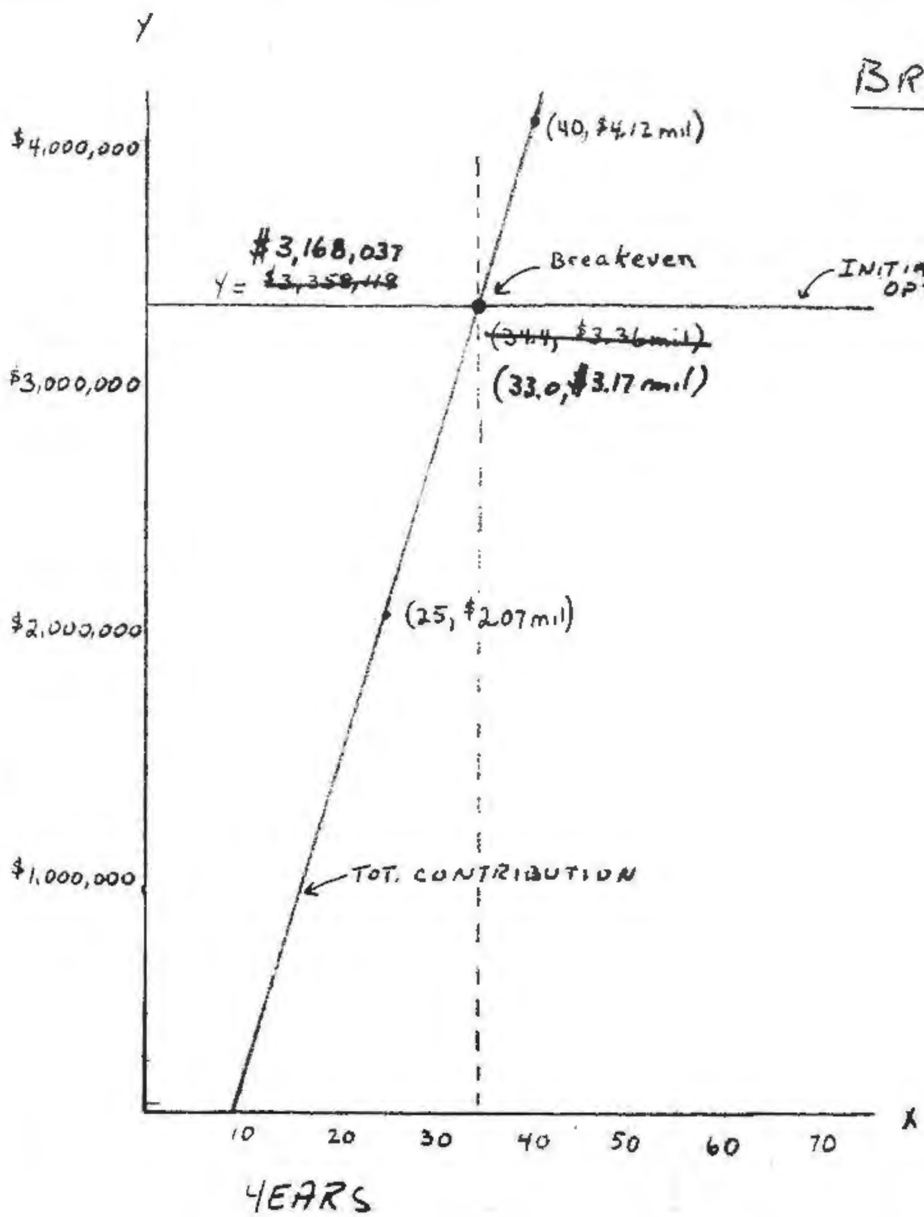
Opt 2 ann. costs = $7,960,341 – $3,358,119 = $4,602,222

Contrib = $6,608,047 – $4,602,222 = $2,005,852

SENECA NORTH
BREAK EVEN ANAL

OPTION 2 vs. BASE CASE
1970 - '80 ESCALATION

BREAKEVEN = ~~34.4~~ 33.0 YRS



The initial cost
is represented by t[...]
#3,168,037 → Y = ~~$3,358,119~~ [...]
each year of ex[...]
a net contribut[...]
#3.17 the ~~$3.36~~ million
cost will be ge[...]
due to lower a[...]
costs (fuel, etc)
with option 2. T[...]
contribution is r[...]
by the sloping [...]
33rd → the ~~34th~~ year, [...]
contribution will
be equal to the
cost and option
become cost e[...]
at that point.

Seneca North, Breakeven, 1970-'80 Escalation

Option 2 initial cost = ~~$3,358,119~~ $3,194,586

25 Year Point
Base ann costs = $7,000,774
Opt 2 ann costs = $8,289,797 − $3,358,119 = $4,931,678
Contribution = $7,000,774 − $4,931,678 = $2,069,096

40 Year Point
Base ann costs = $10,961,537
Opt 2 ann costs = $10,195,759 − $3,358,119 = $6,837,640
Contribution = $10,961,537 − $6,837,640 = $4,123,897

SECTION I-8

LIFE CYCLE COST CALCULATIONS

HTW DISTRIBUTION SYSTEMS

SENECA NORTH
HTW SYSTEM

40 YEAR LIFE
ARMY Escal. Rates

Initial (1/84) : \$ 3,523,806 — \$3,523,806

Ann. Maintenance (1/85) : \$258,511

P.V. (BOD): \$258,511 x 10.245 = \$ 2,648,445

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$ 2,648,445 x $\frac{1}{1.1}$ = 2,407,677 — 2,407,677

Cyclical Maintenance

\$366,249 x (.334 + .004) = \$123,792 — 112,538

$F = N \times \frac{R}{P}$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$123,792 x $\frac{1}{1.1}$ = \$112,538

= .031 x $\frac{3}{25}$ = .004

Operating - Coal

\$68,531 x $1.05^{4.58}$ = \$85,691 — 1,412,811

\$85,691 x 18.136 = \$1,554,092

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$1,554,092 x $\frac{1}{1.1}$ = \$1,412,811

Operating - Electricity

\$18,132 x $1.07^{4.58}$ = \$24,719 — 543,481

\$24,719 x 24.185 = \$597,829

P.V. (1/84) : $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$597,829 x $\frac{1}{1.1}$ = \$543,481

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SUBJECT Life Cycle Costing | AEP NO 80122-000
SHEET 2 OF 8
DESIGNER S. Dunn | DATE 1-26-81
CHECKER | DATE

SENECA NORTH; HTW System; 40 YR; Army Esc

Operating - Elec. Demand

$\$5499 \times 1.07^{4.58} = \$7497$

$\$7497 \times 24.185 = \$181,315$

$P.U.(1/84) = P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$181,315 \times \frac{1}{1.1} = \$164,832$

Operating - Elec. Demand	\$164,832
TOTAL LIFE CYCLE COST	\$8,165,145

SENECA NORTH
HTW SYSTEM

40 Year Life
1970-'80 Escal. Rates

<u>Initial</u> (1/84) = $3,523,806 — $3,523,806

<u>Ann. Maintenance</u> (1/85): $258,511 — 2,407,677

P.V. (BOD): $258,511 x 10.245 = $2,648,445

P.V. (1/84): $P = S\left[\left(\frac{1}{1+i}\right)^n\right]$
= $2,648,445 x $\frac{1}{1.1}$ = $2,407,677

<u>Cyclical Maintenance</u> — 112,538
$366,249 x (.334 + .004) = $123,792

$F = N \times \frac{R}{P}$

P.V. (1/84): $P = S\left[\left(\frac{1}{1+i}\right)^n\right]$
= $123,792 x $\frac{1}{1.1}$ = $112,538

= .031 x $\frac{3}{25}$ = .004

<u>Operating - Coal</u> — 3,855,964
$68,531 x $1.1^{4.58}$ = $106,039
$106,039 x 40.000 = $4,241,560

P.V. (1/84): $P = S\left[\left(\frac{1}{1+i}\right)^n\right]$
= $4,241,560 x $\frac{1}{1.1}$ = $3,855,964

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SUBJECT: Life Cycle Costing
DESIGNER: S. Dunn
CHECKER:

AEP NO: 80122-000
SHEET 4 OF 8
DATE: 1-26-81
DATE:

SENECA NORTH; HTW System; 40 yr; 1970-'80 Esc.

Operating - Electricity

$\$18,132 \times 1.01^{4.58} = \$18,977$

$\$18,977 \times 11.314 = \$214,706$

P.V. (1/84): $P = S\left[\left(\frac{1}{1+i}\right)^n\right]$

$= \$214,706 \times \frac{1}{1.1} = \$195,187$ — 195,187

Operating - Elec. Demand

$\$5499 \times 1.042^{4.58} = \$6639$

$\$6639 \times 16.329 = \$108,408$

P.V. (1/84): $P = S\left[\left(\frac{1}{1+i}\right)^n\right]$

$= \$108,408 \times \frac{1}{1.1} = \$98,553$ — 98,553

Tot Life Cycle Cost — $10,193,725

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SUBJECT: Life Cycle Costing
DESIGNER: J. Steckloff
CHECKER: J. Steckloff
AEP NO: 80122-000
SHEET: 5 OF 8
DATE: 1/5/81
DATE: 1/6/81

SENECA NORTH
HTW SYSTEM

25 YEAR LIFE
1970 – '80 ESCAL. RATES

INITIAL (1/84) = $3,523,806 — $3,523,806

Ann. Maintenance (1/85): $258,511
P.V. (BOD): $258,511 × 9.524 = $2,462,059

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,462,059 × $\frac{1}{1.1}$ = $2,238,235 — 2,238,235

Cyclical Maintenance
$366,249 × .174 = $63,727

$F = N \times \frac{R}{P}$
= .334 × $\frac{13}{25}$ = .174

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $63,727 × $\frac{1}{1.1}$ = $57,934 — 57,934

Operating – Coal
$68,531 × $1.1^{4.58}$ = $106,039
$106,039 × 25.000 = $2,650,975

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,650,975 × $\frac{1}{1.1}$ = $2,409,977 — 2,409,977

Operating – Electricity
$18,132 × $1.01^{4.58}$ = $18,977
$18,977 × 10.325 = $195,938

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $195,938 × $\frac{1}{1.1}$ = $178,125 — 178,125

Seneca North; HTW System; 25 YR; 1970-'80 Esc

Operating - Electric Demand

$\$5499 \times 1.042^{4.58} = \$6639$

$\$6639 \times 13.681 = \$90,831$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$90,831 \times \frac{1}{1.1} = \$82,574$

Operating - Electric Demand	$82,574
TOT LIFE CYCLE COST	$8,490,651

SENECA NORTH
HTW SYSTEM

25 YR LIFE
ARMY ESC RATES

Initial (1/84): \$3,523,806 — **\$3,523,806**

Annual Maintenance (1/85): \$258,511

P.V. (B.O.D): \$258,511 × 9.524 = \$2,462,059

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,462,059 × $\frac{1}{1.1}$ = \$2,238,235 — **2,238,235**

Cyclical Maintenance

\$366,249 × .174 = \$63,727

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$63,727 × $\frac{1}{1.1}$ = \$57,934 — **57,934**

Operating - Coal

\$68,531 × $1.05^{4.58}$ = \$85,691

\$85,691 × 14.776 = \$1,266,170

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$1,266,170 × $\frac{1}{1.1}$ = \$1,151,064 — **1,151,064**

Operating - Electricity

\$18,132 × $1.07^{4.58}$ = \$24,719

\$24,719 × 18.048 = \$446,129

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$446,129 × $\frac{1}{1.1}$ = \$405,572 — **405,572**

Seneca North; HTW System; 25 YR; Army Esc

Operating – Elect Demand

$\$5499 \times 1.07^{4.58} = \$7497$

$\$7497 \times 18.048 = \$135,298$

PV(1184): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$135,298 * \frac{1}{1.1} = \$122,998$

Operating – Elect Demand	\$122,998
TOT LIFE CYCLE COST	\$7,499,609

SECTION I-9

MISCELLANEOUS CALCULATIONS

SUBJECT SENECA ARMY DEPOT
BLDG HEAT LOAD WEIGHTING

AEP NO. 80122-000
SHEET ...... OF ......

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DESIGNER
DATE
CHECKER
DATE

* ASSUMED HEIGHT

BOILER TYPE: 5D4DSB - BOILER PLANT 718

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USE #6 GAL
718	70x40x20 * 4640	3224		5		
701	160x44x20 * 8160	7140	15,300	5	6.95	23,951
702	250x41x20 * 11,640	10,351	21,991	5	9.99	34,427
704	260x40x30 * 18,000	10,370	28,370	5	12.88	44,386
705	90x89x12 * 4296	7996	12,292	5	5.58	19,229
706	100x37x12 * 3288	3705	6993	5	3.18	10,959
707	150x125x12 * 6600	18677	25,277	5	11.48	39,562
708	260x40x30 * 18,000	10,370	28,370	5	12.88	44,386
719	30x12x12 * 1008	374	1382	5	0.63	2171
720	110x39x20 * 5960	4282	10,242	5	4.65	16,025
722	110x43x12 * 3672	4700	6698 COMM. WHSE 1674 PKG. STORE	5	3.04 0.76	10,476 2619
723	344x50x20 * 116x50x12 19,744	22962	GYM 17,082 COMISS. 25,624	5	7.76 11.64	26,742 40,113
724	120x75x12 * 4680	9000	13,680	5	6.21	21,401
732	80x32x12 * 2688	2560	5248	5	2.38	8202
		TOTALS	220,223		100.0	344,614

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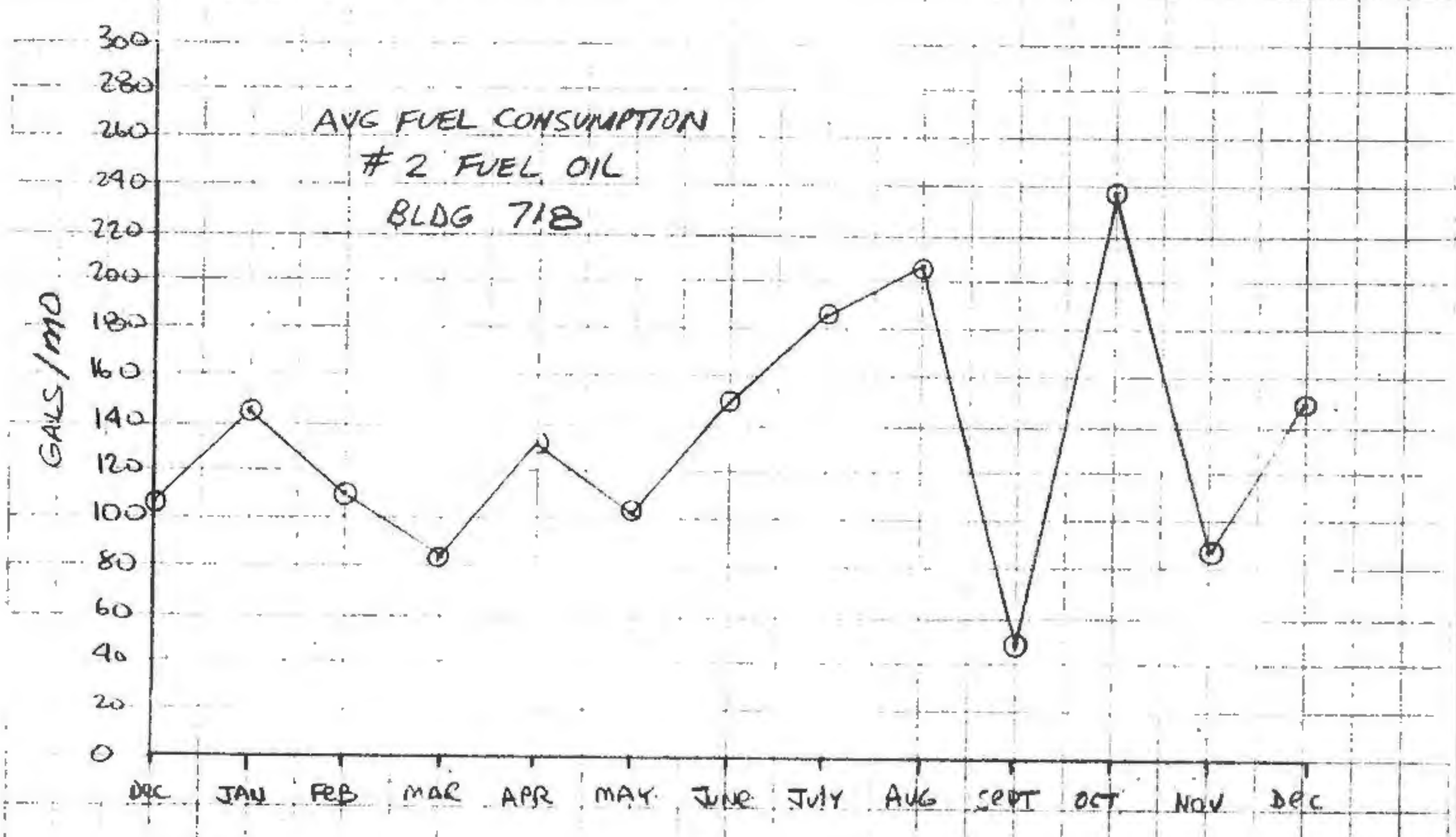
SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA
DESIGNER
CHECKER

AEP NO. 80122-000
SHEET OF
DATE
DATE

BOILER TYPE: 5D4DSB #2 FUEL OIL CONSUMPTION
BLDG 718 (Gallons)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 118	200	—	160	174	201	142
FEB	* 160	162	161	177	—	—	110
MAR	* 113	170	—	—	156	74	86
APR		110	191	229	128	—	132
MAY		177	127	—	—	208	102
JUNE		225	—	203	160	159	149
JULY	260	217	229	160	246	—	185
AUG	—	316	346	121	229	214	204
SEPT	—	—	125	172	—	—	50
OCT	199	561	96	163	207	200	238
NOV	80	—	204	90	—	153	88
DEC	110	140	62	—	145	452	152
TOTALS	—	2278	1541	1475	1445	1661	1638

* 1980



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SUBJECT: SENECA ARMY DEPOT
FUEL CONSUMPTION DATA

AEP NO. 80122-000

SHEET ____ OF ____

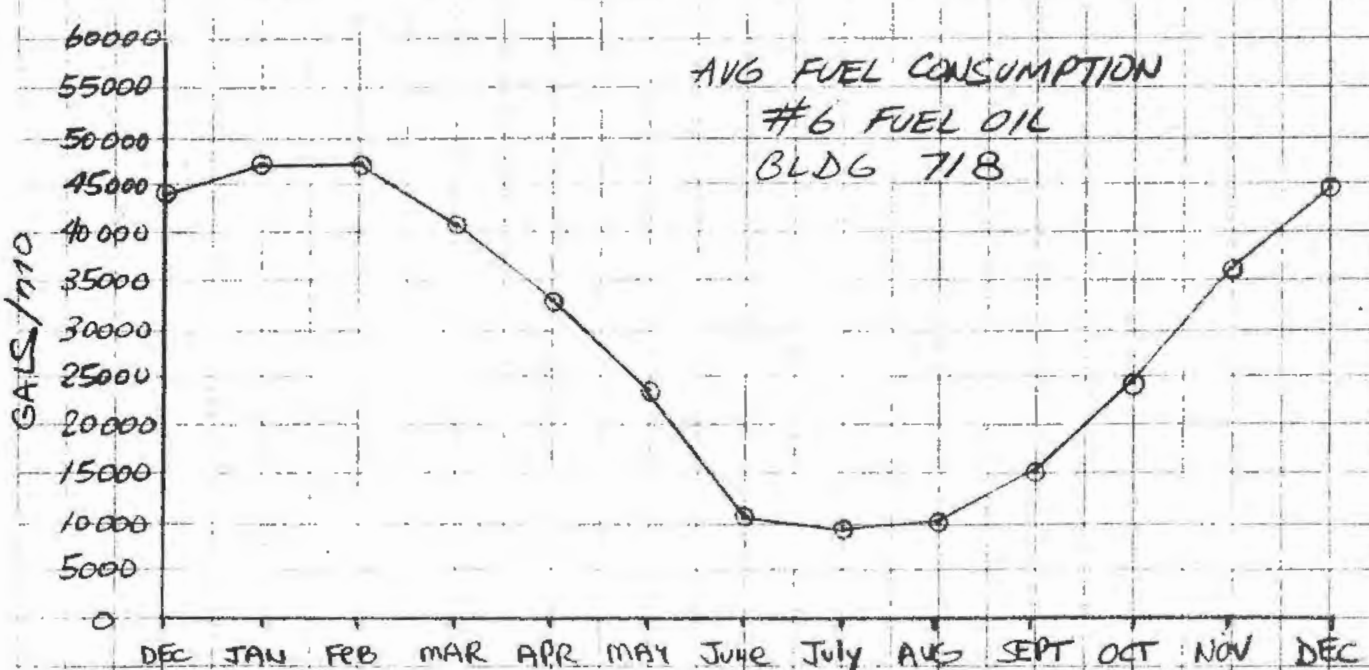
DESIGNER ____ DATE ____

CHECKER ____ DATE ____

BOILER TYPE: 5D4DS13 BLDG 718 — #6 Fuel Oil Consumption (GALLONS)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 39683	48249	46184	53376	47852	48163	47251
FEB	* 53513	36129	52018	53376	47854	47224	48353
MAR	* 39818	38479	40350	40140	41019	42171	40330
APR		37017	39864	33684	31484	26857	33781
MAY		18133	26836	27120	27285	20831	24149
JUNE		18215	13662	6780	—	13966	10525
JULY	12094	6484	13174	13560	6819	6982	9852
AUG	—	12952	12686	13612	7216	14214	10113
SEPT	18161	18371	13150	27224	—	13317	15037
OCT	30099	18223	26661	32398	26498	14100	24663
NOV	30161	27324	47083	34166	36005	42258	36166
DEC	48660	47181	46704	47768	42660	33392	44394
TOTALS	—	310,356	378,371	383,204	314,692	323,475	344,614

* 1980



REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

SUBJECT SENECA ARMY DEPOT
BLDG HEAT LOAD WEIGHTING
DESIGNER
CHECKER

AEP NO. 80122-000
SHEET OF
DATE
DATE

BOILER TYPE: 5D4GAA

* ASSUMED HEIGHT

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USAGE - GAL #1	#2
729	40x70x20 4400 *	2720	7120	4	3,10	54	4513
800	20x13x12 * 792	264	1056	2	0,46	8	670
802	3288	4424	7712	2	3,35	59	4877
805	30x15x12 1080	440	1520	2	0,66	12	961
806	2850	4110	6960	2	3,03	53	4411
807	3360	4300	7660	2	3,33	59	4848
812	135x65x20* 8000	8777	16,777	2	7,30	12.8	10,627
825	3920	4180	8100	2	3,52	62	5124
814	2585	2039	4624	1	2,01	35	2926
710	75x36x12* 2664	2714	5378	6	2,34	41	3407
742	50x28x12 * 1872	1392	3264	6	1,42	25	2067
S-714	160x90x20* 10,000	8845	18,845	7	8,20	144	11,937
740	50x26x30* 4560	1322	5882	7	2,56	45	3727
104	20x33x12* 1032	462	1494	10	0,65	11	946
S-106	6920	10,633	17,553	10	7,64	134	11,122
116	200x68x12 * 6432	13,580	20,012	10	8,71	153	12,68[illegible]
114	9396	12,200	21,596	10	9,39	165	13,670

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SUBJECT SENECA ARMY DEPOT
BLDG HEAT LOAD WEIGHTING
AEP NO. 80122-000
SHEET OF
DESIGNER DATE
CHECKER DATE

BOILER TYPE: 5D4GAA

* ASSUMED HEIGHT

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USAGE - GAL #1	ANNUAL FUEL USAGE - GAL #2
S-220	90x34x20 * 4960	3068	8028	10	3.49	61	5081
310	40x22x12 * 1488	840	2328	11	1.01	18	1470
334	75x21x12 * 2304	1571	3875	12	1.69	30	2460
309	120x100x20 * 8800	8241	17,041	14	7.41	130	10,787
346	NOT HEATED						
606	51x51x12 * 2448	2604	5052	19	2.20	39	3203
2086	28x28x12 * 1344	762	2106	—	0.92	16	1339
2104	36x36x12 * 1728	1300	3028	—	1.32	23	1922
2410	50x49x12 * 2376	3747	6123	—	2.66	47	3872
2411	50x50x12 * 2400	2535	4935		2.15	38	3130
TENNIS BUBBLE	15,000*	—	15,000	—	6.53	115	9506
YOUTH CENTER	62x62x12 * 2976	3827	6803	—	2.96	52	4309
		TOTAL	229,872		100	1758	145,579

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SUBJECT SENACA ARMY DEPOT AEP NO. 80122-000
SHEET OF
DESIGNER S. COWAN DATE 10-15-80
CHECKER DATE

BLDG 812 MASONARY BLDG

44'-8" x 10'-8" x 2 = 953 Ft^2

120'-4" x 10'-8" x 2 = 2568

TOTAL WALL AREA 3521 Ft^2

44'-8" x 120'-4" = TOTAL ROOF AREA = 5375 Ft^2

TOTAL AREA = 8896 Ft^2

BLDG 825 BUTLER TYPE BLDG

40' x 14' x 2 = 1120 Ft^2

100' x 14' x 2 = 2800 Ft^2

TOTAL WALL AREA = 3920 Ft^2

20.9' x 100' x 2 = ROOF AREA = 4180 Ft^2

TOTAL AREA 8100 Ft^2

BLDG 807 BUTLER TYPE BLDG

40 x 12 x 2 = 960 Ft^2
100 x 12 x 2 = 2400 Ft^2

TOTAL WALL AREA = 3360 Ft^2

21.5' x 100' x 2 = TOTAL ROOF AREA = 4300 Ft^2

TOTAL AREA = 7660 Ft^2

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT SENECA ARMY DEPOT AEP NO. 80122-000
SHEET OF
DESIGNER SCowen DATE
CHECKER DATE

BLDG 806

102'-4" x 10'-0" x 2 = 2047 Ft^2

40'-2" x 10'-0" x 2 = 803

TOTAL Wall Area = 2850 Ft^2

102'-4" x 40'-2" = TOTAL Roof Area = 4110 Ft^2

TOTAL Area = 6960 Ft^2

BLDG 802

Assume 12'-0" ceiling

WALL Area = 99' x 12' x 2 + 38' x 12' x 2 = 3288 Ft^2

Roof Area = 103'-8" x 42'-8" = 4424 Ft^2

TOTAL Area = 7712 Ft^2

Bldg 814

wall area = 60'-4" x 14' x 2 + 32' x 14' x 2 = 2585 Ft^2

roof area = 16.9' x 60'-4" x 2 = 2039 Ft^2

Total area = 4624 Ft^2

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SUBJECT Seneca Army Depot AEP NO.
SHEET OF
DESIGNER S. Cowen DATE
CHECKER DATE

BLDG 114

All dim's scaled from DWG 6788-A

61' x 18 x 2 + 200' x 18' x 2 = 9396 Ft^2 wall Area

200' x 61' = 12,200 Ft^2 Roof Area

Total Area = 21,596

Bldg 106

Assume 15' height

167'-0" x 15' x 2 + 63'-8" x 15' x 2 = 6920 Ft^2 wall Area

167 x 63'-8" = 10,633 Ft^2 roof area

total area = 17,553 Ft^2

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SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA

AEP NO. 80122-000

SHEET ...... OF ......

DESIGNER ......

DATE ......

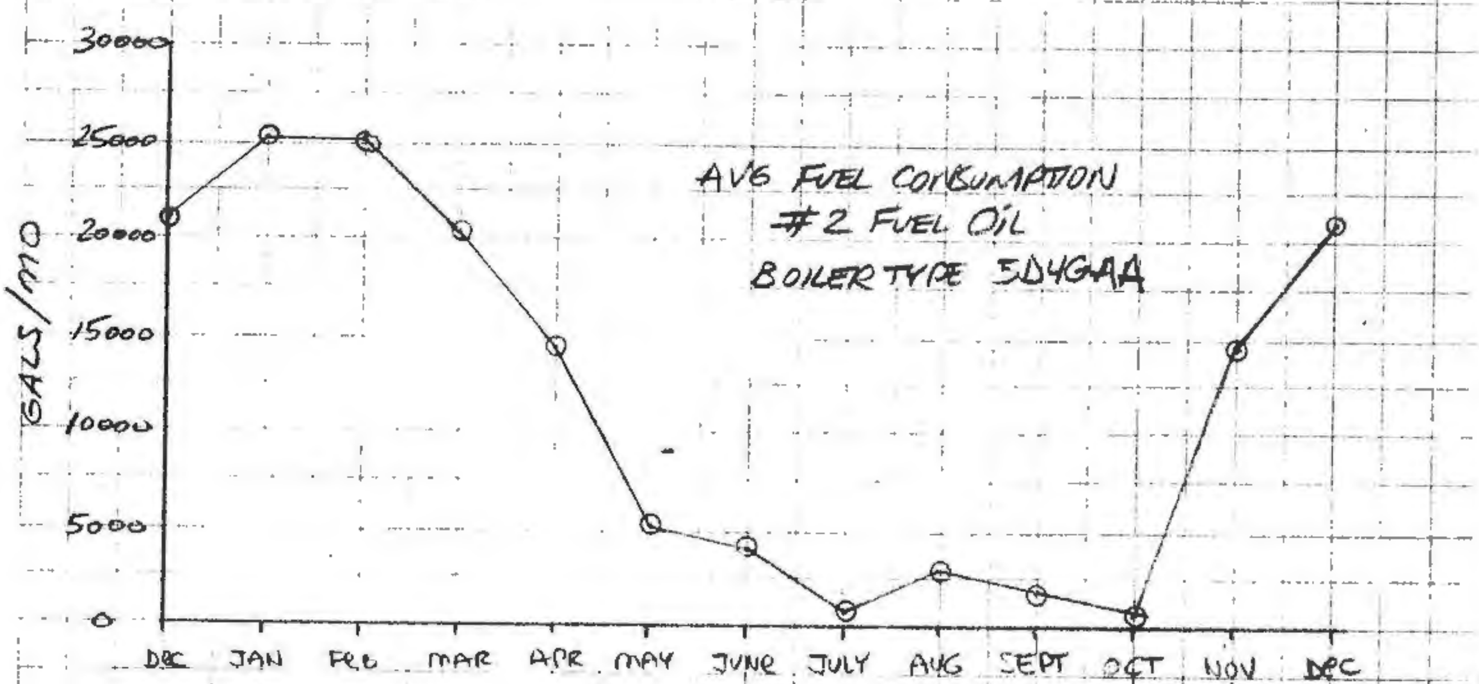
CHECKER ......

DATE ......

BOILER TYPE : 5D4GAA #2 FUEL OIL CONSUMPTION (Gallons)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 21060	26781	29812	22295	25349	29112	25735
FEB	* 29454	25098	17953	24236	30729	23777	25208
MAR	* 18828	20224	17083	17138	25737	22643	20276
APR		19569	12378	11879	15085	14856	14753
MAY		3576	6681	4924	6381	4308	5174
JUNE		4909	3958	2171	3854	4976	3974
JULY	1650	909	1073	1638	1517	3676	1744
AUG	2550	122	2941	6488	2336	2708	2858
SEPT	3097	880	813	1390	2544	946	1612
OCT	8550	4179	8812	10411	4801	9873	7771
NOV	12542	10312	20191	15573	12318	16458	14566
DEC	23878	18222	25219	31332	23841	18955	21908
TOTALS	—	134,781	146,914	139,475	154,492	152,280	145,579

* 1980



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SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA

AEP NO. 80122-000

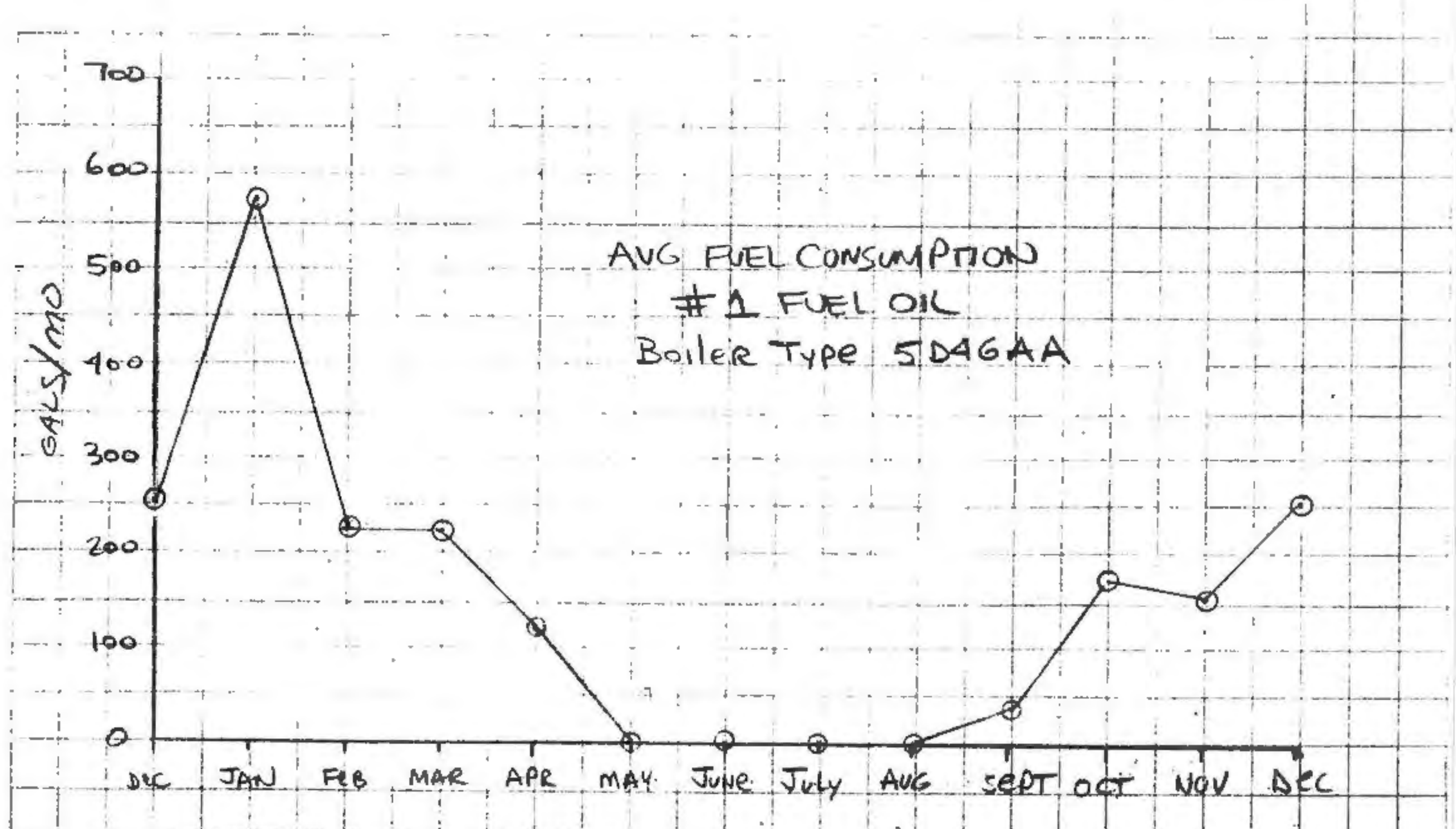
SHEET OF

DESIGNER DATE

CHECKER DATE

BOILER TYPE: 5D4GAA #1 OIL CONSUMPTION (Gallons)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 449	—	1025	771	618	—	573
FEB	* 200	—	532	117	103	192	229
MAR	* 370	—	241	149	175	165	220
APR		—	484	—	—	—	121
MAY		—	—	—	—	—	—
JUNE		—	—	—	—	—	—
JULY		—	—	—	—	—	—
AUG		—	—	—	—	—	—
SEPT		159	—	—	—	—	40
OCT		249	443	—	—	—	173
NOV		—	472	—	—	281	151
DEC		627	—	269	108		251
TOTALS	—	—	3198	1306	1004	638	1758



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Savings Due to Setback in Buildings

Fuel Type		Savings (MBtu)
#6 oil	~	39,000
#2 oil	~	4,000

Bldg #	Savings (MBTU) #6 Fuel Oil	#2 Fuel Oil	ALL TYPES
121	8,720	–	8,720
319	16,830	–	16,830
718	8,370	–	8,370
OTHERS	–	9,140	9,140
TOTALS	33,920	9,140	43,060

Savings Due to Setback Control for Buildings Independent of Central Boiler Plants

Bldg #	Est. Annual Fuel Use #2 (gal)	Savings (%)	Savings (MBtu)	ADEQUATE controls?	AUTH TEMP
101	8000	0.15 [a]	170	Y	65
103	9200	–	–	–	65
104	7600	–	–	–	65
106	17,100	–	–	–	70
113	17,100	0.56	1330	N	60
114	7,000	0.25	240	Y	50/65
116	4700	0.34	220	Y	65
S-142	16,200	0.65	1460	N	65
710	3400	0.34	160	Y	65
729	5000	0.34	240	Y	65
802	3200	0.34	150	Y	65
~~804~~					~~65~~
805	3700	0.34	170	Y	65
806	4200	0.34	200	Y	65
807	4,300	0.34	200	Y	65
810	17,800	0.34	840	Y	60/65
812	13,500	0.34	640	Y	65
813	7,900	0.34	370	Y	65
814	3,500	0.30	150	Y	60
815]					65
816]	25,200	0.34	1190	Y	65
817	3,200	0.34	150	Y	60/65
819	10,300	0.34	490	Y	65
825	1,800	0.20	50	Y	50
TENNIS BUBBLE	12,300	0.25	430	Y	55

I-23

continued

Allocation of Fuel Use by Building for Boiler Plant # 718

Bldg #	WALL U	WALL A	ROOF U	ROOF A	Σ U A	Annual Fuel Use (gal)
701	0.33	8,160	0.09	7,140	3335.4	13,100
702	0.33	11,640	0.09	10,351	4772.8	18,700
704	0.33	18,000	0.11	10,371	7080.8	27,700
705	0.09	4,296	0.11	7,996	1266.2	5,000
706	0.33	3,288	0.11	3,705	1492.6	5,900
707	0.29	6,600	0.10	18,677	3781.7	14,800
708	0.33	18,000	0.11	10,370	7080.7	27,700
718	0.37	4,640	0.27	3,224	2587.3	10,100 ←
719	0.37	1,008	0.27	374	473.9	1,900
720	0.30	5,960	0.15	4,282	2430.3	9,600
721	0.37	624	0.27	177	278.7	1,100 ←
722	0.30	3,672	0.15	4,700	1806.6	7,100
723	0.30	19,744	0.20	22,962	10,515.6	41,200
724	0.30	4,680	0.20	9,000	3204.0	12,600
731	0.07	2,520	0.04	2,717	285.1	1,100
732	0.15	2,688	0.10	2,560	659.2	2,600
					51,050.9	~200,000

Fuel use $51{,}051 \times 3.41 \frac{gal}{\Sigma UA_{121}} = 174{,}000$ + ~15% for greater line losses due to distances from boiler plant

Savings Due to Setback - Boiler Plant # 718

Bldg #	Est. Annual Fuel Use (gal)[b]	Savings (%)	Savings (MBtu)	Adequate Controls?	AUTH TEMP SET
701	13,100	0.52[a]	1020	N	65
702	18,700	—	—	N	65
704	27,700	—	-	N	65
705	5,000	0.26	200	N	65
706	5,900	0.65	580	N	65
707	14,800	0.26	580	N	65
708	27,700	—	-	N	65
714	7,300	0.20	220	Y	65
718	10,100	—	—	—	—
719	1,900	0.65	190	N	50
720	9,600	0.30[b]	430	N	50/65
~~721~~	~~1,100~~	~~0.50~~	~~80~~		
722	7,100	0.59	630	N	50/65
723	41,200	0.54	3340	N	60/65
724	12,600	0.52	980	N	65
731	1,100	—	-	Y	65
732	2,600	0.52	200	N	65
NEW BKS	25,900	—	—	—	65
TOTALS	233,200		8370		

[a] Calculated, remainder were extrapolated from calculations results on similar buildings

[b] partitioning required

Savings Due to Setback for Bldgs. Independent of Central Boiler Plants (cont.)

Bldg #	Est Annual Fuel Use (#2 gal)	Savings (%)	Savings (MBtu)	ADQ. CONT.?	AUTH TEMP
Ammo MAINT.	4,500	30	190	Y	60
Vehicle MAINT.	2,500	30	100	Y	60
SUBTOTAL 2	7,000		290		
TOTAL	213,200		9140		

REYNOLDS, SMITH AND HILLS ARCHITECTS · ENGINEERS · PLANNERS INCORPORATED	SUBJECT SENECA - CENTRAL COAL PLANT	AEP NO. 60122-...	
	DESIGNER J. MCMILLIN	SHEET 1 OF	
	CHECKER	DATE 21 NOV 80	DATE

NORTH BASE
BOILER PLANT 718 SYSTEM

Operating pressure = 50 psig
Assume condensate return @ 10 psig

@ 50 psig = 65 psia, $V_g = 6.653\ ft^3/lb$
$h_g = 1179.1$ Btu/lb.

@ 10 psig = 25 psia, $h_f = 208.52$ Btu/lb

$\Delta h = 1179.1 - 208.52 = 970.58$ Btu/lb

Bldg. 714 - GYM
Estimate annual fuel usage = 7300 Gal
#6 F.O.
Bldg. dimension ≈ 120' x 70' x 30' HIGH (Estimated)

SKIN SURFACE AREA = 19,800 ft^2

PEAK HEAT LOSS = $H_L = 5.8126 \times 10^{-6}\ E_V\ \Delta T \cdot V$

$\Delta T = 60$

$H_L = 5.8126 \times 10^{-6} (7300)(60)(150,000) = 381,914$ BTU/HR

PEAK STEAM FLOW = $\left(\frac{381,914}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 393.5$ lb/hr

BLDG. 701 $\left(\frac{685,400}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 706$ lb/hr.

BLDG. 702 $\left(\frac{978,300\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 1008$ lb/hr.

BLDG. 704 $\left(\frac{1,449,200\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 1493$ lb/hr.

T = 238

REYNOLDS, SMITH AND HILLS
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INCORPORATED

SUBJECT: SENECA - CENTRAL COAL PLANT
DESIGNER: J McMILLIN
CHECKER:

AEP NO: 80122-000
SHEET: 2 OF
DATE: 21 NOV 80
DATE:

BLDG 705 $\left(\frac{267,600}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 270\ lb/hr.$

BLDG 706 $\left(\frac{308,700\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 318\ lb/hr.$

BLDG 707 $\left(\frac{774,300\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 798\ lb/hr$

BLDG 708 $\left(\frac{1,449,200}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 1493\ lb/hr.$

BLDG 719 $\left(\frac{74,600\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 77\ lb/hr.$

BLDG 720 $\left(\frac{376700\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 388\ lb/hr.$

BLDG 722 $\left(\frac{371,500\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 383\ lb/hr.$

BLDG 723 $\left(\frac{2,155,500\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 2221\ lb/hr.$

BLDG 724 $\left(\frac{659,200\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 679\ lb/hr$

BLDG 732 $\left(\frac{136,000\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 140\ lb/hr.$

BLDG 802 FY80 #1 F.O. usage = 3200 gallons
$\Delta T = 60°$

$H_L = 5.8126 \times 10^{-6}\ E_V \Delta T V = 5.8126 \times 10^{-6} (3211)(60)(138,700)$
$= 154,800\ Btu/hr$

$\left(\frac{154,800\ Btu}{hr}\right)\left(\frac{lb}{970.58\ Btu}\right) = 159\ lb/hr.$

T = 239

Bldg 813 $\frac{382{,}100 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 394 lb/HR

Bldg 814 $\frac{155{,}200 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 160 lb/HR

Bldg 815 $\frac{609{,}500 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 628 lb/HR

Bldg 816 $\frac{609{,}500 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 628 lb/HR

Bldg 817 $\frac{154{,}800 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 159 lb/HR

Bldg 805 $\frac{134{,}200 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 138 lb/HR

Bldg 806 $\frac{203{,}200 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 209 LB/HR

Bldg 807 $\frac{173{,}300 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 179 lb/HR

Bldg 810 $\frac{717{,}600 \text{ BTU/HR}}{970.58 \text{ BTU/lb}}$ = 739 lb/HR

Bldg 812 $\frac{653{,}100 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 673 \text{ lb/HR}$

Bldg 825 $\frac{72{,}600 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 75 \text{ lb/HR}$

Bldg 819 $\frac{456{,}700 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 471 \text{ lb/HR}$

Bldg 729 $\frac{241{,}900 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 249 \text{ lb/HR}$

Bldg 718 $\frac{484{,}400 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 499 \text{ lb/HR}$

Bldg 731 $\frac{575{,}500 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 593 \text{ lb/HR}$

New Barracks Fuel use (est.) = 25,900 GAL/YR
#6 F.O.

$H_L = (5.8126 \times 10^{-6})(25900)(60)(150{,}000)$
$= 1{,}355{,}010 \text{ BTU/HR}$

$\frac{1{,}355{,}010 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 1396 \text{ lb/HR}$

Tennis Bubble — Fuel use #2 F.O. = 12,300 GAL/YR

$H_L = (5.8126\times10^{-6})(12,300)(50)(138700)$

$= 495,852$ BTU/HR

$\frac{495,852 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 511$ lb/HR

New Ammunition Facility — Fuel use (est) = 4500 GAL/YR #2 F.O.

$H_L = (5.8126\times10^{-6})(4500)(55)(138,700)$

$= 199,550$ BTU/HR

$\frac{199550 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 206$ lb/HR

Vehicle Maint Facility — Fuel use (est) = 2500 gal/YR #2 F.O.

$H_L = (5.8126\times10^{-6})(2500)(55)(138,700)$

$= 110,861$ BTU/HR

$\frac{110,861 \text{ BTU/HR}}{970.58 \text{ BTU/lb}} = 114$ lb/HR

ARCHITECTS • ENGINEERS • PLANNERS DESIGNER

DATE 10-23-80 BUILDING Heat Loss Calculation

MAP AREA: 1

Revised 12/1/80
per P. Hutchins

	BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY Heat Loss ~ BTU/HR X1000			TOTAL HEAT LOSS ~BTU/HR
				#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
7818	813	SHOP 65°	60	—	7900	—	—	382.1	—	382,100
.453	814	SHOP 60°	55		3500	—		155.2	—	155,200
16	815	SHOP 65	60	—	12600	—	—	609.5	—	609,500
25,188	816	SHOP 65	60	—	12600	—	—	609.5	—	609,500
?17	817	SHOP 65	60	—	3200	—	—	154.8	—	154,800
~~										
-1,852					[illegible]					
					+ (1%				TOTAL	1,911,100
~										

$$H_L = \frac{E_v \Delta T r_c V}{24 \cdot HDD\, C_D} = 5.8126 \times 10^{-6} E_v \Delta T V$$

HDD = 6359
V = 139,204 #1 F.O.
138,700 #2 F.O.
150,000 #6 F.O.

I-243 $C_D = 0.62$
$\eta = 0.55$

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DESIGNER S. COWEN
DATE 10-23-80

SUBJECT Seneca Army Depot
Building Heat Loss Calculation

Revised 11/28/80
per P. Hutchins

MAP AREA: 2

	BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY HEAT LOSS ~ BTU/HR X 1000			TOTAL HEAT LOSS ~ BTU/HR
				#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
3776	800	SENTRY 65°	60	—	—	—			—	—
3211	802	GEN PURP ADMIN 65°	60		3200	—		154.8	—	154,800
3696	805	COMB AC & HT 50°	45		3700	—		134.2	—	134,200
4162	806	APPLIED INST BLDG 65°	60		4200	—		203.2	—	203,200
4301	807	GEN. STORAGE 55	50		4300	—		173.3	—	173,300
11448	810	GEN W'HSE 55°	50		19,800	—		717.6	—	717,600
3510	812	GEN PURP ADMIN 65°	60		13500	—		653.1	—	653,100
766	825	VEHICLE STORAGE 55°	50		1800	—		72.6	—	72,600
	801	INCINERATOR								
	803	ELECTRIC HEATERS								
	804	?								
	808	?								
	809	W'HSE								

$$H = \frac{E_V \Delta T h V}{24 \cdot HDD \cdot L_D} = 5.8126 \times 10^{-6} E_V \Delta T V$$

V = 138,700 #2 FO.
= 134,204 #1 F.O.

I = 2444

DATE 10-23-80 BUILDING Heat Loss Calculations

MAP AREA: 3

Revised 11/28/80 per P. Hutchins

BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY Heat Loss ~ BTU/HR X 1000			TOTAL HEAT LOSS ~ BTU/HR
			#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
819	SHOP 60°	55°	—	10,300	—	—	456.7	—	456,700
								TOTAL	456,700

$H_L = 5.8126 \times 10^{-6} E_V \Delta T V$

V = 138,700 #2 F.O.
= 134,204 #1 F.O.

ARCHITECTS • ENGINEERS • PLANNERS DESIGNER DATE 10-23-80 BUILDING Heat Loss Calculation

MAP AREA: 4

REVISED 11/28/80
P. HUTCHINS

BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS #1 OIL	#2 OIL	#6 OIL	DESIGN HOURLY HEAT LOSS ~ BTU/HR x1000 #1 OIL	#2 OIL	#6 OIL	TOTAL HEAT LOSS ~BTU/HR
5010 729	FIRE STATION 650	60		5000	—		241.9	—	241,900
								TOTT	

$H_L = 5.8126 \times 10^{-6} E_V \Delta T V$ V = 138,700 #2 F.O. = 134,204 #1 F.O.

ARCHITECTS • ENGINEERS • PLANNERS DESIGNER ______ SUBJECT Building Heat Loss Calculations

DATE 10-23-80

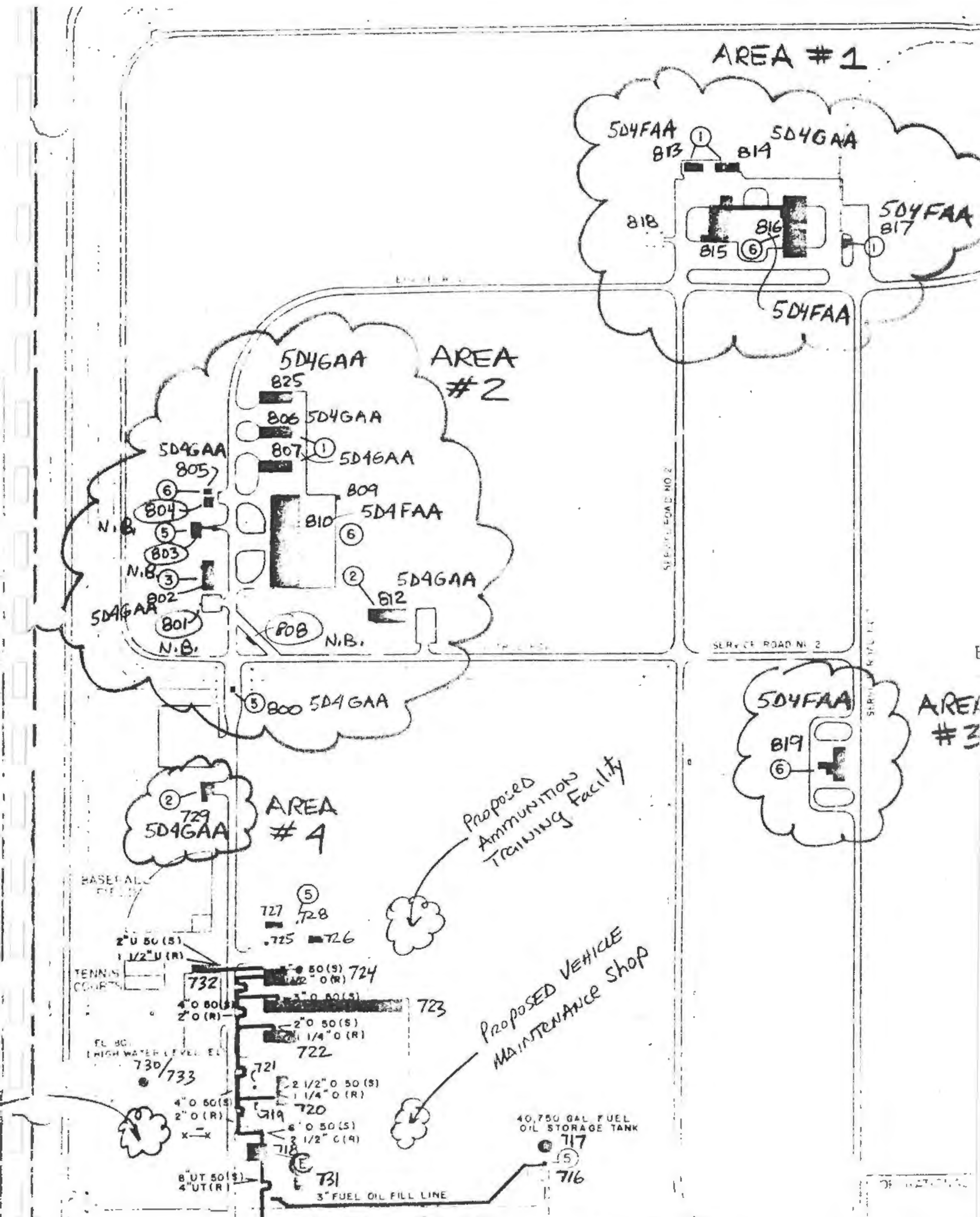
MAP AREA: BOILER PLANT 718

Revised 11/28/80
Per P. Hutchins

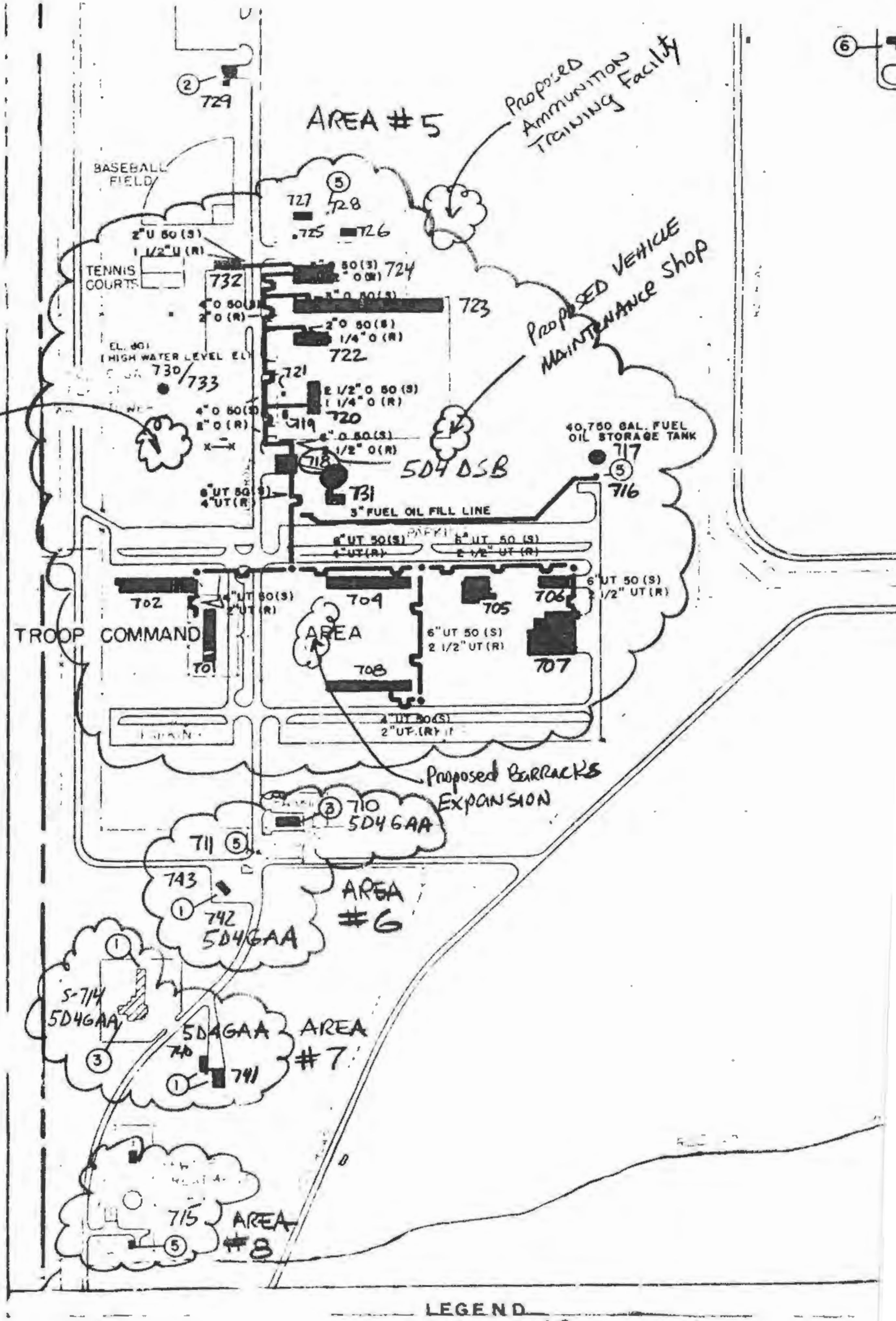
BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY HEAT LOSS ~ BTU/HR ×1000			TOTAL HEAT LOSS ~BTU/HR
			#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
701	ADMIN. 65°	60			13,100			685.4	685,400
702	BOQ 65	60			18,700			978.3	978,300
704	BARRACKS 65	60			27,700			1449.2	1,449,200
705	EM SERV. CLUB 65°	60			5,000			261.6	261,600
706	THEATRE 65°	60			5,900			308.7	308,700
707	DINING FAC + PX - 65	60			14,800			774.3	774,300
708	BARRACKS 65	60			27700			1449.2	1,449,200
719	CLASS IV WHSE 50	45			1900			74.6	74,600
720	143 EOD 50	45			9600			376.7	376,700
722	COMM. WHSE PKG STORE	60			7100			371.5	371,500
723	NORTHERN COMMISS. [illegible]	60			41200			2155.5	2,155,500
724	QM DIV, SKILL	60			12600			659.2	659,200
732	AUTO SHOP	60			2600			136.0	136,000
718	Boiler Plant 60	55			10,100			484.4	484,400
731	NCO 65 ANNEX	60			1,100			575.5	575,500
714	New GYM 65	60			7300			381.9	381,900

$H_L = 5.8126 \times 10^{-6}$ EV ΔTV , V = 150,000 #6 F.O

I_L = 247



AREA #1
5D4FAA
813
814
5D4GAA
818
816
815
5D4FAA
817
5D4FAA
5D4GAA
AREA #2
825
806 5D4GAA
807
5D4GAA
5D4GAA
805
804
809
810
5D4FAA
N.B.
803
N.B.
802
5D4GAA
812
801
808
N.B.
N.B.
800 5D4GAA
SERVICE ROAD NO. 2
5D4FAA
AREA #3
819
729
5D4GAA
AREA #4
Proposed Ammunition Training Facility
BASEBALL FIELD
727
728
725
726
TENNIS COURTS
732
724
723
722
730/733
721
720
719
718
731
Proposed Vehicle Maintenance Shop
40,750 GAL FUEL OIL STORAGE TANK
717
716
3" FUEL OIL FILL LINE



AREA #5
Proposed Ammunition Training Facility
BASEBALL FIELD
TENNIS COURTS
2" U 50 (S)
1 1/2" U (R)
727
728
725
726
729
732
724
723
722
721
720
719
718
731
730/733
EL. 80
(HIGH WATER LEVEL EL)
Swimming Pool
Proposed Vehicle Maintenance Shop
5D4 DSB
40,750 GAL. FUEL OIL STORAGE TANK
717
716
3" FUEL OIL FILL LINE
6"UT 50 (S)
4"UT (R)
2 1/2" UT (R)
702
704
705
706
707
708
701
TROOP COMMAND AREA
6"UT 50 (S)
2 1/2" UT (R)
Proposed BARRACKS EXPANSION
710
5D4GAA
711
743
742
5D4GAA
AREA #6
S-714
5D4GAA
5D4GAA
740
741
AREA #7
715
AREA #8

LEGEND

NOTES

(1) BUILDINGS WITH INDEPENDENT OIL FIRED HOT AIR HEATING SYSTEM

(2) BUILDINGS WITH INDEPENDENT OIL FIRED STEAM HEATING SYSTEM

(3) BUILDINGS WITH INDEPENDENT OIL FIRED HOT WATER HEATING SYSTEM

(4) BUILDINGS WITH SELF CONTAINED OIL FIRED HOT AIR SPACE HEATER

(5) BUILDINGS WITH ELECTRIC HEATERS

(6) BUILDINGS WITH INDEPENDENT OIL FIRED STEAM BOILER AND HEAT EXCHANGER

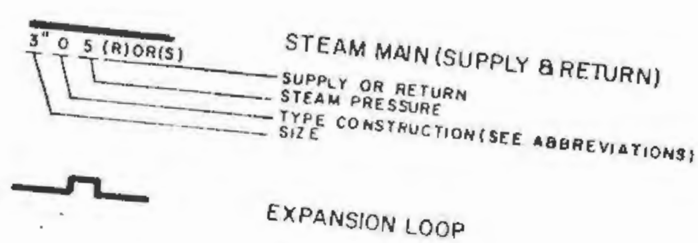
(D) BUILDING NO. 6-(2) BOILERS, LOW PRESSURE-TOTAL 24 H.P.

(E) BUILDING NO. 718-(3) BOILERS, HIGH PRESSURE-TOTAL 930 H.P.

ABBREVIATIONS
O - OVERHEAD
U - UNDERGROUND
T - TUNNEL
UT - UNDERGROUND TUNNEL

LEGEND

EXISTING



Boiler Sizing - North Base

ALT # 1 - DEMAND = 13,016 lb/HR (PEAK)

ANNUAL FUEL USE – BEFORE SET-BACK – AFTER REPAIRS AND MODIFICATIONS HAVE BEEN MADE TO THE EXISTING STEAM DISTRIBUTION SYSTEM = 200,000 ~~NE/HR~~ GAL/HR

Monthly Fuel Consumption

Month	Fuel use before mods/repairs	Fuel use after mods/repairs	Avg daily fuel use ①	Avg hourly fuel use ①	② Avg hourly system demand
JAN	47251	27422	885	36.9	4505 lb/hr
FEB	48353	28062	1002	41.8	5104
MAR	40330	23406	755	31.5	3846
APRIL	33781	19605	654	27.2	3321
MAY	24149	14015	452	18.8	2295
JUNE	10525	6108	204	8.5	1038
JULY	9852	5718	184	7.7	940
AUG	10113	5869	189	7.9	965
SEPT	15037	8727	291	12.1	1477
OCT	24663	14313	462	19.2	2344
NOV	36166	20986	700	29.1	3553
DEC	44394	25764	831	34.6	4225

① AFTER MOD/REPAIRS

② $$\text{Avg hourly syst. demand} = \frac{(\text{Avg hourly fuel use})(150{,}000\ \frac{\text{Btu}}{\text{gal}})(.80)}{982.83\ \text{Btu/lb}}$$

where (.80) = assumed efficiency of existing steam generators

FROM THE ABOVE TABLE:

MAX AVG HOURLY SYSTEM DEMAND = 5104 lb/HR
MIN AVG HOURLY SYSTEM DEMAND = 940 lb/HR

ADD NEW BLDGS TO AVG. HOURLY DEMAND:

NEW BARRACKS - 1396 lb/HR (PEAK)
NEW GYM (#714) - 394 (PEAK)
NEW AMMO FACILITY - 206 (PEAK)

1996 lb/HR (PEAK)

ADJUST PEAK DEMAND TO HOURLY DEMAND
BY RATIO 1996 / 13016 = 15.33 %

∴ MAX AVG HOURLY DEMAND = 5104 × 1.1533

= 5886 lb/HR

MIN AVG HOURLY DEMAND = 940 × 1.1533

= 1084 lb/HR

SIZE BOILERS FOR AVG HOURLY DEMAND
= 5886 × 1.2 = 7063 lb/HR
(1.2 = SAFETY FACTOR)

* SELECT THREE (3) 7,000 lb/HR COAL FIRED STEAM GENERATORS TO BE FIRED AS:

1 UNIT → AVG HOURLY DEMAND, 84% FIRING RATE
2 UNIT → PEAK DEMAND, 93% FIRING RATE
3 UNITS → PROVIDES 161% CAPACITY

ALT #2 - DEMAND = 15593 lb/HR

MONTH	AVG HOURLY SYST. DEMAND ALT #1	(1) ADJUSTED AVG HOURLY SYST. DEMAND ALT #2	ALT #2 HOURLY SYST. DEMAND X 1.2 SAFETY FACTOR
FEB	5886	7051	8461
JULY	1084	1299	1559

(1) ALT #1 x $\frac{15593}{13016}$

* SELECT THREE (3) 8,500 lb/HR COAL FIRED STEAM GENERATORS TO BE FIRED AS:

1 UNIT → AVG HOURLY DEMAND, 83% FIRING RATE
2 UNITS → PEAK DEMAND, 92% FIRING RATE
3 UNITS → PROVIDES 164% CAPACITY

ALT #3 - DEMAND = 16905 lb/HR

MONTH	AVG HOURLY SYST DEMAND ALT #1	(1) ADJUSTED AVG HOURLY SYST DEMAND ALT #3	ALT #3 HOURLY SYST DEMAND X 1.2 SAFETY FACTOR
FEB	5886	7645	9174
JULY	1084	1408	1689

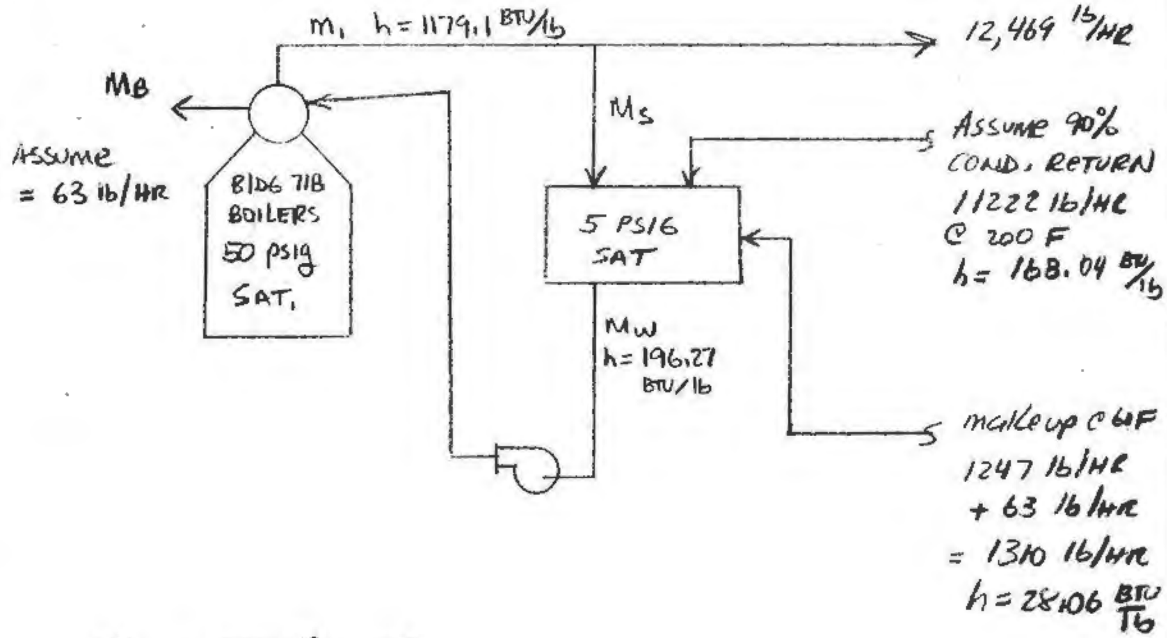
(1) ALT #1 x $\frac{16905}{13016}$

* SELECT THREE (3) 9,000 lb/HR BOILERS TO BE FIRED AS:

1 UNIT - AVG HOURLY DEMAND, 85% FIRING RATE
2 UNITS - PEAK DEMAND, 94% FIRING RATE
3 UNITS - PROVIDES 160% CAPACITY

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

SUBJECT SENECA ARMY DEPOT BASE CASE- Bldg 718- DA LOAD AEP NO. 80122-000
SHEET OF
DESIGNER S. COWEN DATE
CHECKER DATE



$$m_1 = 12469 + m_s$$

$$m_s + 11222 + 1310 = m_w$$

$$m_s(1179.1) + 11222(168.04) + 1310(28.06) = m_w(196.27)$$

$$m_s(1179.1) + 11222(168.04) + 1310(28.06) = (m_s + 11222 + 1310)\,196.27$$

$$m_s = \frac{11222(196.27 - 168.04) + 1310(196.27 - 28.06)}{1179.1 - 196.27}$$

316797.06
+ 220355.1

982.83

$$M_S = 546.5 \text{ lb/HR}$$

$$M_1 = 13016 \text{ lb/HR}$$

$$M_W = 13079 \text{ lb/HR}$$

check $M_B = .005 M_1 = 65$ ✓

coal fired boiler D-A LOAD

for SIZING, Assume Deaerator load is proportional to steam load for ALT-1

Alt-2

steam load = 17836 ✓

Ratio $\frac{ALT 2}{ALT 1}$ = 1.103

D-A LOAD = 446 x 1.103
= 491 lb/HR

Boiler LOAD = 18327 lb/hr

Alt-3

steam load = 16953 ✓

Ratio $\frac{Alt 2}{Alt 1}$ = 1.048

D-A load = 446 x 1.048
= 468 lb/HR

Boiler load = 17421 lb/hr

ALT-4

steam load = 18617 ✓

RATIO $\frac{ALT 4}{ALT 1}$ = 1.151

D-A load = 446 x 1.151
= 513 lb/HR

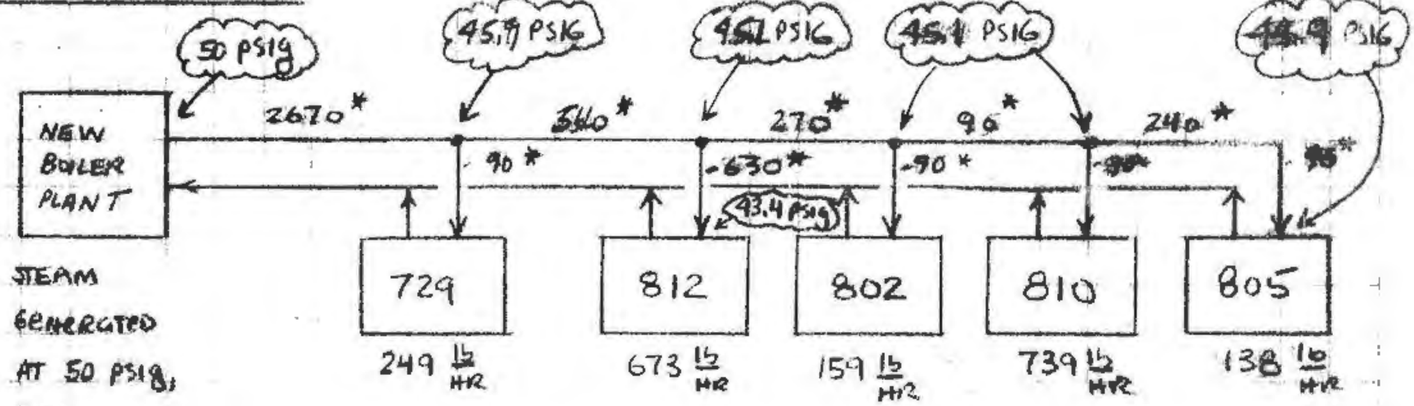
Boiler load = 19130 lb/hr

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA - NORTH BASE Heating System ΔP Calc's
DESIGNER: S. COWEN
CHECKER:
AEP NO. 80122-000
SHEET 1 OF 9
DATE 12-4-80
DATE

PRESSURE DROP / PIPE SIZING CALCULATIONS - LONG PIPE RUNS

ALTERNATE # 2



STEAM GENERATED AT 50 PSIG, SAT.

$h = 1179.1\ \frac{BTU}{lb}$

$\bar{V} = 6.653\ \frac{Ft^3}{lb}$

~~$\mu = 0.016$ centipoise~~

* INCLUDES 20% FOR EXPANSION loops & fittings

TOTAL STEAM FLOW = 1958 lb/HR , ASSUME TOTAL FLOW TO BLDG 805

TRY 4" Sch 40 PIPE $\quad d = 4.026'' \quad d^5 = 1058 \quad A = .0884\ Ft^2$

length of RUN = 3900 Ft

$$Re = \frac{6.31\,W}{d\,\mu} = \frac{6.31 \times 1958}{4.026 \times .016} = 1.9 \times 10^5 \Rightarrow f = .0188$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0188)(3590)(1958)^2(6.653)}{1058}$$

ΔP = 5.9 PSI (11.7% of Inlet Pressure - may have to AVG $\bar{V}$)

∴ USE 4" Sch 40, BOILER PLANT TO BLDG 729 TAKE OFF

length of Run = 2670 Ft

$Re = 1.9 \times 10^5 \qquad f = 0.0188$

$\Delta P = \left(\frac{26801}{39960}\right)(5.9\ PSI) = 4.04\ PSI$

AVAILABLE PRESSURE AT BLDG 729 TAKEOFF = 46.0 PSIG

CALCULATE $\bar{V}$ AT 46.0 PSIG

61.0 PSIA h = 1179.1 BTU/lb

60 PSIA	292.71	1177.6
	T_{60}	1179.1
	300	1181.6

$\frac{x}{7.29} = \frac{1.5}{4.0}$ x = 2.73

T_{60} = 295.44 °F

292.71	7.174
295.44	$\bar{V}_{60}$
300	7.257

$\frac{2.73}{7.29} = \frac{x}{.083}$ x = 0.0311

$\bar{V}_{60} = 7.2051$

65 PSIA $\bar{V} = 6.653$

60	7.2051
61.	$\bar{V}_{61.1}$
65	6.653

$\frac{1.0}{5} = \frac{x}{-0.5521}$ x = −0.1104

$\bar{V}_{61.1} = 7.0947\ ft^3/lb$

AVG $\bar{V}$, Boiler Plant to Bldg 729 = 6.8739 ft^3/lb

RESULTANT $\Delta P = (4.04\ PSI)\left(\frac{6.8739}{6.653}\right) = 4.17\ PSI$

$\Delta(\Delta P) = 4.17 - 4.04 = .13\ PSI$ (Negligible)

AVAILABLE PRESSURE AT BLDG 729 Takeoff = 45.9 PSIG

∴ USE 4" sch 40, Bldg 729 Take-off to Bldg 812 Takeoff

length of Run = 540 Ft. P_1 = 46.7 PSIG
flow rate = 1709 lb/HR μ = .0159 centipoise

$$Re = \frac{6.31\,W}{d\mu} = \frac{6.31 \times 1709}{4.026 \times .0159} = 1.7 \times 10^5 \Rightarrow f = 0.019$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.019)(540)(1709)^2(7.0174)}{1058} = 0.67\ PSI$$

AVAILABLE PRESSURE AT Bldg 812 Takeoff = 45.2 PSIG

TRY 4" sch 40, Bldg 812 to Bldg 802

length of Run = 270 Ft P_1 = 46.1 PSIG
flow rate = 1036 lb/HR μ = .0159 centipoise
$\bar{V}$ = 7.2051 Ft^3/lb

$$Re = \frac{6.31\,W}{d\mu} = \frac{6.31 \times 1036}{4.026 \times .0159} = 1.0 \times 10^5 \Rightarrow f = .0202$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0202)(225)(1036)^2(7.2051)}{1058} = 0.13\ PSI$$

∴ USE 4" sch 40 ⇒ AVAILABLE Pressure AT Bldg 802 Takeoff = 45.1 PSIG

USE 4" sch 40 up to Bldg 810 Takeoff

length of run = 90 flow = 877 lb/HR

$\Delta P \cong 0.05$ PSI/100 Ft

ΔP = negligible

∴ Pressure Available at Bldg 810 Takeoff = 45.1 PSIG

TRY 2" [illegible], Bldg 810 to Bldg 805

length of run = 330 Ft
Flow rate = 138 lb/hr
P_1 = 46 PSIG
μ = .0159 centipoise
$\bar{v}$ = 7.2051 Ft³/lb

d = 1.939"
d^5 = 27.41
A = 0.0205 Ft²

$$Re = \frac{6.31 \times 138}{1.939 \times .0159} = 2.8 \times 10^4 \Rightarrow f = .026$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.026)(330)(138)^2(7.2051)}{27.41} = 0.14 \text{ PSI}$$

Pressure Available at Bldg 805 = 44.9 PSIG

Calculate ΔP - Bldg 812 Takeoff to Bldg 812

length of run = 630 Ft flow rate = 673 lb/HR
P_1 = 46.1 PSIG
$\bar{v}$ = 7.2051 Ft³/lb
μ = .0159 centipoise

TRY 2" sch 80 $d = 1.939''$ $d^5 = 27.41$

$$Re = \frac{6.31 \times 673}{1.939 \times .0159} = 1.4 \times 10^5 \Rightarrow f = 0.0213$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0213)(630)(673)^2(7.0251)}{27.41}$$

$\Delta P = 5.24$ PSI (TOO HIGH)

TRY 2½" sch 40 $d = 2.469''$ $d^5 = 91.75$

$$Re = \frac{6.31 \times 673}{2.469 \times .0159} = 1.1 \times 10^5 \Rightarrow f = 0.0210$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.021)(630)(673)^2(7.0251)}{91.75}$$

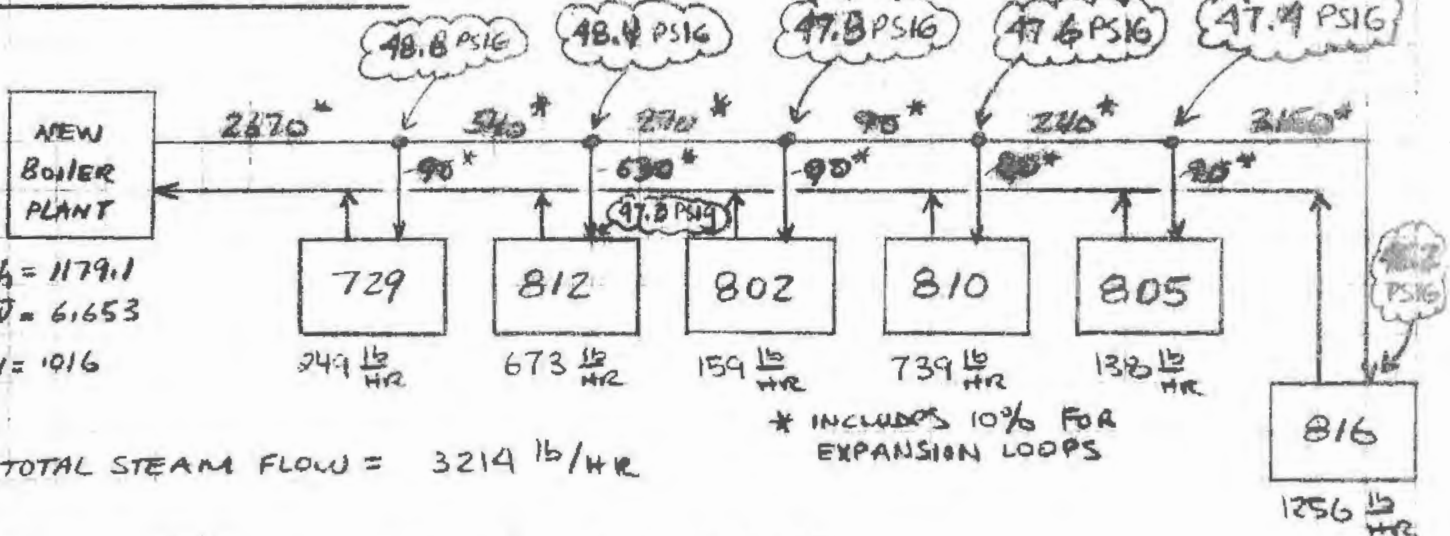
$\Delta P = 1.53$ PSI (satisfactory)

Pressure Available At Bldg 812 = 439 PSIG

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT: SENECA NORTH Base — ΔP CAlc's | AEP NO. 80122-000
DESIGNER: SCowan | SHEET 6 OF 9
DATE: 12-4-80
CHECKER: | DATE:

ALTERNATE #3



$h = 1179.1$
$\bar{v} = 6.653$
$\mu = .016$

TOTAL STEAM FLOW = 3214 lb/HR

Assume TOTAL Flow To Bldg 805 Takeoff

TRY 6" sch 40 $d = 6.065''$ $d^5 = 8206$ $A = 0.2006\ Ft^2$

length of Run = 3610 Ft

$$Re = \frac{6.31 \times 3214}{6.065 \times .016} = 2.1 \times 10^5 \Rightarrow f = .0178$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0178)(3610)(3214)^2(6.653)}{8206}$$

$\Delta P = 1.80$ PSI

TRY 4" sch 40 $d = 4.026''$ $d^5 = 1058$

$$Re = \frac{6.31 \times 3214}{4.026 \times .016} = 3.15 \times 10^5 \Rightarrow f = 0.018$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.018)(3610)(3214)^2(6.653)}{1058}$$

$\Delta P = 14.18$ PSI (Too high) / I-2616

USE 6" sch 40, Boiler Plant to Bldg 729 Takeoff

length of Run = 2670 Ft
flow rate = 3214 lb/HR

$Re = 2.1 \times 10^5 \quad f = .0178$

$\Delta P = 0.05\ PSI/100\ Ft \times 2670\ Ft = 1.34\ PSI$

AVAILABLE PRESSURE AT Bldg 729 Takeoff = 48.6 PSIG

TRY 6" sch 40 TO Bldg 812 Takeoff

flow rate = 2965 lb/HR
length of Run = 540 Ft

$$Re = \frac{6.31 \times 2965}{6.065 \times .016} = 1.9 \times 10^5 \Rightarrow f = 0.018$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.018)(2965)^2(540)(6.653)}{8206} = 0.23\ PSI$$

AVAILABLE PRESSURE AT BLDG 812 Takeoff = 48.4 PSIG

TRY 4" sch 40 TO Bldg 802 Takeoff

length of Run = 220 Ft
Flow rate = 2292 lb/HR
$d = 4.026" \quad d^5 = 1058$

$Re = \frac{6.31 \times 2292}{4.026 \times .016} = 2.2 \times 10^5 \Rightarrow f = 0.0185$

$\Delta P = \frac{(3.36 \times 10^{-6})(.0185)(100)(2292)^2(6.653)}{1058} = \frac{0.205 \text{ PSI}}{100 \text{ Ft}}$

$\Delta P = \frac{.205}{100} \times 270 \text{ Ft} = 0.56 \text{ PSI}$

Available Pressure AT Bldg 802 Takeoff = 47.8 PSIG

USE 4" Sch 40 TO Bldg 810 Takeoff

length of RUN = 80 Ft
flow rate = 2133 lb/HR
$\bar{V}$ = 6.86 Ft³/lb (adjusted to 63 PSIA)

$Re = \frac{2133 \times 6.31}{4.026 \times .01595} = 2.1 \times 10^5 \Rightarrow f = .0185$

$\Delta P = \frac{(3.36 \times 10^{-6})(.0185)(80)(2133)^2(6.86)}{1058} = 0.17 \text{ PSI}$

Available Pressure AT Bldg 810 Takeoff = 47.6 PSIG

USE 4" sch 40 To Bldg 805 Takeoff

length of RUN = 240 Ft
flow Rate = 1394 lb/HR

$$Re = \frac{6.31 \times 1394}{4.026 \times .01595} = 1.4 \times 10^5 \Rightarrow f = .0194$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0194)(240)(1394)^2(6.86)}{1058} = 0.22 \text{ PSI}$$

Available Pressure AT Bldg 805
Takeoff = 47.4 PSIG

TRY 4" sch 40 to Bldg 816

length of RUN = 3150 Ft
flow Rate = 1256 lb/HR

$$Re = \frac{6.31 \times 1256}{4.026 \times .01595} = 1.2 \times 10^5 \Rightarrow f = .020$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.020)(3150)(1256)^2(6.86)}{1058} = 2.17 \text{ PSI}$$

TRY 3" sch 40 — $d = 3.068''$ $d^5 = 271.8$

$$Re = \frac{6.31 \times 1256}{3.068 \times .01595} = 1.6 \times 10^5 \Rightarrow f = 0.020$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.020)(3150)(1256)^2(6.86)}{271.8} = 8.40$$ (Too High)

USE 4" sch 40

AVAILABLE PRESSURE AT Bldg
816 inlet = 45.2 PSIG

STEP I DETERMINE THE BOILER OPERATING CONDITIONS AND THE DISTRIBUTION SUPPLY AND RETURN TEMPERATURE

Design Criteria (Per Ref 1)

1. Send-out temperature is 3-8°F lower than the boiler temperature.

2. Assume a 20°F drop in temperature from beginning to end of the supply line.

3. A 380°F temperature is required at the end of the supply line.

From the above criteria a boiler operating pressure of 250 psig (265 psia) is selected and the following result from this selection:

Boiler Operating Temperature = 406.13 °F

Send-Out Temperature = 400 °F

End-of-line Temperature = 380 °F

Boiler and Equipment Design Temperature = 390°F

Assuming, that steam needs to be generated in each building at 15 psig in order to utilize the existing unit heaters and building piping, the...

Return Temperature = 270 °F

... is selected to supply a 20°F approach to the steam generators which are required in each building. Note that the saturation temp. of 15 psig steam is 250°F. T - 265

STEP II CALCULATE BOILER SIZE

II A. Calculate Peak HTW Demand

For Boiler Sizing calculations the following conditions apply to the HTW distribution system:

Supply Temperature $= \frac{380 + 400}{2} = 390°F$

Return Temperature = 270°F

System Pressure = 250 psig = 265 psia

For building heating ...

$$\Delta h_{HTW} = h_{SUPPLY} - h_{RETURN}$$

$$= (364.36 - 239.39)\ BTU/lbm$$

$$= 124.97\ BTU/lbm$$

$$\text{PEAK HTW DEMAND} = \frac{\text{Peak System Load } (BTU/hr)}{\Delta h_{HTW}\ (BTU/lbm)}$$

$$= \frac{14,498,526^{*}}{124.97}$$

$$= \underline{116016}\ \text{lbm/hr of HTW}$$

* See Tabulation on next page for origination of the Peak System Load.

II A (cont.)

PEAK SYSTEM LOAD TABULATION: TABLE II-1

BUILDING	BUILDING PEAK HEAT * LOAD (BTU/hr)	HTW DEMAND (lb/hr)
701	685,400	5,485
702	978,300	7,828
704	1,449,200	11,596
705	261,600	2,093
706	308,700	2,470
707	774,300	6,196
708	1,449,200	11,596
714	381,914	3,056
718	484,400	3,876
719	74,600	597
720	376,700	3,014
722	371,500	2,973
723	2,155,500	17,248
724	659,200	5,275
729	241,900	1,936
732	136,000	1,088
802	154,800	1,239
805	134,200	1,074
810	717,600	5,742
812	653,100	5,226
NEW BARRACKS	1,355,010	10,843
NEW AMMO FACILITY	199,550	1,597
TENNIS BUBBLE	+ 495,852	+ 3,968

PEAK SYSTEM LOAD = 14,498,526 BTU/hr

PEAK HTW DEMAND = 116,016 lb/hr

* Values taken from Appendix I

II. (cont.)

B. Calculate the Maximum Average Hourly System HTW Demand

The maximum average hourly system HTW demand can be calculated in part from the actual fuel consumption data for BLD'G 718 and from the calculated Peak Building Heat Loads for those buildings to connected to the BLD'G 718 heating system.

The actual monthly fuel consumption is adjusted to the values shown in column two of the following table to account for fuel savings expected from modifications and repair of the existing boiler. In order to determine the HTW demand, the heat input to the boiler is adjusted by the .96 factor shown in the next equation to account for the deaerator steam flow (approx. 4%) which is required by the steam/condensate system but not by the HTW system.

$$\text{lb/hr of HTW (Monthly Demand)} = \frac{.96 \times [\text{Modified Boiler Heat Input}]}{\Delta h_{HTW}}$$

$$= \frac{.96 \times \left[\left(\begin{array}{c}\text{monthly}\\ \text{Fuel Use}\\ \text{After Mod's.}\end{array}\right)\left(150{,}000\ \frac{BTU}{gal}\right)(.80)^{*}\right]}{124.97\ BTU/lbm}$$

See the tabulation of the monthly fuel use for Bldg 718 and the results of the above equation in the following table. (next page).

* It's assumed that the eff. of the existing boiler = 80%

II B. (cont.)

TABLE II-2
AVERAGE HOURLY SYSTEM HTW DEMAND
DUE TO BUILDING 718 CONSUMERS

MONTH	AVG MONTHLY FUEL USE AFT. MODs. (Gal's No.6)	AVG HTW DEMAND (lb/hr) MONTHLY	HOURLY
JAN	27422	25.28×10^6	33,976
FEB	28062	25.87×10^6	37,167
MARCH	23406	21.58×10^6	29,000
APRIL	19605	18.07×10^6	25,100
MAY	14015	12.92×10^6	17,365
JUNE	6108	5.63×10^6	7,820
JULY	5718	5.27×10^6	7,085
AUG.	5869	5.41×10^6	7,272
SEPT	8727	8.04×10^6	11,173
OCT.	14313	13.19×10^6	17,734
NOV	20986	19.35×10^6	26,869
DEC.	25764	23.75×10^6	31,922

From the above table the max. avg hourly demand due to BLD'G 718 consumers is 37,167 lb/hr of HTW. The max. avg hourly demand of the rest of the buildings of the system, that need to be added to the above to get the Total System Max Avg Hourly HTW Demand, is calculated as follows:

$$\text{REMAINING BLD'GS}^{*}\ \text{MAX AVG HOURLY HTW DEMAND} = \left(\frac{\text{Peak Heat Load of Remaining Bldg's}}{\text{Peak Heat Load of Bldg 718 Consumers}}\right) \times \left(\text{Max Avg Hrly HTW Demand of 718 Consumers}\right)$$

$$= \left(\frac{4{,}333{,}926}{10{,}164{,}600}\right)(37{,}167)$$

$$= 15{,}847 \text{ lb/hr of HTW}$$

(cont.)

* REMAINING BLDG's include #729, 812, 802, 805, 810, 714, Tennis Bubble, New Barracks and Ammo Facility.

II B. (cont.)

TOTAL MAX. AVG. HOURLY HTW SYSTEM DEMAND = 37,167 + 15,847

= 53,014 lb/hr

To properly size the boilers a safety margin of 20% is added to the above to give ...

TOTAL MAX AVG HOURLY HTW SYSTEM DEMAND FOR SIZING BOILERS = (1.2)(53,014)

= 63,617 lb/hr

A summary of the TOTAL AVG HOURLY HTW SYSTEM demand for each month is found in the table below.

MONTH	TOT. AVG. HOURLY HTW SYSTEM DEMAND lb/hr
JAN	48,462
FEB	53,014
MARCH	41,365
APRIL	35,802
MAY	24,769
JUNE	11,154
JULY	10,106
AUG.	10,373
SEPT	15,937
OCT	25,295
NOV	38,325
DEC	36,749

II (cont.)

C. Size Boiler

From Appendix II it is noted that for every one lb. of HTW required by the buildings' load, .1686 lbs of feedwater to the Boiler is needed. Therefore @ the PEAK SYSTEM HTW DEMAND...

$$FEEDWATER_{PEAK} = (.1686)(116{,}016 \text{ lb/hr})$$

$$= 19{,}560 \text{ lb/hr}$$

Although the heat balance of Appendix II is applicable at full load only (ie. the temperature and enthalpy of the HTW return vary with load due to the bypass CV's @ the buildings' steam generators), the ratio of .1686 lbs of feedwater / lb of Building HTW load is still valid at lower boiler loads. Therefore the @ the MAXIMUM AVERAGE SYSTEM HTW DEMAND

$$FEEDWATER_{MAX.\ AVG.} = (.1686)(63{,}617 \text{ lb/hr})$$

$$= 10{,}725 \text{ lb/hr}$$

In consideration of these feedwater required flow rates the boiler size selected is ...

10,500 lb/hr * (FIRE-TUBE BOILERS)

FIRING RATES –

MAX AVG (1 Boiler) : 85 % *
PEAK (2 Boilers) : 93 %
TOTAL CAPACITY (3 Boilers) = 161 % of PEAK DEMAND

* Note that the MAX AVG DEMAND includes 20% safety margin.

STEP III CALCULATE SIZE + FEET of NEW PIPING REQUIRED

Design Criteria

1. The maximum HTW velocity to be 5 ft/sec at the PEAK SYSTEM HTW DEMAND flow rate.

2. The specific volume to be determined at the average temperature of the send-out and return lines and at a pressure of 250 psig.

$$Q = \rho A V = \frac{AV}{\nu}$$

$$A = \frac{Q\nu}{V}$$

where ...

$V = 5$ ft/sec

$\nu = .01780$ ft³/lbm @ $T = \frac{400+270}{2} = 335°F$

and $P = 250$ psig

Q = Maximum Average Hourly Demand flow rate for HTW. in lbm/hr. See Table next page for values of Q. and A.

$$A\ (in^2) = \frac{Q\ (.0178)(144)}{(5)(60)(60)} = Q \times (1.424 \times 10^{-4})$$

$T = 272$

III (cont.)

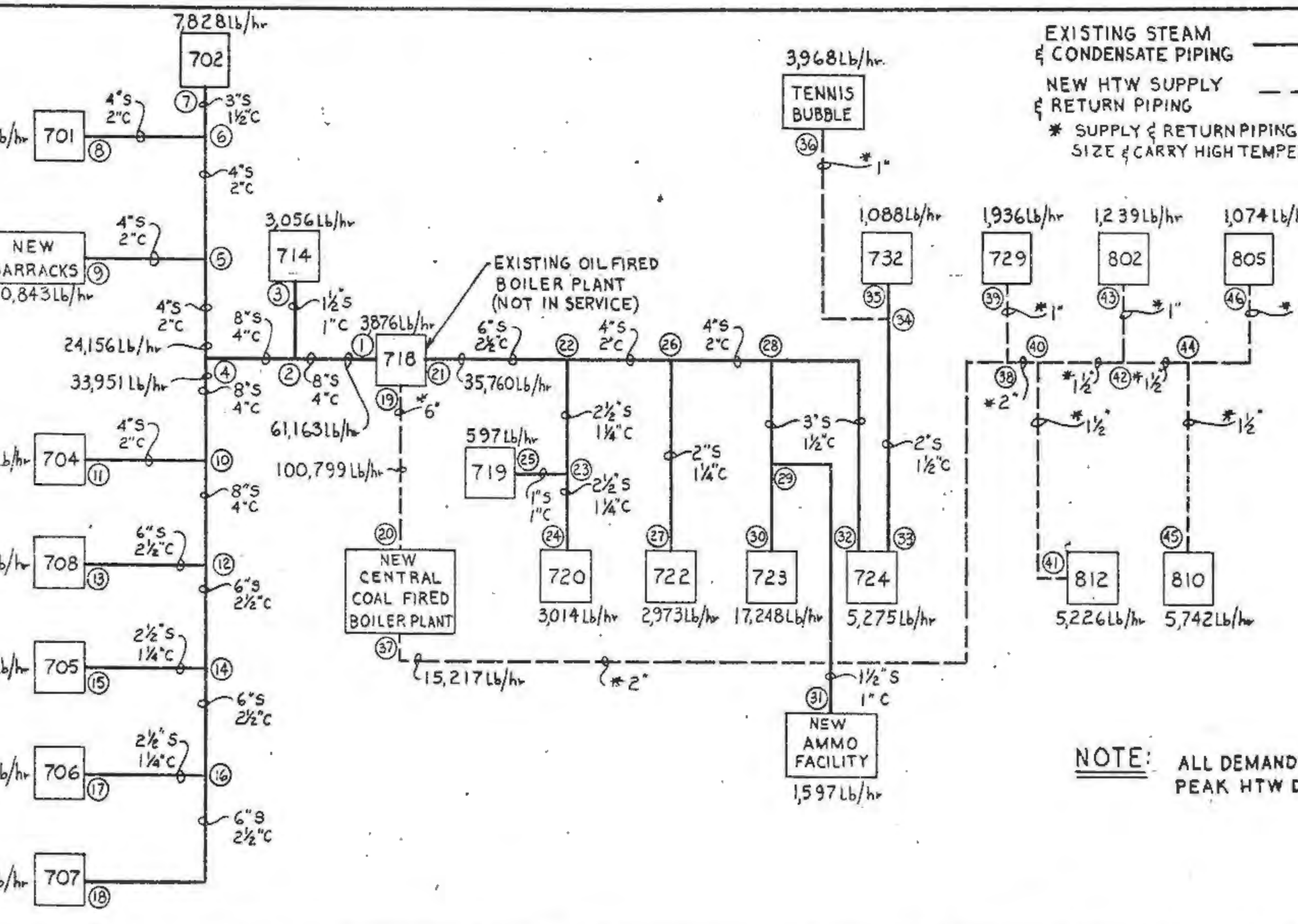
For the following table, designated Table III-1, the information contained in each column originated as follows:

Column 1: PIPE RUN - The piping branch nodes and endpoints are assigned a unique number so that each pipe run can be identified as lying between two such numbers (eg. 37-38). See the numbered piping schematic on sheet 9 to physically identify each pipe run.

Colum 2: PEAK SYSTEM HTW DEMAND - The peak heating load of each pipe run in terms of lbs/hr of HTW. See sheets 3 and 9

Colum 3: PIPE AREA - The cross-sectional area of the pipe as calculated by the equation on the preceeding page.

Column 4: PIPE SIZE - The nominal pipe size that has a cross-sectional area greater than or equal to the area listed in Column 3. Note that 2" and under is SCH 80 and 2½" and over is SCH 40. Piping is carbon steel. No distribution piping will be allowed to be less than 1" nominal size. Allowable pipe sizes are 1", 1½", 2", 2½", 3, 4" and 6". Supply and Return pipe sizes are the same for every pipe run.



REVISION	BY	APP	REFERENCE DRAWINGS

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED
JACKSONVILLE, FLORIDA

DRAWN	CHECKED	DATE
F. C. M.	BLJ	1/29/81

TITLE
SENECA ARMY DEPOT
NORTH BASE
FLOW DIAGRAM - HTW DISTRIBUTION SYSTEM

III (cont.)

TABLE III-1 NEW PIPE SIZES

PIPE RUN	PEAK SYSTEM HTW DEMAND	PIPE AREA (in^2)	NOMINAL PIPE SIZE (in)
19-20	100,799	14.354	6
37-38	15,217	2.167	2
38-39	1,936	.276	1
38-40	13,281	1.891	2
40-41	5,226	.744	1 ½
40-42	8,055	1.147	1 ½
42-43	1,239	.176	1
42-44	6,816	.971	1 ½
44-45	5,742	.818	1 ½
44-46	1,074	.153	1
34-36	3,968	.565	1

III (cont.)

NEW PIPE EXPANSION LOOPS : TABLE III-2

PIPE RUN	STRAIGHT RUN LENGTH (FT)	LOOPS PER RUN	DIMENSIONS	FEET OF PIPE/LOOP	TOTAL FT * of PIPE
19-20	300	2	12 x 6	30	360
37-38	2060	8	12 x 6	30	2300
38-39	90	1	7 x 3.5	18	108
38-40	480	2	11 x 5.5	28	536
40-41	535	2	12 x 6	30	595
40-42	240	1	11 x 5.5	28	268
42-43	95	1	7 x 3.5	18	113
42-44	85	1	7 x 3.5	18	103
44-45	95	1	7 x 3.5	18	113
44-46	310	2	9 x 4.5	23	356
34-36	220	1	11 x 5.5	28	248

* Total Ft of Pipe is for one line only. Multiply these values by two to obtain the total amount of new pipe required for both the supply and return lines.

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INCORPORATED

SUBJECT .... AEP NO. ....

DESIGNER BZJ .... SHEET 12 OF ....

CHECKER .... DATE .... DATE ....

III (cont.)

NEW PIPE SUMMARY: TABLE III-3

PIPE SIZE	TOTAL FEET REQ'D FOR BOTH LINES	TOTAL FITTINGS REQ'D* (Elbows and Tees Only)
1"	1,650	68
1½"	2,158	54
2"	5,672	90
6"	720	20

* Includes two ell's for every branch line to rise above ground.

EXISTING PIPE SUMMARY: TABLE III-4

PIPE SIZE	FEET EXISTING*
1"	407
1¼"	363
1½"	897
2"	1414
2½"	1799
3"	363
4"	1925
6"	1535
8"	770

* Straight run distance was increased by 10% to account for length of expansion loops.

III (cont.)

PIPING SYSTEM VOLUME : TABLE III-5

NEW PIPE	SCH	Ft³/Ft	PIPE LENGTH* (FT)	PIPE VOLUME (FT³)
1	80	.004995	1,650	8.24
1½	80	.012270	2,158	26.48
2	40	.023310	5,672	132.21
6	40	.200803	720	144.58
EXISTING PIPE				
1	80	.004995	407	2.03
1¼	80	.008905	363	3.23
1½	80	.012270	897	11.01
2	40	.023310	1414	32.96
2½	40	.033223	1799	59.77
3	40	.051282	363	18.62
4	40	.088496	1925	170.35
6	40	.200803	1535	308.23
8	40	.347222	770	+ 267.36

TOTAL SYSTEM VOLUME = 1185.07 ft³

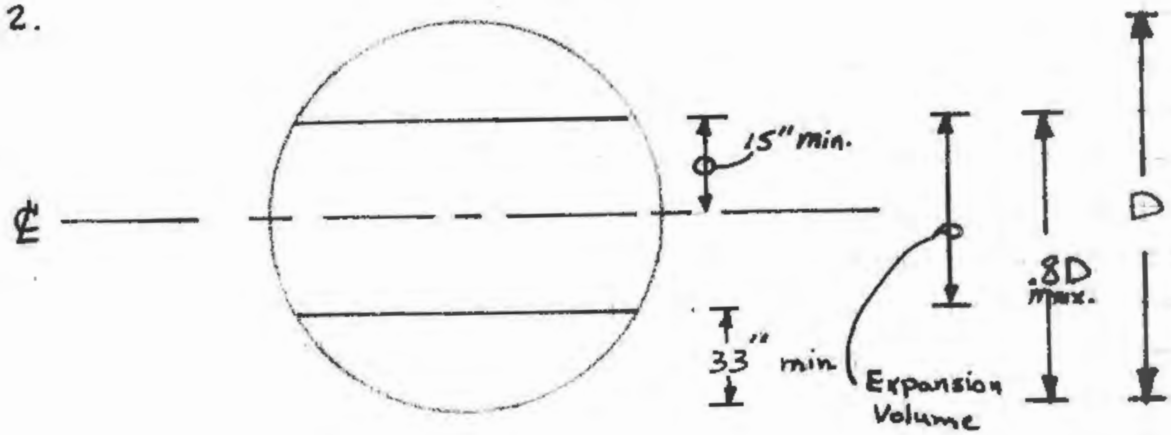
* Pipe Length shown includes both supply and return lines

STEP IV CALCULATE SIZE OF EXPANSION TANK (Direct Heater) REQ'D

Design Criteria (Per Ref)

1. Expansion Volume = 4% of the total system volume.

2.



CROSS-SECTION OF EXPANSION TANK

From Table III-5 the total system volume is 1185 ft^3, therefore

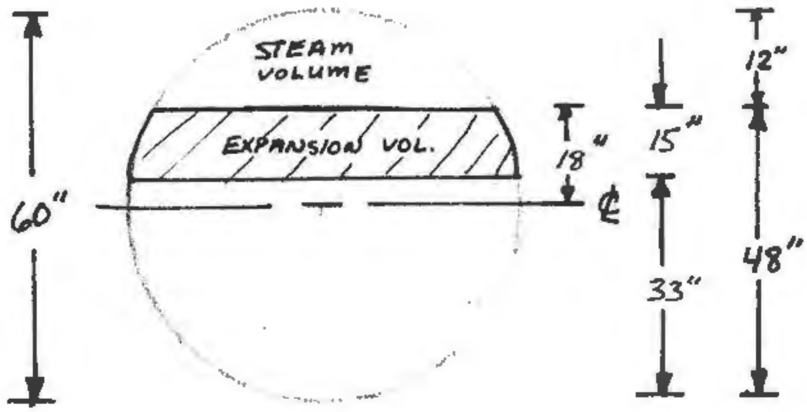
$$\text{Expansion Volume} = (.04)(1185\ ft^3)$$
$$= 47\ ft^3$$

3. The tank should not be less than 15' long in order to provide an adequate steam to water interface. (Nor more than 40').

4. Two full capacity expansion tanks are req'd: One operating and One Standby.

IV (cont.)

Tank Sizing - By trial and error a tank with a diameter of 5 ft and a length of 15 ft meets all of the design criteria as shown below:



1. Expansion Volume = (Steam and Expansion Volume) - (Steam Volume)

Using the Nomogram on the next page....

Expansion Volume = (900 - 300) gals
= 600 gals
= 80.2 ft^3

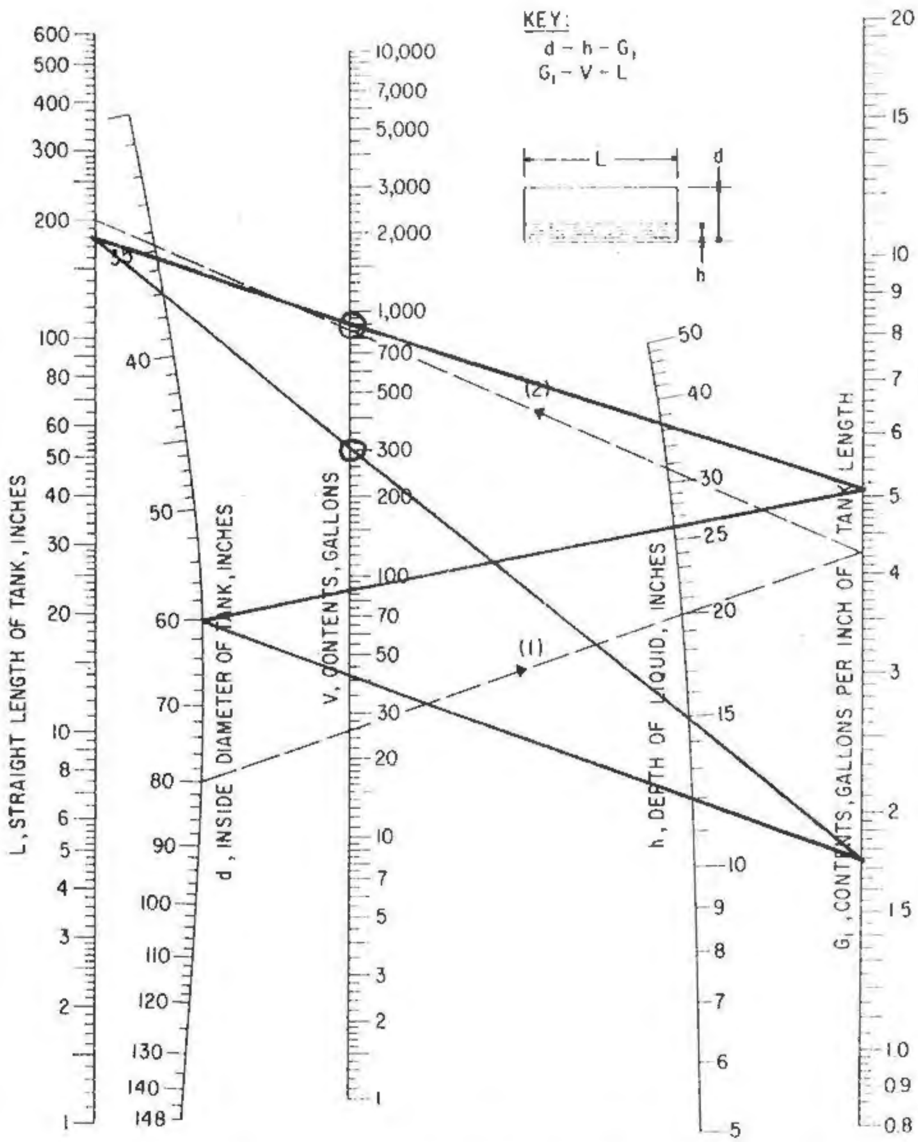
The expansion volume of 80.2 ft^3 is almost twice the volume of 4% of the distribution piping ($47 ft^3$) - allowing sufficient margin to account for the boiler volume

2. Dimensional Check

18" > 15" - OK

48" is 80% of 60 - OK

EXPANSION TANK SIZE : 5' ID x 15' Long



Find Volume of Part-Full Tank

F. Caplan,
Kaiser Engineers, Oakland, Calif.

The volume of part-full horizontal tanks, not considering head volumes, can be found using the following equation:

$$V = 0.00433\, L\left\{\frac{\pi}{8} d^2 - \left[\left(\frac{d}{2} - h\right)\sqrt{dh - h^2} + \frac{d^2}{4}\ \text{arc Sine}\left(\frac{d - 2h}{d}\right)\right]\right\}$$

where

L = Straight length of tank, in.
d = Inside diameter of tank, in.
V = Contents, gals.
h = Depth of liquid, in.

Note: For full tank capacities, multiply V for $h = d/2$ by two; for $h > d/2$, subtract the void volume from the full tank.

Example. For a tank with an ID of 80 inches, depth of liquid = 20 in., and the straight length of the tank is 200 inches, what is the liquid volume content in gallons?

Solution. Follow the arrows on the nomograph and find the volume to be [redacted] gallons.
850

Use Nomograph to Find Drive Chain Tension

Bill Sisson
Nipak, Inc., Pryor, Okla.

To avoid unnecessary slack-side tensioning of chains, the sag from a straight line should not be less than 2 to 3 percent of the horizontal distance.

tension or load in the chain on the slack side, caused by the chain weight, may be determined with the nomograph presented here. The nomograph is based on the following equations:

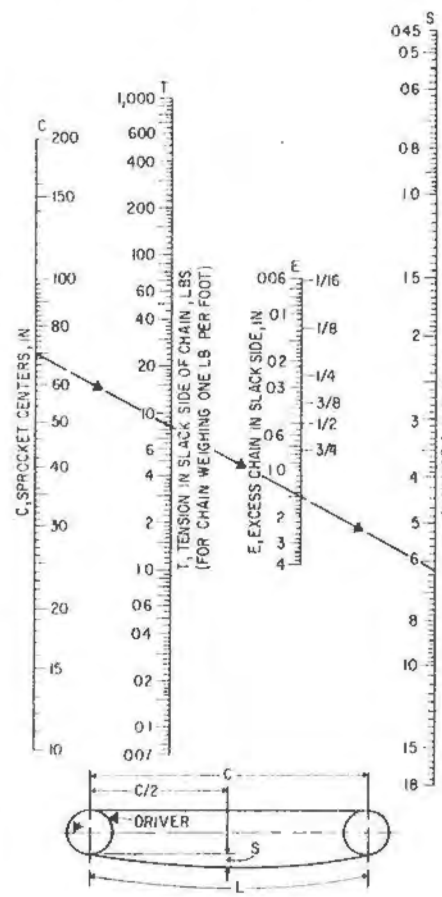
$$S = (0.375\, CE)^{1/2}$$
$$T = (C^2W)/96\, S$$

Where:

S = Sag of chain, inches.
C = Sprocket centers, inches.
E = Excess chain in slack side (Total chain length required in inches, if drawn up tight, deducted from the actual chain length to be used), (No. links x chain pitch), or $E = (L - C)$.
T = Tension in chain caused by its dead weight.
W = Weight of chain per ft.

Example. Given a chain weighing 10 lbs. per ft. and a 70-in. span with an excess length of 1.5 inches. What is the sag of the chain, the tension for a chain weighing 1.0 lbs. per ft. and for a chain weighing 10.0 lbs. per ft.?

Align 70 on C scale with 1.5 on E scale, extend a line to the S scale and read 6.3 in. sag and 8.3 lbs. tension for a chain weighing 1.0 lb. per ft. where the line crosses the T scale. Then (10.0) (8.3) = 83 lbs. for a chain weighing 10 lbs. per ft.



I-281

STEP V SIZE THE BUILDING STEAM GENERATORS AND DETERMINE THE NUMBER OF EACH SIZE REQ'D

Design Criteria

1. Steam Requirement : 15 psig, saturated
2. HTW Supply Temperature = 380°F

   HTW Return Temperature = 270°F

Assume that the...

Condensate Temperature = 240°F (10 psig sat.)

Δh BUILDING STEAM SYSTEM = $h_{STEAM} - h_{CONDENSATE}$

(h_g @ 15 psig, sat)

= 1164.1 − (208.52)

= 955.58 BTU/lbm

STEAM FLOW RATE REQ'D BY BUILDING = $\frac{\text{BUILDING HEAT LOAD in BTU/hr}}{955.58 \text{ BTU/lbm}}$

= (See Building Tabulation Next Page)

V (cont.)

UNFIRED STEAM GENERATOR CAPACITIES : TABLE V-1

BUILDING	BUILDING PEAK HEAT LOAD (BTU/hr)	15 PSIG STEAM REQ'D (lb/hr)	STANDARD CAP. STEAM GENERATOR
701	685,400	717	1,000
702	978,300	1,024	1,000
704	1,449,200	1,517	1,500
705	261,600	274	500
706	308,700	323	500
707	774,300	810	1,000
708	1,449,200	1,517	1,500
714	381,914	400	500
718	484,400	507	500
719	74,600	78	250
720	376,700	394	500
722	371,500	389	500
723	2,155,500	2,256	3,000
724	659,200	690	1,000
729	241,900	253	250
732	136,000	142	250
802	154,800	162	250
805	134,200	140	250
810	717,600	751	1,000
812	653,100	683	1,000
NEW BARRACKS	1,335,010	1,397	1,500
NEW AMO FACILITY	199,550	209	250
TENNIS BUBBLE	495,852	519	500

UNFIRED STEAM GENERATOR SUMMARY : TABLE V-7

PATTERSON-KELLEY MODEL No	* STEAM CAPACITY (lb/hr)	QTY. REQ'D.
H 245 A	250	6
H 245 B	500	7
H 305	1,000	6
H 307	1,500	3
H 369	3,000	1

* See Brochure attached.

STEP VI SIZE HTW CIRCULATING PUMPS

Design Criteria

1. The distribution piping systems can be "broken-down" into two subsystems - one being the existing piping and the other being the new piping. If the piping resistances of the two subsytems are found to be within 10%, then the two systems can be supplied off the same header. If the resistances are considerably different, then each subsystem should be supplied by a seperate set of circulating pumps.

2. The system resistance is that of the main supply and return lines only. No branch line pressure drops are included

3. The flow rate used to size the pumps will be that corresponding to the Peak HTW Demand times an 83 % diversity factor.

4. The specific volume for the HTW supply will be determined at the average of the send-out and end-of-line temperatures or (400 + 380)/2 = 390°F. The return line specific volume will be determined at 270 °F. Note that both line pressures will be assumed constant at 250 psig.

5. The Peak HTW Demand is taken from the table in Section III.

VI (cont.)

Design Criteria (cont.)

6. Since piping drawings are not available for the existing piping, the point-to-point lengths will be increased by 10% to account for expansion loop piping.

7. Both new and existing pipe lengths will be increased by 15% to account for the equivalent pipe length of fittings.

Calculation Procedure

The head loss in feet of liquid for each pipe run is calculated using the following equation and data:

$$h_L = f \frac{L_{TOT\ EQUIV.}}{D} \frac{V^2}{2g} \quad (ft)$$

where $V = 0.0509\, W v / d^2$ (ft/sec)
W = flow rate, lbm/hr
v = specific volume (ft³/lbm)
= .01849 for HTW Supply
= .01716 for HTW Return
L = Total equivalent pipe length including expansion loops and fittings
f = See table below from Crane-410
D = Inside pipe diam (ft), $g = 32.2\ ft/sec^2$

NOM. PIPE SIZE	1"	1½"	2"	2½, 3"	4"	5"	6"	8-10"
f	.023	.021	.019	.018	.017	.016	.015	.014

VI (cont.)

PIPING PRESSURE DROP : TABLE VI-1

PIPE RUN	PEAK DEMAND, lb/hr of HTW	PIPE SIZE - SCH	PIPE LENGTH, ft	HEAD LOSS, ft SUPPLY	HEAD LOSS, ft RETURN	HEAD LOSS, ft TOTAL
20-19	100,799	6,6 - 40	360	.88	.75	1.63
21-22	35,760	6,2½ - 40	195	.06	6.00	6.06
22-26	32,149	4,2 - 40	260	.61	16.59	17.20
26-28	29,176	4,2 - 40	110	.21	5.78	5.99
28-32	10,331	3,1½ - 40,80	105	.11	3.80	3.91
33-34	5,056	2,1½ - 40,80	130	.24	1.13	1.37
34-35	1,008	2,1½ - 40,80	15	.00	.01	+ .01
						34.54
1-2	61,163	8,4 - 40	65	.02	.48	.50
2-4	58,107	8,4 - 40	230	.05	1.53	+ 1.58
						2.08
4-5	24,156	4,2 - 40	70	.09	2.52	2.61
5-6	13,313	4,2 - 40	210	.09	2.30	2.39
6-8	5,485	4,2 - 40	175	.01	.32	+ .33
						5.33
4-10	33,951	8,4 - 40	170	.01	.39	.40
10-12	22,355	8,4 - 40	210	.01	.21	.22
12-14	10,759	6,2½ - 40	250	.01	.81	.82
14-16	8,666	6,2½ - 40	290	.01	.52	.53
16-18	6,196	6,2½ - 40	105	.00	.10	+ .10
						2.07
37-38	15,217	2,2 - 40	2,300	35.06	30.20	65.26
38-40	13,281	2,2 - 40	536	6.22	5.36	11.58
40-42	8,055	1½,1½ - 80	268	6.28	5.41	11.69
42-44	6,816	1½,1½ - 80	103	1.73	1.49	3.22
44-46	1,074	1,1 - 80	356	1.53	1.32	+ 2.85
						94.60

Notes

1) The pipe lengths and flow rates shown above are the base values which do not include the "adders" of the Design Criteria that were used to calculate the pressure Drop 2) The new piping runs are identified by having the same size supply and return lines.

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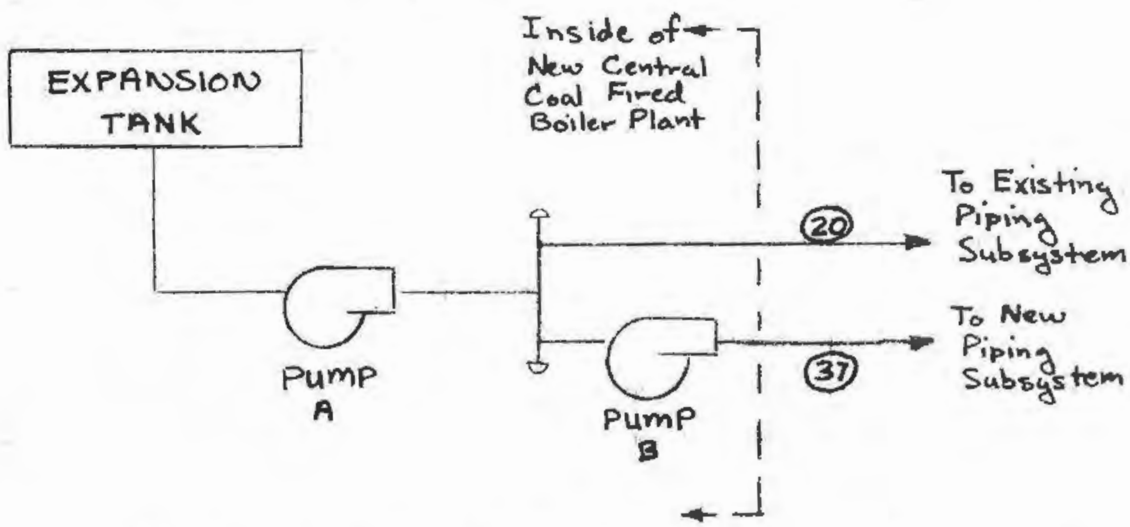
VI (cont.)

From Table VI-1 and the piping-run layout sketch on Sheet 9, it can be seen that the pipe run from point (20) to (35) with a total pressure drop of 36.17 ft (1.63+35.54) is the controlling run for the existing piping subsystem. The new piping subsystem running from point (37) to (46) has a total pressure drop of 94.60 ft. Since the pressure drops of the two subsystems are not within 10% of each other the two subsystems must be supplied by seperate pumps.

Due to the high head and low flow of the pump supplying the new piping subsystem, the following pumping arrangement is required:



Although the pumps are sized to supply 83% of the system Peak HTW Demand, they will normally operate at much smaller flows.

	DESIGN CONDITIONS		SUCTION	
PUMP	FLOW (GPM)	HEAD (ft)	PSIG	°F
A	225	40	250	400
B	30	55	261	400

VII. FUEL CONSUMPTION

A. Electrical Load for Boiler Plant (Approx Hp's)

1. Boiler Requirements

a. BTU/hr Input :

Assume Boiler Eff = 70%
Boiler Rating = 10,500 lbs/hr

$\Delta h = h_{STEAM} - h_{supply\ WATER}$ (STEAM: 250 psig sat; supply WATER: 250 psig, 400°F)

$= 1201.7 - 375.12$
$= 826.58$ BTU/lbm

$$\text{BTU/hr INPUT} = \frac{(10,500 \text{ lb/hr})(826.58 \text{ BTU/lbm})}{.70}$$

$= \underline{12.399 \times 10^6 \text{ BTU/hr}}$

b. Theoretical Air :

Coal - 12,500 BTU/lbm
30 % Volatile Matter (Dry, Ash-Free)

THEORETICAL AIR = 7.6 lbs / 10,000 BTU
per B&W

$= \underline{9,423 \text{ lbs/hr}}$

c. Total Air :

Assume 30% Excess Air

TOTAL AIR = (1.3)(9,423) = $\underline{12,250 \text{ lb/hr}}$

VII. A. (cont.)

2. Boiler Fans' Horsepower

Assume that the Total Air is divided between the boiler fans as follows:

OFA	- 15 %	=	1,838 lb/hr
FD	- 85 %	=	10,412
ID	- 100 %	=	12,250

a. OFA FAN:

Assume: ΔP = 15 "wg
Inlet Air Temp = 60°F
Flow Safety Factor = 1.2
Fan Eff = 67.5 %
Motor Eff = 81 %
Service Factor = 1.15

ρ_{AIR} = .0764 lb/ft³ @ 60°F

$$\text{Flow} = \frac{(1,838\ \text{lb/hr})(1.2)}{(.0764)} = 28,869\ \text{ft}^3/\text{hr}$$

$$\text{Fan Hp} = \frac{.0158 \times \text{cfm} \times \text{in.wg}}{\eta_{FAN\,(\%)}} \quad (B+W)$$

$$= \frac{(.0158)(28,869)(15)}{(67.5)(60)}$$

$$= 1.69$$

$$\text{Motor Hp}_{OFA} = \frac{(1.69)(1.15)}{.81} = 2.40 \Rightarrow 3$$

VII A.2. (cont.)

b. FD FAN:

Same assumptions as for OFA Fan except
Motor Eff = .85
ρ_{AIR} = .0764 lb/ft³

$$\text{Flow} = \frac{(10{,}412)(1.2)}{.0764} = 163{,}539 \text{ ft}^3/\text{hr}$$

$$\text{Fan Hp} = \frac{(.0158)(163{,}539)(15)}{(67.5)(60)} = 9.57$$

$$\text{Motor Hp} = \frac{(9.57)(1.15)}{.85} = 12.95$$

Motor Hp FD = 15

c. ID FAN:

Assume ΔP = 20" wg
Inlet Air Temp = 350°F
Flow Safety Factor = 1.2
Fan Efficiency = 67.5%
Motor Efficiency = 90%
Service Factor = 1.15

ρ_{AIR} = .049 lbm/ft³ @ 350°F

$$\text{Flow} = \frac{(12{,}250)(1.2)}{.049} = 300{,}000 \text{ ft}^3/\text{hr}$$

$$\text{Fan Hp} = \frac{(.0158)(300{,}000)(20)}{(67.5)(60)} = 23.41$$

VII A. 2. b. (cont)

$$\text{Motor Hp} = \frac{(23.41)(1.15)}{.90} = 29.91$$

Motor Hp = 30
ID

3. Boiler Feed Pump Horsepower:

Flow = 10,500 lb/hr

Head = 30 ft (assumption)

Temperature = 400 °F
Pressure = 250 psig
} ⇒ $v = .01863\ ft^3/lbm$

$$\text{Gpm} = \frac{(10{,}500\ \text{lb/hr})(.01863\ \text{ft}^3/\text{lb})(7.48\ \text{gal/ft}^3)}{(60\ \text{min/hr})} = 24.4$$

Assume: Pump Eff = 60%
Motor Eff = 81%
Service Factor = 1.15

$$\text{Pump BHP} = \frac{\text{GPm} \times H \times \text{spec. grav}}{3960 \times \eta_{pump}}$$

$$= \frac{(24.4)(30)(.8594)}{(3960)(.6)}$$

$$= .26$$

$$\text{Motor Hp} = \frac{(.26)(1.15)}{.81} = .37$$

Motor Hp = ½
BFP

VII A. (cont.)

4. Circulating Water Pumps' Horsepower

Referring to the sketch on Sheet 22 the Design Horsepowers of Pumps A and B are given in the I-R telecon as follows

a. Pump "A": 225 GPM, 40 ft, 66 % eff, 2.96 BHP } Per telecon

$$\text{Motor Hp} = \frac{(2.96)(1.15)}{.81} = 4.2$$

Pump A Motor Hp	= 5

b. Pump "B": 30 gpm, 55 ft, 44 % eff, .81 BHP } Per telecon

$$\text{Motor Hp} = \frac{(.81)(1.15)}{.81} = 1.15$$

Pump B Motor Hp	= 1½

VII A. (cont.)

5. Coal and Ash Handling Equipment Horsepower's

Assume the following horsepowers:

Bucket Elevator	15	Total of 1 ea. for boiler plant
Drag Chain Conveyor	10	
Screw Conveyor	5	
Boiler Coal Feeder	7½	1 ea. per boiler
Ash Discharge Screw	5	

6. Installed Horsepower

EQUIPMENT	QTY REQ'D for 3 Boilers	MOTOR HP EACH	INSTALLED HP
OFA Fan	3	3	9
FD Fan	3	15	45
ID Fan	3	30	90
BFP	6	½	3
CIRC. PUMPS			
"A"	2	5	10
"B"	2	1½	3
Bucket Elev.	1	15	15
Drag Chain	1	10	10
Screw Conveyor	1	5	5
Coal Feeder	3	7½	22.5
Ash Screw	3	5	15

Total Installed HP = 227.5

VII A. (cont.)

7. Operating Horsepower Per Boiler:

EQUIPMENT	MOTOR HP @ Rated Boiler Cap.
OFA Fan	3
ID Fan	30
FD Fan	15
BFP	½
Bucket Elev	15
Drag Chain	10
Screw Conveyor	5
Coal Feeder	7½
Ash Screw	5

Assume these operate continuously. (Bucket Elev, Drag Chain, Screw Conveyor)

Total HP per Boiler* = 91
= 67.86 kw

* Add the Motor Horsepower of the HTW Circulating Pumps (6½ Hp for both pumps). The same horsepower is reqd for these pumps no matter how many boilers are operating. Therefore the total kw load of one boiler is 72.7 and the kw load for two boilers is 118.2

8. Boiler Plant Electrical Consumption:

The annual Boiler Plant Electrical Consumption is calculated by summing the KWH's required for each month. The KWH values are calculated assuming the following:

% BOILER LOAD	% BOILER PLANT KW LOAD	BOILER PLNT KW
0-25%	67	48.7
25-50%	80	58.2
50-100%	100	72.7

(cont.)

VII A 8. (cont.)

$$\% \text{ Boiler Load} = \frac{\left(\text{TOT. AVG. HRLY HTW SYS DEMAND}\right)(.1686)}{10{,}500}$$

where ...

TOT AVG HRLY HTW SYS. DEMAND is taken from Section II B. and is in lb/hr

.1686 = lbs of Boiler Feedwater per lb of HTW supply (See Heat Balance in Appendix II.)

10,500 = Boiler Rated Capacity

MONTH	TOT AVG. HRLY HTW SYS DEM.	% BOILER LOAD	Corresponding Plant Load (kw)	MONTHLY BOILER PLANT ELECTRICAL CONSUMPTION (KWH)
JAN	48,462	78	72.7	54,089
FEB	53,014	85	72.7	50,599
MARCH	41,365	66	72.7	54,089
APRIL	35,802	57	72.7	52,344
MAY	24,769	40	58.2	43,301
JUNE	11,154	18	48.7	35,064
JULY	10,106	16	48.7	36,233
AUG.	10,373	17	48.7	36,233
SEPT	15,937	26	58.2	41,904
OCT	25,295	41	58.2	43,301
NOV	38,325	62	72.7	52,344
DEC	36,749	59	72.7	+ 54,089

TOTAL AVERAGE BOILER PLANT KWH CONSUMPTION PER YEAR = 661,768

VII B. CALCULATE COAL CONSUMPTION

The tons of coal req'd per year is calculated by comparing the heat input req'd for the HTW system to that req'd for a typical steam/condensate system. This ratio is then multiplied by the number of tons per year req'd by the typical condensate system

$\Delta h_{\text{HTW @ BLDG's}} = 371 - 239 = 132$ BTU/lbm

371: Assume a 3.5° temp drop in supply line per Ref 1, p-97

239: @ 270°F

$\Delta h_{\text{STEAM/COND @ BLDG's}} = 1179 - 219 = 960$ BTU/lbm

1179: 50 PSIG sat stm

219: 15 psig sat wtr

For each 10,000 BTU/hr of BLDG LOAD:

HTW Req'd = 75.758 lb/hr
STEAM Req'd = 10.417 lb/hr
} at BLDG's

$$\frac{\text{lbs of feedwater}}{\text{lb of HTW Supply}} = 0.1686 \quad \text{(See App 2)}$$

$$\frac{\text{lbs of feedwater}}{\text{lb of STEAM}} = 1.0525$$

$$\text{RATIO of HEAT INPUT TO BOILER} = \frac{[(75.758)(.1686)]\,[1202 - 375 \tfrac{BTU}{lbm}]}{[(10.417)(1.0525)]\,[1179 - 196 \tfrac{BTU}{lbm}]}$$

$$= 0.98$$

VII B (cont)

The ratio assumes the same Boiler efficiency for the STEAM/COND. SYS as for the HTW system and the same coal BTU content.

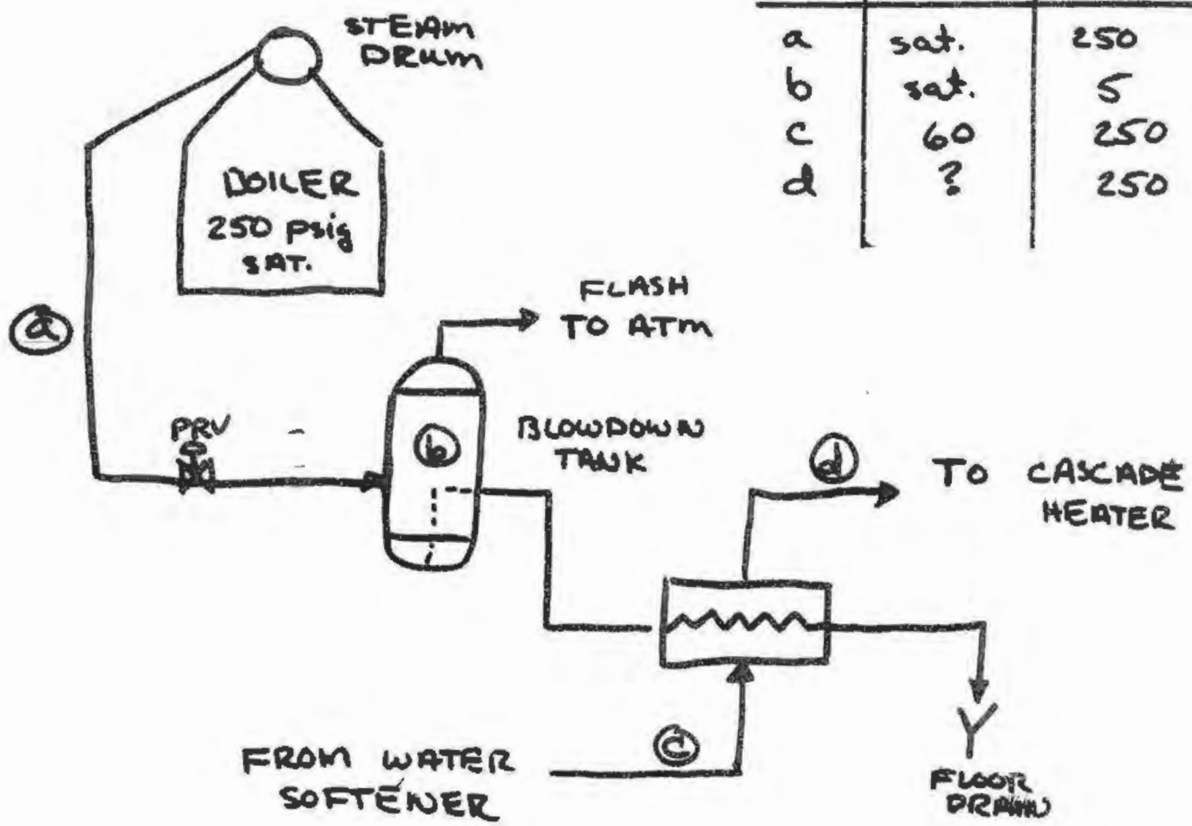
TONS of COAL REQ'D FOR HTW SYSTEM = (.98)(1295 tons/yr)

= 1269 tons/yr

HEAT BALANCE - PART "A"

The enthalpy of the make-up water introduced to the Cascade Heater is calculated as follows:

POINT	°F	PSIG
a	sat.	250
b	sat.	5
c	60	250
d	?	250



Assume the following:

1) Continuous blowdown

2) Blowdown Rate = Make-up Water Flow Rate

3) Make-up Water Temperature = 60°F

4) Blowdown Tank Back Pressure = 5 psig

5) Heat Exchanger Approach Temp = 10°

PART "A" (cont.)

$$\% \text{ FLASH} = \frac{h_{f_{(a)}} - h_{f_{(b)}}}{h_{fg_{(b)}}} = \frac{382-196}{960} = .194$$

Mass Balances:

$$\dot{m}_a = \dot{m}_b$$

$$\dot{m}_b = (1-.194)\ \dot{m}_c$$
$$= 0.806\ \dot{m}_c$$

Heat Balance

$$\dot{m}_b\ c_p\ \Delta T_b = \dot{m}_c\ c_p\ \Delta T_c$$

Substituting in for $\dot{m}_b$ gives...

$$.806\ \dot{m}_c\ c_p\ \Delta T_b = \dot{m}_c\ c_p\ \Delta T_c$$

$$.806\ \Delta T_b = \Delta T_c$$

$$.806\ (T_d - 60) = 228 - (T_d + 10)$$

$$.806 T_d - 48.375 = 218 - T$$

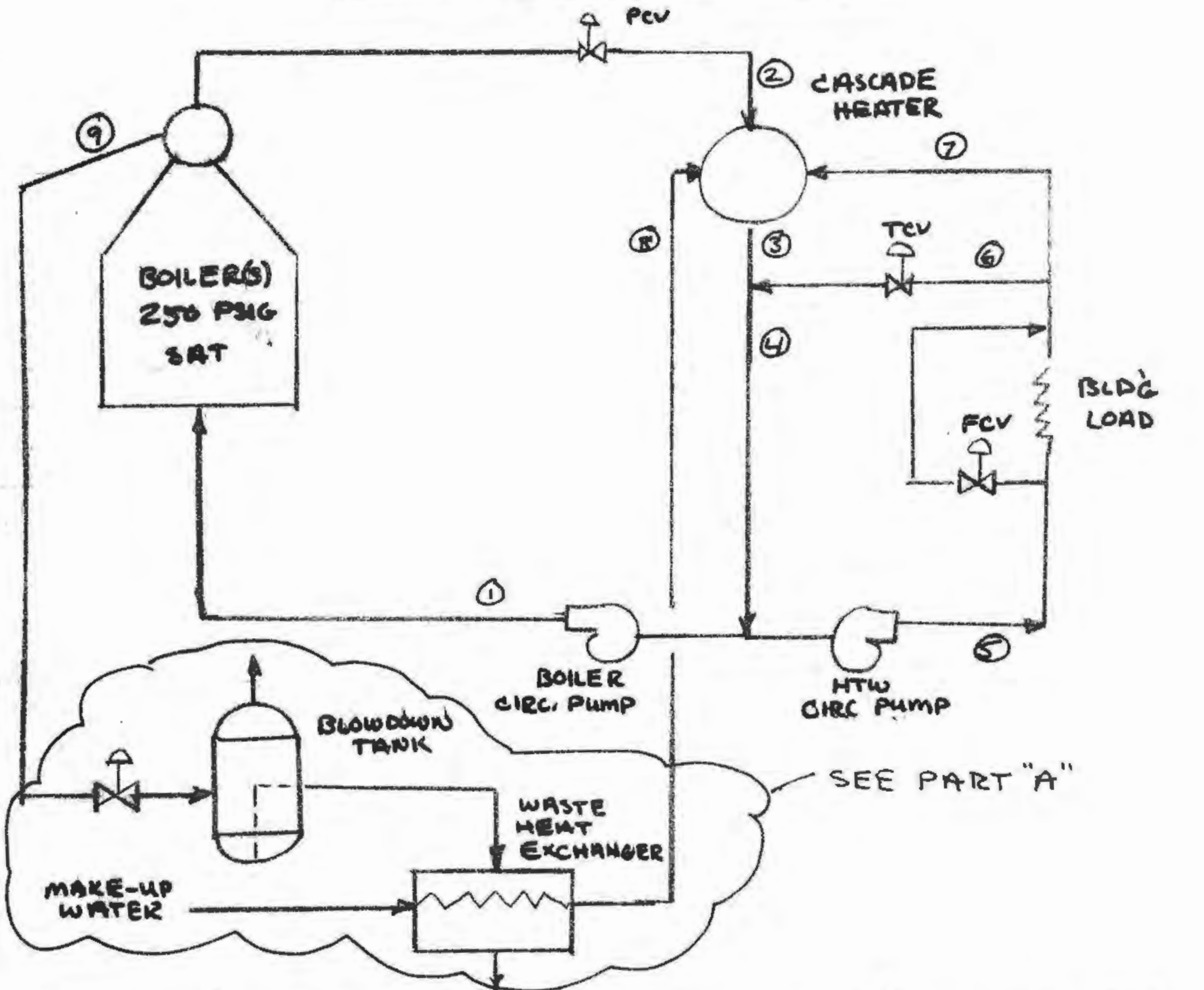
$$1.806\ T_d = 218 + 48.375$$

$$T_d = 147.5$$

$$\therefore h_d\ @\ 147.5°F \approx 147.5 - 32$$

$$= 115\ \text{BTU/lbm}$$

HEAT BALANCE PART "B"



POINT	TEMP. (°F)	PRESSURE (PSIG)	ENTHALPY BTU/lbm
1	400	265	375
2	sat stm	250	1202
3	sat wtr	250	382
4	400	265	375
5	400	300	375
6	267	250	236
7	267	250	236
8	147	250	115 (FROM PART A)
9	sat wtr	250	382

Assume the following:

1) Normal Blowdown = 1/4 % Rated Load (continuously)
2) Building Bypass does not effect boiler load
   Note that the values tabulated on the previous page are for a bypass flow equal to zero (ie. the temp @ ⑥ and ⑦ is 267°F)
3) Negligible make-up water DA Load

MASS BALANCES (Note $m = \dot{m}$)

$$m_1 = m_2 + m_9$$

$$m_3 = m_2 + m_8 + m_7$$

$$m_4 = m_3 + m_6$$

$$m_4 = m_1 + m_5$$

$$m_6 = m_5 - m_7$$

$$m_8 = m_9 = \text{constant}$$

HEAT BALANCES

ⓐ $m_2 h_2 + m_2 h_8 + m_7 h_7 - m_3 h_3 = 0$

ⓑ $m_3 h_3 + m_6 h_6 - m_4 h_4 = 0$

Get ⓐ and ⓑ in terms of m_3, m_5, m_7 and m_9

$$m_2 = m_1 - m_9$$

$$m_1 = m_4 - m_5$$
$$m_5 = m_6 + m_7$$
$$m_4 = m_3 + m_6$$
$$m_1 = m_3 + m_6 - m_6 - m_7$$
$$m_1 = m_3 - m_7$$

$$\underline{m_2 = m_3 - m_7 - m_9}$$

$$m_4 = m_3 + m_6$$
$$m_6 = m_5 - m_7$$
$$\underline{m_4 = m_3 + m_5 - m_7}$$

$$\underline{m_6 = m_5 - m_7}$$

$$m_8 = m_9$$

Substituting for m_2 and m_8 in ⓐ and m_6 and m_4 in ⓑ gives ⓐ′ and ⓑ′

ⓐ′ $(m_3 - m_7 - m_9) h_2 + m_7 h_7 + m_9 h_8 - m_3 h_3 = 0$

ⓐ′ $m_3(h_2 - h_3) + m_7(h_7 - h_2) + m_9(h_8 - h_2) = 0$

ⓑ′ $m_3 h_3 + (m_5 - m_7) h_6 - (m_3 + m_5 - m_7) h_4 = 0$

ⓑ′ $m_3(h_3 - h_4) + m_5(h_6 - h_4) + m_7(h_4 - h_6) = 0$

Solving ⓑ′ for m_3 gives ...

$$m_3 = \frac{m_5(h_4 - h_6) + m_7(h_6 - h_4)}{h_3 - h_4}$$

Substiting this value of m_3 into ⓐ' gives

$$\left[\frac{m_5(h_4-h_6)+m_7(h_6-h_4)}{h_3-h_4}\right](h_2-h_3)+m_7(h_7-h_2)+m_9(h_8-h_2)=0$$

Substituting in for the known enthalpies gives

$$\left[\frac{m_5(375-236)+m_7(236-375)}{382-375}\right](1202-382)+m_7(236-1202)+m_9(115-1202)=0$$

$$\left[\frac{139\,m_5-139\,m_7}{7}\right]820-966\,m_7-1087\,m_9=0$$

$$16{,}283\,m_5-16{,}283\,m_7-966\,m_7-1{,}087\,m_9=0$$

$$16{,}283\,m_5-17{,}249\,m_7-1{,}087\,m_9=0$$

$$m_7=\frac{16{,}283\,m_5-1087\,m_9}{17{,}249}$$

$$\boxed{m_7=.9440\,m_5-.0630\,m_9}$$

$$m_3=(m_5-m_7)\frac{(h_4-h_6)}{h_3-h_4}$$

$$m_3=(m_5-m_7)\frac{(375-236)}{382-375}$$

$$\boxed{m_3=19.8571\,(m_5-m_7)}$$

FOR m_5 =	16,016 lb/hr (PEAK)	63,617 lb/hr (MAX AVG)
No. of Boilers Req'd =	2	1
m_9 = (Boilers)(.0025)(10,500) =	52	26
m_1 (lb/hr)	19,555	10,718
m_2	19,503	10,692
m_3	129,071	70,771
m_4	135,571	74,335
m_5	116,016	63,617
m_6	6,500	3,564
m_7	109,516	60,053
m_8	52	26
m_9	52	26
m_1/m_5	.1686	.1685

1. INCREMENTAL COST FOR ADDING Bldg's # 729, 802, 805, 810 AND 812 TO THE EXISTING STEAM DISTRIBUTION SYSTEM = $ 535,636

Fuel Savings which would result from adding these bldgs to the coal fired steam system would be $ 18,112 / YR

$$\text{Payback} = \frac{535{,}636}{18{,}112} = 29.6 \text{ yrs}$$

∴ These buildings ARE TO become part of the base case

2. INCREMENTAL COST FOR ADDING Bldg # 816 TO THE SYSTEM DESCRIBED ABOVE = $ 479,178

Fuel SAVINGS which would result from adding this bldg to the coal fired steam system would be $ 10,565 / YR

$$\text{Payback} = \frac{479{,}178}{10{,}565} = 45.4 \text{ yrs}$$

∴ Bldg # 816 will no longer be considered

FUEL SAVINGS

No. 2 FUEL OIL

$$\left(\frac{\$0.9675}{gal}\right)\left(\frac{gal}{138,700\,Btu}\right)\left(\frac{10^6\,Btu}{MBtu}\right) = \$6.98 / MBtu$$

COAL

$$\left(\frac{\$60}{ton}\right)\left(\frac{ton}{2000\,lb}\right)\left(\frac{lb}{12,500\,Btu}\right)\left(\frac{10^6\,Btu}{MBtu}\right) = \$2.40 / MBtu$$

∴ In 1980 costs fuel saving (burning coal rather than No. 2 fuel oil) is \$4.58 / MBtu

Buildings No. 729, 802, 805, 810, and 812 are all possible candidates for being tied into coal plant

TOTAL ANNUAL NO. 2 USAGE =

BLDG.	GALLONS
729	5000
802	3200
805	3700
810	17,800
812	13,500
	43,200 gals

Set back will save 34% of this

∴ After setback = (1-0.34)(43,200) = 28,512 gals

$$\left(\frac{28,512\,gal}{yr}\right)\left(\frac{138,700\,Btu}{gal}\right)\left(\frac{MBtu}{10^6\,Btu}\right)\left(\frac{\$4.58}{MBtu}\right) = \$18,112 / yr.$$

Bldg. 815, 816

TOTAL No 2 F.O. = 0.66 (25,200) = 16,632 gallons

→ \$10,565 / yr.

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COST ESTIMATE - MAIN STEAM & CONDENSATE PIPING - CENTRAL PLANT TO BUILDING 805 (No 816)

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OUTSIDE OF EXCLUSION AREA							
4" buried conduit (sch 40)	2696	Ft	14.82	39955	30.00	80880	120835
1½" buried conduit (sch 80)	2546	Ft	12.12	30858	20.25	51557	82415
4" elbows	42	EA	148.20	6224	210.00	8820	15044
1½" elbows	30	EA	121.20	3636	110.00	3300	6936
EXCAVATION & BACKFILL	2696	Ft	6.32	17039	–	–	17039
INSIDE EXCLUSION AREA							
4" sch 40 buried conduit	524	Ft	29.64	15531	30.00	15720	31251
2" sch 40 buried conduit	338	Ft	25.84	8734	19.50	6591	15325
2" elbows	12	EA	258.40	3101	134.00	1608	4709
1½" sch 80 buried conduit	150	Ft	24.24	3636	20.25	3038	6674
1" sch 80 buried conduit	688	Ft	24.24	16677	18.00	12384	29061
1" elbows	16	EA	242.40	3878	104.00	1664	5542
EXCAVATION & backfill	862	Ft	12.64	10896	–	–	10896
SUB-TOTAL				160165		185562	345727
LINE TO BLDG 729	SEE APPL. SHEETS			4815		5492	10307
LINE TO BLDG 802	↓	↓	↓	9630		5492	15122
LINE TO BLDG 812				41483		27542	69025
LINE TO BLDG 810				9902		5553	15455
SUB-TOTAL				225995		229641	455636
PORTION OF BOILER PLANT REQUIRED FOR THIS OPTION							80,000
TOTAL							$535,636

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

CONSTRUCTION COST ESTIMATE

PROJECT
ENERGY ENGINEERING ANALYSIS

LOCATION COST ESTIMATE - MAIN STEAM & CONDENSATE PIPING - CENTRAL PLANT TO BUILDING 816

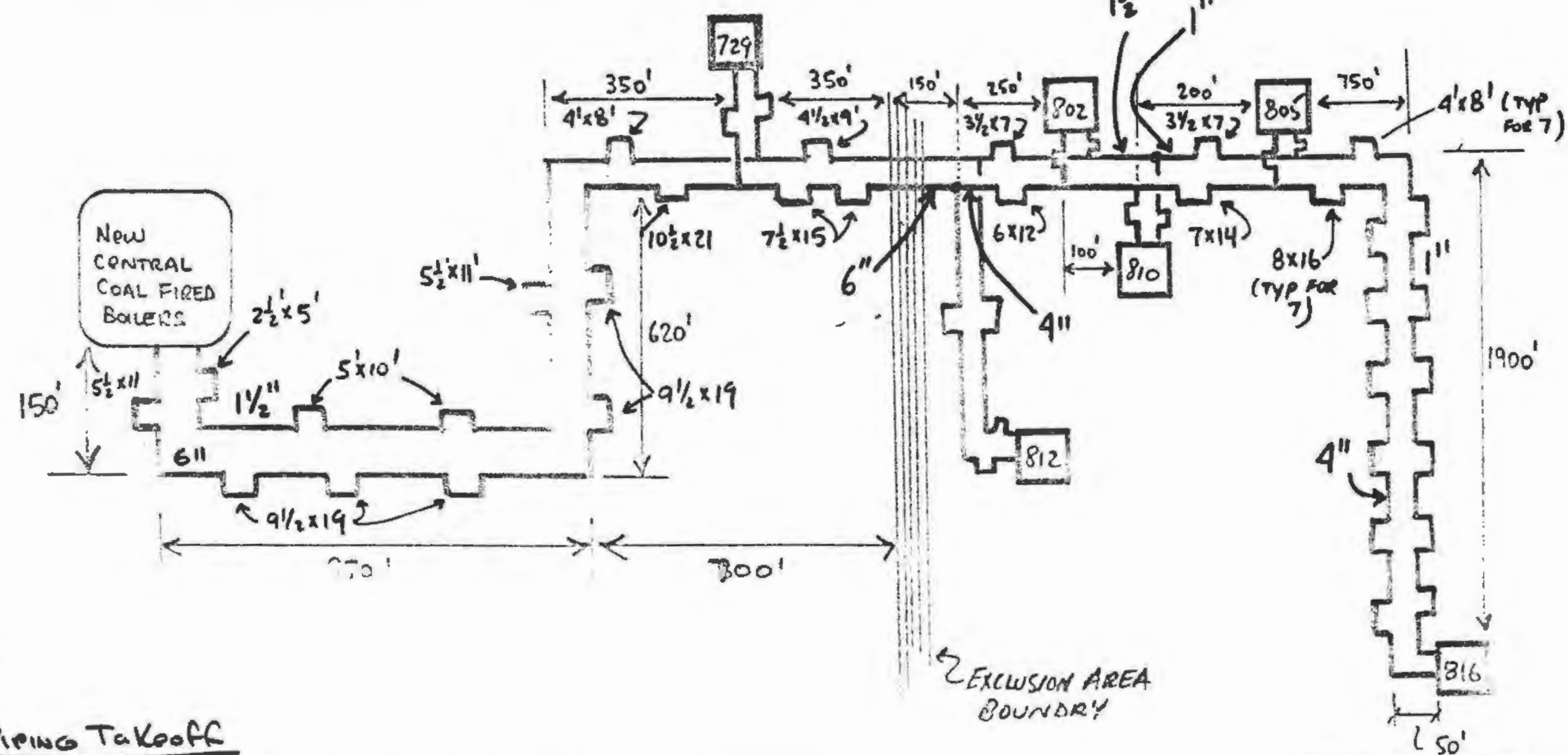
ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OUTSIDE OF EXCLUSION AREA							
6" sch 40 buried conduit	2754	Ft	17.70	48746	45.00	123930	172676
6" elbows	42	EA	177.00	7434	260.00	10920	18354
1½" sch 80 buried conduit	2546	Ft	12.12	30858	20.25	51557	82415
1½" elbows	30	EA	121.20	3636	110.00	3300	6936
EXCAVATION & BACKFILL	2754	Ft	6.32	17405	—	—	17405
INSIDE EXCLUSION AREA							
6" sch 40 buried conduit	150	Ft	35.40	5310	45.00	6750	12060
4" sch 40 buried conduit	3250	Ft	29.64	96330	30.00	97500	193830
4" loop piping	276	Ft	29.64	8181	30.00	8280	16461
4" elbows	44	EA	296.40	13042	210.00	9240	22282
1½" sch 80 buried conduit	514	Ft	24.24	12459	20.25	10409	22868
1½" elbows	4	EA	242.40	970	110.00	440	1410
1" sch 80 buried conduit	3026	Ft	24.24	73350	18.00	54468	127818
1" elbows	36	EA	242.40	8726	104.00	3744	12470
EXCAVATION & BACKFILL	3676	Ft	12.64	46465	—	—	46465
SUB-TOTAL				372912		380538	753450
LINE TO BLDG 729	SEE APPL. SHEETS	↓	↓	4815		5492	10307
LINE TO BLDG 802	↓	↓	↓	9630		5492	15122
LINE TO BLDG 812	↓	↓	↓	41483		27542	69025
LINE TO BLDG 810	↓	↓	↓	9902		5553	15455
LINE TO BLD 805	↓	↓	↓	9902		5553	15455
SUB-TOTAL				448644		430170	878814
PORTION OF BOILER PLANT REQUIRED FOR THIS OPTION							136,000
TOTAL							$1,014,814

ENG FORM 150
1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

T-308



Piping Takeoff

Outside exclusion area

6" pipe 2440' plus
1 lp @ 22
5 lp @ 38
1 lp @ 42
2 lp @ 30
= 314'

6" pipe = 2754'

6" elbows 4 x lp + 6

42 6" elbows

1½" pipe 2440' plus
1 lp @ 10
2 lp @ 20
1 lp @ 22
1 lp @ 16
1 lp @ 18
= 106'

1½" pipe 2546'

1½" elbows 4 x lp + 6

30 1½" elbows

6" els (0), 4" els (4 x Lp + 4) (44)

Inside exclusion area

1½" els (4)
1" els (36)

6" pipe 150'

4" pipe 3250' plus
1 Lp @ 24
1 lp @ 28
7 lp @ 32
= 276'

4" pipe 3526'

1½" pipe 500' plus
1 Lp @ 14

1½" pipe 514'

1" pipe 2900' plus
1 Lp @ 14
7 Lp @ 16

1" pipe 3026'

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COST ESTIMATE - ANCILLARY BUILDINGS NEAR EXCLUSION AREA (OR INSIDE E-A)

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BUILDING 729							
1½" sch 80 Conduit	110	Ft	12.12	1333	20.25	2228	3561
1½" elbows	6	EA	121.20	727	110.00	660	1387
1" sch 80 Conduit	110	Ft	12.12	1333	18.00	1980	3313
1" elbows	6	EA	121.20	727	104.00	624	1351
EXCAVATION & BACKFill	110	Ft	6.32	695	—	—	695
* TOTAL				4815		5492	10307
BUILDING 802							
1½" sch 80 CONDUIT	110	Ft	24.24	2666	20.25	2228	4894
1½" elbows	6	EA	242.40	1454	110.00	660	2114
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & BACKFILL	110	Ft	12.64	1390	—	—	1390
* TOTAL				9630		5492	15122
BUILDING 810							
2" sch 40 Conduit	110	Ft	25.84	2842	19.50	2145	4987
2" elbows	6	EA	258.40	1550	134.00	804	2354
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & backfill	110	Ft	12.64	1390	—	—	1390
* TOTAL				9902		5553	15455

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: COST ESTIMATE - ANCILLARY BUILDINGS IN EXCLUSION AREA

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BUILDING 812							
2½" sch 40 CONDUIT	568	Ft	27.62	15688	26.25	14910	30598
2½" elbows	10	EA	276.20	2762	162.00	1620	4382
1" sch 80 Conduit	554	Ft	24.24	13429	18.00	9972	23401
1" elbows	10	EA	242.40	2424	104.00	1040	3464
EXCAVATION & backfill	568	Ft	12.64	7180	—	—	7180
* TOTAL				41483		27542	69025
BUILDING 805							
2" sch 40 Conduit	110	Ft	25.84	2842	19.50	2145	4987
2" elbows	6	EA	258.40	1550	134.00	804	2354
1" sch 80 Conduit	110	Ft	24.24	2666	18.00	1980	4646
1" elbows	6	EA	242.40	1454	104.00	624	2078
EXCAVATION & backfill	110	Ft	12.64	1390	—	—	1390
* TOTAL				9902		5553	15455

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

LABOR COSTS

ASSUME PRODUCTIVITY IN EXCLUSION AREA = 1/2 OF NORMAL level of productivity

6" buried conduit ; normal labor = 0,774 MAN-HRS/FT

4" buried conduit ; normal labor = 0,648 MAN-HRS/FT

2" buried conduit ; normal labor = 0,565 MAN-HRS/FT

1½" buried conduit ; normal labor = 0,53 MAN-HRS/FT

1" buried conduit ; normal labor = 0,53 MAN-HRS/FT

2½" buried conduit ; normal labor = 0,604 MAN-HRS/FT

LABOR RATE = $ 22,87 /HR

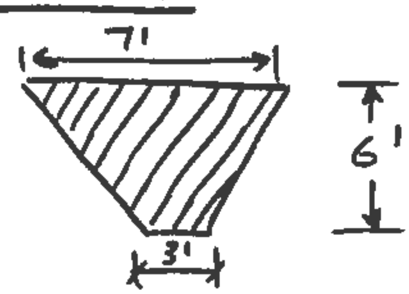
6" CONDUIT :	INSIDE EXCLUSION AREA	$ 35,40/Ft
	OUTSIDE AREA	$ 17.70/Ft
4" CONDUIT :	INSIDE AREA	$ 29,64/Ft
	OUTSIDE AREA	$ 14,82/Ft
1½" OR 1" CONDUIT :	INSIDE AREA	$ 24.24/Ft
	OUTSIDE AREA	$ 12,12/Ft
2" CONDUIT :	INSIDE AREA	$ 25,84/Ft
	OUTSIDE AREA	$ 12,92/Ft
2½" CONDUIT :	INSIDE AREA	$ 27,62
	OUTSIDE AREA	$ 13,81

Assume Labor Req'd for Elbows equal to 10 Ft of same size pipe

6" elbows	INSIDE EXCLUSION AREA	$ 354.00
	OUTSIDE AREA	$ 177.00
4" elbows	INSIDE AREA	$ 296.40
	OUTSIDE AREA	$ 148.20
2½" elbows	INSIDE AREA $ 276.20	
	OUTSIDE AREA $ 138.10	
1½" elbows / **1" elbows**	INSIDE AREA	$ 242.40
	OUTSIDE AREA	$ 121.20
2" elbows	INSIDE AREA	$ 258.40
	OUTSIDE AREA	$ 129.20

EXCAVATION & BACKFILL

TRENCH REQ'D



Normal labor = 0.039 MAN-HRS / Ft

Cost = $162/MAN-HOUR

INSIDE EXCLUSION AREA $ 12.64/Ft
OUTSIDE AREA $ 6.32/Ft

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122

Local X L.D. ______ Placed ✓ Rec'd ______ Date 12/12/80

ANDY LAKE Conversed with WES SHAVER

Of SHAVER PIPE & SUC Regarding CROWIL

PRICES FOR BLACK STEEL, FOB SENECA

Ø	COST/FT
8	55.50
6	45
4	30
3	27.75
2½	26.25
2	19.00
1½	20.25
1	18.00

(ADD 5% FOR GALVANIZED STEEL)

90° ELS

Ø	COST/Ø
8	327
6	260
4	210
3½	178
2½	152
2	134
1½	110
1	104

[illegible] SOIL [illegible] —

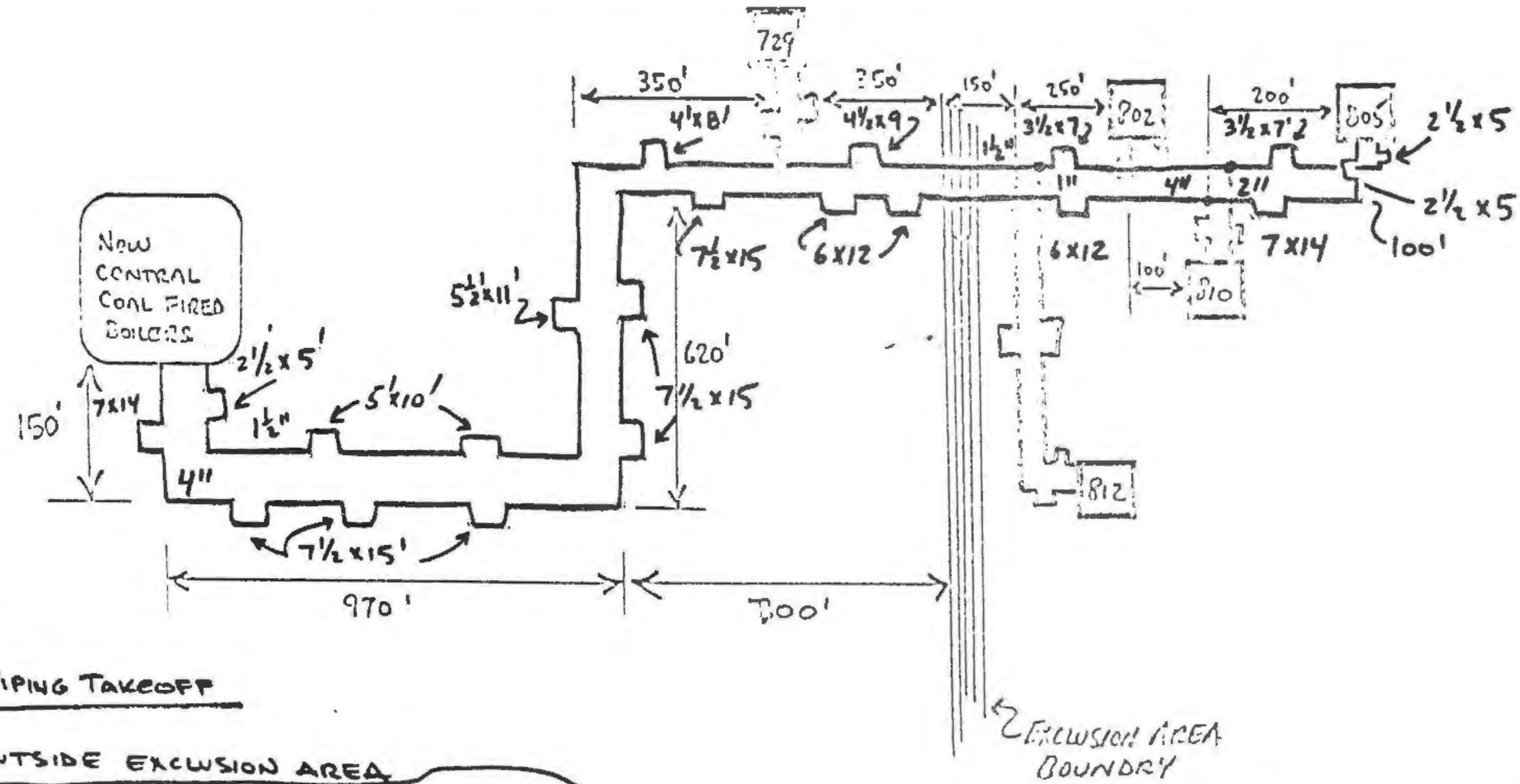
[illegible]

Distribution:

RS&H FORM 102

I - 314

11/72



Piping Takeoff

Outside Exclusion Area

4" pipe 2440' plus 1 Lp e 28, 6 Lp e 30, 2 Lp e 24 } 256'

4" pipe = 2696'

1½" pipe 2440' plus 1 Lp e 10, 2 Lp e 20, 1 Lp e 22, 1 Lp e 16, 1 Lp e 18 } 106'

1½" pipe = 2546'

4" elbows 4 x Lp + 6 = 42

1½" elbows = 30

Inside Exclusion Area

4" pipe 500' plus 1 Lp e 24

4" pipe 524'

\# 2" pipe 300' plus 1 Lp e 28, 1 Lp e 10 } 38'

2" pipe 338'

1½" pipe 150'

1" pipe 650' plus 2 Lp e 14, 1 Lp e 10 } 38'

1" pipe 688'

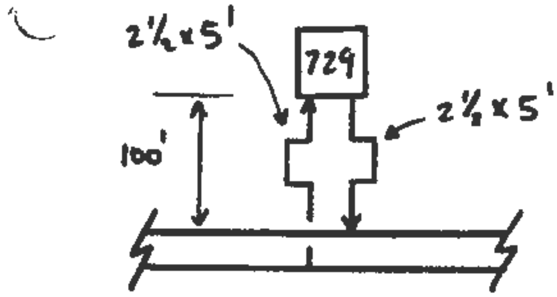
4" elbows = 0

2" elbows = 4 x Lp + 4 = 12

1½" elbows = 0

1" elbows = 4 x Lp + 4 = 16

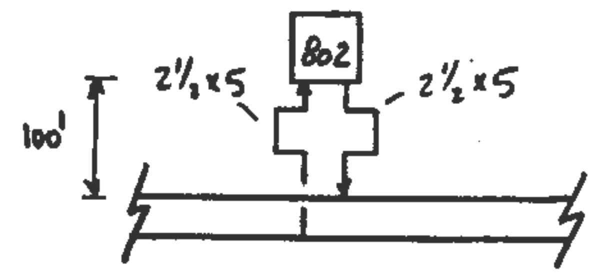
BUILDING 729



<u>STEAM</u> 1½" sch 80 6 Elbows 110'

<u>COND</u> 1" sch 80 6 Elbows 110'

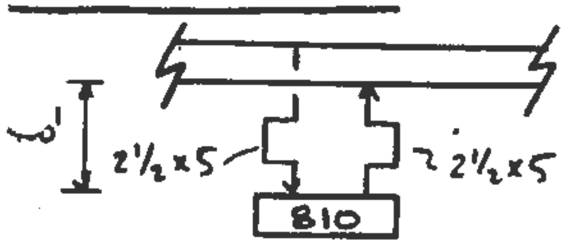
BUILDING 802



<u>STEAM</u> 1½" sch 80 6 elbows 110'

<u>COND</u> 1" sch 80 6 elbows 110'

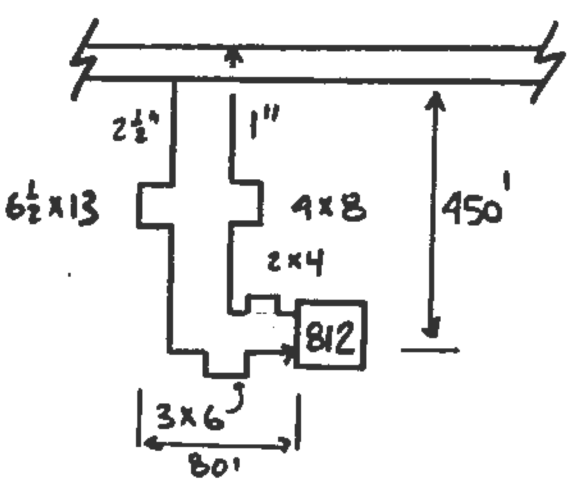
BUILDING 810



<u>STEAM</u> 2" sch 40 6 elbows 110'

<u>COND</u> 1" sch 80 6 elbows 110'

BUILDING 812



<u>STEAM</u> 2½" sch 40 10 Elbows 568'

<u>COND</u> 1" sch 80 10 Elbows 554'

BUILDING 805

SAME AS BLDG 810

<u>STEAM</u> 2" sch 40 6 elbows 110'

<u>COND</u> 1" sch 80 6 elbows 110'

PRELIMINARY ANALYSIS - BASED ON "ROUGH" 1ST CUT BOILER COSTS

ESTIMATE BOILER COST DIFFERENTIAL FOR VARIOUS Configurations.

1) EXISTING Systems only → (3) 7,000 lb/HR boilers
   APPROXIMATE Boiler COST = $ 908,000
   ESTIMATE for structural, electrical, & buildings (30%) = $ 272,000

   TOTAL $ 1,180,000

2) EXISTING SYSTEMS plus Bldgs # 729, 802, 805, 810, 812 → (3) 8500 lb/HR boilers
   Approximate Boiler Cost = $ 970,000
   ESTIMATE for structural, elect., & buildings (30%) = $ 290,000

   TOTAL $ 1,260,000

3) EXISTING systems plus Bldgs # 729, 802, 805, 810, 812, plus Bldg 816 → (3) 9,000 lb/HR boilers
   Approximate Boiler Cost = $ 1,012,000
   ESTIMATE for struct., elect., & buildings (30%) = $ 304,000

   TOTAL = 1,316,000

INCREMENTAL COST TO ADD BLDG # 819 TO COAL FIRED STEAM SYSTEM = $ 281,064

Fuel Savings which would result from Adding this bldg to the new steam system would be $ 4318 /YR

$$\text{PAYBACK} = \frac{281,064}{4,318} = 65.1 \text{ yrs}$$

∴ Bldg # 819 will no longer be considered

REYNOLDS, SMITH AND HILLS ARCHITECTS · ENGINEERS · PLANNERS INCORPORATED	SUBJECT SENECA - CENTRAL COAL PLANT DESIGNER J. MCMILLIN CHECKER	AEP NO. 80122-000 SHEET 2 OF DATE 12 DEC 80 DATE

Bldg. 819 0.66(10,300) = 6798 gallons
→ $4318/yr.

Bldg. 812 0.66(13,500) = 8910 gallons
→ $5660/yr.

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SENECA - CENTRAL COAL PLANT

AEP NO. 80122-000

SHEET 2 OF

DESIGNER J. MCMILLIN

DATE 12 DEC 80

CHECKER

DATE

Bldg. 819

0.66(10,300) = 6798 gallons

→ $4318 /yr.

Bldg. 812

0.66(13,500) = 8910 gallons

→ $5660 /yr.

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT
ENERGY ENGINEERING ANALYSIS

LOCATION COST ESTIMATE - STEAM & CONDENSATE PIPING TO BUILDING B19

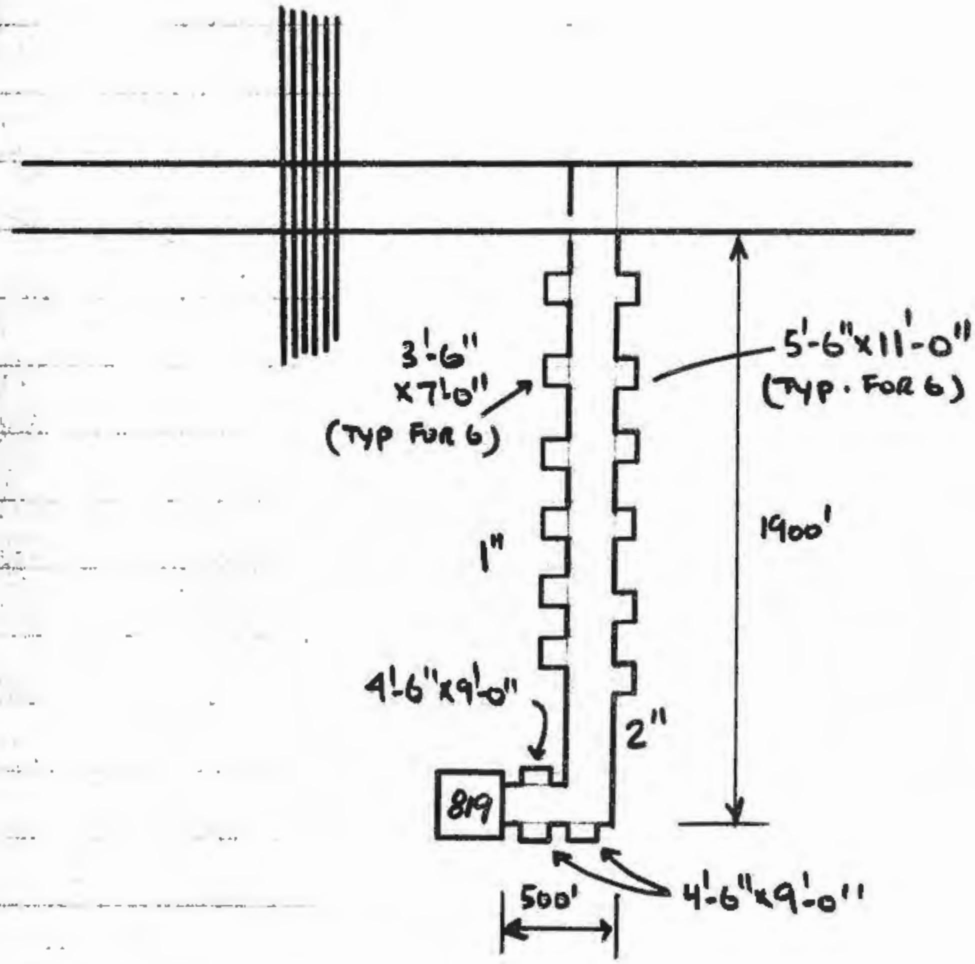
ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.	ESTIMATOR	CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
2" sch 40 buried conduit	2590	Ft	25.84	66926	19.50	50505	117431
2" elbows	36	EA	258.40	9302	134.00	4824	14126
1" sch 40 buried conduit	2502	Ft	24.24	60648	18.00	45036	105684
1" elbows	32	EA	242.40	7757	104.00	3328	11085
excavation & backfill	2590	Ft	12.64	32738	—	—	32738
TOTAL				177371		103693	281,064

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)



STEAM 2" sch 40, 36 elbows, 2590'

COND 1" sch 80, 32 elbows, 2502'

(3)

ENERGY ENGINEERING ANALYSIS PROGRAM

472-Ø2

FINAL

Seneca Army Depot
NEW YORK

FEASIBILITY STUDY CENTRAL COAL-FIRED HEATING PLANTS

APPENDIX - Volume 2

INCREMENT E

Contract No. DACA 65-80-C-0003
NORFOLK DISTRICT
CORPS OF ENGINEERS

REYNOLDS, SMITH AND HILLS
Architects-Engineers-Planners, Incorporated

ENERGY ENGINEERING ANALYSIS

FORT DEVENS

SENECA ARMY DEPOT

LETTERKENNY ARMY DEPOT

CONTRACT NO. DACA65-80-C-0003

FEASIBILITY STUDY

INCREMENT E

CENTRAL COAL-FIRED HEATING PLANTS

APPENDIX - VOLUME 2

SENECA ARMY DEPOT

February 1982

Reynolds, Smith and Hills

Architects-Engineers-Planners,

Incorporated

FINAL SUBMITTAL

TABLE OF CONTENTS

6.0 APPENDIX

VOLUME II

SECTION II-1

CAPITAL COST ESTIMATE

BASE CASE

Base Case - Seneca South

1/2/81

1. Anticipated Midpoint of Construction

   Does not apply to Base case

2. Beneficial Occupancy Date

   same as #1, Above

3. Economic Life

Bldg 121 Systems	→	30 years
" 319 "	→	30 years
" S-142 "	→	20 years
" 101 "	→	20 years
" 103 "	→	20 years
" 113 "	→	20 years

Piping System → 25 years

4. Date of Estimate

   December 1980

5. Initial Cost

   Does not apply

7. ANNUAL MAINTENANCE COSTS (12/80 $)

		MAINTENANCE	OPERATING
BLDG	121	$ 5660	$ 106,246
	319	$ 13,200	$ 106,246
	S-142	$ 404	—
	101	$ 181	—
	103	$ 181	—
	113	$ 404	—

$20,030 + $212,492 = $232,522

7. CYCLICAL MAINTENANCE COSTS

1991	$ 515,736	WITH 30 YR life
1991	$ 9978	WITH 20/YR life
1996	$ 22000	WITH 20 YR life
1996	$ 430,340	WITH 25 YR life
2011	$ 9978	WITH 20 YR life
2016	$ 22000	WITH 20 YR life
2021	$ 515,736	WITH 30 YR life
2021	$ 430,340	WITH 25 YR life

8. ANNUAL FUEL COST

#6 F.O.	151,967 GAL/YR	$ 77928
#2 F.O.	29,159 GAL/YR	$ 28,193

9. ANNUAL ELECTRICAL CONSUMPTION

145,116 Kwh

10. ELECTRICAL DEMAND RATE

27.3 KW

REPLACEMENT REQUIRED IN 1991 (30-yr life Exp.)

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BLDG 121				19200		94000	113,200
BLDG 319				54000		210,000	264,000
SUBTOTAL				73200		304,000	377,200
LABOR BURDEN	22%			16104			16104
SALES TAX	5%			—		15,200	15200
SUBTOTAL							408504
OVERHEAD & PROFIT	25%						102126
BOND	1%						5106
TOTAL REPLACEMENT COST IN DEC '80 $ →							$515,736

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

REPLACEMENT REQUIRED IN 1991 (20-YR life exp.)

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
BLDG 101				915		2700	3615
BLDG 103				915		2700	3615
SUB-TOTAL				1830		5400	7230
LABOR BURDEN	22%			403		—	403
SALES TAX	5%			—		270	270
SUBTOTAL							7903
OVERHEAD & PROFIT	25%						1976
BOND	1%						99
TOTAL REPLACEMENT COST IN DEC 1980 $ →							$ 9978

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE 1959 O—516148

REPLACEMENT REQUIRED IN 1990 (EXPECTANCY)

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
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- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify) ____________

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
Bldg 113				1375		6700	8075
Bldg S-142				1375		6700	8075
SUBTOTAL				2750		13400	16150
Labor Burden	22%			605		—	605
Sales Tax	5%			—		670	670
SUBTOTAL							17425
Overhead & Profit	25%						4356
Bond	1%						219
TOTAL REPLACEMENT COST IN Dec '80 # →							#22000

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1960 O-516160

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: CODE A (No design completed) / CODE B (Preliminary design) / CODE C (Final design) / OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: J. MCMILLIN

CHECKED BY:

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
OVERHEAD PIPING							
4" Sch 40, insulated	845	FT	* 8.12	6861	19.06	16,106	
3" Sch. 40, "	2015	FT	* 6.44	12977	15.51	31,253	
2 1/2" Sch 40, "	1040	FT	* 5.84	6074	12.01	12,490	
2" Sch 40	1690	FT	* 2.88	4867	9.29	15,700	
1 1/2" Sch. 80	195	FT	* 2.63	513	9.10	1775	
1 1/4" Sch 80	1495	FT	* 2.63	3932	9.10	13,605	
SUBTOTALS				35224		90,929	126153
UNDERGROUND PIPING							
EXCAVATION & BACKFILL	2510	Ft	6.32	15863	—	—	
8" Sch 40 insulated	845	FT	11.28	9532	40.80	34,476	
6" Sch 40,	923	FT	9.02	8325	31.04	28,650	
5" Sch 40	195	FT	9.02	1759	31.04	6053	
3" Sch 40	2743	FT	5.20	14264	15.51	42,544	
2 1/2" Sch 40	325	FT	4.73	1537	12.01	3903	
2" Sch 40	845	FT	2.28	1927	9.29	7850	
1 1/2" Sch. 80	650'	FT	2.07	1346	9.10	5915	
SUB TOTALS				54553		129,391	183944
PLUS				35224		90,929	
SUBTOTAL				89777		220,320	310097
LABOR BURDEN	22%			19751		—	19751
SALES TAX	5%			—		11,016	11,016
SUBTOTAL							340864
OVERHEAD & PROFIT	25%						85216
BOND	1%						4260
TOTAL REPLACEMENT COST (1980 $)							430340

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

REPLACEMENT REQUIRED IN ---- (20-YR LIFE EXP.)

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

BASIS FOR ESTIMATE
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- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

LOCATION

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.

ESTIMATOR

CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BLDG 101				915		2700	3615
BLDG 103				915		2700	3615
SUB-TOTAL				1830		5400	7230
LABOR BURDEN	22%			403		—	403
SALES TAX	5%			—		270	270
SUBTOTAL							7903
OVERHEAD & PROFIT	25%						1976
BOND	1%						99
TOTAL REPLACEMENT COST IN DEC 1980 $ →							$ 9978

REPLACEMENT REQUIRED IN 2010 (EXPECTANCY)

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR

CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Bldg 113				1375		6700	8075
Bldg S-142				1375		6700	8075
Subtotal				2750		13400	16150
Labor Burden	22%			605		—	605
Sales Tax	5%			—		670	670
Subtotal							17425
Overhead & Profit	25%						4356
Bond	1%						219
TOTAL REPLACEMENT COST IN DEC '80 $ →							$22000

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: | ESTIMATOR: | CHECKED BY:

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BLDG 121				19200		94000	113,200
BLDG 319				54000		210,000	264,000
SUBTOTAL				73200		304,000	377,200
LABOR BURDEN	22%			16104			16104
SALES TAX	5%			—		15,200	15200
SUBTOTAL							408504
OVERHEAD & PROFIT	25%						102126
BOND	1%						5106
TOTAL REPLACEMENT COST IN DEC '80 $ →							$515,736

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

REPLACEMENT OF EXISTING PIPING 2021 (LIFE)

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: J. McMILLIN

CHECKED BY:

SUMMARY	QUANTITY: NO. UNITS	QUANTITY: UNIT MEAS.	LABOR: PER UNIT	LABOR: TOTAL	MATERIAL: PER UNIT	MATERIAL: TOTAL	TOTAL COST
OVERHEAD PIPING							
4" sch 40, insulated	845	FT	*8.12	6861	19.06	16,106	
3" sch. 40, "	2015	FT	*6.44	12977	15.51	31,253	
2 1/2" sch. 40, "	1040	FT	*5.84	6074	12.01	12,490	
2" sch 40	1690	FT	*2.88	4867	9.29	15,700	
1 1/2" sch. 80	195	FT	*2.63	513	9.10	1775	
1 1/4" sch 80	1495	FT	*2.63	3932	9.10	13,605	
SUBTOTALS				35224		90,929	126153
UNDERGROUND PIPING							
EXCAVATION & BACKFILL	2510	Ft	6.32	15863	—	—	
8" sch 40 insulated	845	FT	11.28	9532	40.80	34,476	
6" sch 40,	923	FT	9.02	8325	31.04	28,650	
5" sch 40	195	FT	9.02	1759	31.04	6053	
3" sch 40	2743	FT	5.20	14264	15.51	42,544	
2 1/2" sch 40	325	FT	4.73	1537	12.01	3903	
2" sch 40	845	FT	2.28	1927	9.29	7850	
1 1/2" sch. 80	650'	FT	2.07	1346	9.10	5915	
SUB TOTALS				54553		129,391	183944
PLUS				35224		90,929	
SUBTOTAL				89777		220,320	310097
LABOR BURDEN	22%			19751		——	19751
SALES TAX	5%			—		11,016	11,016
SUBTOTAL							340864
OVERHEAD & PROFIT	25%						85216
BOND	1%						4260
TOTAL REPLACEMENT COST (1980 $)							430340

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

BUILDING: 121 DESCRIPTION: Steam Plant

1. EQUIPMENT NAME	(2) Kewanee Compact Type C Boilers	Riley Stoker Boiler	Deaerator	Boiler Feed Pumps
2. DESCRIPTION	199 HP, 15 PSIG Gas/oil fired Rated 6650 MBTU	12,600 #/HR Coal Fired, 15 psig CONTRACT 6972	—	(2)
3. CONDITION AS OF OCT. 1980	fair	Not operable No gas cleanup equipment	—	—
4. CURRENT AGE	20 yrs	Built 1963 17 yrs	20 yrs	20 yrs
5. LIFE EXPECTENCY	30 yrs	DeCommissioned	30 yrs	30 yrs
6. Replacement Cost (Dec '80 $)	$ 83,200 mat 64,000 lab 19,200	N.A.	$ 20,000	$ 10,000

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 106,246

8. ANNUAL FUEL COST, (DEC. '80 $) $ 31725

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 5660

10. ANNUAL ELECTRICAL DEMAND 62921 Kwh

11. ELECTRICAL DEMAND RATE 12.2 Kw

BLDG 121

ANNUAL OPERATING COST

OPERATING PERSONNEL

	# REQ'D	DEC '80 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. Boiler Plant Operator/Leader	1/2 *	$ 23,150	$ 11575
2. Boiler Plant Operators	4	21,038	84,152
3. Heating Equip. Mechanic	1/2 *	21038	10519
		TOTAL	$ 106,246

NOTE: Dec '80 Salary = March '80 Hourly Rate x 2080 hrs + 10.3 % Fringes + 7% escalation

ANNUAL FUEL COST

Fuel use before setback = 120,000 GAL/YR #6 F.O.

Setback Savings = 8720 MBTU

$$\text{Annual Fuel Use} = 120{,}000 - \frac{8720000000}{150{,}000} = 61867 \text{ GPY}$$

Annual Fuel Cost = 61867 x $.5128 = $ 31725

ANNUAL MAINTENANCE COST

Assume as 5% of replacement cost

.05 x (83,200 + 20,000 + 10,000) = $ 5660

BLDG 121, CONT.

ANNUAL ELECTRICAL CONSUMPTION

KEWANEE BOILERS (2)

FD FAN	5 Hp
OIL PUMP	1/2 Hp
Atom Air Comp	1 1/2 Hp
AIR OIL PUMP	1/3 Hp
BFP	3 Hp
COND PUMP	1 Hp
MISC	5 Hp

$16\frac{1}{3}$ Hp ÷ 1.341 Hp/KW = 12.2 KW

0-25% LOAD = 0.67 × 12.2 = 8.2 KW
25-50% LOAD = .80 × 12.2 = 9.8 KW
50-100% LOAD = 12.2 KW

MONTH	AVG HOURLY STEAM DEMAND	% BOILER LOAD	KW	KWH
JAN	3945	58.3	12.2	9077
FEB	3781	55.9	12.2	8198
MAR	2823	41.7	9.8	7291
APRIL	1601	23.7	8.2	5904
MAY	1109	16.4	8.2	6100
JUNE	479	7.1	8.2	5904
JULY	–	–	–	–
AUG	–	–	–	–
SEPT	–	–	–	–
OCT	1109	16.4	8.2	6100
NOV	2533	37.4	9.8	7056
DEC	3365	49.7	9.8	7291
			TOTAL	62,921 KWH

ELECTRICAL DEMAND RATE

12.2 KW

BLDG 121

Boiler Replacement Cost

(2) Kewanee Compact Type "C" boilers, model 7L285, 199 Hp, 15 psig

$1 32,000 Complete

ADD 20% for installation $ 6400

ADD 10% for demolition $ 3200

TOTAL INSTALLED COST $ 41,600 EACH

	AVG SYSTEM HOURLY DEMAND # 121	# 319	TOTAL	TOTAL HOURLY SYSTEM DEMAND INCLUDING 101, 103, 113, & S-142 (1)	BLR SIZE	KW	KWH
JAN	3945	6886	10831	12812	15,000	92	68448
FEB	3781	7411	11192	13239	15,000	92	61824
MAR	2823	5226	8049	9521	15,000	92	68448
APRIL	1601	3431	5032	5952	8,000	64	46080
MAY	1109	574	1683	1991	8,000	43	31903
JUNE	479	—	479	567	8,000	43	3087[illegible]
JULY	—	—	—	—	—	—	—
AUG	—	—	—	—	—	—	—
SEPT	—	—	—	—	—	—	—
OCT	1109	1294	2403	2843	8000	51	38093
NOV	2533	3077	5610	6636	8000	64	46080
DEC	3365	6227	9592	11346	15000	92	68448

TOTAL 460,198 KWH

(1) BASED ON EXISTING FUEL RECORDS FOR 121 & 319, PLUS ALLOWANCE FOR 101, 103, 113 & S-142 BASED ON RATIO OF 101+103+113+S142+CENTRAL PLANT PEAK (2958) TO EXISTING 121 & 319 PEAK (16172) = 0.1829

15000#/HR BLR 92 KW		8000#/HR BLR 64 KW	
0-3750	62 KW	0-2000	43 KW
3750-7500	74 KW	2000-4000	51 KW
7500+	92 KW	4000+	64 KW

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: BASE CASE

DESIGNER

CHECKER

REF NO

SHEET OF

DATE

DATE

BUILDING: 319 DESCRIPTION: Steam PlANT

1.	EQUIPMENT NAME	INTERNATIONAL BoilER - TYPE FDH18-356	(1) [illegible] Boiler	Deaerator	Boiler Feed Pumps
2.	DESCRIPTION	Water tube, #6 F.O. FIRED, 130 psig design 1429 Ft² H.S., Todd Burner #6 F.O. 120 GPH	Serial 116415 200 psig design 1475 Ft² H.S. 15,000 #/HR #6 F.O. FIRED	—	(2) —
3.	CONDITION AS OF OCT. 1980	fair - good	Excellent	—	—
4.	CURRENT AGE	≈ 20 YRS	installed 1978 ([illegible] yr. old)	20 yrs	20 yrs
5.	LIFE EXPECTENCY	30 YRS	[illegible] YEARS	30 yrs	30 yrs
6.	Replacement Cost (Dec '80 $)	$91,000 TOTAL $70,000 mat. $21,000 labor	$14[illegible],000 TOTAL $110,000 mat. $ [illegible] labor	$20,000	$10,000

7. ANNUAL OPERATING COST, (DEC. '80 $) $106,246

8. ANNUAL FUEL COST, (DEC. '80 $) $46,203

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 13200

10. ANNUAL ElECTRICAL DEMAND 74871 Kwh

11. ElECTRICAL DEMAND RATE 15.3 KW

BLDG 319

ANNUAL OPERATING COST

OPERATING PERSONNEL	#/REQ'D	DEC '80 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. Boiler Plant Operator/Leader	1/2 *	$ 23,150	$ 11,575
2. Boiler Plant Operators	4	21,038	$ 84,152
3. Heating Equipment Mechanics	1/2 *	21,038	$ 10,519
		TOTAL	$ 106,246

* ASSUME SPLITUP WITH BUILDING # 121

NOTE: Dec '80 Salary = March '80 Hourly rate x 2080 hrs + 10.3 % Fringes + 7% escalation

ANNUAL FUEL COST

Fuel Use Before Setback = 202,300 GAL/YR #6 F.O.

Setback Savings = 16,830 mBTU

Annual Fuel Use = $202{,}300 - \frac{16830000000}{150000} = 90100$ GPY

Annual Fuel Cost = 90,100 x $.5128 = $ 46203

ANNUAL MAINTENANCE COST

Assume as 5% of Replacement cost

.05 x (91,000 + 143,000 +20,000 + 10,000) = $ 13200 /YR

ANNUAL ELECTRICAL CONSUMPTION

BLDG # 31[illegible], CONT.

KEELER BOILER

FD FAN	10 Hp
OIL PUMP	1½ Hp
AIR COMP	3 Hp
BFP	5 Hp
COND PUMP	1 Hp
MISC.	5 Hp
	25½ Hp

Full load $\frac{25\frac{1}{2}\text{ Hp}}{1.341\text{ Hp/Kw}} = 19\text{ Kw}$

0 - 25% load 19 Kw x .67 = 12.7 Kw
25 - 50% load 19 Kw x .8 = 15.2 Kw
50 - 100% load = 19.0 Kw

INTERNATIONAL BOILER

FD FAN	5 Hp
OIL PUMP	1½ Hp
AIR COMP	3 Hp
BFP	5 Hp
COND PUMP	1 Hp
MISC.	5 Hp
	20½ Hp

Full load $\frac{20\frac{1}{2}\text{ Hp}}{1.341\text{ Hp/Kw}} = 15.3\text{ Kw}$

0-25% load 15.3 x .67 = 10.2 Kw
25-50% load 15.3 x .8 = 12.2 Kw
50-100% load = 15.3 Kw

Month	AVG HOURLY STEAM DEMAND	% LOAD (INT or KEELER)	Kw	Kwh
JAN	6886	I - 57 %	15.3	11383
FEB	7411	I - 61.2 %	15.3	10282
MAR	5226	I - 43.2%	12.2	9077
APRIL	3431	I - 28.3%	12.2	8784
MAY	574	I - 4.7%	10.2	7589
JUNE	-	—	-	-
JULY	-	—	-	-
AUG	-	—	-	-
SEPT	-	—	-	-
OCT	1294	I - 10.7 %	10.2	7589
NOV	3077	I - 25.4 %	12.2	8784
DEC	6227	I - 51.4 %	15.3	11383
			TOTAL	74871 Kwh

Bldg 319, CONT.

ELECTRIC DEMAND Rate

15.3 KW

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SETUD ~ SOUTH DASE
AEP NO 80127-000
SHEET ...... OF ......
DESIGNER SCOWEN
DATE
CHECKER
DATE

(BLDG 319, CONT.)

BOILER REPLACEMENT COST

KEELER, water-tube, 15,000 #/HR, #6 F.O. FIRED, Complete

$ 110,000

ADD 20% for installation $ 22,000

ADD 10% for demolition of existing boiler $ 11,000

TOTAL INSTALLED COST $ 143,000

INTERNATIONAL BOILER - Type FDH18-356, 356 Hp, #6 F.O., Complete

$ 70,000

ADD 20% for INSTALLATION $ 14,000

add 10% for demolition $ 7,000

TOTAL INSTALLED COST $ 91,000

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT "OPTION 2" Elec. Consumption
DESIGNER S [illegible]
CHECKER
AEP NO
SHEET OF
DATE
DATE

	AVG SYSTEM HOURLY DEMAND #121	#319	TOTAL	TOTAL HOURLY SYSTEM DEMAND INCLUDING 101, 103, 113, & S-142 ①	BLR SIZE	KW	KWH
JAN	3945	6886	10831	12812	15,000	92	68448
FEB	3781	7411	11192	13239	15,000	92	61824
MAR	2823	5226	8049	9521	15,000	92	68448
APRIL	1601	3431	5032	5952	8,000	64	46080
MAY	1109	574	1683	1991	8,000	43	31903
JUNE	479	—	479	567	8,000	43	30874
JULY	—	—	—	—	—	—	—
AUG	—	—	—	—	—	—	—
SEPT	—	—	—	—	—	—	—
OCT	1109	1294	2403	2843	8000	51	38093
NOV	2533	3077	5610	6636	8000	64	46080
DEC	3365	6227	9592	11346	15000	92	68448

TOTAL 460,198 KWh

① BASED ON EXISTING FUEL RECORDS FOR 121 & 319, PLUS ALLOWANCE FOR 101, 103, 113 & S-142 BASED ON RATIO OF 101 + 103 + 113 + S142 + CENTRAL PLANT PEAK (2958) TO EXISTING 121 & 319 PEAK (16172) = 0.1829

15000 #/HR BLR	92 KW
0-3750	62 KW
3750-7500	74 KW
7500+	92 KW

8000 #/HR BLR	64 KW
0-2000	43 KW
2000-4000	51 KW
4000+	64 KW

Project No. 80122-020

Telephone Call Confirmation

reynolds, smith and hills

Local ___ L.D. (circled) ___ Placed (circled) ___ Rec'd ___ Date 2 JAN 80

J. McMILLIN ___ Conversed with JIM RICE

Of M.L. BALL CO. ___ Regarding Keeler boiler cost

404-447-5660

Cost for 15,000 lb/hr. 150 psig boiler.

$100,000 - $110,000 complete except for stack

15,000 lb/hr → 435 hp. #6 F.O.

Distribution:

II-23

RS&H FORM 102 11/72

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ___ L.D. (circled) ___ Placed (circled) ___ Rec'd ___ Date 2 JAN 80

J. McMILLIN Conversed with ___

Of INTERNATIONAL BOILER Regarding Budget cost for

International Boiler 717-421-5100

International boiler type FDH 18-356 - cost

$70,000 - 356 hp.

Distribution:

II - 24

RS&H FORM 102 11/72

Project No. 8022-000

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. ______ Placed ______ Rec'd ______ Date 2 JAN 80

J. McMILLIN ______ Conversed with ______

Of KEWANEE BOILER CORP Regarding Budget costs for Kewanee Boilers 309-853-3541

Compact Type "C" boiler, model #7L285, 199 hp, 15 psig working pressure. $32,000 complete

Scotch Marine Type, Size 300, 310 hp, 50 psig pressure, $46,500 complete

Distribution:

II-25

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD – SOUTH BASE
BASE CASE
DESIGNER
CHECKER

AEP NO 00122-000
SHEET ______ OF ______
DATE
DATE

BUILDING: S-142 DESCRIPTION: ______

1.	EQUIPMENT NAME	DID NOT SEE THIS UNIT			
2.	DESCRIPTION	for study purposes, Assume This UNIT IS SIMILAR			
3.	CONDITION AS OF OCT. 1980	TO BLDG 810 WEIL-MCLAIN 1000 #/HR			
4.	CURRENT AGE	5 yrs			
5.	LIFE EXPECTENCY	20 yrs			
6.	Replacement Cost (Dec '80 $)	$ 8075 1375 lab 6700 mat			

7. ANNUAL OPERATING COST, (DEC. '80 $) — 0 —

8. ANNUAL FUEL COST, (DEC. '80 $) $5490

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $404

10. ANNUAL ELECTRICAL DEMAND 1831 Kwh

11. ELECTRICAL DEMAND RATE — 0 —

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD ~ SOUTH BASE
AEP NO 60162-000
SHEET ____ OF ____
DESIGNER S Cowen
DATE
CHECKER
DATE

BLDG S-142

ANNUAL OPERATING COST

$ 0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 16,200 GAL/YR #2 F.O.

SET BACK SAVINGS = 1460 MBTU

ANNUAL FUEL USE = 16200 GPY − $\frac{1460\,000\,000 \text{ BTU}}{138,700 \text{ BTU/GAL}}$ = 5674 GPY

ANNUAL FUEL COST = 5674 GPY × $.9675/GAL = $ 5490/YR

ANNUAL MAINTENANCE COST

Assume as 5% of Replacement Cost

.05 × $8075 = $ 404

ANNUAL ELECTRICAL CONSUMPTION

1/2 Hp Blower

$\frac{1/2 \text{ HP}}{1.341 \text{ HP/KW}}$ = 0.373 Kwh × 4910 $\frac{\text{hrs}}{\text{YR}}$ = 1831 Kwh/YR

ELECTRICAL DEMAND Rate

0 Kw

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD — SOUTH BASE
BASE CASE
DESIGNER
CHECKER

AEP NO 00122-000
SHEET ____ OF ____
DATE
DATE

BUILDING: 101 DESCRIPTION: Admin. Building

1. EQUIPMENT NAME	Steam Boiler			
2. DESCRIPTION	Burnham Pace King #2 F.O.			
3. CONDITION AS OF OCT. 1980	fair to good			
4. CURRENT AGE	Nameplate not readible 10-20 yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$ 3615 915 lab 2700 mat			

7. ANNUAL OPERATING COST, (DEC. '80 $) — -0-

8. ANNUAL FUEL COST, (DEC. '80 $) — $ 6536

9. ANNUAL MAINTENANCE COST, (DEC '80 $) — $ 181

10. ANNUAL ELECTRICAL DEMAND — 1831 Kwh

11. ELECTRICAL DEMAND RATE — -0-

BLDG 101

ANNUAL OPERATING COST

$0 (NO OPERATORS REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 8,000 GAL/YR #2 F.O.

SET BACK SAVINGS = 170 MBTU

$$\text{ANNUAL FUEL USE} = 8000\ \text{GPY} - \frac{170{,}000{,}000\ \text{BTU/YR}}{138{,}700\ \text{BTU/GAL}} = 6774\ \text{GPY}$$

ANNUAL FUEL COST = 6774 GPY x $.9675 /GAL = $6536

ANNUAL MAINTENANCE COST

Assume as 5% of Replacement Cost

.05 x $3615 = $181

ANNUAL ELECTRICAL CONSUMPTION

1/2 Hp Blower

$$\frac{1/2\ \text{Hp}}{1.341\ \text{Hp/Kw}} = 0.373\ \text{Kw} \times 4910\ \text{hrs} = 1831\ \text{Kwh}$$

ELECTRICAL DEMAND RATE

-0-

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-000

Local ______ L.D. (circled) ______ Placed (circled) ______ Rec'd ______ Date 31 DEC 80

J. McMillin Conversed with R. FISHER

Of BURNHAM, CORP. Regarding Cost for Burnham Corps boiler

717-397-4701

List price for 15 psig #2 F.O. 400 lb/hr. steam output cast iron construction is $2700. Life expectancy is approximately 20 years. List price given is approximate. 1/2 hp ~~boil~~ blower motor.

MATERIAL $ 2700

labor 40 hrs @ 22.87 = $ 915

TOTAL $ 3615

Distribution:

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD – SOUTH [illegible]
BASE CASE
DESIGNER
CHECKER

AEP NO 00122-000
SHEET ____ OF ____
DATE
DATE

BUILDING: 103 DESCRIPTION: Civilian Personnel Office

1. EQUIPMENT NAME	NOT able TO get in to			
2. DESCRIPTION	see THIS EQUIPMENT Assume SAME As BLDG # 101			
3. CONDITION AS OF OCT. 1980	Assume BURNHAM Pace King			
4. CURRENT AGE	10 yrs			
5. LIFE EXPECTENCY	20 yrs			
6. Replacement Cost (Dec '80 $)	$ 3615 915 lab 2700 mat			

7. ANNUAL OPERATING COST, (DEC. '80 $) — 0 —

8. ANNUAL FUEL COST, (DEC. '80 $) $ 8900

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 181

10. ANNUAL ELECTRICAL DEMAND $ 1831 Kwh

11. ELECTRICAL DEMAND RATE — 0 —

BLDG 103

ANNUAL OPERATING COST

$ 0 (NO OPERATORS REQUIRED)

ANNUAL FUEL COST

Fuel use before setback = 9200 GAL/YR #2 F.O.

SAVINGS due to setback = 0

ANNUAL Fuel Cost = 9200 x $.9675 = $ 8900

ANNUAL MAINTENANCE COST

Assume AS 5% of Replacement Cost

.05 x $ 3615 = $ 181

ANNUAL Electrical Consumption

1/2 Hp Blower

$$\frac{1/2 \text{ HP}}{1.341 \text{ HP/KW}} = 0.373 \text{ KW} \times 4910 \text{ hrs} = 1831 \text{ Kwh}$$

ELECTRICAL DEMAND Rate

- 0 -

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD – SOUTH BASE
BASE CASE
DESIGNER
CHECKER

AEP NO 80122-000
SHEET ____ OF ____
DATE
DATE

BUILDING: 113 DESCRIPTION: ____

1.	EQUIPMENT NAME	Steam Boiler			
2.	DESCRIPTION	CRANE Co. "80" series MODEL 80-1350-Z #2 F.O. 11.9 GPH, 15 PSI design, 350#/HR 4250 Ft² H.S.			
3.	CONDITION AS OF OCT. 1980	This system appeared to be in good condition			
4.	CURRENT AGE	5-10 yrs			
5.	LIFE EXPECTENCY	20 yrs			
6.	Replacement Cost (Dec '80 $)	Assume same as Weil-McLain 1000#/HR 1375 lab + 6700 mat $8075			

7. ANNUAL OPERATING COST, (DEC. '80 $) $ 0

8. ANNUAL FUEL COST, (DEC. '80 $) $ 7267

9. ANNUAL MAINTENANCE COST, (DEC '80 $) $ 404

10. ANNUAL ELECTRICAL DEMAND 1831 Kwh

11. ELECTRICAL DEMAND RATE – 0 –

BLDG 113

ANNUAL OPERATING COST

$0 (No operators REQ'D)

ANNUAL FUEL COST

FUEL USE BEFORE SETBACK = 17,100 GAL/YR #2 F.O.

SETBACK SAVINGS = 1330 MBTU

ANNUAL FUEL USE = $17{,}100 - \frac{1330000000}{138{,}700} = 7511$ GPY

ANNUAL FUEL COST = 7511 × $.9675 = $7267

ANNUAL MAINTENANCE COST

Assume as 5% of the replacement cost

.05 × $8075 = $404

ANNUAL ELECTRICAL CONSUMPTION

1/2 Hp Blower

$\frac{1/2 \text{ HP}}{1.341 \text{ HP/KW}} = 0.373$ Kw × 4910 hrs = 1831 Kwh

ELECTRICAL DEMAND RATE

– 0 –

Telephone Call Confirmation

reynolds, smith and hills

(Local) L.D. (Placed) Rec'd Date 31 DEC 80

J. McMILLIN Conversed with BOB MEYERS

Of R.M. Meyers Regarding Weil - McLain Boiler

904-387-2743

Asked for life expectancy, electrical requirements and cost for Weil-McLain boilers of 250 lb/hr and 1000 lb/hr size. Fuel is no 2 fuel oil, 15 psi pressure, cast iron.

Life expectancy of cast iron boilers is 15-20 years.

A 1000 lb/hr. boiler, model PL-686-SF, would cost $6700, has 1/2 hp blower motor.

A 250 lb/hr. boiler, model P-766, would cost $1533, has less than 1/3 hp blower motor.

Distribution:

RS&H FORM 102 11/72

Savings Due to Setback - Boiler Plant #319

Bldg #	Est. Annual Fuel Use (#6 gal)	Savings[a] (%)	Savings (MBtu)	Adequate Controls?	AUTH. TEMP
316 317 318	112,700	0.56	9,470	N	60/65
319	8,700	–		–	–
320	13,800	0.56	1160	N	60/65
321	13,400	0.64	1290	N	50/65
323	53,700	0.61	4910	N	50/65
TOTAL	202,300		16,830		

[a] Calculated

Savings Due to Setback
Boiler Plant # 121

Bldg #	Est. Annual Fuel Use (#6 gal)	Savings (%)	Savings (MBTU)	Adequate Controls?	AUTH. TEMP. SET.
115	18,100	34 [a]	920	Y	65
117	29,600	56	2490	N	60
118	29,600	56 [a]	2370	N	60
119	5,600	56	470	N	65
120	1,600	65	160	N	50
121	7,200	–	–	–	–
122	11,900	56	1000	N	50/65
123	3,400	34	770	Y	65
124	3000	56	250	N	65
125	1,900	34	100	Y	65
127	8,100	65	790	N	50
TOTAL	120,000		8720		

[a] calculated, remainder were extrapolated from calculation results on similar buildings

Allocation of Fuel Use by Building
for Boiler Plant #319

Bldg #	Annual Fuel Use (gal)		
316	50,100	112700	37566⅔
317	50,100		37566⅔
318	50,100		37567
320	13,800	13800	
321	13,400	13400	
323	53,700	53700	
TOTAL	231,200		

319 8700

202,300

Allocation of Fuel Use by Building for Boiler Plant #121

Bldg #	WALL U	WALL A	ROOF U	ROOF A	Σ UA	Annual Fuel Use (gal)	
115	0.24	10,821	0.20	3,579	5312.8	18,100	
117	0.37	13,960	0.10	19,261	7091.3	24,200	29,6[illegible]
118	0.37	13,920	0.27	18,928	10,261.0	35,000	29,6[illegible]
119	0.37	3360	0.27	1,473	1640.9	5,600	
120	0.37	960	0.27	400	463.2	1,600	
121	0.37	4000	0.27	2,400	2128.0	7,200	
122	0.24	9,480	0.10	12,318	3507.0	11,900	
123	0.24	3,216	0.05	4,436	993.6	3,400	
124	0.37	1,992	0.10	1,567	893.7	3,000	
125	0.24	1,992	0.05	1,567	556.4	1,900	
127	0.24	7,200	0.10	6,517	2379.7	8,100	
					35,227.7	120,000	

[a] equated due to infiltration problem in 117 in battery charging shop.

3.41 gal / ΣUA

Savings Due to Setback Control for Buildings Independent of Boiler Plants

Bldg #	Est. Annual Fuel Use (gal)	Savings (%)	Savings (MBtu)	ADEQUATE controls?	AUTH TEMP
101	8000	0.15 [a]	170	Y.	65
103	9200	–	–	–	65
104	7600	–	–	–	65
106	17,100	–	–	–	70
113	17,100	0.56	1330	N	60
114	7,000	0.25	240	Y	50/65
116	4700	0.34	220	Y	65
S-142	16,200	0.65	1460	N	65
710	3400	0.34	160	Y	65
729	5000	0.34	240	Y	65
802	3200	0.34	150	Y	65
~~804~~					~~65~~
805	3700	0.34	170	Y	65
806	4200	0.34	200	Y	65
807	4,300	0.34	200	Y	65
810	17,800	0.34	840	Y	60/65
812	13,500	0.34	640	Y	65
813	7,900	0.34	370	Y	65
814	3,500	0.30	150	Y	60
815]					65
816]	25,200	0.34	1190	Y	65
817	3,200	0.34	150	Y	60/65
819	10,300	0.34	490	Y	65
825	1,800	0.20	50	Y	50
TENNIS BUBBLE	12,300	0.25	430	Y	55

II-40

continued

Savings Due to Setback in Buildings

Fuel Type		Savings (MBtu)
#6 oil	~	39,000
# 2 oil	~	4,000

Bldg #	Savings (MBTU)		
	#6 Fuel Oil	#2 Fuel Oil	ALL TYPES
121	8,720	–	8,720
319	16,830	–	16,830
718	8,370	–	8,370
OTHERS	–	9,140	9,140
TOTALS	33,920	9,140	43,060

SENECA ...

CENTRAL COAL-FIRED
STEAM PLANT

1. ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

2. BENEFICIAL OCCUPANCY DATE JAN '85

3. ECONOMIC LIFE 25 YEARS

4. DATE OF ESTIMATE DEC '80 $

5. INITIAL COST $ 3,662,306

6. ANNUAL MAINTENANCE COSTS
   OPERATIONS (labor) $ 170416
   MAINTENANCE MATERIAL $ 97051
   } TOTAL = $ 267,467

7. CYCLICAL MAINTENANCE COSTS
   1) EXISTING PIPING WILL BE REPLACED IN 1996 & 2021 AT A COST OF $ 430,340 IN DEC '80 $
   2) INITIAL SYSTEMS WILL BE REPLACED AFTER 25 YRS (2010) AT A TOTAL REPLACEMENT COST OF $ 2,926,723 IN DEC '80 $

8. ANNUAL FUEL COST
   COAL → 1074 TONS @ $ 54/TON = $ 57,996

9. ANNUAL ELECTRICAL CONSUMPTION 460,175 Kwh

10. ELECTRICAL DEMAND RATE 134 KW

SECTION II-2

CAPITAL COST ESTIMATE

OPTION TWO

CONSTRUCTION COST ESTIMATE

DATE PREPARED: | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT | ESTIMATOR: | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				255,736		407,968	663,704
Valves, Specialties, etc.				12,287		17,524	29,811
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
ROAD WORK & CIVIL SITE PREP				—		35,000	35,000
Bldg Cond Return Systems				2196		17,168	19,364
Stm Plant Cond Coll. Syst.				1432		5350	6782
Makeup Water Softeners				366		2000	2366
FOUNDATIONS				—		166,100	166,100
ELECTRICAL				158,000		158,000	316,000
Instr. & Control (misc.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				454,991		857,336	1,312,327
LABOR BURDEN	22%			100,098		—	100,098
SALES TAX	5%			—		42,867	42,867
SUB-TOTAL							1,455,292
OVERHEAD & PROFIT	25%						363,823
BOND	1%						18,191
SUB-TOTAL							1,837,306
Boilers, Auxiliaries, Fuel Handling Equip., etc	(Lump Sum Installed)						1,825,000
ENGINEERING & DESIGN	6%						~~219,738~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~$ 3,882,044~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) U.S. GOVERNMENT PRINTING OFFICE 1959 O-516140

$ 3,662,306

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD - SOUTH BASE
"OPTION 2" Elec. CONSUMPTION
DESIGNER S COWEN
CHECKER

AEP NO. 0U1662000
SHEET ____ OF ____
DATE
DATE

	AVG SYSTEM HOURLY DEMAND #121	#319	TOTAL	TOTAL Hourly SYSTEM DEMAND INCLUDING 101, 103, 113, & S-142 (1)	BLR SIZE	KW	KWH
JAN	3945	6886	10831	12812	15,000	92	68448
FEB	3781	7411	11192	13239	15,000	92	61824
MAR	2823	5226	8049	9521	15,000	92	68448
APRIL	1601	3431	5032	5952	8,000	64	46080
MAY	1109	574	1683	1991	8,000	43	31903
JUNE	479	—	479	567	8,000	43	30874
JULY	—	—	—	—	—	—	—
AUG	—	—	—	—	—	—	—
SEPT	—	—	—	—	—	—	—
OCT	1109	1294	2403	2843	8000	51	38093
NOV	2533	3077	5610	6636	8000	64	46080
DEC	3365	6227	9592	11346	15000	92	68448

TOTAL 460,198 KWH

(1) BASED ON EXISTING FUEL RECORDS FOR 121 & 319, PLUS Allowance for 101, 103, 113 & S-142 based on Ratio of 101+103+113+S142+CENTRAL PLANT PEAK (2958) TO EXISTING 121 & 319 PEAK (16172) = 0.1829

15000 #/HR BLR	92 KW	8000 #/HR BLR	64 KW
0-3750	62 KW	0-2000	43 KW
3750-7500	74 KW	2000-4000	51 KW
7500+	92 KW	4000+	64 KW

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA - CENTRAL COAL PLANT
AEP NO: 8011-000
SHEET ___ OF ___
DESIGNER: J. MCMILLIN
DATE
CHECKER
DATE

YEARLY FUEL USAGE

SOUTHBASE

BLDG	GAL #2 F.O.	GAL #6 F.O.	Fuel Usage Before Setback (MBtu)	Setback Savings (MBtu)	Fuel Usage After Setback (MBtu)
121	—	120,000	18,000	8720	9280
319	—	202,300	30,345	16,830	13,515
101	8000	—	1110	170	940
103	9200	—	1276	—	1276
113	17,100	—	2372	1330	1042
S-142	16,200	—	2247	1460	787
				TOTAL	26,840 MBtu/yr
			OR	#6 F.O.	22,795 MBtu/yr
				#2 F.O.	4045 MBtu/yr

#2 F.O. $\left(138,700 \text{ Btu/gal}\right)\left(\frac{\# \text{gal}}{\text{yr}}\right)\left(\frac{\text{MBtu}}{10^6 \text{ Btu}}\right) = \text{MBtu/yr}$

#6 F.O. $\left(150,000 \text{ Btu/gal}\right)\left(\frac{\# \text{gal}}{\text{yr}}\right)\left(\frac{\text{MBtu}}{10^6 \text{ Btu}}\right) = \text{MBtu/yr}$

COAL USAGE

$$\left(\frac{26,840 \text{ MBtu}}{\text{yr}}\right)\left(\frac{10^6 \text{ Btu}}{\text{MBtu}}\right)\left(\frac{\text{lb}}{12,500 \text{ Btu}}\right)\left(\frac{\text{ton}}{2000 \text{ lbs}}\right) = 1074 \text{ ton/yr}$$

@ $54/TON = $57996 DEC 1980 COST

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$23,150
2. BOILER PLANT OPERATOR	4	$21,038	$84,152
3. COAL EQUIPMENT OPERATOR	1	$21,038	$21,038
4. HEATING EQUIPMENT MECHANIC	2	$21,038	$42,076

TOTAL = $170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 97051
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 267467

REPLACEMENT COST AFTER 25 YEARS

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS	BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)	
LOCATION: SENECA ARMY DEPOT - SOUTH BASE		
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT	ESTIMATOR	CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				255,736		407,968	663,704
Valves, specialties, etc.				12,287		17,524	29,811
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
Bldg Cond Return Systems				2196		17,168	19,364
Stm Plant Cond Coll. Syst.				1432		5350	6782
Makeup Water Softeners				366		2000	2366
Electrical				158,000		158,000	316,000
Instr. & Control (misc.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				454,991		656,236	1,111,227
LABOR BURDEN	22%			100,098		—	100,098
SALES TAX	5%			—		32,812	32,812
SUB-TOTAL							1,244,137
OVERHEAD & PROFIT	25%						311,034
BOND	1%						15,552
SUB-TOTAL							1,570,723
Boilers, Auxiliaries, Fuel Handling Equip., etc	(Lump Sum Installed)						1,356,000
TOTAL ESTIMATED 25TH YEAR REPLACEMENT COST (DEC 1980 $)							$ 2,926,723

ENG FORM 1 AUG 59 150 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) U.S. GOVERNMENT PRINTING OFFICE

REPLACEMENT OF EXISTING PIPING - 1996 / 2021

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: J. McMILLIN

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
4" sch 40, insulated	845	FT	*8.12	6861	19.06	16,106	
3" sch 40, "	2015	FT	*6.44	12977	15.51	31,253	
2 1/2" sch 40, "	1040	FT	*5.84	6074	12.01	12,490	
2" sch 40	1690	FT	*2.88	4867	9.29	15,700	
1 1/2" sch 80	195	FT	*2.63	513	9.10	1775	
1 1/4" sch 80	1495	FT	*2.63	3932	9.10	13,605	
SUBTOTALS				35224		90,929	126153
UNDERGROUND PIPING							
EXCAVATION & BACKFILL	2510	Ft	6.32	15863	—	—	
8" sch 40, insulated	845	FT	11.28	9532	40.80	34,476	
6" sch 40,	923	FT	9.02	8325	31.04	28,650	
5" sch 40	195	FT	9.02	1759	31.04	6053	
3" sch 40	2743	FT	5.20	14264	15.51	42,544	
2 1/2" sch 40	325	FT	4.73	1537	12.01	3903	
2" sch 40	845	FT	2.28	1927	9.29	7850	
1 1/2" sch 80	650'	FT	2.07	1346	9.10	5915	
SUB TOTALS				54553		129,391	183944
PLUS				35224		90,929	
SUBTOTAL				89777		220,320	310097
LABOR BURDEN	22%			19751		—	19751
SALES TAX	5%			—		11,016	11,016
SUBTOTAL							340864
OVERHEAD & PROFIT	25%						85216
BOND	1%						4260
TOTAL REPLACEMENT COST (1980 $)							430340

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) * U.S. GOVERNMENT PRINTING OFFICE

* INCLUDES ADDITIONAL 50% FOR DEMOLITION OF EXISTING PIPING

SOUTH BASE.

Existing distribution piping take-off.

Overhead piping

Size	length	Plus 20% loops	Plus 10% fitting	TOTAL
2½"	800'	160	80	1040
2"	1300	260	130	1690
1¼"	1150	230	115	1495
1½"	150	30	15	195
3"	1550	310	155	2015
4"	650	130	65	845

Use 1½" unit prices for 1¼" pipe

Underground piping - assume in trenches

Size	length	Plus 20% loops	Plus 10% fittings	TOTAL
8"	650	130	65	845
6"	710	142	71	923
3"	2110	422	211	2743
2½"	250	50	25	325
2"	650	130	65	845
5"	150	30	15	195
1½"	500	100	50	650

Use 6" unit prices for 5" pipe

PIPE SIZE/ SCH	PIPE COST ($/20')	INSULATION COST ($/20')*	LABOR COST			TOTAL COST			
			WELDING	FITTING (Per 20')		Per 20'		Per Ft	
			Per Joint	Overhead	In Trench	Overhead	In Trench	Overhead	In Trench
1/80	36.38	121.00	24.01	15.44	13.40	196.83	194.79	9.84	9.74
1½/80	54.39	127.60	26.30	17.42	15.13	225.71	223.42	11.29	11.17
2/40	44.68	141.20	28.59	19.41	16.86	233.88	231.33	11.69	11.57
2½/40	57.68	182.60	75.47	21.88	19.03	337.63	334.78	16.88	16.74
3/40	72.80	237.40	82.33	24.86	21.62	417.39	414.15	20.87	20.71
4/40	103.48	277.80	105.20	29.84	25.94	516.32	512.42	25.82	25.62
6/40	178.33	442.40	144.08	41.77	36.32	806.58	801.13	40.33	40.06
8/40	257.99	558.00	178.39	52.22	47.13	1046.60	1041.51	52.33	52.08
10/40	356.54	656.00	214.98	70.14	60.97	1297.66	1288.49	64.88	64.42

NOTES

1. Cost does not include
   a) Pipe Rack or Trench
   b) Fittings and Valves
   c) Contingency, bond or sales tax
   d) Protective Conduit
2. Cost of Labor to Owner
   a) Pipefitter 21.62 $/hr
   b) Welder 22.87 $/hr
3. Insulation Cost includes

SOURCES

1. Pipe Cost - Manufacturer quote*
2. Insulation Cost - 1979 Richardson's
3. Pipe fitting and Welding - Man-hours from 1979 Richardson's
   a) 1" thru 2" Socketweld and 2½" up Buttweld
   b) 1" and 1½ are A-106, 2" and up are A-53

SENECA SOUTH BASE

1. McBURNEY CORP. THREE (3) B&W FM TYPE STEAM GENERATORS, TWO (2) RATED AT 15,000 lb/HR AND ONE (1) RATED AT 8,000 lb/HR, EACH FIRED ON STOKER SIZE (1¼x0) 12,500-13,000 BTU/lb EASTERN BITUMINOUS COAL, AT 50 psig, SAT; complete with: Boilers, boiler trim, combustion controls, deaerator, boiler feed pumps (3), Ash removal system, baghouse, stacks, fuel handling EQUIPMENT including three (3) 50-TON storage silo's, in-ground truck unloading hopper WITH A screw feeder, bucket elevator, insulated prefabricated building AND enclosure. $1,800,000

ADD TO McBURNEY QUOTE

80' Long Drag Chain Conveyor & two 12"x12" Gate valves $ 31,650

TOTAL McBURNEY COST $1,831,650

2. HURST BOILER COMPANY THREE (3) HRT STEAM GENERATORS, two (2) rated at 15,525 lb/HR AND ONE (1) rated at 8625 lb/HR, to be fired on stoker size 12,500-13,000 BTU/lb Eastern BITUMINOUS COAL, at 50 psig, saturated; complete with: boilers, boiler trim, stokers, feed hoppers, combustion & pollution control equipment, cond. return system, boiler feed pumps (3); DOES NOT INCLUDE COAL UNLOADING & HANDLING EQUIPMENT, structural steel, deaerator, or the building enclosure $1,200,000

ADD TO HURST QUOTE

DEAERATOR: $15,000

MATERIAL HANDLING EQUIPMENT: $127,200

Bldg. Enclosure & Structural: $469,000

TOTAL HURST COST $1,811,200

McBURNEY COST:	$ 1,831,650
HURST COST:	$ 1,811,200
AVERAGE COST =	$ 1,821,425

USE $ 1,825,000

Approximate the sizes of the motors ASSOCIATED WITH THE Boiler PLANT

Boiler CAPACITY - 15,000 #/HR (Also, calculate for 8800 #/HR)

Fuel to be burned - Eastern Bituminous, 12500-13000 BTU/lb, Vol. Matter ~ 30-35%

Theoretical Air Req'd - Approx. 7.6 #/10,000 BTU's FUEL

At 50 psig, SAT steam output & 5 psig, sat feedwater input, $\Delta h = 982.83$ BTU/lb

$$\text{Fuel Req'd} = \frac{15{,}000\ \#/\text{HR} \times 982.83\ \text{BTU/lb}}{.70\ (\text{Assumed efficiency})} = 21.1 \times 10^6\ \frac{\text{BTU's}}{\text{HR}}$$

$$\text{Theoretical Air Req'd} = \frac{7.6\ \#}{10{,}000\ \text{BTU}} \times 21.1 \times 10^6\ \frac{\text{BTU}}{\text{HR}} = 16{,}000\ \text{lb/HR}$$

Assume 30% excess AIR

TOTAL AIR REQ'D = 16,000 x 1.3 = 20,800 lb/HR

Assume OFA FAN PROVIDES 15% = 3120 #/HR
FD FAN Provides 85% = 17,680 #/HR
ID FAN Handles 100% = 20,800 #/HR

OFA FAN Assume 60 F Temp in boiler house ⇒ $\rho = .0764\ \frac{\#}{Ft^3}$
Assume $\Delta P = 15"$ w.g.

$$\text{Flow} = \frac{3120\ \#/\text{HR}}{.0764\ \#/\text{Ft}^3 \times 60\ \text{MIN/HR}} \times 1.2\ (\text{Safety factor}) = 816.8\ \text{CFM}$$

$$Hp = \frac{0.0158 \times 816.8 \times 15}{67.5} = 2.87 \times 1.15 \text{ (SERVICE FACTOR)}$$

$$= 3.3$$

USE 5 Hp MOTOR ✓

FD FAN $\rho = .0764$ #/Ft³ $\Delta P = 15$"

$$Flow = \frac{17680}{.0764 \times 60} \times 1.2 = 4628 \text{ CFM}$$

$$Hp = \frac{.0158 \times 4628 \times 15}{67.5} = 16.25 \times 1.15 = 18.69 \text{ Hp}$$

USE 20 Hp MOTOR ✓

ID FAN ASSUME Temp = 350 F ⇒ $\rho = 0.0490$ #/Ft³
$\Delta P = 20$"

$$Flow = \frac{20,800}{.0490 \times 60} \times 1.2 = 8490 \text{ CFM}$$

$$Hp = \frac{0.0158 \times 8490 \times 20}{67.5} = 39.7 \times 1.15 = 45.7 \text{ Hp}$$

USE 50 Hp Motor ✓

BOILER CAPACITY ~ 8,000 #/HR

$$\text{Fuel REQ'D} = \frac{8{,}000\ \#/\text{HR} \times 982.83\ \text{BTU/lb}}{.70} = 11.23 \times 10^6\ \frac{\text{BTUS}}{\text{HR}}$$

$$\text{Theoretical Air REQ'D} = \frac{7.6\ \#}{10^4\ \text{BTU}} \times 11.23 \times 10^6\ \frac{\text{BTU}}{\text{HR}} = 8536\ \text{lb/HR}$$

ASSUME 30% EXCESS AIR

$$\text{TOTAL AIR REQ'D} = 8536 \times 1.3 = 11{,}100\ \#/\text{HR}$$

ASSUME OFA FAN PROVIDES 15% = 1665 #/HR
FD FAN PROVIDES 85% = 9435 #/HR
ID FAN HANDLES 100% = 11,100 #/HR

OFA FAN ASSUME 60 F TEMP ⇒ $\rho = .0764\ \#/\text{FT}^3$
$\Delta P = 15''$

$$\text{Flow} = \frac{1665}{.0764 \times 60} \times 1.2 = 435.9\ \text{CFM}$$

$$\text{Hp} = \frac{.0158 \times 435.9 \times 15}{67.5} = 1.53 \times 1.15 = 1.76\ \text{Hp}$$

USE 2 Hp MOTOR ✓

FD FAN $\rho = .0764$ $\Delta P = 15''$

$$\text{Flow} = \frac{9435}{.0764 \times 60} \times 1.2 = 2469.9\ \text{CFM}$$

$$Hp = \frac{.0158 \times 2469.9 \times 15}{67.5} = 8.67 \times 1.15 = 9.97\ Hp$$

USE 10 Hp MOTOR ✓

ID FAN Assume 350 F ⇒ $\rho = .0490\ \#/Ft^3$
$\Delta P = 20''$

$$Flow = \frac{11{,}100}{.0490 \times 60} \times 1.2 = 4530.6\ CFM$$

$$Hp = \frac{.0158 \times 4530.6 \times 20}{67.5} = 21.2 \times 1.15 = 24.4\ Hp$$

USE 25 Hp Motor ✓

Boiler Feed Pumps

Size Each Pump for MAX PEAK demAND = 19,130 #/HR
= 38 GPM

$$\text{HEAD REQ'D} = (50\ psig - 5\ psig) \times 2.448 + 20' = 130.2'$$

$$\text{Hp REQ'D} = \frac{38\ GPM \times \frac{130.2}{2.448}}{1714 \times .65} = 1.8 \times 1.15 = 2.1$$

USE 3 Hp MOTORS ✓

CONDENSATE TRANSFER PUMPS

SIZE EACH PUMP FOR MAX PEAK DEMAND = 38 GPM

HEAD REQ'D = $\frac{5 \text{ PSIG} \times 2.395}{.8} + 20' = 32'$

Hp REQ'D = $\frac{38 \times \frac{32}{2.395}}{1714 \times .65} = 0.46 \times 1.15 = 0.52$ Hp

USE 3/4 Hp MOTOR ✓

MATERIAL HANDLING EQUIPMENT

SCREW FEEDER AT TRUCK UNLOADING HOPPER ~ 5 Hp
BUCKET ELEVATOR ~ 15 Hp
DRAG CHAIN CONVEYOR ~ 10 Hp

COAL SCREW FEEDER, 1 PER BOILER ~ 10 Hp
ASH SCREW FEEDER, 1 PER BOILER ~ 5 Hp

SUMMARY

	(2) 15,000 #/HR	8,000 #/HR	TOTAL Hp IN BOILER PLANT
OFA FAN	5	2	12 Hp
FD FAN	20	10	50 Hp
ID FAN	50	25	125 Hp
BOILER FEED PUMPS	3	3	9 Hp
COND. TRANSFER PUMPS	3/4	3/4	1½ Hp
SCREW FEEDER	5	5	5 Hp
BUCKET ELEVATOR	15	15	15 Hp
DRAG CHAIN CONVEYOR	10	10	10 Hp
COAL SCREW FEEDER	10	10	30 Hp
ASH SCREW FEEDER	5	5	15 Hp

ELECTRICAL REQUIREMENTS

CASE	MAXIMUM [(2) 15,000 lb/HR (1) 8,000 lb/HR]	PEAK [(1) 15,000 lb/HR (1) 8,000 lb/HR]	AVG HOURLY [(1) 15,000 lb/HR]
OFA FAN	12 Hp	7 Hp	5 Hp
FD FAN	50	30	20
ID FAN	125	75	50
BFP'S	9	6	3
COND TR PUMPS	1 1/2	1 1/2	3/4
COAL SCREW FDR	30	20	10
ASH SCREW FDR	15	10	5
HOPPER SCREW	5	5	5
BUCKET ELEV.	15	15	15
DRAG CHAIN CONV.	10	10	10
TOTAL Hp	272.5	179.5	123.75
TOTAL Kw	203.2	133.9	92.3

SENECA-SOUTH BASE

AVERAGE Hourly DEMAND = 13,478 lb/HR

Steam at 50 psig, SAT. ⇒ h = 1179.1 BTU/lb
Condensate at 5 psig, SAT ⇒ h = 196.3 BTU/lb
} $\Delta h = 982.8 \frac{BTU}{lb}$

ASSUME BOILER EFFICIENCY = 70%

$$\text{HEAT INPUT REQ'D} = \frac{13{,}478 \text{ lb/HR} \times 982.8 \text{ BTU/lb}}{.70} = 18{,}923{,}112 \text{ BTU/HR}$$

ASSUME 13,000 BTU/lb COAL

$$\text{COAL REQ'D} = \frac{18{,}923{,}112 \text{ BTU/HR}}{13{,}000 \text{ BTU/lb} \;\; 2000 \frac{lb}{TON}} = 0.73 \text{ TONS/HR}$$

DAILY COAL REQ'D = 24 x .73 = 17.5 TONS/DAY

* PROVIDE ON-SITE STORAGE FOR 14 DAYS = 245 TONS

$$\text{VOLUME REQ'D} = \frac{245 \text{ TONS} \times 2000 \text{ lbs/TON}}{50 \text{ lb/Ft}^3} = 9800 \text{ Ft}^3$$

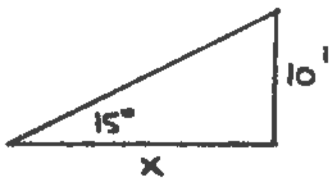
(THIS COULD BE STORED IN A SILO)

* PROVIDE ON-SITE STORAGE FOR 30 DAYS = 525 TONS

$$\text{VOLUME REQ'D} = \frac{525 \times 2000}{50} = 21{,}000 \text{ Ft}^3$$

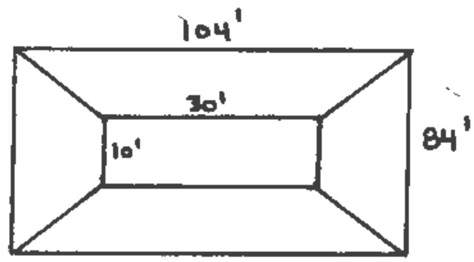
(THIS WOULD REQUIRE ON-GROUND STORAGE AND RECLAIM)

Assume Pile is shaped like Frustrum of Pyramid,
max slope on sides = 15°
max height = 10'



$\tan 15° = \frac{10}{x}$

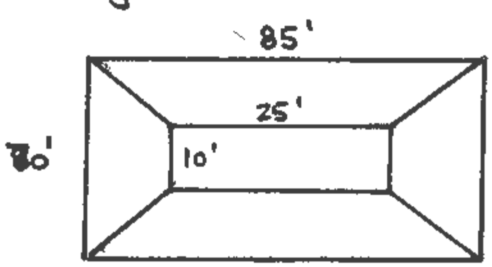
$X = 37.3'$



$V = \frac{1}{3} \times 10 \left[10 \times 30 + 84 \times 104 + \sqrt{10 \times 30 \times 84 \times 104} \right]$

$V = \frac{1}{3} \times 10 \left[300 + 8736 + 1619 \right] = 35{,}517 \text{ Ft}^3$ (Nominal 900 Tons)

Assume max height = 8 Ft



$V = \frac{1}{3} \times 8 \left[10 \times 25 + 70 \times 85 + \sqrt{10 \times 25 \times 70 \times 85} \right]$

$V = \frac{1}{3} \times 8 \left[250 + 5950 + 1220 \right] = 19{,}800 \text{ Ft}^3$ (Nominal 500 Tons)

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - SOUTH BASE

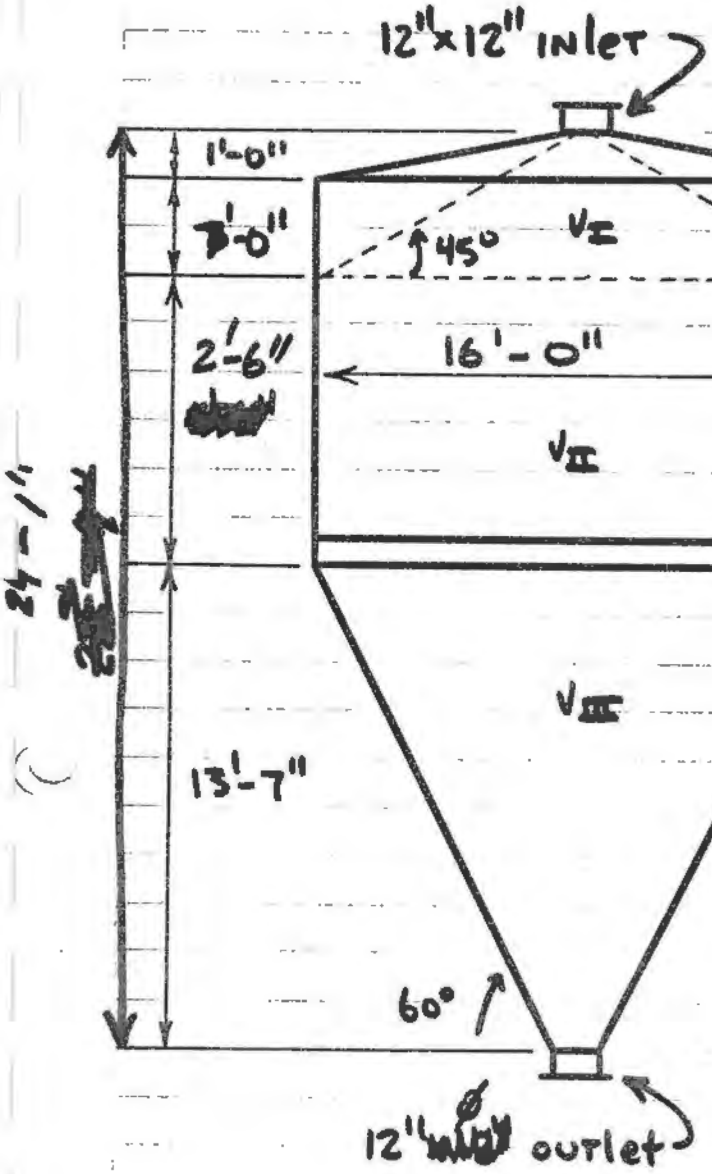
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: | ESTIMATOR: | CHECKED BY:

MATERIAL HANDLING EQUIPMENT SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
50 Ton Storage Bunker	3	EA	6200	18600	12650	37950	56550
Gate Valves 12"x12"	2	EA	45	90	780	1560	1,650
Drag-Chain Conv. 80'	80	Ft	50	4000	325	26000	30,000
Bucket Elevator 85'	85	Ft	50	4250	250	21250	25,500
Screw Feeder 10'	10	Ft	50	500	200	2000	2,500
Truck Unloading Hopper	1	EA	–	–	11,000	11,000	11,000
Sub-TOTAL							127,200
EQUIPMENT REQ'D FOR FIRING Supplemental Fuel							
10 Ton Storage Bunker	2	EA	1283	2566	3952	7904	10,470
Gate Valves 12"x12"	2	EA	45	90	780	1560	1650
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
Sub-TOTAL							

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) U.S. GOVERNMENT PRINTING OFFICE



SOUTH BASE
50 TON BUNKERS

50 TONS = 2000 Ft³ @ 50#/Ft³

$V_I + V_{II} + V_{III} = 2000$ Ft3

$V_I = \frac{1}{3}\pi R^2 h = \frac{1}{3}\pi\, 64 \times 8$

$V_I = 536.2$ Ft3

$V_{III} = \frac{1}{3}\pi h\,(R_1^2 + R_2^2 + R_1 R_2)$

$R_1 = 8'$ $R_2 = .5'$

$V_{III} = \frac{\pi}{3}(13.583)(.5^2 + 8^2 + .5 \times 8)$

$V_{III} = 970.8$ Ft3

$V_{II} = 2000 - 970.8 - 536.2$

$V_{II} = 493.0$ Ft3

$h_{II} = \dfrac{493.0}{\pi\,(8)^2} = 2.45$ Ft

$= 2'-6"$

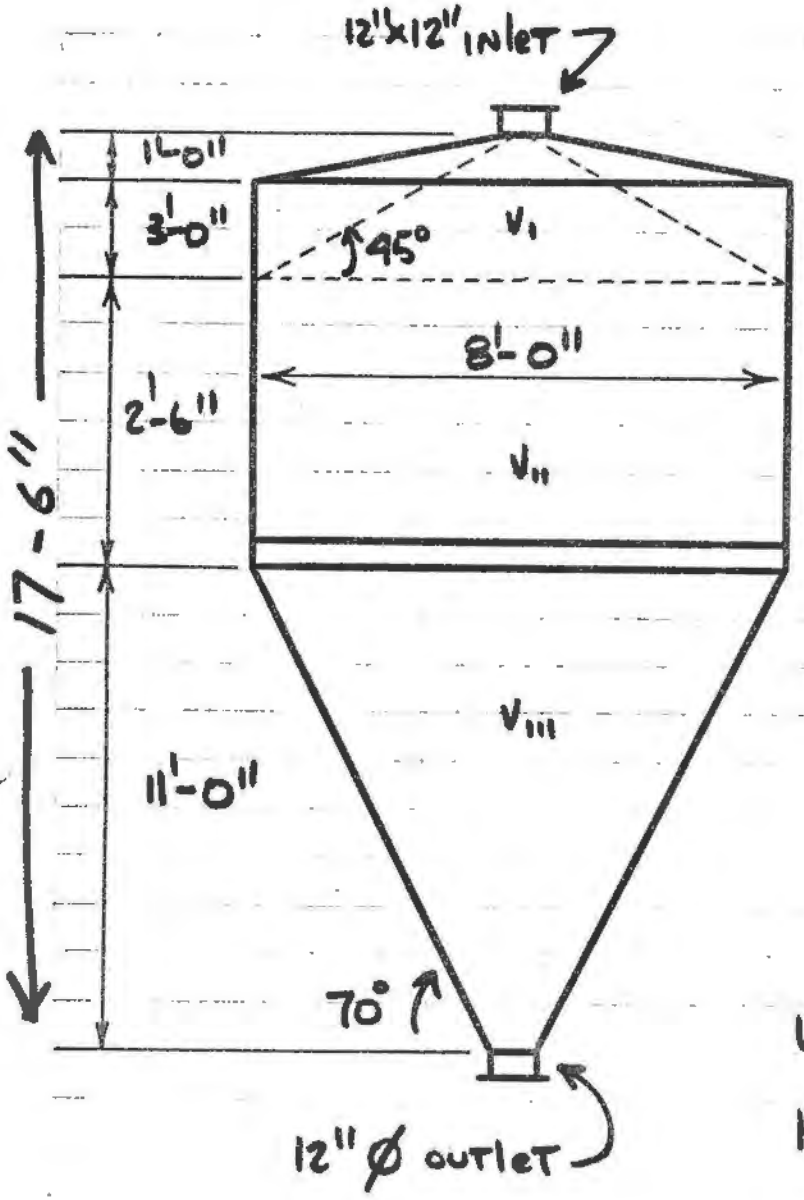
Surface Area = 1074 Ft²

$\rho = \dfrac{15.3\#}{Ft^2}$ weight = 16432.2 lbs

material cost = 16432 × \$.77/16 = \$12,650

labor cost = 16432 × \$.38/16 = \$6200

SOUTH BASE
10 TON BUNKERS



$$\frac{10\text{ TONS}}{50\ \#/Ft^3} = 400\ Ft^3$$

$$V_I + V_{II} + V_{III} = 400\ Ft^3$$

$$V_I = \frac{1}{3}\pi \frac{D^2}{4} h = \frac{\pi}{3} \times \frac{8^2}{4} \times 4 = 67.0\ Ft^3$$

$$V_{III} = \frac{1}{3}\pi h \left(R_1^2 + R_2^2 + R_1 R_2\right)$$

$$= \frac{\pi}{3} \times 11.0 \left(4^2 + .5^2 + 4 \times .5\right)$$

$$= 210.2\ Ft^3$$

$$V_{II} = 400 - 210.2 - 67 = 122.8\ Ft^3$$

$$h_{II} = \frac{122.8}{\pi \frac{(64)}{4}} = 2.44' = 2'\text{-}6''$$

Surface Area = 335.5 # $\quad \rho = 15.3\ \#/Ft^2 \quad$ weight = 5133 lbs

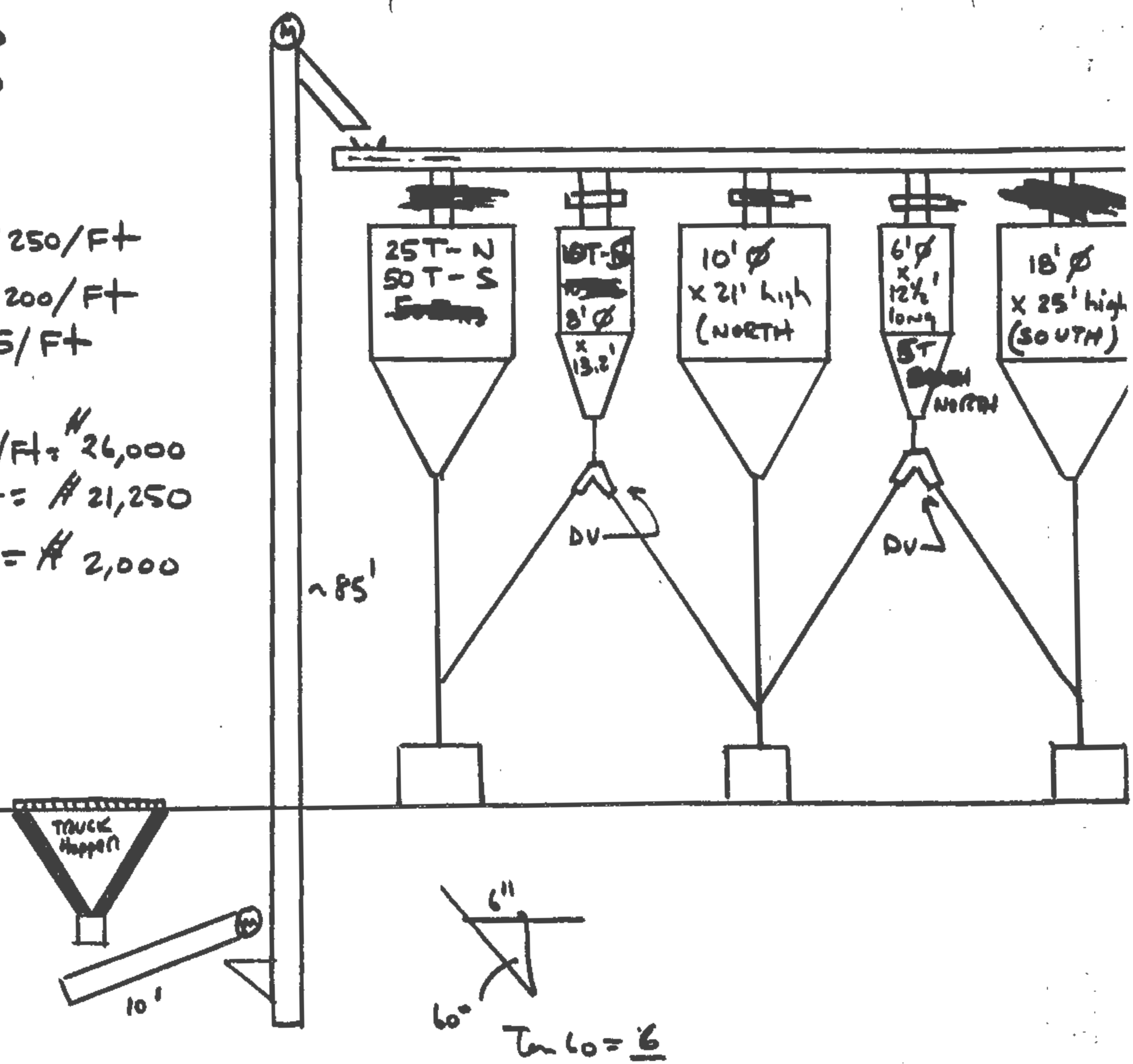
material cost = 5133 x \$.77/lb = \$3952

labor cost = 5133 x \$.23/lb = \$1283

North Base 8 TPD
South Base 17 TPD

Budgetary Cost
: Bucket Elevator # 250/Ft
Screw Conveyor # 200/Ft
: Drag Chain # 325/Ft

Drag Chain 80' x # 325/Ft = # 26,000
Bucket 85' x 250/Ft = # 21,250
Screw 10' x 200/Ft = # 2,000
iate Values
Truck hopper



SENECA ARMY DEPOT — SOUTH BASE

BOILERS, AUXILIARIES, FUEL HANDLING EQUIPMENT, ENCLOSURE, ETC.	$ 1,825,000
BREAKOUT COST FOR BOILERS (50%)	$ 913,000
BREAKOUT COST FOR STRUCTURAL & ENCLOSURE	$ 469,000
SUB-TOTAL	$ 443,000
ADD FOR: STEAM PLANT COND. SYSTEM	$ 6782
WATER SOFTENERS	$ 2366
MISC. INSTR. & CONTROL	$ 20100
MECHANICAL EQUIP. TOTAL =	$ 472,248

Rule of Thumb → Electrical Installation Cost approximately 67% of cost of MECH EQUIPMENT, 50/50 labor/MAT.

USE: Electrical Labor = $ 158,000
" Material = $ 158,000

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT: SENECA ARMY DEPOT
SOUTH BASE
DESIGNER: S COWEN
CHECKER:

AEP NO: 60122-000
SHEET ____ OF ____
DATE:
DATE:

MAKEUP WATER SOFTENERS

Size Softeners for 20% of maximum boiler capacity

38,000 lb/HR = 76 GPM x .2 = 15.2 GPM

USE DUPLEX AUTOMATIC UNIT

EQUIPMENT COST: $ 2000

labor to install = 16 hrs @ 22.87 = $ 365.92

CONDENSATE TRANSFER PUMPS

SIZE FOR 50% OF TOTAL BOILER CAPACITY

38,000 lb/HR = 76 GPM x .5 = 38 GPM

CAPACITY : 40 GPM
HEAD : 5 PSIG x 2.395 + 20' = 32'

$$\text{MOTOR Hp} = \frac{40 \times \frac{32}{2.395}}{1714 \times .70} = 0.445$$

1.15 S.F. x .445 = 0.512

USE 3/4 Hp MOTOR

TOTAL COST, PUMP & MOTOR $1500

labor for installation : 16 hrs @ 22.87 = $366

TOTAL STM PLANT COND, COLLECT SYST

	MAT	LABOR
PUMPS (2)	3,000	~~366~~ 732
TANK	2350	700
TOTAL	~~3850~~ $5350	~~1066~~ $1432

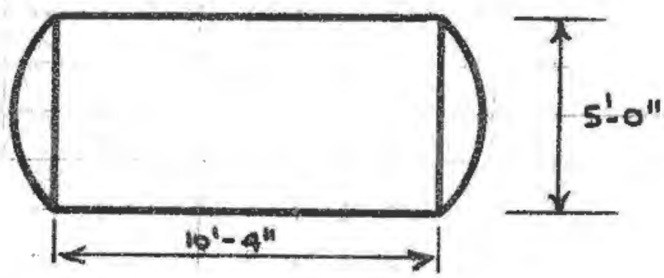
Condensate Collection Tank

Size tank to hold minimum of 20 minute capacity of all three (3) boilers, at mid-level of tank:

$38{,}000\ \text{lb/HR} = 76\ \frac{\text{GAL}}{\text{MIN}} \times 20\ \text{MIN} = 1520\ \text{Gallons}$

USE 5' Ø TANK

$$\text{LENGTH} = \frac{1520\ \text{Gal}}{7.48\ \frac{\text{GAL}}{\text{Ft}^3} \times \frac{\pi (5)^2}{4}} = 10.3'$$



Assume 3/8" Pl

Surface Area = πDL + DISHED HEADS
= 161.8 ft² + D.H.
say 200 Ft²

$\rho = 15.3\ \text{lb/Ft}^2$ WEIGHT = 3060 lbs

For budgetary cost Carbon Steel, use \$1.00/lb installed (\$.77/lb material, \$.23/lb labor)

material: 3060 × .77 = \$2350

labor: 3060 × .23 = \$700

REYNOLDS, SMITH AND HILLS
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INCORPORATED

SUBJECT: SENECA ARMY DEPOT
SOUTH BASE
DESIGNER: S. COWEN
CHECKER:

AEP NO. [illegible]
SHEET ____ OF ____
DATE
DATE

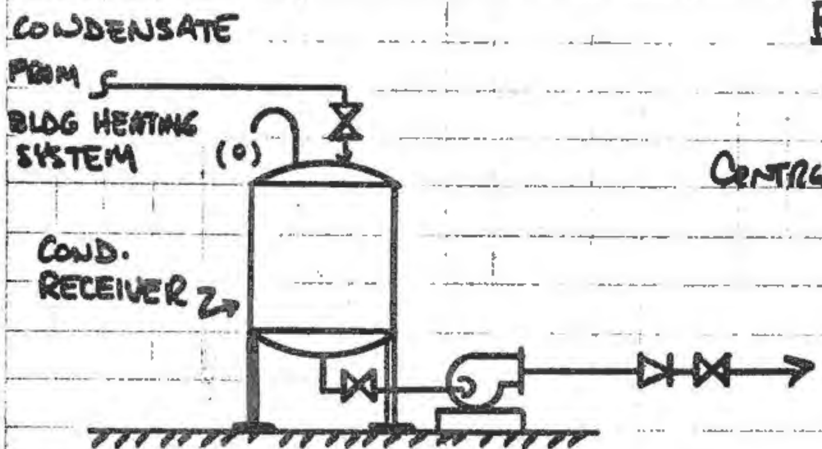
CONDENSATE RETURN SYSTEMS

MATERIAL PRICES: QUOTED BY AURORA PUMP CO.

Labor prices: Assume 16 hrs at $22.87/HR to install Pump, Tank, valves, vent, local piping, etc.

	MATERIAL	LABOR
BLDG 103	$ 2317	$ 366
101	2317	366
S-142	2317	366
121	3300	366
113	2317	366
319	4600	366
TOTALS	$ 17168	$ 2196

CONDENSATE RETURN SYSTEMS



CONDENSATE RETURN
TO CENTRAL COAL PLANT

3530'

BLDG 103
EL 755'

CENTRAL PLANT 740'

Assume Δh = 2'/100'

Friction head = 71'

Flow = 1 GPM (5 GPM Pump)

Hd @ C.P. = 8 15' + 5 PSIG × 2.395 = 27'

Pump TDH = 27' + 71' + (740 − 755) = 83' say 90'

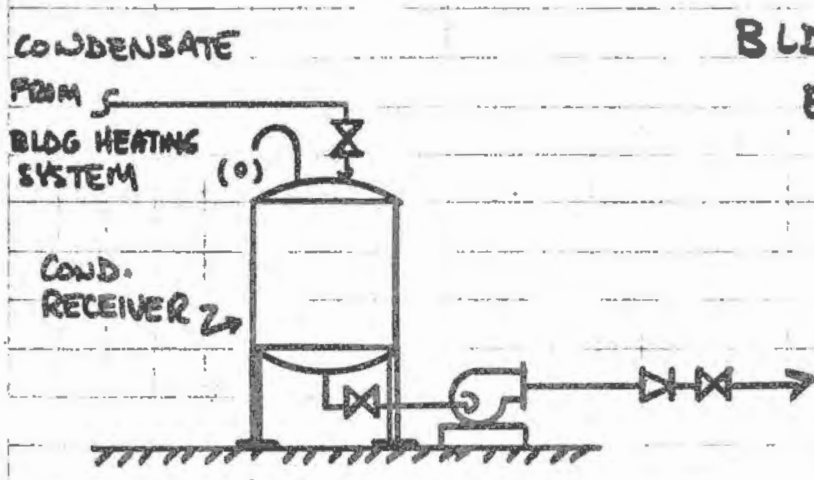
$$Hp = \frac{5\,GPM \times \frac{90}{2.395}}{1714 \times .7} = 0.16\ Hp$$

× 1.15 SF = 0.18 Hp

1/4 Hp MOTOR

AURORA E4T-1.5
30 gallon TANK
$ 2317 EA

CONDENSATE RETURN SYSTEMS



BLDG 101
EL 755'

3110'

Assume Δh = 2'/100'

friction head = 63'

flow = .8 GPM (5 GPM Pump)

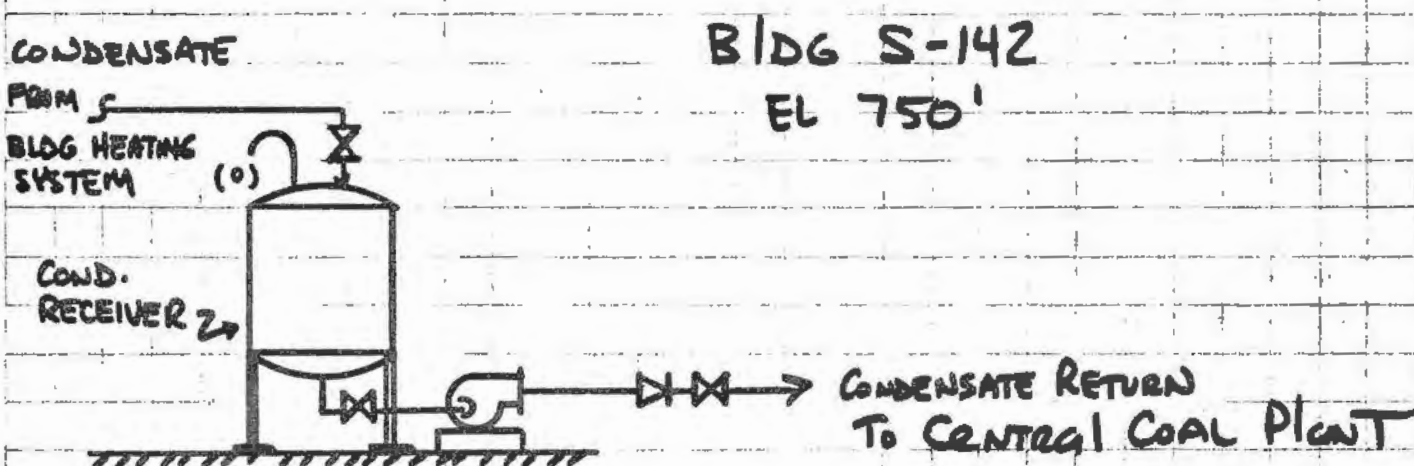
HD @ C.P. = 27'

Pump TDH = 63' + 27' + (740 - 755) = 75'

1/4 Hp motor

AURORA E4F1.5
30 gal TANK
2317

CONDENSATE RETURN SYSTEMS



2770'

Assume Δh = 2'/100'

friction head = 55'

Flow = 1½ GPM (5 GPM Pump)

Hd @ C.P. = 27'

Pump TDH = 55 + 27 + (740 − 750) = 72'

1/4 Hp Motor

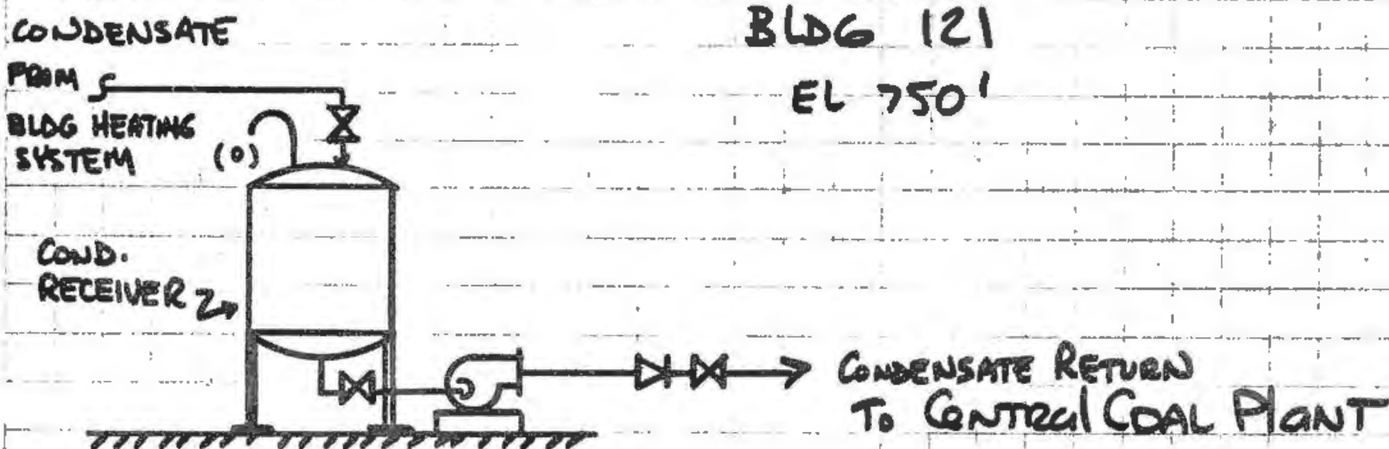
AURORA E4T-1.5
30 gal TANK
2317

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA ARMY DEPOT SOUTH BASE | AEP NO. 80122-000
SHEET ___ OF ___
DESIGNER ___ DATE ___
CHECKER ___ DATE ___

CONDENSATE RETURN SYSTEMS

BLDG 121
EL 750'



2620'

Assume $\Delta h = 2'/100'$

friction head = 53'

flow = 12 GPM (15 GPM Pump)

Hd @ C.P. = 27'

Pump TDH = 53 + 27 + (740 - 750) = 70'

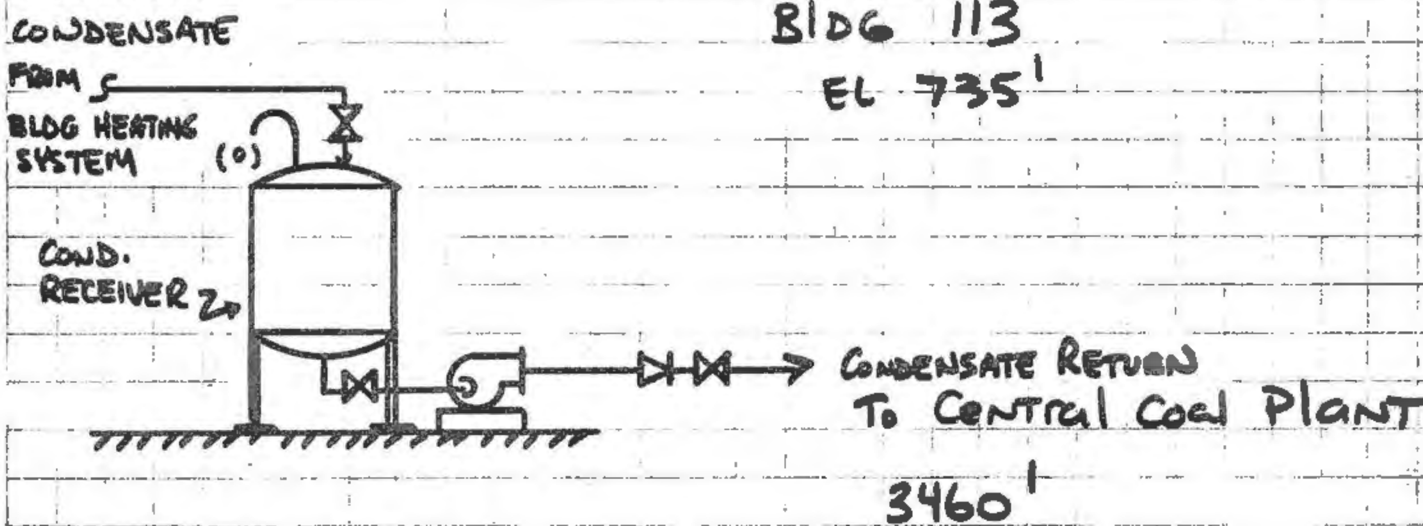
~~1/4 Hp Motor~~

~~AURORA LS-75~~
AURORA KS-5
150 gal TANK
\$3300

$$Hp = \frac{15 \times \frac{70}{2.395}}{1714 \times .7} \times 1.15\ S.F. = .42$$

1/2 Hp Motor

CONDENSATE RETURN SYSTEMS



BLDG 113
EL 735'

Assume $\Delta h = 2'/100'$

friction head = 70'

flow = 1½ GPM (5 GPM pump)

HD @ C.P. = 27'

Pump TDH = 70' + 27' + ~~740~~ (740-735) = 102'

Say 110'

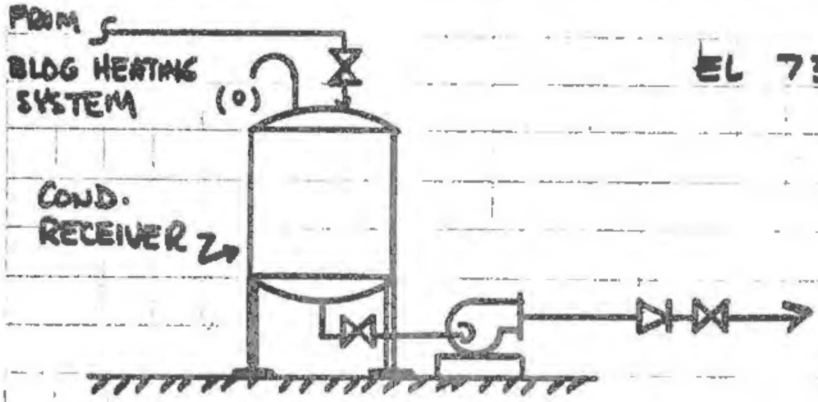
1/4 Hp motor

Aurora E4T-1.5
30 gal TANK
2317

CONDENSATE RETURN SYSTEMS

BLDG 319

EL 735'



420'

Assume $\Delta h = 2'/100'$

Friction head = 9'

Flow = 21 GPM (25 GPM Pump)

HDe CP = 27'

Pump TDH = 27' + 9' + (740 − 735) = 41'

Say 50'

$$Hp = \frac{25\ GPM \times \frac{50}{2.395}}{1714 \times .7} = 0.44$$

× 1.15 S.F. = .50

USE 1/2 Hp Motor

AURORA L5-7.5
250 gal TANK
4600

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
SITE IMPROVEMENTS							
GRADING	1.6	AC	–	–	3125	5000	5000
PAVING	2000	SY	–	–	15	30,000	30,000
TOTAL						35,000	35,000

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT [illegible] COAL PLANT
DESIGNER J. McMILLIN
CHECKER

AEF NO [illegible]
SHEET 1 OF
DATE 19 DEC 80
DATE

PLANT BATHROOM FACILITIES

Bathroom to include 2 water closets, 2 showers, 3 lavatories and a drinking fountain

EST. COST

LABOR $4500
MATL. 3500
$8000 TOTAL

ADD $ 750 material } for Roomsize A/C & ventilator for control Room
$ 250 labor

HVAC & PLUMBING

labor $ 4750
material $ 4250

TOTAL $ 9,000

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY: NO. UNITS	QUANTITY: UNIT MEAS.	LABOR: PER UNIT	LABOR: TOTAL	MATERIAL: PER UNIT	MATERIAL: TOTAL	TOTAL COST
TRUCK SCALES							
60×10/60 TON/4 SECTION TRUCK SCALE complete WITH: 90-7300/3100 DIGITAL INSTR. AND DOT MATRIX PRINTER, 2-MANHOLES RINGS & COVERS, TYPE REGISTER BEAM, SHORT IRON & PILLAR, SURGE VOLTAGE PROTECTION						$21026	$21026
INSTALLATION, INCLUDING PIT				$11,074			$11,074
TOTAL							$32,100

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE | DATE PREPARED | SHEET OF

PROJECT
ENERGY ENGINEERING ANALYSIS

LOCATION SOUTH BASE- MAIN SYSTEM INCLUDING BLDGS 101, 103, S-142 & 113

ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
☐ CODE A (No design completed)
☐ CODE B (Preliminary design)
☐ CODE C (Final design)
☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
8" sch 40 CONDUIT	2134	Ft	19.62	41869	55.50	118437	160306
6" sch 40 CONDUIT	1190	Ft	17.70	21063	45.00	53550	
3" sch 40 Conduit	528	Ft	14.11	7450	27.75	14652	
2½" sch 40 CONDUIT	1746	Ft	13.81	24112	26.25	45833	
2" sch 40 Conduit	938	Ft	12.92	12119	19.50	18291	
8" elbows	32	EA	196.20	6278	327.00	10464	
6" elbows	27	EA	177.00	4779	260.00	7020	
3" elbows	8	EA	141.10	1129	178.00	1424	
2½" elbows	24	EA	138.10	3314	162.00	3888	
2" elbows	25	EA	129.20	3230	134.00	3350	
2½" conduit sch 40	486	Ft	13.81	6712	26.25	12758	
2" sch 40 Conduit	2544	Ft	12.92	32868	19.50	49608	
1½" sch 80 Conduit	500	Ft	12.12	6060	20.25	10125	
1" sch 80 Conduit	2638	Ft	12.12	31973	18.00	47484	
2½" elbows	12	EA	138.10	1657	162.00	1944	
2" elbows	30	EA	129.20	3876	134.00	4020	
1½" elbows	4	EA	121.20	485	110.00	440	
1" elbows	45	EA	121.20	5454	104.00	4680	
ECAVATION & BACKFILL	6536	Ft	6.32	41308	—	—	
SUBTOTAL				255,736		407,968	663,704

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

PIPING TAKEOFF   Condensate system

2½" PIPE   420' + 1 Lp @ 12 + 1 Lp @ 14 = 446' + 40' = 486'
2½ Elbows   4 x Lp + 4 = 12

2" PIPE   1830' + 4 Lp @ 18 = 1902'
2" elbows   4 x Lp + 2 = 18

1" PIPE   1650' + 3 Lp @ 16 + 1 Lp @ 20 = 1718'
1" elbows   4 x Lp + 4 = 20

2" PIPE   ~~420~~ 610' + 1 Lp @ 14 + 1 Lp @ 18 = ~~[illegible]~~ = 642'
2" elbows   4 x Lp + 4 = 12

1½" PIPE   480' + 1 Lp @ 20 = 500'
1½" elbows   4 x Lp = 4

1" PIPE   870' + 2 Lp @ 16 + 1 Lp @ 8 + 1 Lp @ 10 = 920'
1" elbows   4 x Lp + 9 = 25

SUMMARY

STEAM

	CONDUIT	Elbows
8"	2134'	32
6"	1190'	27
3"	528'	8
2½"	1746'	24
2"	938'	25
TOTAL 5"	6536'	

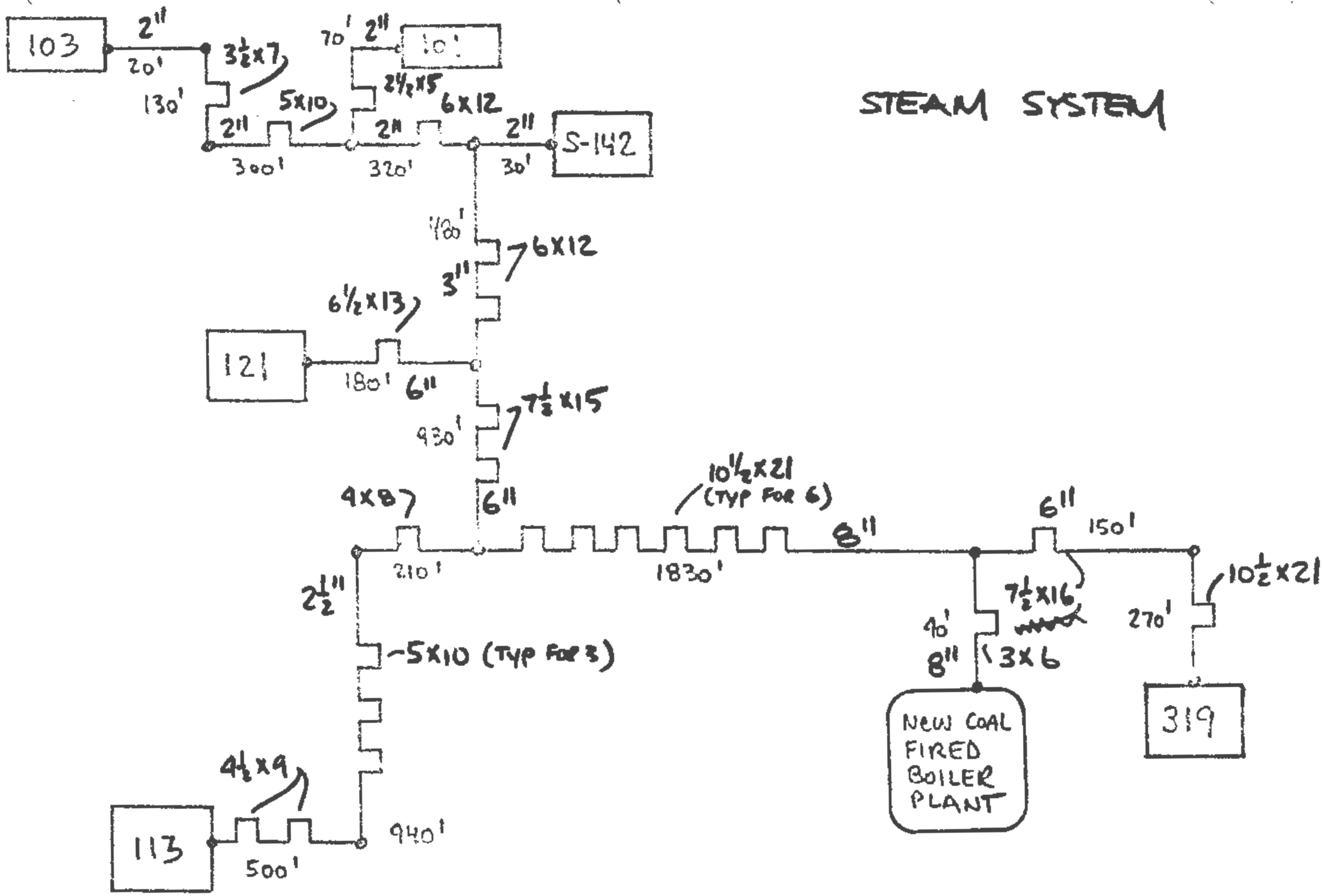
CONDENSATE

	CONDUIT	Elbows
2½"	486	12
2"	2544	30
1½"	500	4
1"	2638	45
TOTAL	6168	

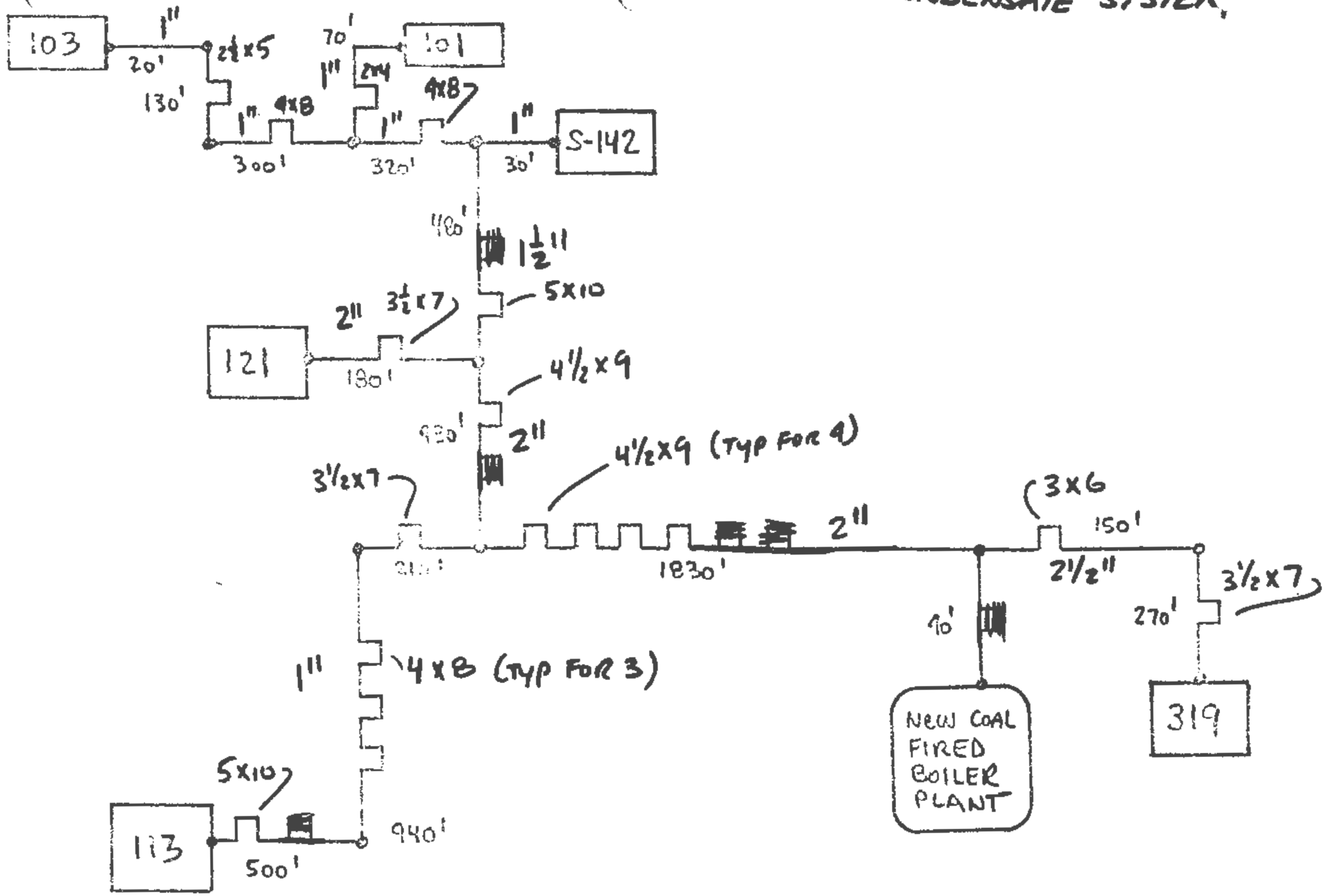
PIPING TAKEOFF   STEAM SYSTEM

8" sch 40	40' + 1 Lp @ 812 = 52 1830' + 6 Lp @ 42 = 2082	} 2134'
8" Elbows	4 x Lp + 4 = 32	
6" sch 40	420' + 1 Lp @ 32 1 Lp @ 42 } 74 =	494'
6" elbows	4 x Lp + 3 = 11	
6" sch 40	610' + 2 Lp @ 30 1 Lp @ 26 } 86' =	696'
6" elbows	4 x Lp + 4 = 16	
3" sch 40	480' + 2 Lp @ 24 =	528'
3" elbows	4 x Lp = 8	
2½" sch 40	1650' + 3 Lp @ 20 2 Lp @ 18 } 96' =	1746'
2½" elbows	4 x Lp + 4 = 24	
2" sch 40	870' + 1 Lp @ 24 1 Lp @ 10 1 Lp @ 20 1 Lp @ 14 } 68' =	938'
2" elbows	4 x Lp + 9 = 25	

STEAM SYSTEM



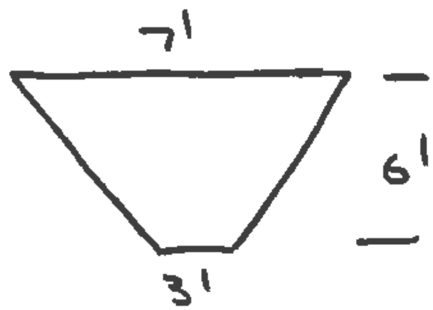
CONDENSATE SYSTEM



LABOR COST

CONDUIT SIZE	MAN-HRS / FT	COST/HR @ 22.87	Elbows @ 10' per elbow
8"	.858	19.62	196.20
6"	.774	17.70	177.00
4"	.648	14.82	148.20
3"	.617	14.11	141.10
2½"	.604	13.81	138.10
2"	.565	12.92	129.20
1½"	.530	12.12	121.20
1"	.530	12.12	121.20

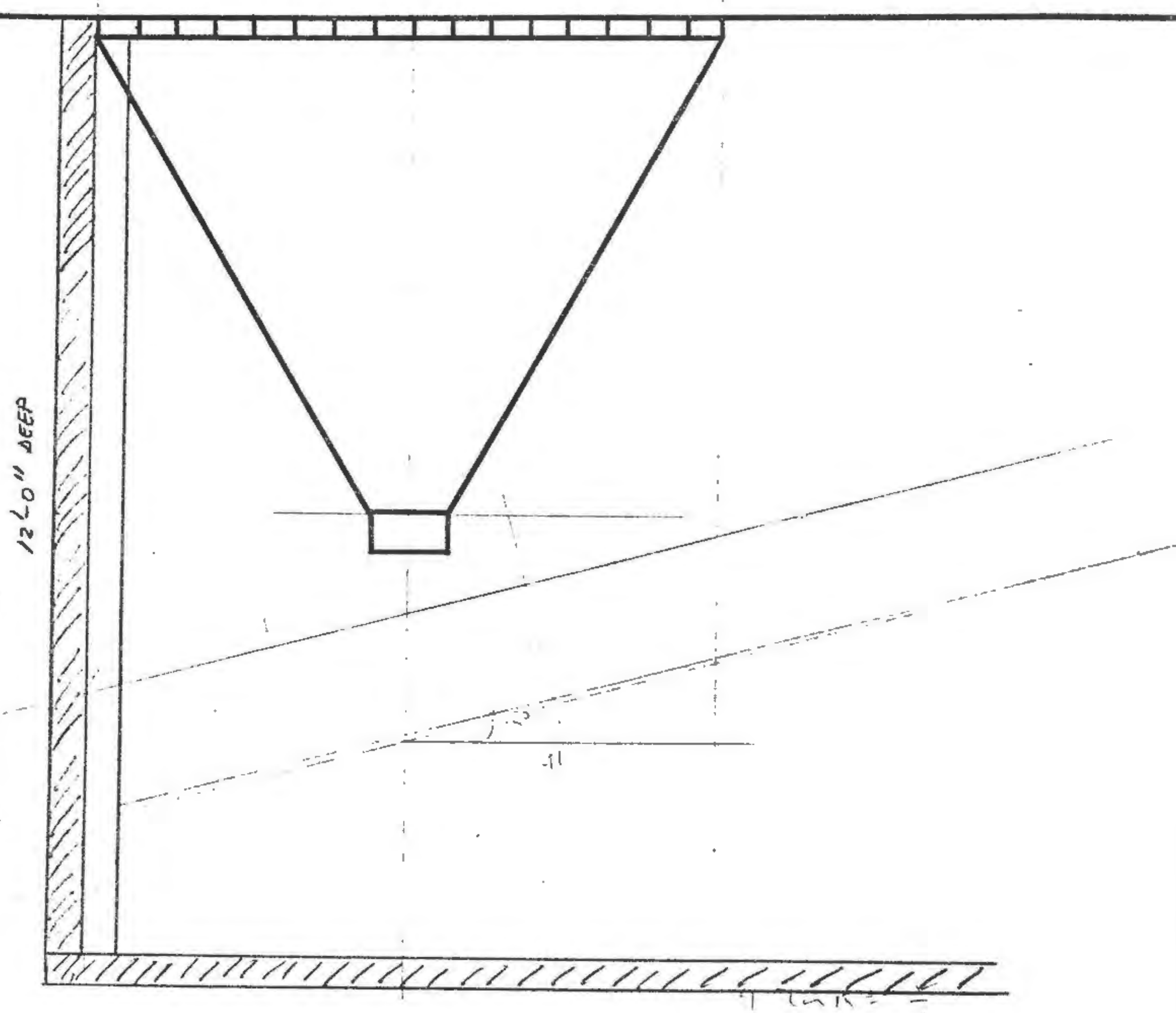
EXCAVATION & BACKFILL



Labor = 0.039 MAN-HRS / FT
Cost = $162/HR

Labor = $ 6.32/Ft

TRUCK UNLOADING HOPPER



5 x 4.24 = $450	12' Deep x 15' long x 8' WIDE	= 1440 Ft³ = 53 yds x 2 (hole)
$7314	CONCRETE = (2 x 12 x 15 + 2 x 12 x 8) x 1'	= 792 Ft³ = 30 yds x $243.80
$1928	steel plate (3/8")	$S = \frac{1}{2} \times (4 \times 1 + 4 \times 8) \times 7 = 126\ Ft^2 \times 15.3\#/Ft^2 = 1928\#$ @ $1.00/#
$1454	CONTINGENCY (15%)	
$11,146	TOTAL	

say $11,000

VALVES, SPECIALTIES, ETC

TRAP STATIONS : Assume 1 station per 500' of steam line run plus 1 station per building

	PIPING	BLDG's
BLDG 103, 101, S-142	3	3
BLDG 319	1	1
BLDG 121	5	1
BLDG 113	3	1
	12	6

18 TRAP STATIONS × ~~[illegible]~~ $479.70 = $8635 (MAT)
× $530.58 = $9550 (Labor)

$18,185 TOTAL

PRESSURE REDUCING STATIONS :

	TYPE 500 lb/HR	6000 lb/HR
BLDG 101	✓	
103	✓	
S-142	✓	
121		✓
113	✓	

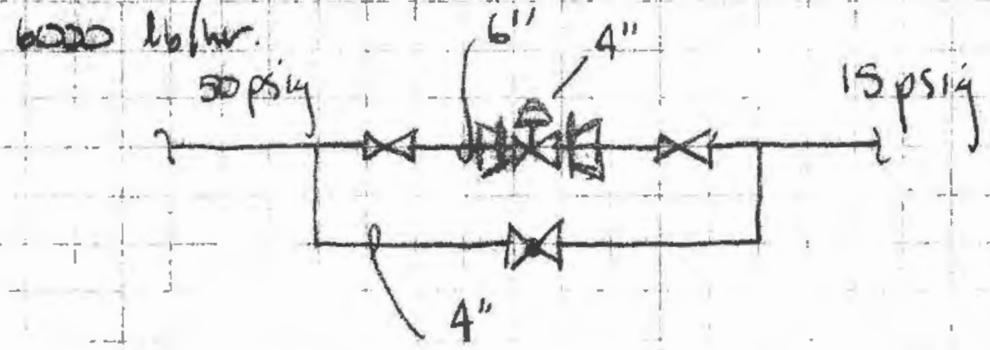
(4) PR Stations × $402.50 = $1610 LABOR
$1280.00 = $5120 MATERIAL
TOTAL = $6730

(1) PR Station × $1127 = $1127 labor
$3769 = $3769 material
$4896

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT	SENECA - CENTRAL COAL PLANT	AEP NO	00126-000
		SHEET	3 OF
DESIGNER	J. MCMILLIN	DATE	19 DEC 80
CHECKER		DATE	

PRESSURE REDUCING STATION



Assume 10' 6" Φ sch 40 pipe
10' 4" Φ sch 40 pipe

	LABOR	MATL.
(1) 4" PRV	4	1100
(2) 6" GATE	2(2,7) = 5,4	1750
(1) 4" GLOBE	2,1	659
10' 6" PIPE	10/100 (35,0) = 3,5	65
10' 4" PIPE	10/100 (25,0) = 2,5	38
(2) 4" ELLS	2(3,8) = 7,6	14,40
(2) 6" TEES	2(7,5) = 15,00	82,10
(2) 4" FLANGES	3,8	31,60
(2) 6"x4" REDUCERS	9,4	289
	49,3 MH	$3769

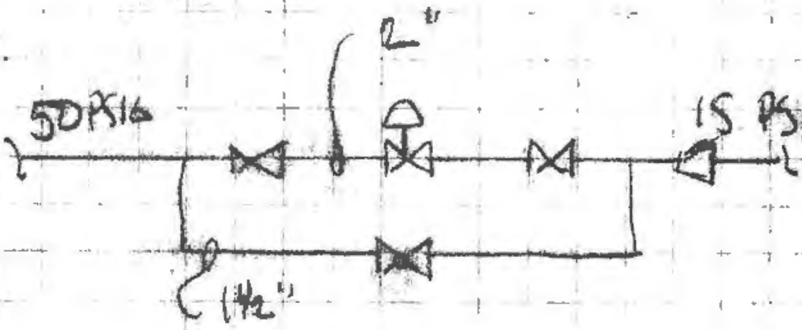
49,3(22,87) = $1127
\+ 3769
$4896 → SAY $4900

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA - CENTRAL COAL PLANT
AEP NO: 80128-000
SHEET: 2 OF
DESIGNER: J. McMILLIN
DATE: 19 DEC 80
CHECKER:
DATE:

TYPICAL PRESSURE REDUCING STATIONS

500 lbs/hr.



Assume 10' 2" ϕ sch 80 pipe
10' 1½" ϕ sch 80 pipe

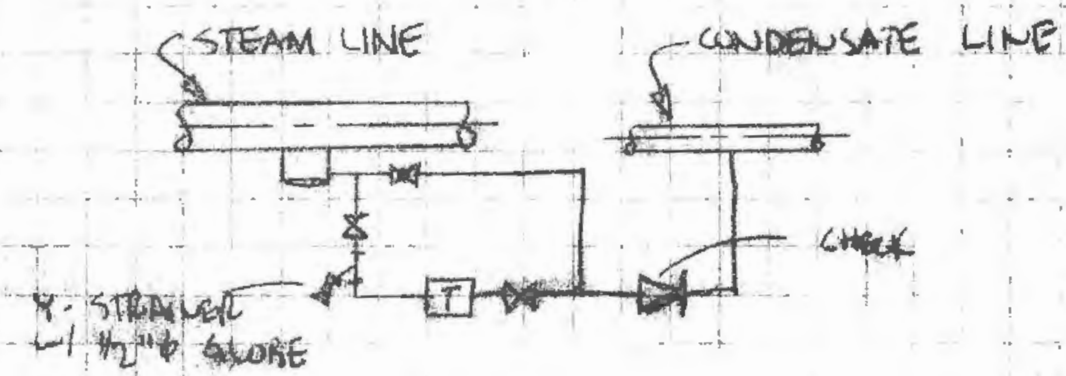
	LABOR	MATL.
(1) 2" PRV	2	630
(2) 2" GATE	2(1,7) = 3,4	2(216) = 432
(1) 1½" GLOBE	1,6	140,00
10' 2" SCH 80 PIPE	$\frac{10}{100}$(17,2) = 1,7	10,00
10' 1½" SCH 80 PIPE	$\frac{10}{100}$(16,0) = 1,6	10,00
(2) 1½" ELLS	2(1,40) = 2,8	24,00
(2) 2" TEES	2(2,25) = 4,5	34,00
	17,6 MH	1280,

$\left(\frac{17{,}6\ MH}{1}\right)\left(\frac{\$22{,}87}{MH}\right) = 402{,}50$

1280,

TOTAL = $1683 → SAY **$1700**

TYPICAL TRAP STATION



All valves and piping 3/4"ϕ except as noted

	LABOR (MH) EACH	MATL (EACH)
3/4" INV. BUCKET TRAP (1)	1.6	155.40
3/4" Y-STRAINER	0.5	5.70
3/4 GLOBE	1.7	51.70
3/4 GATE	1.7	39.50
3/4 CHECK	1.3	47.00
3/4" A-106 SCH 80 PIPE	12.6/100 ft	142.60/100 ft
1/2" GLOBE	1.2	44.20
3/4" ELBOW	1.2	4.60
3/4" TEE	1.8	5.80

	MH	MATL
(1) 3/4" INV. BUCKET TRAP	1.6	155.40
(1) 3/4" Y-STRAINER	0.5	5.70
(1) 3/4" GLOBE	1.7	51.70
(2) 3/4" GATE	3.4	79.00
(1) 3/4" CHECK	1.3	47.00
(1) 1/2" GLOBE	1.2	44.20
(3) ELBOWS	3.6	13.80
(2) TEES	3.6	11.60
50' PIPE	6.3	71.30
SUBTOTALS =	23.2 MH	$479.70

$$\left(\frac{23.2\ MH}{1}\right)\left(\frac{\$22.87}{MH}\right) = \$530.58$$

TOTAL COST / STATION = 479.70 + 530.58 = $1010.28

NORTH BASE

BOILER FOUNDATION (80X100 BLDG)

EXCAVATION : 1110 cy @ $4.24 = $4700

BACKFILL : 850 cy @ $6.36 = $5400

Concrete : 640 cy @ $243.80 = $156,000

TOTAL $166,100

Boiler Enclosure & STRUCTURAL STEEL

STRUCTURAL STEEL : 180 Tons @ $1500/TON = $270,000

GRATING : 4000 Ft² @ $4.24 = $16960

stairs : 100 riser @ $116 = $11,600

handrail: 400 Ft @ $15.90 = $6360

TOTAL = $304,920

Say $305,000

ARCHITECTURAL ENCLOSURE $164,000

TOTAL $469,000

SECTION II-3

CAPITAL COST ESTIMATE

OPTION THREE

AFBC PLANT

ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

2. BENEFICIAL OCCUPANCY DATE JAN '85

3. ECONOMIC LIFE 25 YEARS

4. DATE OF ESTIMATE DEC '80 $

5. INITIAL COST ~~$ 4,593,454~~ $ 4,333,454

6. ANNUAL MAINTENANCE COSTS

OPERATIONS (labor) $ 170,416
MAINTENANCE MATERIAL $ 114,836
TOTAL = $ 285,252

7. CYCLICAL MAINTENANCE COSTS

1) EXISTING PIPING WILL BE REPLACED IN 1996 & 2021 AT A COST OF $ 430340 IN DEC '80 $

2) AFBC Systems will be replaced after 25 years (2010) AT A TOTAL Replacement COST OF $ 3,445,153 IN DEC '80 $

8. ANNUAL FUEL COST

COAL → 940 TONS @ $ 54/TON = $ 50,760
LIMESTONE → 235 TONS @ $ 13.35/TON = $ 3137
TOTAL = $ 53,897

9. ANNUAL ELECTRICAL CONSUMPTION 757,214 Kwh

1. ELECTRICAL DEMAND RATE 217 KW

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: "OPTION 3" CENTRAL COAL FIRED AFBC STEAM PLANT

ESTIMATOR:

CHECKED BY:

SUMMARY	QUANTITY: NO. UNITS	QUANTITY: UNIT MEAS.	LABOR: PER UNIT	LABOR: TOTAL	MATERIAL: PER UNIT	MATERIAL: TOTAL	TOTAL COST
South Base AFBC Steam Plant - Complete				587598		2586256	3173854
Labor Burden	22%			129272		—	129272
Sales Tax	5%			—		129313	129313
SUBTOTAL							3432439
Overhead & Profit	25%						858110
Bond	1%						42905
~~SUBTOTAL~~							4333454
~~Engineering & Design~~	~~6%~~						~~260000~~
~~Total~~							~~4593454~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD- SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 3" CENTRAL COAL FIRED AFBC STEAM PLANT

ESTIMATOR:

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST	
STEAM & CONDENSATE PIPING				255736		407968	663704	*
VALVES, SPECIALTIES, ETC				12287		17524	29811	*
TRUCK SCALE				11074		21026	32100	*
HVAC, Plumbing, Etc				4750		4250	9000	*
Roadwork & Civil Site Prep				–		35000	35000	*
Bldg Cond Return Systems				2196		17168	19364	*
Steam Plant Cond Collect Syst				1432		5350	6782	*
Makeup Water Softeners				366		2000	2366	*
Foundations				–		166100	166100	*
Electrical				145000		145000	290000	
Misc. Instr & Controls				1950		18150	20100	*
Fire Protection				7200		4800	12000	*
Deaerator				1830		15000	16830	
Boiler Feed Pumps				1375	6000	18000	19375	
Fuel Handling Equipment				49659		187745	237404	
Ash Removal System				–		120000	120000	
Ash Hopper - 25 Ton				2143		7175	9318	
Structural Steel				–		305000	305000	*
Enclosure				–		164000	164000	*
Sub-TOTAL				496998		1661256	2158254	
(2) 15,000 #/HR AFBC Steam Generators			30200	60400	325000	650000	710400	
(1) 10,000 #/HR AFBC Steam Generators			30200	30200	275000	275000	305200	
TOTAL W/O MARKUPS				587598		2586256	3173854	

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1959 O—510168

* SAME AS [illegible]

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 3" AFBC PLANT REPLACEMENT COST

ESTIMATOR:

CHECKED BY:

SUMMARY	QUANTITY: NO. UNITS	QUANTITY: UNIT MEAS.	LABOR: PER UNIT	LABOR: TOTAL	MATERIAL: PER UNIT	MATERIAL: TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				255736		407968	663704
values, specialties, etc				12287		17524	29811
truck scale				11074		21026	32100
HVAC, Plumbing, etc				4750		4250	9000
Bldg Cond Return Systems				2196		17168	19364
STEAM Plant Cond Coll. System				1432		5350	6782
makeup water softeners				366		2000	2366
Electrical				145000		145000	290000
Misc. Instr & Controls				1950		18150	20100
Fire Protection				7200		4800	12000
Deaerator				1830		15000	16830
Boiler Feed Pumps				1375		18000	19375
Fuel Handling Equipment				49659		187745	237404
Ash Removal System				–		120000	120000
Ash Hopper - 25 Ton				2143		7175	9318
(1) 10,000 (2) 15,000 #/H AFBC Boilers				90600		925000	1015600
SUBTOTAL				587598		1916156	2503754
Labor Burden	22%			129272		–	129272
Sales Tax	5%			–		95808	95808
SUBTOTAL							2728834
overhead & Profit	25%						682209
Bond	1%						34110
TOTAL REPLACEMENT COST AFTER 25 YRS IN DEC '80 $ →							$3,445,153

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF
PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS	BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)	
LOCATION: SENECA ARMY DEPOT - SOUTH BASE		
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO.: EXISTING PIPING REPLACEMENT	ESTIMATOR: J. McMILLIN	CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
4" sch 40, insulated	845	FT	*8.12	6861	19.06	16,106	
3" sch 40, "	2015	FT	*6.44	12977	15.51	31,253	
2 1/2" sch 40, "	1040	FT	*5.84	6074	12.01	12,490	
2" sch 40	1690	FT	*2.88	4867	9.29	15,700	
1 1/2" sch 80	195	FT	*2.63	513	9.10	1775	
1 1/4" sch 80	1495	FT	*2.63	3932	9.10	13,605	
SUBTOTALS				35224		90,929	126153
UNDERGROUND PIPING							
EXCAVATION & BACKFILL	2510	Ft	6.32	15863	—	—	
8" sch 40, insulated	845	FT	11.28	9532	40.80	34,476	
6" sch 40,	923	FT	9.02	8325	31.04	28,650	
5" sch 40	195	FT	9.02	1759	31.04	6053	
3" sch 40	2743	FT	5.20	14264	15.51	42,544	
2 1/2" sch 40	325	FT	4.73	1537	12.01	3903	
2" sch 40	845	FT	2.28	1927	9.29	7850	
1 1/2" sch 80	650'	FT	2.07	1346	9.10	5915	
SUBTOTALS				54553		129,391	183944
PLUS				35224		90,929	
SUBTOTAL				89777		220,320	310097
LABOR BURDEN	22%			19751		—	19751
SALES TAX	5%			—		11,016	11,016
SUBTOTAL							340864
OVERHEAD & PROFIT	25%						85216
BOND	1%						4260
TOTAL REPLACEMENT COST			(1989 $)				430340

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

YEARLY FUEL USAGE

SOUTHBASE

BLDG	GAL #2 F.O.	GAL #6 F.O.	Fuel Usage Before Setback (MBtu)	Setback Savings (MBtu)	Fuel Usage After Setback (MBtu)
121	—	120,000	18,000	8720	9280
319	—	202,300	30,345	16,830	13,515
101	8000	—	1110	170	940
103	9200	—	1276	—	1276
113	17,100	—	2372	1330	1042
S-142	16,200	—	2247	1460	787
				TOTAL	26,840 MBtu/yr
			OR	#6 F.O.	22,795 MBtu/yr
				#2 F.O.	4045 MBtu/yr

$$\#2\ F.O.\quad (138{,}700\ Btu/gal)\left(\frac{\#\ gal}{yr}\right)\left(\frac{MBtu}{10^6\ Btu}\right) = MBtu/yr$$

$$\#6\ F.O.\quad (150{,}000\ Btu/gal)\left(\frac{\#\ gal}{yr}\right)\left(\frac{MBtu}{10^6\ Btu}\right) = MBtu/yr$$

COAL USAGE

$$\left(\frac{26{,}840\ MBtu}{yr}\right)\left(\frac{10^6\ Btu}{MBtu}\right)\left(\frac{lb}{12{,}500\ Btu}\right)\left(\frac{ton}{2000\ lb}\right) = 1074\ ton/yr$$

@ $54/TON = $57996 DEC 1980 COST

NOTE

AFBC Boiler (.180/.170) more efficient than conventional coal fired boilers in this size range ⇒ Annual Fuel Consumption = 7/8 × 1074 = 940 TONS × $54/TON = $50,760

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD-South Base
Fuel Consumption
DESIGNER S Cowen
CHECKER

A&P NO. 80122-000
SHEET ... OF ...
DATE
DATE

ANNUAL LIMESTONE CONSUMPTION

ANNUAL COAL USAGE = 940 TONS

LIMESTONE USAGE = 1/4 COAL USAGE = 235 TONS/YR

COST FOR LIMESTONE = 235 TONS × \$13.35/TON

= \$ 3137

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. X Placed X Rec'd ______ Date 12-9-80

Steve Cowen Conversed with John WALLISH

Of Johnston Boiler Co. Regarding FBC PACKAGE BOILERS

Requested budgetary cost information regarding the Johnson Boiler Co. Atmospheric Fluidized Bed Package Boilers, with the following noted:

1) Steaming rate: 8500 lb/hr & 15,000 lb/hr
2) Eastern Bituminous - 13,000 BTU/lb
   3.5% Sulphur (potential)
3) Design Pressure: our system 50 psig, SAT
   their boiler 150 psig, SAT

For the 8500 lb/hr Boiler, they will provide a 10,000 lb/hr Packaged FBC unit complete with:
FD & ID FANS, STEAM BOILER TRIM, COMBUSTION CONTROLS & PANEL, COAL METERING SYSTEM, LIMESTONE METERING SYSTEM, MECH COLLECTORS, standby gas/oil firing, etc → Their scope of supply would start at the outlet of the coal & limestone feed bunkers and end at the gas outlet of the mechanical collectors. Cost $275,000. To add a baghouse collector, complete with controls, insulation, rotary airlock, etc. Add $80,000.
* Does not include installation, ash or spent bed removal

For the 15,000 lb/hr unit, the price would be $325,000 plus $100,000 for the baghouse collector

Note: ① Installation of FBC compared to conventional coal fired unit is minimal labor - unit is fired at factory and arrives on site ready to be hooked into utilities & started up!

② Turndown ratio on this unit is about 6:1 10,000 lb/hr unit 1666 lb/hr min fire, 15,000 lb/hr unit 2500 lb/hr min.

Distribution: J. McMillin

1-616-842-5050

Johnson Boiler Co.
Bob Shedd

Package

2500# – 50,000#
FIRETUBE CONVECTION SECTION
AFBC

(1) IN plant 3 years 10,000 lb/HR + Auger feeders
(1) IN Ohio 3 mos. 40,000 lb/HR overbed feed NO LIM
ROTARY FEEDER 150–200 psig, S

(2) Charlotte, N.C. 20,000 lb/HR (SOON) Gas/Oil/Future Coal
(3) Brazil 25,000 lb/HR (SOON) will be tested IN their SHOP IN THE NEXT COUPLE OF WEEKS
↳ Alcohol pilot 50% ASH COAL

* Call them WITH AS much lead time as possible to set up plant visit after we are short-listed on ANL JOB

---

② General Resources Corp. MINNEAPOLIS, MINN.
612-9337474
out to lunch!
left word for someone to call back → THIS COMPANY DOES NOT MFG BOILERS – Strictly pneumatic Feeders

---

③ Keeler; Williamsport; PA. PFBC for Curtis-Wright
NOT IN AFBC BUSINESS Dorr-Oliver

---

④ ZURN ERIE CITY; ERIE CITY, PA
814-4526421 Bob SEIBEL
Not presently in this business but would be most interested in participating – They have done a lot of work on paper

---

⑤ FLUIDYNE, MINNEAPOLIS, MINN.
612-5442721
ERVIN LENTZ

(1) 40,000 lb/HR UNIT ON order for deli[very] IN MID '81
(1) 18 Ft² unit IN plant set up as Airhea[ter]
(2) 2¼ Ft² FBC's IN Lab → doing test work for T

II-98

FLUIDYNE, CONTD.

They are teamed up with FLUOR POWER SERVICES, INC ON THE ANL JOB - would be happy TO WORK WITH US IF we get THE JOB

They would have International Boiler Works (IBW) do the steam side of the unit - they are capable of producing FBC's in the 50-75 MMBtu input range (@ 200 PSIG, SAT, η ≈ .82-84%, MCR = 40-60,000 lb/HR)

⑥ DELTAK CORP., ACTIVE WITH [Copeland Associates]

vertical inbed surface - deep bed { 5-6 FPS velocity, 5-6 Ft Bed }

[(BROS BOILER Co.) → people came from there]

[Steve Smithson]

SENECA SOUTH BASE

JOHNSTON BOILER COMPANY THREE MULTI-FUEL FLUIDIZED BED COMBUSTION PACKAGE BOILERS, RATED AT: (1) 10,000 #/HR, (2) 15,000 #/HR, to be fired ON Eastern BITUMINOUS COAL, 12500-13000 BTU/lb, max sulphur 3.5%, Vol. matter 30-35%, size: up to 1 1/4"; Complete WITH FD & ID Fans, Boiler Trim, Combustion CONTROLS & PANEL, COAL Metering SYSTEM, Limestone metering SYSTEM, MECH. collectors, standby gas or oil firing system. Their scope of supply would begin at the outlet of the coal & limestone feedbunkers and end at the gas outlet of the mech collectors. Their cost does NOT include the deaerator, boiler feed pumps, coal & limestone handling equipment, ash removal system, ASH hopper, structural steel, foundations, building enclosure, installation or electrical $925,000

ADD TO QUOTE:

DEAERATOR $15,000

Boiler Feed Pumps $18000

Fuel Handling Equipment $237,404

Ash Removal System $120,000

Ash Hopper $9318

structural steel $305,000

enclosure $164,000

foundations $166,100

MECHANICAL EQUIPMENT:

Steam Plant COND. SYSTEM	$ 6782
water softeners	2366
MISC. INSTR & CONTROLS	20 100
DEAERATOR	16830
Boiler Feed Pumps	19375
Fuel Handling Equip	237404
Ash Removal SYSTEM	120 000
Ash Hopper	9318
	$ 432175

Rule of Thumb → Elec Install = .67 Mech Equip Installed
= .67 x $ 432175 = $ 290,000
split 50/50 mat/labor

DEAERATOR INSTALLATION

Assume 80 hrs req'd
@ $22.87/HR = $ 1830

BOILER FEED PUMPS INSTALLATION

Assume 20 hrs per pump
x 3 pumps = 60 hrs
@ $22.87/HR = $ 1375

AFBC STEAM GEN. INSTALLATION

Conv. Coal Fired Package Boiler System -
installation about 4,000 manhours
Johnston Blr Co. quotes approximately 67% savings
on installation due to shop fabrication feature of
their unit, with minimal field hook up
4000 hrs x .67 = 2680 hrs saved per boiler

4000-2680 = 1320 hrs @ $22.87 = $ 30,200 per Boiler

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT
INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION
SEAD - SOUTH BASE

ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [ ] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.	ESTIMATOR	CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
50 Ton Coal Bunker	3	EA	6200	18600	12650	37950	56550
25 Ton Limestone Bunker	3	EA	2143	6429	7175	21525	27954
Gate Values 12"x12"	4	EA	45	180	780	3120	3300
Drag Chain Conveyor	2	EA	4000	8000	26000	52000	60000
Bucket Elevator	2	EA	4250	8500	21250	42500	51000
Screw Feeder 12'	1	EA	500	500	2000	2000	2500
Truck Unloading Hopper	1	EA	–	–	11000	11000	11000
Limestone Storage - 50 Ton	1	EA	6200	6200	12650	12650	18850
Screw Feeder - 25'	1	EA	1250	1250	5000	5000	6250
SUBTOTAL				49659		187745	237404

ENG FORM 150
1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)
* U.S. GOVERNMENT PRINTING OFFICE 1959 O—510148

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

AFBC – OPTION 3
DESIGNER SCOWEN
CHECKER
SHEET ___ OF ___
DATE
DATE

ELECTRICAL REQUIREMENTS

	AVG HOURLY (1) 15,000	PEAK (1) 15,000 (1) 10,000	MAXIMUM (2) 15,000 (1) 10,000
FD FANS (3/BLR, 2 BLR-10 Hp, 1 BLR 7½ Hp)	30	52½	82½
COAL FEEDERS (3/BLR, ¾ Hp EA)	2¼	4½	6¾
LIME FEEDERS (3/BLR, ¼ Hp EA)	¾	1½	2¼
ID FAN (1/BLR, 2 BLR-60 Hp, 1 BLR-50 Hp)	60	110	170
Boiler Feed Pumps (3@ 3 Hp)	3	6	9
Cond Trans Pumps (2@ ¾ Hp)	¾	1½	1½
Hopper Screw Fdrs (2@ 5 Hp)	10	10	10
Bucket Elevators (2@ 15 Hp)	30	30	30
Drag Chain Conv. (2@ 10 Hp)	20	20	20
Bottom Ash Pneumatic Blower (1/BLR, 2 BLR-30 Hp, 1 BLR-25 Hp)	30	55	85
TOTAL Hp	186.75	291.0	417.0
KW	139.3	217.0	311.0

Assume 139.3 KW for AVG loading with (1) 15,000 lb/HR Boiler in operation; At 0-25% BLR load, KW = .67 × 139.3 = 93.3 KW; At 25-50% BLR load, KW = 0.80 × 139.3 = 111.4 KW; Above 50% load, use 139.3 KW

MONTH	AVG HOURLY STEAM DEMAND	Boiler SIZE	% Boiler load	KW REQ'D	Electric Consumption MONTHLY - KWH
JAN	12812	15,000	85.4	139.3	103,639
FEB	13239	15,000	88.3	139.3	93,610
MAR	9521	10,000	95.2 *	121.6	90,470
APRIL	5952	10,000	59.5 *	121.6	87,552
MAY	1991	10,000	19.9 *	81.0	60,264
JUNE	567	10,000	5.7 *	81.0	58,320
JULY-SEPT	0	—	—	—	—
OCT	2843	10,000	28.4 *	97.0	72,168
NOV	6636	10,000	66.4 *	121.6	87,552
DEC	11346	15,000	75.6	139.3	103,639
				TOTAL CONSUMED	757,214 Kwh

* For (1) 10,000 lb/HR Boiler, KW AT 0-25% load = 81 KW; 25-50% load = 97 KW
Full load = 121.6 KW

REYNOLDS, SMITH AND HILLS
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INCORPORATED

SUBJECT SEMD~~—UNIT BASE "OPTION 3"
DESIGNER S COWEN
CHECKER
AEP NO 00122-000
SHEET ____ OF ____
DATE
DATE

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$ 23,150
2. BOILER PLANT OPERATOR	4	$ 21,038	$ 84,152
3. COAL EQUIPMENT OPERATOR	1	$ 21,038	$ 21,038
4. HEATING EQUIPMENT MECHANIC	2	$ 21,038	$ 42,076

TOTAL = $ 170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALLATION

TOTAL ANNUAL LABOR COST = $ 170416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 114836
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 285,252

SECTION II-4

CAPITAL COST ESTIMATES

OPTION 2 + WOOD
OPTION 2 + RDF

WOOD FIRING / SENECA SOUTH

1. ANTICIPATED MIDPOINT OF CONSTRUCTION JAN '84

2. BENEFICIAL OCCUPANCY DATE JAN '85

3. ECONOMIC LIFE 25 YRS

4. DATE OF ESTIMATE Dec '80 $

5. INITIAL COST ~~$ 3,910,186~~ $ 3,688,855

6. ANNUAL MAINTENANCE COSTS

   OPERATIONS (labor) $ 191,454 }
   MAINTENANCE MATERIAL $ 97755 } $ 289,209 TOTAL

7. CYCLICAL MAINTENANCE COSTS

   1) EXISTING PIPING WILL BE REPLACED IN 1996 & 2021 AT A COST OF $ 430,340 IN DEC '80 $
   2) INITIAL SYSTEM will be replaced after 25 YRS (2010) At A total Replacement cost of $ 2,953,272 IN Dec '80 $

8. ANNUAL FUEL COST

   $ 58512 → (141.7 TONS WOOD @ $ 20/TON = $ 2834
   \+ 1011 TONS COAL @ $ 54/TON = $ 54594)
   TOTAL = 57428

9. ANNUAL ELECTRICAL CONSUMPTION

   460,198 Kwh

10. ELECTRICAL DEMAND RATE

   150 KW

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: WOOD FIRING SUB-OPTION

ESTIMATOR | CHECKED BY

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
10 Ton Storage Bunker	2	EA	1283	2566	3952	7904	10,470
Gate Values 12"x12"	4	EA	45	180	780	3120	3300
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
12" Ø feed chute	100	Ft	6.86	686	18.86	1886	2572
SUBTOTAL				3612		15830	19442
LABOR BURDEN	22%			795		—	795
SALES TAX	5%			—		792	792
SUBTOTAL							21029
OVERHEAD & PROFIT	25%						5257
BOND	1%						263
~~SUB~~TOTAL							26549
~~ENGINEERING & DESIGN~~	~~6%~~						~~1593~~
~~TOTAL~~							~~$ 28,112~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE

DATE PREPARED | SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SEAD - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: WOOD FIRING SUB-OPTION

ESTIMATOR:

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
10 Ton Storage Bunker	2	EA	1283	2566	3952	7904	10,470
Gate Values 12" x 12"	4	EA	45	180	780	3120	3300
DIVERTING VALVES	2	EA	90	180	1460	2920	3100
12" Ø feed chute	100	Ft	6.86	686	18.86	1886	2572
SUBTOTAL				3612		15830	19442
LABOR BURDEN	22%			795		—	795
SALES TAX	5%			—		792	792
SUBTOTAL							21029
OVERHEAD & PROFIT	25%						5257
BOND	1%						263

TOTAL REPLACEMENT COST IN DEC 1980 $ ⟶ $ 26549

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

ADDITIONAL EQUIPMENT REQUIRED FOR WOOD FIRING:

(2) WOOD SURGE BUNKERS, 10 TON CAPACITY, TO BE "TOPPED UP" by the existing coal reclaim hopper / BUCKET ELEVATOR / DRAG CHAIN CONVEYOR SYSTEM - WOOD WOULD NOT BE STORED IN THESE SURGE BINS, BUT WOULD BE FED TO THE BOILER THRU THESE BINS. Note! THESE BINS WOULD HAVE TO BE EQUIPPED WITH VIBRATORS TO KEEP THE WOOD FLOWING

(4) 12" Ø COAL CHUTES, 25' long EACH

(4) 12"x12" slide gate valves

(2) 12x12"x12" DIVERTING VALVES

Note! WOOD IS TO BE FIRED ONLY AS A SUPPLEMENTAL FUEL. IT HAS BEEN ASSUMED THAT NO MORE THAN 10% of the TOTAL HEAT INPUT will BE PROVIDED BY THE WOOD.

PEAK load of steam GENERATOR = 19130 lb/HR

Steam Pressure = 80 psig, Temperature = SAT } h = 1179.1

Feedwater Temperature = 228 F } h = 196.27

$\Delta h = 982.83$ BTU/lb

Assume Boiler Efficiency = 70%
WOOD HHV = 5528 BTU/lb
MOISTURE = 37.5 %

$$\text{MAX WOOD BURN RATE} = \frac{19130\ \text{lb/HR} \times 982.83\ \frac{\text{BTU}}{\text{lb}} \times 10\%}{.70 \times 5528\ \text{BTU/lb}} = 486\ \frac{\text{lbs}}{\text{HR}}$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT SEAD- SOUTH BASE
OPTIONAL WOOD FIRING
DESIGNER S COWEN
CHECKER

AEP NO 80122-000
SHEET ___ OF ___
DATE
DATE

ADDITIONAL O&M COSTS ASSOCIATED WITH WOOD FIRING:

1) ASSUME THAT 1 ADDITIONAL OPERATOR WILL BE REQUIRED PER SHIFT THAT WOOD IS BEING FIRED @ $21038 PER YEAR PER OPERATOR (Assume 1-shift per day, 5 days per week)

Additional labor cost = $ 21038

2) ASSUME THAT THE MAINTENANCE COSTS will be the same % as with the central coal plant (2½% OF INITIAL COST)
(.025 x $ 28142) = $ 704/YR

FUEL COST FOR WOOD FIRING

MONTH	AVG HOURLY STEAM DEMAND Lb/HR	Heat INPUT MBTU/HR ①	Heat INPUT FROM WOOD MBTU/HR ②	TOTAL HRS/Mo WOOD FIRING (1 shift/5 days) ③	TOTAL Heat INPUT/MO BY WOOD MBTU	TOTAL WOOD BURNED TONS
JAN	12812	17.99	1.80	176.7	318.1	28.8
FEB	13239	18.59	1.86	159.6	296.9	26.8
MAR	9521	13.37	1.34	176.7	236.8	21.4
APRIL	5952	8.36	0.83	171.0	141.9	12.8
MAY	1991	2.80	0.28	176.7	49.5	4.5
JUNE	567	0.80	0.08	171.0	13.7	1.2
JULY	—	—	—	—	—	—
AUG	—	—	—	—	—	—
SEPT	—	—	—	—	—	—
OCT	2843	3.99	0.40	176.7	70.7	6.4
NOV	6636	9.32	0.93	171.0	159.0	14.4
DEC	11346	15.93	1.59	176.7	281.0	25.4
				TOTALS	1567.6	195.9

① $\text{HEAT INPUT} = \dfrac{\text{Steam DEMAND} \times 982.83 \frac{\text{BTU}}{\text{lb}}}{70\% \text{ efficiency}}$

② Heat input x 10%

③ $\text{TOTAL HRS} = \dfrac{\text{DAYS IN MONTH}}{365} \times 260 \times 8 \text{ hrs}$

The cost of wood chips, delivered to the Seneca Army Depot, is assumed to be \$20/ton. It should be noted, however, that there are no chipping or harvesting operations currently in progress in the area of the base, and therefore, this ~~cost~~ could be much greater when such an operation is started.

Annual Wood Fuel Cost = 141.7 Tons x \$20/ton = \$2834

$$\text{Annual Coal Use} = 1074\ \text{Tons} - \frac{1567600000\ \text{BTU}}{12500\ \frac{\text{BTU}}{\text{lb}} \times 2000\ \frac{\text{lb}}{\text{Ton}}} = 1011\ \text{Tons}$$

Annual Coal Cost = 1011 Tons x \$54/Ton = \$54594

TOTAL ANNUAL FUEL COST = \$57428

CONSTRUCTION COST ESTIMATE

DATE PREPARED:	SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR:

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				255,736		407,968	663,704
Valves, specialties, etc.				12,287		17,524	29,811
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
ROAD WORK & CIVIL SITE PREP				—		35,000	35,000
BLDG COND RETURN SYSTEMS				2196		17,168	19,364
STM PLANT COND COLL. SYST.				1432		5350	6782
MAKEUP WATER SOFTENERS				366		2000	2366
FOUNDATIONS				—		166,100	166,100
ELECTRICAL				158,000		158,000	316,000
INSTR. & CONTROL (MISC.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				454,991		857,336	1,312,327
LABOR BURDEN	22%			100,098		—	100,098
SALES TAX	5%			—		42,867	42,867
SUB-TOTAL							1,455,292
OVERHEAD & PROFIT	25%						363,823
BOND	1%						18,191
SUB-TOTAL							1,837,306
BOILERS, AUXILIARIES, FUEL HANDLING EQUIP., ETC	(LUMP SUM INSTALLED)						1,825,000
~~ENGINEERING & DESIGN~~	~~6%~~						~~219,738~~
TOTAL ESTIMATED CONSTRUCTION COST (DEC 1980 $)							~~$ 3,882,044~~

$ 3,662,306

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

ANNUAL OPERATION AND MAINTENANCE COST
(DECEMBER 1980 DOLLARS)

TITLE	# REQ'D	DEC 1980 SALARY INCL. FRINGES	TOTAL ANNUAL COST
1. BOILER PLANT OPERATOR LEADER	1	$23,150	$23,150
2. BOILER PLANT OPERATOR	4	$21,038	$84,152
3. COAL EQUIPMENT OPERATOR	1	$21,038	$21,038
4. HEATING EQUIPMENT MECHANIC	2	$21,038	$42,076

TOTAL = $170,416

NOTE: Assume Coal OPERATOR Rate = Boiler OPERATOR RATE

DEC '80 ANNUAL SALARY = MARCH '80 Hourly Rate x 2080 hrs + 10.3% FRINGES + 7% ESCALLATION

TOTAL ANNUAL LABOR COST = $ 170,416

TOTAL ANNUAL MAINTENANCE MATERIAL = $ 97051
(ASSUME 2.5% CAPITAL COST)

TOTAL ANNUAL O&M = $ 267467

25TH YEAR REPLACEMENT COST

CONSTRUCTION COST ESTIMATE

DATE PREPARED:

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

DRAWING NO.: "OPTION 2" CENTRAL COAL FIRED STEAM PLANT

ESTIMATOR:

CHECKED BY:

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

SUMMARY	QUANTITY: NO. UNITS	QUANTITY: UNIT MEAS.	LABOR: PER UNIT	LABOR: TOTAL	MATERIAL: PER UNIT	MATERIAL: TOTAL	TOTAL COST
STEAM & CONDENSATE PIPING				255,736		407,968	663,704
Valves, specialties, etc.				12,287		17,524	29,811
TRUCK SCALE				11,074		21,026	32,100
HVAC, Plumbing, etc.				4750		4250	9000
Bldg Cond Return Systems				2196		17,168	19,364
Stm Plant Cond Coll. Syst.				1432		5350	6782
Makeup Water Softeners				366		2000	2366
Electrical				158,000		158,000	316,000
Instr. & Control (misc.)				1950		18,150	20,100
Fire Protection				7200		4800	12,000
SUB-TOTAL				454,991		656,236	1,111,227
LABOR BURDEN	22%			100,098		—	100,098
SALES TAX	5%			—		32,812	32,812
SUB-TOTAL							1,244,137
OVERHEAD & PROFIT	25%						311,034
BOND	1%						15,552
SUB-TOTAL							1,570,723
Boilers, Auxiliaries, Fuel Handling Equip., etc.	(Lump Sum Installed)						1,356,000

TOTAL ESTIMATED 25TH YEAR REPLACEMENT COST (DEC 1980 $) $ 2,926,723

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE

DATE PREPARED:

SHEET OF

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA ARMY DEPOT - SOUTH BASE

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: EXISTING PIPING REPLACEMENT

ESTIMATOR: J. McMILLIN

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
OVERHEAD PIPING							
4" sch. 40, insulated	845	FT.	*8.12	6861	19.06	16,106	
3" sch. 40, "	2015	FT	*6.44	12977	15.51	31,253	
2 1/2" sch. 40, "	1040	FT	*5.84	6074	12.01	12,490	
2" sch 40	1690	FT	*2.88	4867	9.29	15,700	
1 1/2" sch 80	195	FT	*2.63	513	9.10	1775	
1 1/4" sch 80	1495	FT	*2.63	3932	9.10	13,605	
SUBTOTALS				35224		90,929	126153
UNDERGROUND PIPING							
EXCAVATION & BACKFILL	2510	ft	6.32	15863	—	—	
8" sch 40 insulated	845	FT	11.28	9532	40.80	34,476	
6" sch 40,	923	FT	9.02	8325	31.04	28,650	
5" sch 40	195	FT	9.02	1759	31.04	6053	
3" sch 40	2743	FT	5.20	14264	15.51	42,544	
2 1/2" sch 40	325	FT	4.73	1537	12.01	3903	
2" sch 40	845	FT	2.28	1927	9.29	7850	
1 1/2" sch 80	650'	FT	2.07	1346	9.10	5915	
SUBTOTALS				54553		129,391	183944
PLUS				35224		90,929	
SUBTOTAL				89777		220,320	310097
LABOR BURDEN	22%			19751		—	19751
SALES TAX	5%			—		11,016	11,016
SUBTOTAL							340864
OVERHEAD & PROFIT	25%						85216
BOND	1%						4260
TOTAL REPLACEMENT COST			(19[illegible] $)				430340

* INCLUDES ADDITIONAL 20% FOR DEMOLITION OF EXISTING PIPING

while lumber people use the ovendry weight basis. The different methods do not present much of a problem as long as it is understood which one is being used.

The green weight method expresses the moisture content as a percentage of the total weight of green wood (i.e., wood and water). Moisture content is computed by the following formula:

$$\frac{\text{green weight - ovendry weight}}{\text{green weight}} \times 100 = \text{MC\%}$$

The ovendry weight method expresses the moisture content as a percentage of the ovendry weight of the wood. Moisture content is computed by the following formula:

$$\frac{\text{green weight - ovendry weight}}{\text{ovendry weight}} \times 100 = \text{MC\%}$$

If we ask the question: "What is the average moisture content of your green wood?", pulp-mill people might say 45% meaning 45% of the green weight (wood and water) is water, while lumber people might say (for the same wood) 82% meaning that the weight of the water is equivalent to 82% of the ovendry weight of the wood. The term "ovendry" means dried to a constant weight at 212° F or 100-103° C.

Conversion between the two bases (green weight = gw and ovendry = odw) can be accomplished with these formulas:

$$\text{MC\% odw} = \frac{100 \times \text{MC\% gw}}{100 - \text{MC\% gw}} \quad \text{and}$$

$$\text{MC\% gw} = \frac{100 \times \text{MC\% odw}}{100 - \text{MC\% odw}}$$

Some typical moisture contents for green wood are:

Aspen	50% (gw)	100% (odw)
Hard Maple	36% (gw)	56% (odw)
Red Oak	43% (gw)	75% (odw)
Jack Pine	47% (gw)	87% (odw)
Red Pine	60% (gw)	150% (odw)

As a guide, 1-inch green red oak lumber in southern Wisconsin will dry to 20% MC (odw) or 17% MC (gw) in about 60 days when piled out in June-July. The same wood piled out in Oct.-Nov. may require 120 days or more to dry.

SECTION II-5

CAPITAL COST ESTIMATE

DIRECT BURIAL VS HEAT CHANNEL
DISTRIBUTION SYSTEMS

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 1 OF 13

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - CONCRETE TRENCH VS. CONDUIT PIPING

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
A) UNDERGROUND TRENCH SYSTEM (TRENWA)							
EXCAVATION & BACKFILL (SH.4)			—	20,740	—	—	20,740
TRENWA TRENCH (SH 3)	3300	FT	—	39,100	31.50	103,950	143,050
(SH.?) 8" Ø SCH. 40 PIPE	2070	FT	11.28	23,350	40.80	84,456	107,806
(SH.5) 6" Ø SCH. 40 PIPE	1218	FT	9.02	10,986	31.04	37,807	48,793
2½" Ø SCH 40 PIPE	500	FT	4.73	2365	12.01	6005	8370
2" Ø SCH. 40 PIPE	2788	FT	2.28	6357	9.29	25,900	32,257
8" Ø SCH. 40 ELLS	25	EA	164.66	4117	26.55	664	4781
6" Ø SCH. 40 ELLS	22	EA	128.07	2818	16.39	361	3179
2½" Ø SCH 40 ELLS	9	EA	54.89	494	3.18	29	523
2" Ø SCH. 40 ELLS	38	EA	45.74	1738	2.04	78	1816
20' CASING PIPE (SH4)		L.S.	—	1824	—	3887	5711
SUBTOTALS.				113,889		263,137	377,026
LABOR BURDEN	22%			25,056		—	25,056
SALES TAX	5%			—		13,157	13,157
SUBTOTAL							$415,239
OVERHEAD & PROFIT	25%						103,810
BOND	1%						5190
~~SUB~~ TOTAL							$ 524,239
~~ENGINEERING~~	~~6%~~						~~31454~~
~~TOTAL~~							~~$555693~~

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET 2 OF 13

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - CONCRETE TRENCH VS. CONDUIT PIPING

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
B) UNDERGROUND CONDUIT SYSTEM (RIC-WIL)							
EXCAVATION & BACKFILL (SH. 4)			—	20,740	—	———	20,740
8" CONDUIT (SH 8 &	2070	FT	19.62	40,613	55.50	114,885	155,498
6" CONDUIT SH. 6)	1218	FT	17.70	21,559	45.00	54,810	76,369
2½" CONDUIT	500	FT	13.81	6905	26.25	13,125	20,030
2" CONDUIT	2788	FT	12.92	36,021	19.50	54,366	90,387
8" ELLS (CONDUIT)	25	EA	196.20	4905	327	8175	13,080
6" ELLS (CONDUIT)	22	EA	177.00	3894	260	5720	9614
2½" ELLS (CONDUIT)	9	EA	138.10	1243	162	1458	2701
2" ELLS (CONDUIT)	38	EA	129.20	4910	134	5092	10,002
(SH 4) 20" CASING PIPE	LS	—	—	1824	—	3887	5711
SUBTOTALS				142,614		261,518	404,132
LABOR BURDEN	22%			31,375		———	31,375
SALES TAX	5%			———		13,076	13,076
SUBTOTAL							448,583
OVERHEAD & PROFIT	25%						112,146
BOND	1%						5607
~~SUB~~ TOTAL						$	566,336
~~ENGINEERING~~	~~6%~~						~~33980~~
~~TOTAL~~							~~$600316~~

REPLACEMENT AFTER 25 YEARS

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET 3 OF 13

PROJECT: INCREMENT E CENTRAL BOILER PLANT PROJECTS

LOCATION: SENECA - CONCRETE TRENCH VS. CONDUIT PIPING

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE: ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
C) UNDERGROUND TRENCH SYSTEM — REPLACEMENT COST							
8"φ SCH 40 PIPE	2070	FT	11.28	23,350	40.80	84,456	107,806
6"φ SCH 40 PIPE	1218	FT	9.02	10,986	31.04	37,807	48,793
2½"φ SCH 40 PIPE	500	FT	4.73	2365	12.01	6005	8370
2"φ SCH 40 PIPE	2788	FT	2.28	6357	9.29	25,900	32,257
8"φ ELLS	25	EA	164.66	4117	26.55	664	4781
6"φ ELLS	22	EA	128.07	2818	16.39	361	3179
2½"φ ELLS	9	EA	54.89	494	3.18	29	523
2"φ ELLS	38	EA	45.74	1738	2.04	78	1816
20" CASING PIPE	—	LS	—	1824	—	3887	5711
SUBTOTALS				54,049		159,187	213,236
DEMOLITION OF PIPING - Assume 20% of ORIGINAL PIPE LABOR COSTS 0.20(54,049) =				10,810		—	10,810
SUBTOTALS				64,859		159,187	224,046
LABOR BURDEN	22%			14,269		—	14,269
SALES TAX	5%			—		7959	7959
SUBTOTAL							246,274
OVERHEAD & PROFIT	25%						61,569
BOND	1%						3078
TOTAL							$310,921
D) UNDERGROUND CONDUIT SYSTEM - Cost will be the same as original system - Assume that no demolition will be required.							
TOTAL							$566336

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

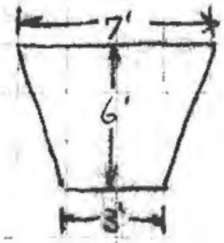
REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SEAD SOUTH BASE STEAM PIPING
DESIGNER: A LANE
CHECKER: J. McMILLIN

AEP NO. 80-122
SHEET 4 OF 18
DATE 12/5/80
DATE 12/30/80

A) THERE IS ~3300' OF PIPING
B) FROST DEPTH = ~4' (G. KITTELL, SEAD), THUS EXCAVATION DEPTH = 6' ← ALLOWS FOR 16" OF PIPE & BRACKET, INSUL., AND GRAVEL
C) OVERBURDEN IS HEAVY CLAY SOIL TYPICALLY 6' DEEP OVER WEATHERED SHALE BEDROCK.

A 3300-FOOT LONG EXCAVATION OF CROSS-SECTION SHOWN BELOW



IS ESTIMATED TO TAKE 100 MAN·HOURS TO DIG, AND 28 MAN·HOURS TO BACKFILL AT A RATE OF $162/MAN·HR

EXCAVATION & BACKFILL OF TRENCH = $20,740

TRENWA® CONCRETE CULVERT SYSTEM (BRACKETS, SIDE-WALLS, AND CONCRETE SLAB COVER, WITH UNISTRUT PIPE SUPPORT IN BRACKETS) COSTS APPROX. 31^{50}/FT FOB SENECA.

31^{50} x 3300 = $103,950

INSTALLATION OF TRENWA® CONCRETE CULVERT IS ESTIMATED TO TAKE 2300 MAN·HRS AT A RATE OF $17/MAN·HR

2300 x 17^{00} = $39,100

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

RR TRACKS
DESIGNER A. LANE
CHECKER J. McMILLIN

SHEET 2 OF [illegible]
DATE 12/10/80
DATE 12/30/80

PIPING BENEATH RR TRACKS

TWO METHODS, BASICALLY, ARE USED TO RUN PIPING BENEATH RAILROAD TRACKS

A) JACK & BORE METHOD — GENERALLY RUNS $300 Ft to run underground casing (large Ø). This is excluding pipe cost.

B) HAND-EXCAVATION - COSTS APPROX. $20/cu yd.

FOR LAYING A 20" STEEL CASING PIPE UNDER, E.G., TWO ADJACENT RR TRACKS (75' SPAN)

APPROX. JACK & BORE COSTS + PIPE COST

$300 \times 75 = 22{,}500 + (\$115 \times 75) = \boxed{\$31{,}125}$

↑ cost of 20" pipe = 115/ft

APPROX. HAND EXCAVATION — PIPE COST

$\frac{75 \times 2 \times 6}{27} \times 20 = 667 + (115 \times 75) = \boxed{\$9{,}300.}$

↑ assume 2' wide × 6' deep trench

THUS, IF A LINE IS NOT USED FREQUENTLY, IT IS PREFERABLE TO USE HAND EXCAVATION TO RUN PIPE BENEATH TRACK.

Total 105 ft.

MATL. 105' PIPE @ \$28.13/ft = \$2954

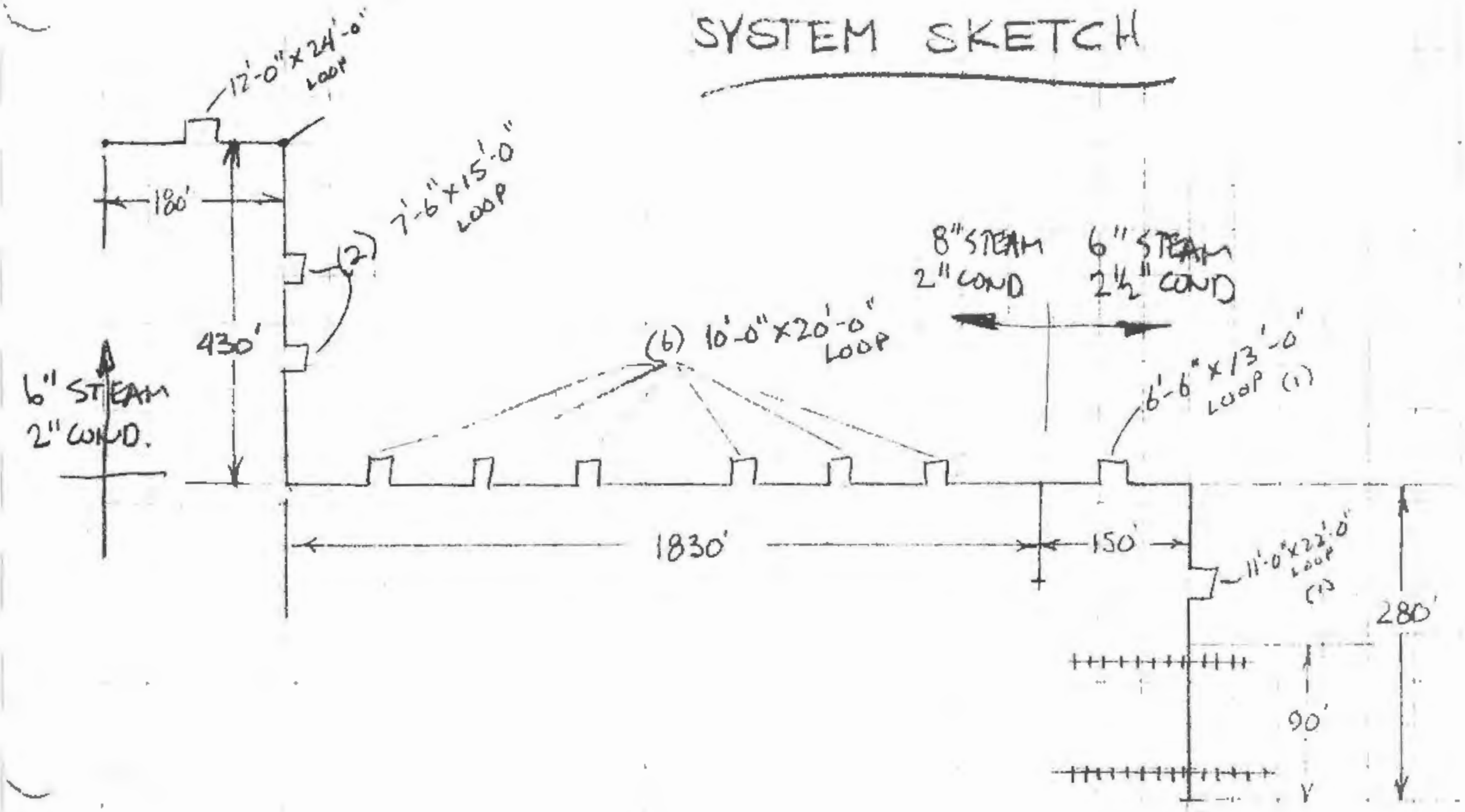
LABOR 105' $\left(\frac{36.9\ MH}{100'}\right)\left(\frac{\$22.87}{MH}\right) = \$886$

EXCAVATION $\frac{105 \times 2 \times 6}{27} \times 20 = \$933$

LABOR WELDS. $5\left(\frac{8.2\ MH}{weld}\right)\left(\frac{\$22.87}{MH}\right) = \$938$

TOTAL MATL = 933 + 2954, T. LABOR = 886 + 938

SYSTEM SKETCH



SYSTEM LIFETIMES:

UNDERGROUND CONCRETE CULVERT = 25 YR.
UNDERGROUND CONDUIT PIPING = 25 YR.

8" ϕ LINE -	PIPE	2070'
	ELLS	(25)
2" LINE	PIPE	2788'
	ELLS	(38)
6" LINE -	PIPE	1218'
	ELLS	(22)
2½" LINE -	PIPE	500'
	ELLS	(9)

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT SEAD UNDERGROUND CONDUIT SYSTEM
AEP NO 80-122
SHEET 7 OF 13
DESIGNER A LANE
DATE 12/10/80
CHECKER J. McMILLIN
DATE 12/30/80

COMPUTATION OF TOTAL LABOR COST FOR CONDUIT SYSTEM ASSEMBLY (SOURCE: EBCO, SHEET 9)

PIPE Ø	MAN-HRS/FT. SYS	× FT	× COST/MAN-HR	= COST/SYS
1	.53	3300	22.87	40,000
1½	.53			40,000
2	.565			42,640
2½	.604			45,600
3	.617			46,570
4	.648			48,900
6	.774			58,410
8	.858			64,750

ASSUME ELBOW LABOR = 10 ft straight pipe

UNDERGROUND PREFAB CONDUIT SYSTEM TOTAL COST

Ø	MATERIAL	LABOR	SYST COST	+ 10% CONT	= SYST COST*
8	301077	64750	365827		402,410
6	235832	58410	294242		323666
4	175649	48900	224549		247,004
3	140495	46570	187065		205771
2½	115986	45600	161586		177745
2	111150	42640	153830		169213
1½	91806	40000	131806		144987
1	82134	40000	122134		134347

DELETE — VOID

*EXCL EXCAV

PIPE SIZE/ SCH	PIPE COST ($/20')	INSULATION COST ($/20')	LABOR COST			TOTAL COST			
			WELDING	FITTING (Per 20')		Per 20'		Per Ft	
			Per Joint	Overhead	In Trench	Overhead	In Trench	Overhead	In Trench
1/80	36.38	121.00	24.01	15.44	13.40	[illegible]	194.79	[illegible]	9.74
1½/80	54.39	127.60	26.30	17.42	15.13	[illegible]	[illegible]	[illegible]	[illegible]
2/40	44.68	141.20	28.59	19.41	16.86	[illegible]	[illegible]	[illegible]	[illegible]
2½/40	57.68	182.60	75.47	21.88	19.03	[illegible]	[illegible]	16.88	[illegible]
3/40	72.80	237.40	82.33	24.86	21.62	[illegible]	414.15	[illegible]	[illegible]
4/40	103.48	277.80	105.20	29.84	25.94	[illegible]	[illegible]	[illegible]	[illegible]
6/40	178.33	442.40	144.08	41.77	36.32	[illegible]	[illegible]	[illegible]	[illegible]
8/40	257.99	558.00	178.39	52.22	47.13	[illegible]	1041.51	[illegible]	[illegible]
10/40	356.54	656.00	214.98	70.14	60.97	[illegible]	1288.49	[illegible]	[illegible]

NOTES

1. Cost does not include
   a) Pipe Rack or Trench
   b) Fittings and Valves
   c) Contingency, bond or sales tax
   d) Protective Conduit
2. Cost of Labor to Owner
   a) Pipefitter 21.62 $/hr
   b) Welder 22.87 $/hr
3. Insulation Cost includes material installation and 12% esc. from '79 to '80

SOURCES

1. Pipe Cost – Manufacturer quote*
2. Insulation Cost – 1979 Richardson's
3. Pipe fitting and Welding – Man hours from 1979 Richardson's
   a) 1" thru 2" Socketweld and 2½" up Buttweld
   b) 1" and 1½ are A-106
   2" and up are A-53

* Peninsular Supply Co[illegible]

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122
SHEET 9 OF 13

Local X L.D. ______ Placed X Rec'd ______ Date 12/12/80

ALEX LANE Conversed with WES SHAVER

Of SHAVER SALES & SVC Regarding RICWIL PRICES

PRICES FOR BLACK STEEL, FOB SENECA

Ø	COST / FT
8	55.50
6	45
4	30
3	27.75
2½	26.25
2	19.50
1½	20.25
1	18.00

(ADD 5% FOR GALVANIZED STEEL)

90° ELS

Ø	COST/@
8	327
6	260
4	210
3	178
2½	162
2	134
1½	110
1	104

LIFETIME DEPENDS ON SOIL CONDITIONS —

AVG SOIL CONDITIONS — 20-25 yrs.

ALTERNATIVE FOR ESTIMATING COST OF FITTINGS — ADD 50% TO LINEAR FOOT COST

Distribution:

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80-122 000

SHEET 10 OF 13

Local ______ L.D. 312-724-4500 Placed X Rec'd ______ Date 12/9/80

ALEX LANE Conversed with FRAN SASSO

Of EBCO (E.B. KAISER Co.) Regarding LABOR FOR PREFAB. COND. PIPE SYST. UNDER TRI-SVC. SPEC.

MANHOURS FOR PIPE (FIT & WELD), PER FOOT	MANHOURS FOR CONDUIT CASING, ASTM A-139 PER FOOT	PIPE / CONDUIT Ø
.05	.45	1 / 6"
.05	.48	1½ / 6"
.065	.50	2 / 8"
.082	.52	2½ / 10"
.097	.52	3 / 10"
.128	.52	4 / 10"
.194	.58	6 / 14"
.258	.60	8 / 18"

CORRECTION TO KAISER QUOTE OF 12/8 : INSULATION IS AS PER TRI-SVC SPEC.

I.E.

PIPE Ø	INSUL
1-2"	1½"
2½-4"	2"
6-8"	2½"

TRI-SVC SPEC IS USA CE-301.21
USN TS-15P28
USAF 88-007.1

Distribution:

II-126

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80-122

SHEET 11 OF 13

Local ____ L.D. ____ Placed X Rec'd ____ Date 12/?/80

ALEX LANE Conversed with ALLAN LAW

Of TRENWA [illegible] Regarding [illegible] TRENCH

606-781-0831

TRENWA® SYSTEM USED PRIMARILY FOR CABLE, CAN BE USED (IS USED) FOR PIPING. THERE IS 16 OR 24" DEEP TYPE THAT IS 10", 20", 30" OR 40" WIDE.

WITH UNISTRUT INSTALLED, A 24" DEEP, 30"-WIDE MODULAR CONCRETE TRENCH WILL COST $30-32/FT.

SYSTEM CAN WITHSTAND 7k LOAD.

12/5 A. LAW HAS NO DATA RE: TRENCH LIFETIME.

RSH ELECTR. DEPT. NOTES LIFETIME IS SUFF. FOR ELEC. SUBSTATION PURPOSES.

Distribution:

NOTE: N. POST (RSH) CONFIRMS CONCRETE TRENCH LIFETIME

RS&H FORM 102 11/72

Project No. 80-122-000
SHEET 12 OF 13

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. X Placed ______ Rec'd X Date 12/8/80

ALEX LANE Conversed with ED KAISER

Of EBCO Regarding UNDERGROUND, PREFAB, INSULATED PIPING SYS.

PRICES FOR STEAM & CONDENSATE PIPING

STEAM	PRICE/FT (MILL QUAN.)
8"/40/A-53	$60.
6	47
4	35
3	28
2	23
CONDENSATE	
2½/40/A53	24
2/40/A53	23
1½/80/A-106	19
1/80/A-106	17

FOB GLENVIEW
10 GA. BLACK STEEL CASING W/ HOT TAR
INSULATED PIPE

SIZE	INSULATION
8"	3"
6	2½"
4	2"
3	2"
<2	1"

E.K. ADVISES OVERALL 18% INCREASE IF 10 GA GALV. STEEL CONDUIT IS TO BE USED.

PRICES ARE FOB GLENVIEW; EK ADVISES 5% INCREASE FOR TRANSPORT TO SYRACUSE

EACH 90° EL <=> 12-15' LF OF PIPE

[redacted]

NOTE: PRICES [illegible] [illegible] [illegible] WE PRICES. [illegible] FITTING PRICES RESULTS [illegible]

Project No. 80122000

SHEET 13 OF 13

Telephone Call Confirmation

reynolds, smith and hills

Local ___ L.D. X Placed X Rec'd ___ Date 12/10/80

A. LANE Conversed with GARY KITTREL

Of SEAD Regarding WATER PIPE

DISCUSSED A) PIPE LIFETIME AT SEAD; B) SOIL COMPOSITION AT SEAD.

A) G.K. INDICATES SOIL IN SEAD AREA ALLOWS LONG LIFETIME FOR UNDERGROUND PIPE. GK ASSERTS THAT MOST PROBLEMS ARISE FROM POOR ENGINEERING PRACTICE, i.e., SURVEYED STEAM PIPE SHOWS DETERIORATION FROM WITHIN; SUGGESTS WATER TREATMENT.

B) SEAD SOIL IS SILTY CLAY LOAM ON WEATHERED SHALE BEDROCK. SENECA CO. SOIL COMPRISED OF

- DARIEN-DANLEY-CAZENOVIA SILT LOAM
- DARIEN SILT LOAM
- ILION SILTY CLAY LOAM
- ROMULUS SILTY CLAY
- ODESSA SILT
- ONTARIO LOAM

Distribution:

RS&H FORM 102 11/72

SECTION II-6

LIFE CYCLE COST CALCULATIONS

BASE CASE, OPTION 2, OPTION 3,
OPTION 2 + WOOD, OPTION 2 + RDF, OPTION 2 SENSITIVITY ANALYSIS

CALCULATION RATIONALE

Cost Estimate	12/80
Construction Midpoint	1/84
Beneficial Occupancy Date (BOD)	1/85
Midpoint of First Year of Facility Use	7/85

(1) Planning Date - Time Calculations

(a) Time from project cost estimate (12/80) to midpoint of first year of facility use (7/85) is five years - seven months (5.58 years).

(b) Time from anticipated midpoint of construction (1/84) to the project BOD (1/85) is 1 year.

(2) Initial Costs

Initial cost differential cost growth factor for this analysis is 1.0, as it is anticipated that its cost will grow at the same rate as that of general inflation. Therefore, the initial cost estimate dated 12/80 will be the same dollar value as the anticipated midpoint of construction date estimated for all alternates.

(3) Maintenance Costs

Maintenance cost differential cost growth factor is 1.0, for the same reason as the initial cost factor. Hence, the maintenance cost estimates dated 12/80 will be the same dollar value as the BOD year cost estimtaes for all alternates.

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing
DESIGNER J. Steckloff
CHECKER
AEP NO.
SHEET 2 OF 46
DATE 1/5/81
DATE

Seneca South; Base Case, 25 Yr; Army Esc

D) Existing Pipe Replacement
$\$430,340 \times .174 = \$74,879$

$F = N \times \frac{2}{P}$
$= .334 \times 13/25 = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$74,879 \times \frac{1}{1.1} = \$68,072$

Operating – #6 Fuel Oil
$\$77,928 \times 1.08^{4.58} = \$110,860$
$\$110,860 \times 20.050 = \$2,222,743$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$\$2,222,743 \times \frac{1}{1.1} = \$2,020,675$

2,020,675

Operating – #2 Fuel Oil
$\$28,193 \times 1.08^{4.58} = \$40,107$
$\$40,107 \times 20.050 = \$804,145$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$804,145 \times \frac{1}{1.1} = \$731,041$

731,041

Operating – Electricity
$\$3976 \times 1.07^{4.58} = \$5420$
$\$5420 \times 18.048 = \$97,820$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$97,820 \times \frac{1}{1.1} = \$88,927$

88,927

Senrca South; Base Case, 25 Yr, Army Esc

Operating - Elect Demand

$\$1065 \times 1.07^{4.58} = \$1452$

$\$1452 \times 18.048 = \$26,206$

P.V. (1/84): $P = s\left[\frac{1}{(1+i)^n}\right]$

$= \$26,206 \times \frac{1}{1.1} = \$23,824$

TOTAL LIFE CYCLE COST

Operating - Elect Demand	23,824
TOTAL LIFE CYCLE COST	$5,105,926

SENECA SOUTH
BASE CASE

40 YEAR LIFE
1970 - 1980 ESCALATION RATES

INITIAL (1/84): \$0	\$ -0-
ANN. MAINTENANCE (1/85): \$232,522 P.V. (B.O.D.): \$232,522 × 10.245 = \$2,382,188 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$2,382,188 × $\frac{1}{1.1}$ = \$2,165,625	2,165,625
CYCLICAL MAINTENANCE	
A) BUILDINGS 121, 319 \$515,736 (.538 + .003) = \$279,013 $F = N \times \frac{R}{P}$ = .031 × $\frac{3}{30}$ = .003 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$279,013 × $\frac{1}{1.1}$ = \$253,648	253,648
B) BUILDINGS 101, 103 \$9978 (.538 + .052) = \$5,887 $F = N \times \frac{R}{P}$ = .080 × $\frac{13}{20}$ = .052 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$5,887 × $\frac{1}{1.1}$ = \$5,352	5,352
C) BUILDINGS 113, S-142 \$22,000 (.334 + .020) = \$7,788 $F = N \times \frac{R}{P}$ = .050 × $\frac{8}{20}$ = .020 P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$7,788 × $\frac{1}{1.1}$ = \$7,080	7,080

SENECA SOUTH, BASE, 40 YR, 1979-1980 ESC.

D) EXISTING PIPE REPLACEMENT

$430,340 (.334 + .004) = $145,455

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$145,455 \times \frac{1}{1.1} = \$132,232$

132,232

OPERATING – #6 FUEL OIL

$77,928 × $1.11^{4.58}$ = $125,682
$125,682 × 48.209 = $6,059,004

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$6,059,004 \times \frac{1}{1.1} = \$5,508,185$

5,508,185

OPERATING – #2 FUEL OIL

$28,193 × $1.11^{4.58}$ = $45,470
$45,470 × 48.209 = $2,192,063

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$2,192,063 \times \frac{1}{1.1} = \$1,992,785$

1,992,785

OPERATING – ELECTRICITY

$3,976 × $1.01^{4.58}$ = $4,161
$4,161 × 11.314 = $47,078

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$47,078 \times \frac{1}{1.1} = \$42,798$

42,798

SENECA SOUTH, BASE 40 YR., 1970-1980 ESC.

OPERATING - ELEC. DEMAND

$\$1,065 \times 1.042^{4.58} = \$1,286$

$\$1,286 \times 16.329 = \$20,999$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$20,999 \times \frac{1}{1.1} = \$19,090$

19,090

TOTAL LIFE CYCLE COST

\$10,126,795

SENECA SOUTH
BASE CASE

40 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): \$0 — \$ -0-

ANN. MAINTENANCE (1/85): \$232,522 — 2,165,625

P.V. (E.O.D.): \$232,522 × 10.245 = \$2,382,188

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$2,382,188 × $\frac{1}{1.1}$ = \$2,165,625

CYCLICAL MAINTENANCE

A) BUILDINGS 121, 319 — 253,648
\$515,736 (.538 + .003) = \$279,013

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{30} = .003$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$279,013 × $\frac{1}{1.1}$ = \$253,648

B) BUILDINGS 101, 103 — 5,352
\$9,978 (.538 + .053) = \$5,887

$F = N \times \frac{R}{P}$
$= .080 \times \frac{13}{20} = .052$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$5,887 × $\frac{1}{1.1}$ = \$5,352

C) BUILDINGS 113, S-142 — 7,080
\$22,000 (.334 + .020) = \$7,788

$F = N \times \frac{R}{P}$
$= .050 \times \frac{8}{20} = .020$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= \$7,788 × $\frac{1}{1.1}$ = \$7,080

SENECA SOUTH BASE, 40 YR, ARMY ESC.

D) EXISTING FIPE REPLACEMENT

$430,340 (.334 + .004) = $145,455

$F = N \times \frac{R}{P}$

$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$145,455 \times \frac{1}{1.1} = \$132,232$ — 132,232

OPERATING – #6 FUEL OIL

$\$77,928 \times 1.08^{4.58} = \$110,860$

$\$110,860 \times 28.328 = \$3,140,442$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$3,140,442 \times \frac{1}{1.1} = \$2,854,947$ — 2,854,947

OPERATING – #2 FUEL OIL

$\$28,193 \times 1.08^{4.58} = \$40,107$

$\$40,107 \times 28.328 = \$1,136,151$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$1,136,151 \times \frac{1}{1.1} = \$1,032,865$ — 1,032,865

OPERATING – ELECTRICITY

$\$3,976 \times 1.07^{4.58} = \$5,420$

$\$5,420 \times 24.185 = \$131,083$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$131,083 \times \frac{1}{1.1} = \$119,166$ — 119,166

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AEP NO. 0 0122 000
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SENECA SOUTH, BASE, 46 YR, ARMY ESC.

OPERATING - ELEC. DEMAND

$1,065 × 1.07^{4.58} = $1,452

$1,452 × 24.185 = $35,117

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$35,117 \times \frac{1}{1.1} = \$31,925$

31,925

TOTAL LIFE CYCLE COST

$6,602,840

SENECA SOUTH
BASE CASE

25 YEAR LIFE
1970 - 1980 ESCALATION RATES

INITIAL (1/84): $0

ANN. MAINTENANCE (1/85): $232,522

P.V. (B.O.D.): $232,522 × 9.524 = $2,214,540

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$2,214,540 \times \frac{1}{1.1} = \$2,013,218$

CYCLICAL MAINTENANCE

A) BUILDINGS 121, 319
$515,736 × .323 = $166,583

$F = N \times \frac{R}{P}$
$= .538 \times \frac{18}{30} = .323$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$166,583 \times \frac{1}{1.1} = \$151,439$

B) BUILDINGS 101, 103
$9,978 × .484 = $4,829

$F = N \times \frac{R}{P}$
$= .538 \times \frac{18}{20} = .484$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$4,829 \times \frac{1}{1.1} = \$4,390$

C) BUILDINGS 113, S-142
$22,000 × .217 = $4,774

$F = N \times \frac{R}{P}$
$= .334 \times \frac{13}{20} = .217$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$4,774 \times \frac{1}{1.1} = \$4,340$

$

2

SENECA SOUTH, BASE 25 YR, 1970-1980 ESC.

D) EXISTING PIPE REPLACEMENT

$\$430,340 \times .174 = \$74,879$

$F = N \times \frac{R}{P} = .334 \times \frac{12}{25} = .174$

68,072

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$74,879 \times \frac{1}{1.1} = \$68,072$

OPERATING – #6 FUEL OIL

3,205,348

$\$77,928 \times 1.11^{4.58} = \$125,682$

$\$125,682 \times 28.054 = \$3,525,883$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$3,525,883 \times \frac{1}{1.1} = \$3,205,348$

OPERATING – #2 FUEL OIL

1,159,650

$\$28,193 \times 1.11^{4.58} = \$45,470$

$\$45,470 \times 28.054 = \$1,275,615$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$1,275,615 \times \frac{1}{1.1} = \$1,159,650$

OPERATING – ELECTRICITY

39,056

$\$3,976 \times 1.01^{4.58} = \$4,161$

$\$4,161 \times 10.325 = \$42,962$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$42,962 \times \frac{1}{1.1} = \$39,056$

SENECA SOUTH BASE 25 YR. 1976-1980 ESC.

OPERATING - ELEC. DEMAND

$\$1,065 \times 1.042^{4.58} = \$1,286$

$\$1,286 \times 13.681 = \$17,594$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$17,594 \times \frac{1}{1.1} = \$15,995$

15,995

TOTAL LIFE CYCLE COST

$6,661,508

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SUBJECT
DESIGNER A. Chambers
CHECKER S. Dunn
REF NO.
SHEET 13 OF 46
DATE 12/30/80
DATE

SENECA SOUTH — OPTION 2 — 40 YR LIFE — ARMY ESCALATION RATES

INITIAL (1/84): ~~$3,882,044~~ $3,662,306

ANN. MAINTENANCE (1/86): $267,467

P.V. (B.O.D.): $267,467 × 10.245 = $2,740,199

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,740,199 × $\frac{1}{1.1}$
= $2,491,090

CYCLICAL MAINTENANCE

A) $2,926,723 × .049 = $143,409

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $143,409 × $\frac{1}{1.1}$ = $130,372

B) $430,340 (.334 + .004) = $145,455

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $145,455 × $\frac{1}{1.1}$ = $132,232

OPERATING – COAL

$57,996 × $1.05^{4.58}$ = $72,518
$72518 × 18.136 = $1,315,186

$3,662,306
~~$3,882,044~~
2,491,090
130,372
132,232
1,195,624

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SUBJECT Life Cycle Costing
DESIGNER A. Chambers
CHECKER

AEP NO. 0912C000
SHEET 14 OF 46
DATE 12/30/80
DATE

SENECA SOUTH, OPT. 2, 40 YR. ARMY ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1,315,186 \times \frac{1}{1.1} = \$1,195,624$

OPERATING – ELECTRICITY
$\$12,609 \times 1.07^{4.58} = \$17,189$
$\$17,189 \times 24.185 = \$415,716$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$415,716 \times \frac{1}{1.1} = \$377,924$ — 377,924

OPERATING – ELECT. DEMAND
$\$5,850 \times 1.07^{4.58} = \$7,975$
$\$7,975 \times 24.185 = \$192,875$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$192,875 \times \frac{1}{1.1} = \$175,341$ — 175,341

TOTAL LIFE CYCLE COST — $8,164,889

~~$8,394,627~~

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DESIGNER S. Dunn
CHECKER J. Steckloff

AEP NO
SHEET 15 OF 46
DATE 12/30/80
DATE 12/31/80

SENECA SOUTH
OPTION 2

25 Yr Life
1970-'80 Escalation Rates

Initial (1/84): ~~$3,882,044~~ $3,662,306 — $3,662,306 ~~$3,882,044~~

Ann. Maintenance (1/85): $267,467
P.V. (B.O.D.): $267,467 x 9.524 = $2,547,356

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= 2,547,356 × $\frac{1}{1.1}$
= $2,315,778 — $2,315,778

Cyclical Maintenance
A) $430,340 (.174) = $74,879

$F = N \times \frac{R}{P}$
$= .334 \times \frac{13}{25} = .174$

P.V. (1/84) $P = S\left[\frac{1}{(1+i)^n}\right]$
= $74,879 × $\frac{1}{1.1}$ = $68,072 — $68,072

Operating - Coal
$57,996 × $1.10^{4.56}$ = $89,738
$89,738 × 25.000 = $2,243,450

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
= $2,243,450 × $\frac{1}{1.1}$ = $2,039,500 — $2,039,500

Seneca South, Opt. 2, 25 yr, ALANTEL Esc.

Operating - Electricity

$\$12{,}609 \times 1.01^{4.58} = \$13{,}197$

$\$13{,}197 \times 10.325 = \$136{,}259$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= 136{,}259 \times \frac{1}{1.1} = \$123{,}872$ — $123,872

Operating - Elect. Demand

$\$5{,}850 \times 1.042^{4.58} = \$7{,}063$

$\$7{,}063 \times 13.681 = \$96{,}629$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$96{,}629 \times \frac{1}{1.1} = \$87{,}845$ — $87,845

Total Life Cycle Cost — $8,297,373

~~$8,517,111~~

SENECA SOUTH
OPTION 2

25 YR LIFE
ARMY Escalation Rates

Initial (1/84): ~~$3,882,044~~ $3,662,306	$3,662,306 ~~$3,882,044~~
Ann. Maintenance (1/85): $267,467	
P.V. (B.O.D): $267,467 x 9.524 = $2,547,356	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = 2,547,356 x $\frac{1}{1.1}$ = $2,315,778	$2,315,778
Cyclical Maintenance	
A) $430,340 (.174) = 74,879 — F = N x $\frac{R}{P}$ = .334 x $\frac{13}{25}$ = .174	
P.V. (1/84) $P = S\left[\frac{1}{(1+i)^n}\right]$ = $74,879 x $\frac{1}{1.1}$ = $68,072	$68,072
Operating – Coal	
$57,996 x $1.05^{4.58}$ = $72,518	
$72,518 x 14.776 = $1,071,526	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = $1,071,526 x $\frac{1}{1.1}$ = $974,115	$974,115

<u>Seneca South, Opt. 2, 25 yr, Army Esc.</u>

<u>Operating</u> - Electricity

$\$12,609 \times 1.07^{4.58} = \$17,189$

$\$17,189 \times 18.048 = \$310,227$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$310,227 \times \frac{1}{1.1} = \$282,025$ — \$282,025

<u>Operating</u> - Elect Demand

$\$5,850 \times 1.07^{4.58} = \$7975$

$\$7,975 \times 18.048 = \$143,933$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$143,933 \times \frac{1}{1.1} = \$130,848$ — \$130,848

<u>Total Life Cycle Cost</u> — \$7,433,144 ~~\$7,652,582~~

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SENECA SOUTH
OPTION 2

40 YEAR LIFE
1970–1980 ESCALATION RATES

INITIAL (1/84): ~~\$3,882,044~~ \$3,662,306 — \$3,662,306 ~~\$3,882,044~~

ANN. MAINTENANCE (1/85): \$267,467 — 2,491,090

P.V. (B.O.D.): \$ 267,467 × 10.245 = \$2,740,199

F.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,740,199 × $\frac{1}{1.1}$

= \$2,491,090

CYCLICAL MAINTENANCE

A) \$2,926,723 × .049 = \$143,409 — $F = N \times \frac{R}{P}$ = .088 × $\frac{14}{25}$ = .049 — 130,372

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$143,409 × $\frac{1}{1.1}$ = \$130,372

B) \$430,340 (.334 + .004) = \$145,455 — $F = N \times \frac{R}{P}$ = .031 × $\frac{3}{25}$ = .004 — 132,232

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$145,455 × $\frac{1}{1.1}$ \$132,232

OPERATING – COAL — 3,263,200

\$57,996 × $1.10^{4.58}$ = \$89,738

\$89,738 × 40.000 = \$3,589,520

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SUBJECT Life Cycle Costing
DESIGNER A. Chambers
CHECKER
AEP NO. 80122-000
SHEET 20 OF 46
DATE 12/30/80
DATE

SENECA SOUTH, OPT. 2, 40 YR., 1970-'80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$3,589,520 \times \frac{1}{1.1} = \$3,263,200$

OPERATING – ELECTRICITY
$\$12,609 \times 1.01^{4.58} = \$13,197$
$\$13,197 \times 11.314 = \$149,311$ — 135,737

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$149,311 \times \frac{1}{1.1} = \$135,737$

OPERATING – ELECT. DEMAND — 104,847
$\$5,850 \times 1.042^{4.58} = \$7,063$
$\$7,063 \times 16.329 = \$115,332$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$115,332 \times \frac{1}{1.1} = \$104,847$

TOTAL LIFE CYCLE COST — \$9,919,784 ~~\$10,139,522~~

SENECA SOUTH
COAL SENSITIVITY ANALYSIS

40 YEAR LIFE
1970-'80 ESCALATION

Life Cycle Cost if Coal Increased:

	9%	10%	11%
Option 2	$9,759,425	$10,139,522	$11,365,477
Option 2 - Wood Firing	9,660,333	10,264,860	11,051,851
Option 3	10,459,058	10,791,734	11,882,239

	9%	10%	11%
Option 2	9,539,687	9,919,784	11,165,739
Option 2 - Wood Firing	9,439,002	10,043,529	10,830,520
Option 3	10,199,058	10,531,734	11,622,239

SENSITIVITY ANALYSIS

Seneca South Opt 2 Wood Firing Subopt 40 yr 1970-80 TOTAL

Oper Coal

@ 10% = $3,071,782	10,043,529	~~10,264,860~~
@ 9% (.8032) = $2,467,255	9,439,002	~~9,660,333~~
@ 11% (1.2562) = $3,858,773	10,830,520	~~11,051,851~~

Seneca South Opt 3 40 yr Life 1970-80

Oper Coal

@ 10% = $3,141,680	10,531,734	~~10,791,734~~
@ 9% (.8032) = $2,523,397	10,199,058	~~10,459,058~~
@ 11% (1.2562) = $3,946,578	11,622,239	~~11,882,239~~

Seneca South Opt 2 40 yr life 1970-80

Open Coal

@ 10% = $3,589,520	9,919,784	~~10,139,522~~
@ 9% (.8032) = $2,883,103	9,539,687	~~9,759,425~~
@ 11% (1.2562) = $4,509,155	11,165,739	~~11,385,477~~

SENECA SOUTH
OPTION 3

25 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~\$4,593,454~~ \$4,333,454 — \$4,333,454 (~~\$4,593,454~~)

ANN. MAINTENANCE (1/85): \$285,252

P.V. (B.O.D.): \$285,252 × 9.524 = \$2,716,740

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,716,740 × $\frac{1}{1.1}$ = \$2,469,764 — 2,461,764

CYCLICAL MAINTENANCE

EXISTING PIPING

\$430,340 × .174 = \$74,879

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$74,879 × $\frac{1}{1.1}$ = \$68,072 — 68,072

OPERATING – COAL

\$50,760 × $1.05^{4.58}$ = \$63,470

\$63,470 × 14.776 = \$937,833

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$937,833 × $\frac{1}{1.1}$ = \$852,575 — 852,575

OPERATING – LIMESTONE

\$3,137 × 9.524 = \$29,877 — 27,161

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DESIGNER ____ DATE ____
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SENECA SOUTH, OPT. 3, 25 YR., ARMY ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$29,877 \times \frac{1}{1.1} = \$27,161$

OPERATING – ELECTRICITY | 464,080
$\$20,748 \times 1.07^{4.58} = \$28,285$
$\$28,285 \times 18.048 = \$510,488$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$510,488 \times \frac{1}{1.1} = \$464,080$

OPERATING – ELECT. DEMAND | 189,291
$\$8,463 \times 1.07^{4.58} = \$11,537$
$\$11,537 \times 18.048 = \$208,220$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$208,220 \times \frac{1}{1.1} = \$189,291$

TOTAL LIFE CYCLE COST | \$8,404,397 ~~\$8,661,397~~

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SUBJECT LIFE CYCLE COSTING
DESIGNER A. CHAMBERS
CHECKER S. DUNN

DATE 1/8/81
DATE 1-9-81

SENECA SOUTH
OPTION 3

40 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~\$4,593,454~~ \$4,333,454 — \$4,333,454 ~~\$4,593,454~~

ANN. MAINTENANCE (1/85): \$285,252

P.V. (6.O.D.): \$285,252 × 10.245 = \$2,922,407

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,922,407 × $\frac{1}{1.1}$ = \$2,656,734 — 2,656,734

CYCLICAL MAINTENANCE

A) EXISTING PIPING

\$430,340 (.334 + .004) = \$145,455

$F = N \times \frac{R}{P}$
$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$145,455 × $\frac{1}{1.1}$ = \$132,232 — 132,232

B) AFCC SYSTEMS

\$3,445,153 × .049 = \$168,812

$F = N \times \frac{R}{P}$
$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$168,812 × $\frac{1}{1.1}$ = \$153,465 — 153,465

OPERATING – COAL

\$50,760 × $1.05^{4.58}$ = \$63,470

\$63,470 × 18.136 = \$1,151,092 — 1,046,447

SENECA SOUTH, OPT. 3, 40 YR., ARMY ESE

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1,151,092 \times \frac{1}{1.1} = \$1,046,447$

OPERATING – LIMESTONE | 29,217
$\$3,137 \times 10.245 = \$32,139$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$32,139 \times \frac{1}{1.1} = \$29,217$

OPERATING – ELECTRICITY | 621,885
$\$20,748 \times 1.07^{4.58} = \$28,285$
$\$28,285 \times 24.185 = \$684,073$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$684,073 \times \frac{1}{1.1} = \$621,885$

OPERATING – ELECT. DEMAND | 253,656
$\$8,463 \times 1.07^{4.58} = \$11,537$
$\$11,537 \times 24.185 = \$279,022$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$279,022 \times \frac{1}{1.1} = \$253,656$

TOTAL LIFE CYCLE COST | \$9,227,090 ~~\$9,487,090~~

SENECA SOUTH
OPTION 3

40 YEAR LIFE
1970 - '80 ESCALATION RATES

INITIAL (1/84): ~~$4,593,454~~ $4,333,454 — $4,333,454 ~~$4,593,454~~

ANN. MAINTENANCE (1/85): $285,252

P.V. (B.O.D.): $285,252 × 10.245 = $2,922,407 — 2,656,734

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$2,922,407 \times \frac{1}{1.1} = \$2,656,734$

CYCLICAL MAINTENANCE

A) EXISTING PIPING

$430,340 (.334 + .004) = $145,455 — 132,232

$F = N \times \frac{R}{P}$

$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$145,455 \times \frac{1}{1.1} = \$132,232$

B) AFBC SYSTEMS

$3,445,153 × .049 = $168,812 — 153,465

$F = N \times \frac{R}{P}$

$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$168,812 \times \frac{1}{1.1} = \$153,465$

OPERATING - COAL — 2,856,073

$\$50,760 \times 1.10^{4.58} = \$78,542$

$\$78,542 \times 40.00 = \$3,141,680$

SENECA SOUTH, OPT. 3, 40 YR., 1970-'80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$3,141,680 \times \frac{1}{1.1} = \$2,856,073$

OPERATING - LIMESTONE | 24,745

$\$3,137 \times .988^{4.58} = \$2,968$
$\$2,968 \times 9.171 = \$27,220$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$27,220 \times \frac{1}{1.1} = \$24,745$

OPERATING - ELECTRICITY | 223,349

$\$20,748 \times 1.01^{4.58} = \$21,715$
$\$21,715 \times 11.314 = \$245,684$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$245,684 \times \frac{1}{1.1} = \$223,349$

OPERATING - ELECT. DEMAND | 151,682

$\$8,463 \times 1.042^{4.58} = \$10,218$
$\$10,218 \times 16.329 = \$166,850$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$166,850 \times \frac{1}{1.1} = \$151,682$

TOTAL LIFE CYCLE COST | \$10,531,734 ~~\$10,791,734~~

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SUBJECT LIFE CYCLE COSTING
DESIGNER A. CHAMBERS
CHECKER J. Stockloff
AEP NO 80122-000
SHEET 29 OF 46
DATE 1/8/81
DATE 1/12/81

SENECA SOUTH
OPTION 3

25 YEAR LIFE
1970 - '80 ESC. RATES

INITIAL (1/84): ~~$4,593,454~~ $4,333,454

ANN. MAINTENANCE (1/85): $285,252

P.V. (B.O.D.): $285,252 × 9.524 = $2,716,740

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $2,716,740 × $\frac{1}{1.1}$ = $2,469,764

CYCLICAL MAINTENANCE

EXISTING PIPING

$430,340 × .174 = $74,879

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $74,879 × $\frac{1}{1.1}$ = $68,072

OPERATING - COAL

$50,760 × $1.10^{4.58}$ = $78,542

$78,542 × 25.00 = $1,963,550

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= $1,963,550 × $\frac{1}{1.1}$ = $1,785,045

OPERATING - LIMESTONE

$3,137 × $.988^{4.58}$ = $2,968

$2,968 × 8.663 = $25,712

$4,333,454
~~$4,593,454~~
2,469,764
68,072
1,785,045
23,375

SENECA SOUTH, OPT. 3, 25 YR., 1970 – '80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$25,712 \times \frac{1}{1.1} = \$23,375$

OPERATING – ELECTRICITY — 203,825

$\$20,748 \times 1.01^{4.58} = \$21,715$
$\$21,715 \times 10.325 = \$224,207$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$224,207 \times \frac{1}{1.1} = \$203,825$

OPERATING – ELECT. DEMAND — 127,084

$\$8,463 \times 1.042^{4.58} = \$10,218$
$\$10,218 \times 13.681 = \$139,792$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$139,792 \times \frac{1}{1.1} = \$127,084$

TOTAL LIFE CYCLE COST — $9,010,619 ~~$9,270,619~~

SENECA SOUTH
OPTION 2 – RDF FIRING SUBOPTION

25 YEAR LIFE
1970-80 ESCALATION)

INITIAL (1/84): ~~$ 4617724~~ $4,356,343 — $4,356,343 ~~$4617724~~

ANNUAL MAINTENANCE (1/85): $ 283129 — $2,451,382

P.V. (B.O.D.): $ 283129 × 9.524 = $ 2696521

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= 2696521 \times \frac{1}{1.1} =$ $ 2,451,382

CYCLICAL MAINTENANCE — $68072

$F = N \times \frac{R}{P} = .334 \times \frac{13}{25} = .174$

$ 430,340 × .174 = $ 74879

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$ 74879 \times \frac{1}{1.1} =$ $ 68072

OPERATING – COAL — $1,726,170

$ $49086 \times 1.10^{4.58}$ = $ 75951

75951 × 25 = $ 1,898,787

P.V. (1/84): $P = S\left(\frac{1}{(1+i)^n}\right)$

$= 1898787 \times \frac{1}{1.1} =$ $ 1,726,170

SENECA SOUTH - OPT 2 - RDF FIRING - 25 YR 1970-80 ESC.

OPERATING - ELECTRICITY	\$129,402
480728 Kwh x .0274 = \$13,172	
\$13172 x $1.01^{4.58}$ = \$13786	
13786 x 10.325 = \$142,342	
P.V. (1/84): $P = S\left(\frac{1}{(1+i)^n}\right) = 142342 \times \frac{1}{1.1}$ = \$129,402	
OPERATING - ELEC. DEMAND	165,148
282 Kw x \$39 = \$10998	
\$10998 x $1.042^{4.58}$ = \$13278	
13278 x 13.681 = \$181,663	
P.V. (1/84): $P = S\left(\frac{1}{(1+i)^n}\right)$	
$= 181{,}663 \times \frac{1}{1.1}$ = \$165,148	
TOTAL LIFE CYCLE COST	\$8,896,517 ~~\$9157898~~

SENECA SOUTH
OPTION 2 - RDF FIRING SUBOPTION

25 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~\$ 4,617,724~~ \$ 4,356,343	\$4,356,343 ~~\$ 4617724~~
ANNUAL MAINT. (1/85): \$ 283,129	\$ 2451382
P.V. (BOD) = \$ 283,129 × 9.524 = \$ 2696521	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= 2696521 \times \frac{1}{1.1} =$ \$ 2,451,382	
CYCLICAL MAINT:	\$ 68072
\$ 430,340 × .174 = \$ 74879	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= 74879 \times \frac{1}{1.1} =$ \$ 68072	
OPERATING - COAL	\$ 824,459
\$ 49086 × $1.05^{4.58}$ = \$ 61377	
61377 × 14.776 = \$ 906904	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$	
$= 906904 \times \frac{1}{1.1} =$ \$ 824,459	

SENECA NORTH - OPT. 2 RDF FIRING - 25 YEAR - ARMY ESCALATION

OPERATING - ELECTRICITY — # 294,622

$$\# 13172 \times 1.07^{4.58} = \# 17957$$
$$17957 \times 18.048 = \# 324,085$$

$$\text{P.V. } (1/84): \quad P = S\left[\frac{1}{(1+i)^N}\right]$$
$$= 324085 \times \frac{1}{1.1} = \# 294,622$$

OPERATING - ELEC DEMAND — # 245,996

$$\# 10998 \times 1.07^{4.58} = \# 14993$$
$$14993 \times 18.048 = \# 270,595$$

$$\text{P.V. } (1/84): \quad P = S\left[\frac{1}{(1+i)^N}\right]$$
$$= 270,595 \times \frac{1}{1.1} = \# 245,996$$

TOTAL LIFE CYCLE COST — # 8,240,874 ~~# 8,502,255~~

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SUBJECT: LIFE CYCLE COST ANAL
SEAD SOUTH – RDF

DESIGNER: Cowen

CHECKER:

AEP NO. 00122-000

SHEET 35 OF 46

DATE:

DATE:

SENECA SOUTH
OPTION 2 – RDF FIRING SUBOPTION

40 YEAR LIFE
1970-80 ESCALATION RATES

INITIAL: (1/84) ~~# 4617724~~ $ 4,356,343 — $ 4,356,343 ~~# 4617724~~

ANNUAL MAINT 1/85: # 283,129 — # 2636961

P.V. (B.O.D.): # 283129 ^ 10.245' = # 2900657

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 2900657 \times \frac{1}{1.1} = \# 2636961$

CYCLICAL MAINTENANCE — # 284,739

A) # 430,340 (334 · .004) = # 145,455

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 145455 \times \frac{1}{1.1} = \# 132,231$

B) # 3423642 × .049 = # 167,758

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = \# 167758 \times \frac{1}{1.1} = \# 152,508$

OPERATING – COAL — # 2,761,871

$\# 49086 \times 1.10^{4.58} = \# 75951$

75951 × 40 = # 3,038,059

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 3038059 \times \frac{1}{1.1} = \# 2,761,871$

SENECA SOUTH – OPT 2 – RDF FIRING SUBOPT 40 YEAR 1970-80 ESCALATION

OPERATING – ELECTRICITY

$$\$13172 \times 1.01^{4.58} = \$13{,}786$$
$$13786 \times 11.314 = \$155{,}975$$

$$P.V.\ (1/84):\ P = S\left[\frac{1}{(1+i)^{n}}\right] = 155975 \times \frac{1}{1.1} = \$141{,}795$$

Column total: $\$141795$

OPERATING – ELEC. DEMAND

$$\$10998 \times 1.042^{4.58} = \$13278$$
$$13278 \times 16.329 = \$216{,}816$$

$$P.V.\ (1/84):\ P = S\left[\frac{1}{(1+i)^{n}}\right] = 216816 \times \frac{1}{1.1} = \$197{,}106$$

Column total: $\$197106$

TOTAL LIFE CYCLE COST

~~\$10,640,196~~

\$10,378,815

A SOUTH | 40 YEAR LIFE
N 2 RDF SUBOPTION | ARMY ESCALATION RATES

L (1/84): ~~$ 4617724~~ $ 4,356,343 | $ 4,356,343 ~~$ 4,617,724~~

L MAINTENANCE (1/85): $ 283,129 | $ 2,636,961

(BOD): 283129 × 10.245 = $ 2,900,657

(1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 2900657 \times \frac{1}{1.1} =$ $ 2,636,961

AL MAINTENANCE | $ 284,739

30,340 (.334 + .004) = $ 145,455

V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 145455 \times \frac{1}{1.1} =$ $ 132,231

3,423,642 × .049 = $ 167,758

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 167758 \times \frac{1}{1.1} =$ $ 152,508

ATING – COAL | $ 1,011,937

$9086 \times 1.05^{4.58}$ = $ 61377
,1377 × 18.136 = $ 1,113,131

V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 1113131 \times \frac{1}{1.1} =$ $ 1,011,937

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SENECA SOUTH – OPT 2 RDF FIRING SUBOPT 40 YR ARMY ESC.

OPERATING ELECTRICITY	
$\$13172 \times 1.07^{4.58} = \$17957$	
$17957 \times 24.185 = \$434286$	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 434286 \times \frac{1}{1.1} = \$394{,}805$	$394805
OPERATING – ELEC DEMAND	
$\$10998 \times 1.07^{4.58} = \$14993$	
$14993 \times 24.185 = \$362608$	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^N}\right] = 362608 \times \frac{1}{1.1} = \$329644$	$329644
TOTAL LIFE CYCLE COST	~~$9,275,810~~
	$9,014,429

SENECA SOUTH
OPTION 2 - WOOD FIRING SUBOPTION

25 YEAR LIFE
1970-'80 ESC. RATES

INITIAL (1/84): ~~\$3,910,186~~ \$3,688,855

ANN. MAINTENANCE (1/85): \$289,209

P.V. (B.O.D.): \$289,209 × 9.524 = \$2,754,427

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,754,427 × $\frac{1}{1.1}$ = \$2,504,025

CYCLICAL MAINTENANCE

EXISTING PIPING

\$430,340 × .174 = \$74,879

$F = N \times \frac{R}{P}$

$= .334 \times \frac{13}{25} = .174$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$74,879 × $\frac{1}{1.1}$ = \$68,072

OPERATING - WOOD

\$2,834 × $1.07^{4.58}$ = \$3,863

\$3,863 × 18.048 = \$69,719

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$69,719 × $\frac{1}{1.1}$ = \$63,381

OPERATING - COAL

\$54,594 × $1.10^{4.58}$ = \$84,474

\$84,474 × 25.00 = \$2,111,850

\$3,688,855 ~~\$3,910,186~~
2,504,025
68,072
63,381
1,919,864

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SENECA SOUTH OPT. 2 WOOD FIRING SUBOPT. 25 YEAR, 1970-'80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$2,111,850 \times \frac{1}{1.1} = \$1,919,864$

OPERATING – ELECTRICITY
$\$12,609 \times 1.01^{4.58} = \$13,197$ — 123,872
$\$13,197 \times 10.325 = \$136,259$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$136,259 \times \frac{1}{1.1} = \$123,872$

OPERATING – ELECT. DEMAND
$\$5,850 \times 1.042^{4.58} = \$7,063$ — 87,845
$\$7,063 \times 13.681 = \$96,629$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$96,629 \times \frac{1}{1.1} = \$87,845$

TOTAL LIFE CYCLE COST — $8,455,914

~~$8,677,245~~

SENECA SOUTH
OPTION 2—WOOD FIRING SUBOPTION

40 YEAR LIFE
ARMY ESCALATION RATES

INITIAL (1/84): ~~\$3,910,186~~ \$3,688,855

ANN. MAINTENANCE (1/85): \$289,209

P.V. (B.O.D.): \$289,209 × 10.245 = \$2,962,946

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$2{,}962{,}946 \times \frac{1}{1.1} = \$2{,}693{,}587$

CYCLICAL MAINTENANCE

A) EXISTING PIPING

\$430,340 (.334 + .004) = \$145,455

$F = N \times \frac{R}{P}$

$= .031 \times \frac{3}{25} = .004$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$145{,}455 \times \frac{1}{1.1} = \$132{,}232$

B) INITIAL SYSTEM

\$2,953,272 × .049 = \$144,710

$F = N \times \frac{R}{P}$

$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$144{,}710 \times \frac{1}{1.1} = \$131{,}555$

OPERATING — WOOD

$\$2{,}834 \times 1.07^{4.58} = \$3{,}863$

\$3,863 × 24.185 = \$93,427

SENECA SOUTH, OPT. 2, WOOD FIRING SUBOPT., 40 YR., ARMY ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$93,427 \times \frac{1}{1.1} = \$84,934$

OPERATING – COAL
$\$54,594 \times 1.05^{4.58} = \$68,264$
$\$68,264 \times 18.136 = \$1,238,036$ — 1,125,487

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1,238,036 \times \frac{1}{1.1} = \$1,125,487$

OPERATING – ELECTRICITY — 377,924
$\$12,609 \times 1.07^{4.58} = \$17,189$
$\$17,189 \times 24.185 = \$415,716$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$415,716 \times \frac{1}{1.1} = \$377,924$

OPERATING – ELECT. DEMAND — 175,341
$\$5,850 \times 1.07^{4.58} = \$7,975$
$\$7,975 \times 24.185 = \$192,875$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$192,875 \times \frac{1}{1.1} = \$175,341$

TOTAL LIFE CYCLE COST — \$8,409,915 ~~\$8,631,246~~

SENECA SOUTH
OPTION 2 - WOOD FIRING SUBOPTION

40 YEAR LIFE
1970-'80 ESC. RATES

INITIAL (1/84): ~~\$3,910,186~~ \$3,688,855 — \$3,688,855 ~~\$3,910,186~~

ANNUAL MAINTENANCE (1/85): \$289,209

P.V. (B.O.D.): \$289,209 × 10.245 = \$2,962,946 — 2,693,587

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$2,962,946 × $\frac{1}{1.1}$ = \$2,693,587

CYCLICAL MAINTENANCE

A) EXISTING PIPING — $F = N \times \frac{R}{P}$ = .031 × $\frac{3}{25}$ = .004

\$430,340 (.334 + .004) = \$145,455 — 132,232

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$145,455 × $\frac{1}{1.1}$ = \$132,232

B) INITIAL SYSTEM — $F = N \times \frac{R}{P}$ = .088 × $\frac{14}{25}$ = .049 — 131,555

\$2,953,272 × .049 = \$144,710

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

= \$144,710 × $\frac{1}{1.1}$ = \$131,555

OPERATING - WOOD — 84,934

\$2,834 × $1.07^{4.58}$ = \$3,863

\$3,863 × 24.185 = \$93,427

SENECA SOUTH, OPT. 2, WOOD FIRING SUBOPT., 40 YR., 1970-'80 ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$93,427 \times \frac{1}{1.1} = \$84,934$

OPERATING – COAL — 3,071,782

$\$54,594 \times 1.10^{4.58} = \$84,474$
$\$84,474 \times 40.00 = \$3,378,960$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$3,378,960 \times \frac{1}{1.1} = \$3,071,782$

OPERATING – ELECTRICITY — 135,737

$\$12,609 \times 1.01^{4.58} = \$13,197$
$\$13,197 \times 11.314 = \$149,311$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$149,311 \times \frac{1}{1.1} = \$135,737$

OPERATING – ELECT. DEMAND — 104,847

$\$5,850 \times 1.042^{4.58} = \$7,063$
$\$7,063 \times 16.329 = \$115,332$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$115,332 \times \frac{1}{1.1} = \$104,847$

TOTAL LIFE CYCLE COST — \$10,045,529 ~~\$10,264,860~~

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SUBJECT: LIFE CYCLE COSTING — AEP NO. 80122-000
SHEET 45 OF 46
DESIGNER: A. CHAMBERS — DATE 1/9/81
CHECKER: J. Steckloff — DATE 1/12/81

SENECA SOUTH — 25 YEAR LIFE
OPTION 2 - WOOD FIRING SUBOPTION — ARMY ESC. RATES

<u>INITIAL</u> (1/84): ~~\$3,910,186~~ \$3,688,855	\$3,688,855 ~~\$3,910,186~~
<u>ANN MAINTENANCE</u> (1/85): \$289,209	
P.V. (B.O.D.): \$289,209 × 9.524 = \$2,754,427	2,504,025
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$2,754,427 × $\frac{1}{1.1}$ = \$2,504,025	
<u>CYCLICAL MAINTENANCE</u>	
EXISTING PIPING	
\$430,340 × .174 = \$74,879	68,072
$F = N \times \frac{R}{P}$ = .334 × $\frac{13}{25}$ = .174	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$74,879 × $\frac{1}{1.1}$ = \$68,072	
<u>OPERATING</u> - WOOD	63,381
\$2,834 × $1.07^{4.58}$ = \$3,863	
\$3,863 × 18.048 = \$69,719	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$ = \$69,719 × $\frac{1}{1.1}$ = \$63,381	
<u>OPERATING</u> - COAL	916,972
\$54,594 × $1.05^{4.58}$ = \$68,264	
\$68,264 × 14.776 = \$1,008,669	

SENECA SOUTH OPT. 2 WOOD FIRING SUBOPT. 25 YR. ARMY ESC.

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$1{,}008{,}669 \times \frac{1}{1.1} = \$916{,}972$

OPERATING – ELECTRICITY | 282,025
$\$12{,}609 \times 1.07^{4.58} = \$17{,}189$
$\$17{,}189 \times 18.048 = \$310{,}227$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$310{,}227 \times \frac{1}{1.1} = \$282{,}025$

OPERATING – ELECT. DEMAND | 130,848
$\$5{,}850 \times 1.07^{4.58} = \$7{,}975$
$\$7{,}975 \times 18.048 = \$143{,}933$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$
$= \$143{,}933 \times \frac{1}{1.1} = \$130{,}848$

TOTAL LIFE CYCLE COST | \$7,654,178
~~\$7,875,509~~

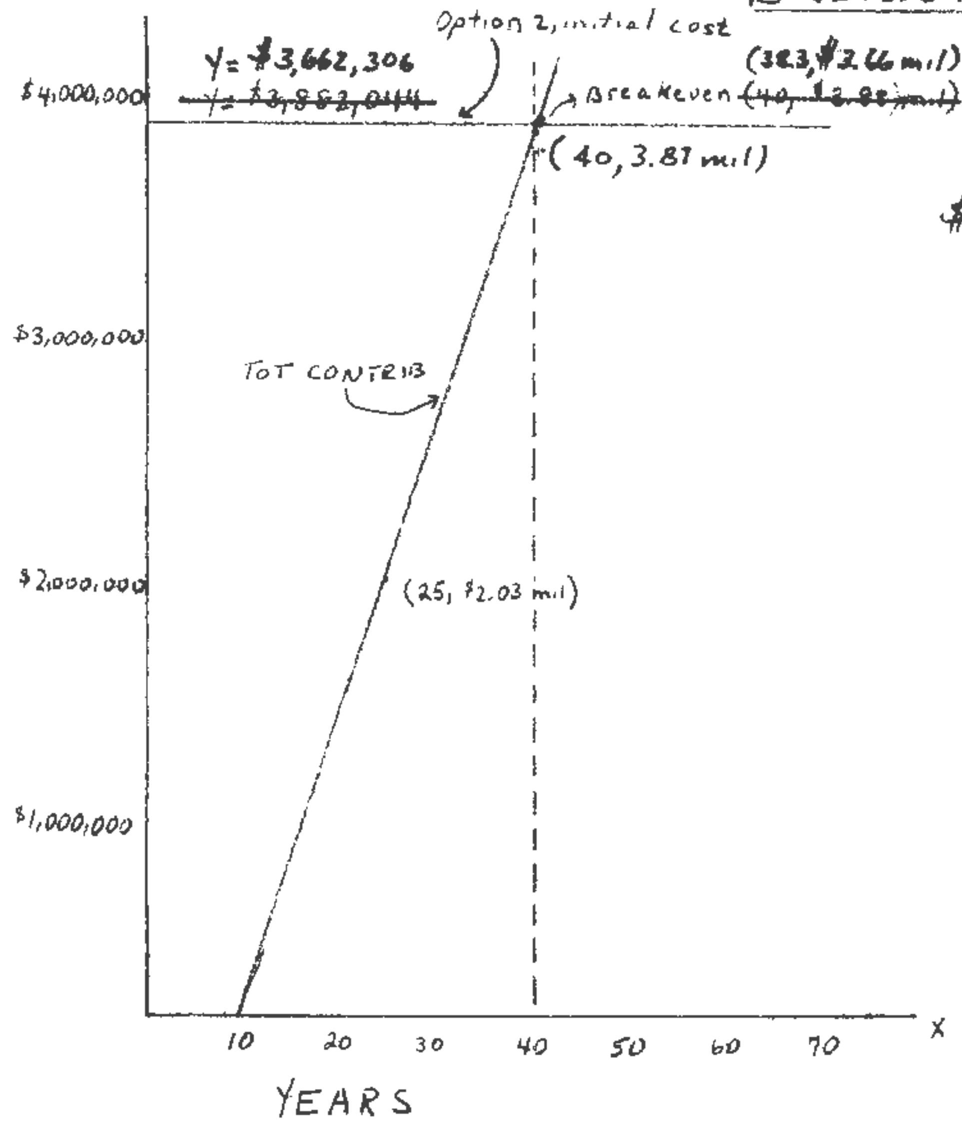
SECTION II-7

LIFE CYCLE COST CALCULATIONS
BREAKEVEN ANALYSIS

SENECA SOUTH
BREAKEVEN ANAL

OPTION 2 VS. BASE CASE
1970-'80 ESCALATION RATES

38.3
Breakeven = ~~40.1~~ years



The initial cost of op[...]
is represented by t[...]
$3,662,306 → Y = ~~$3,882,044~~. Dur[...]
year of existence [...]
contribution towar[...]
$3.66 ~~$3.88~~ million initi[...]
will be generate[...]
to lower annual [...]
(fuel, etc) assoc[...]
with option 2. T[...]
contribution is re[...]
by the sloping li[...]
38.3 → year ~~40~~, this co[...]
will finally be e[...]
the initial cost, [...]
option 2 will b[...]
cost effective a[...]
point.

Seneca South; Breakeven Anal; 1970-'80 Esc Rate

Option 2 initial cost = ~~$3,882,044~~ $3,662,306

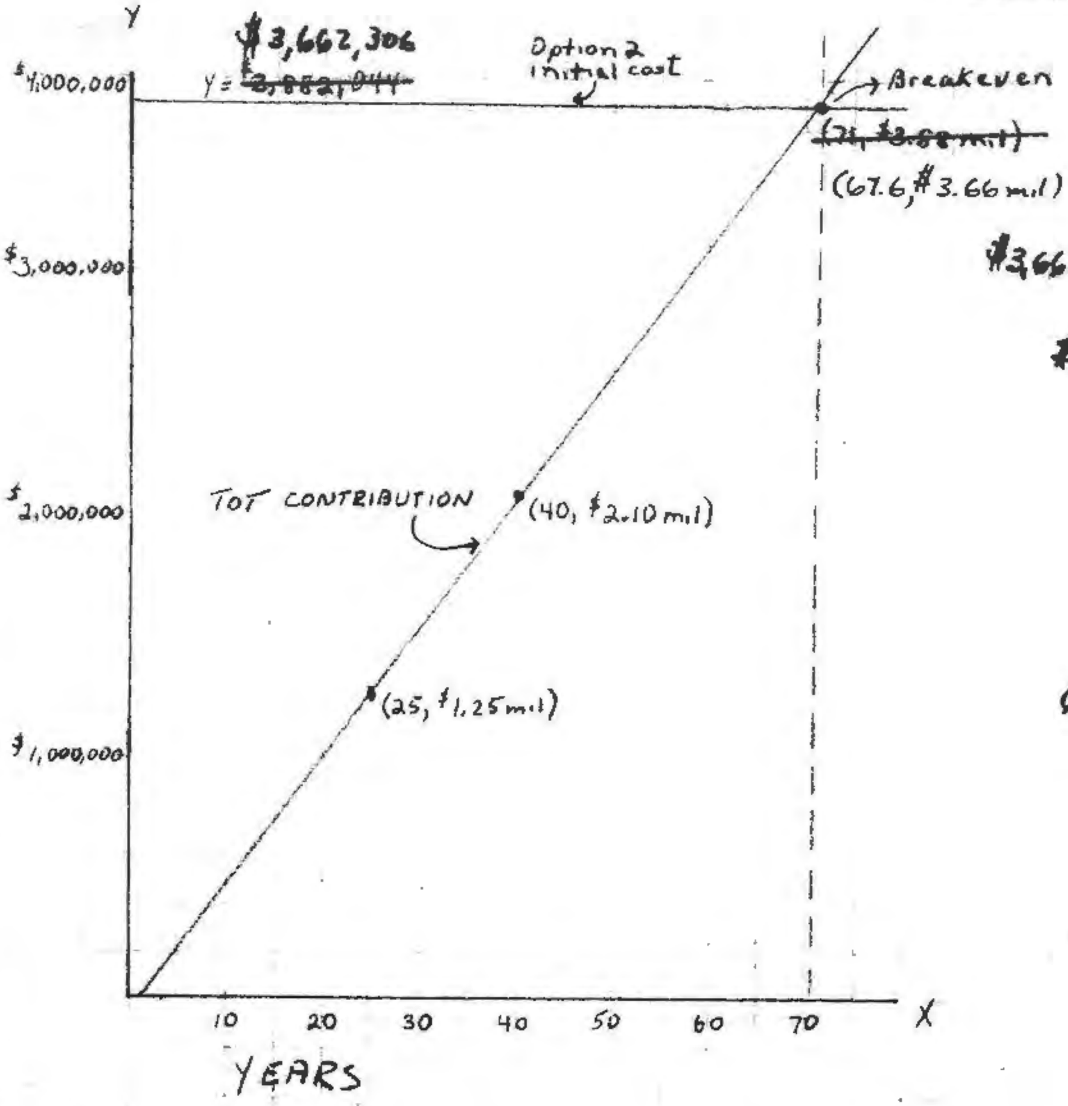
25 Year Point:
Base ann. costs = $6,661,508
Opt 2 ann costs = $8,517,111 − $3,882,044 = $4,635,067
Contribution = $6,661,508 − $4,635,067 = $2,026,441

40 Year Point:
Base ann costs = $10,126,795
Opt 2 ann costs = $10,139,522 − $3,882,044 = $6,257,478
Contribution = $10,126,795 − $6,257,478 = $3,869,317

SENECA SOUTH
BREAKEVEN ANAL

OPTION 2 VS. BASE CASE
ARMY ESCALATION RATES

BREAKEVEN = ~~71.3~~ 67.6 YRS



The initial cost of
is represented by
Y = ~~$3,882,044~~. D
$3,662,306 → year of existenc
contribution tow
$3.66 → ~~$3.88~~ million in
will be generate
lower annual c
(fuel, etc) assoc
with option 2.
contribution is r
by the sloping l
67.6 → year ~~71~~, this co
will finally be
to the initial c
option 2 will b
cost effective
point.

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing
DESIGNER J. Steckloff
CHECKER

AEP NO. 80122-000
SHEET 4 OF 4
DATE 1/12/81
DATE

Seneca South; Breakeven, Army Esc

Option 2, initial cost = ~~$3,882,044~~ $3,662,306

25 Year Point:
Base ann costs = $5,105,926
Opt 2 ann costs = $7,652,882 − $3,882,044 = $3,770,838
Contribution = $5,015,926 − $3,770,838 = $1,245,088

40 Year Point
Base ann costs = $6,602,840
Opt 2 ann costs = $8,384,627 − $3,882,044 = $4,502,583
Contribution = $6,602,840 − $4,502,583 = $2,100,257

SECTION II-8

LIFE CYCLE COST CALCULATIONS

DIRECT BURIAL VS HEAT CHANNEL
DISTRIBUTION SYSTEMS

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: Life Cycle Costing
DESIGNER: A. Chambers
CHECKER: S. Dunn
AEP NO: 80122-000
SHEET: 1 OF 2
DATE: 12/31/80
DATE:

SENECA — 40 YEAR LIFE
CHANNEL DIST. SYSTEM

<u>INITIAL</u> (1/84): ~~\$555,693~~ \$524,239	\$524,239 ~~\$555,693~~
<u>CYCLICAL MAINTENANCE</u>	
\$310,921 × .049 = \$15,235 $F = N \times \frac{R}{P} = .088 \times \frac{14}{25} = .049$	
P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right] = \$15,235 \times \frac{1}{1.1} = \$13,850$	13,850
<u>TOTAL LIFE CYCLE COST</u>	\$538,089 ~~\$569,543~~

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT Life Cycle Costing
DESIGNER A. Chambers
CHECKER S. Dunn

AEP NO 80122-000
SHEET 2 OF 2
DATE 12/31/80
DATE

SENECA 40 YEAR LIFE
BURIED DIST. SYSTEM

INITIAL (1/84): ~~\$600,316~~ \$566,336 — \$566,336 (~~\$600,316~~)

CYCLICAL MAINTENANCE

\$566,336 × .049 = \$27,750

$F = N \times \frac{R}{P}$

$= .088 \times \frac{14}{25} = .049$

P.V. (1/84): $P = S\left[\frac{1}{(1+i)^n}\right]$

$= \$27{,}750 \times \frac{1}{1.1} = \$25{,}227$ — 25,227

TOTAL LIFE CYCLE COST — \$591,563 (~~\$625,543~~)

SECTION II-9

MISCELLANEOUS CALCULATIONS

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

SUBJECT: BLDG HEAT LOAD WEIGHTING
SHEET OF
DESIGNER
DATE
CHECKER
DATE

BOILER TYPE: 5D4ESA

* Assumed height

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USE - GAL #6
ELIMINATE		319				
318	300x60x20 17280	18120	35,400	12	13.172	36291
317	300x60x20 17,280	18071	35351	12	13.156	36247
316	300x60x20 17280	18120	35400	12	13.172	36291
ELIMINATE		315				
320	210x57x20 10,680	12000	22,680	12	8.44	23254
321	210x57x20 10,680	12000	22,680	12	8.44	23254
323	500x180x20 27,200	90,000	117,200	12	43.62	120180
		TOTALS	268,711		100.00	275511

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

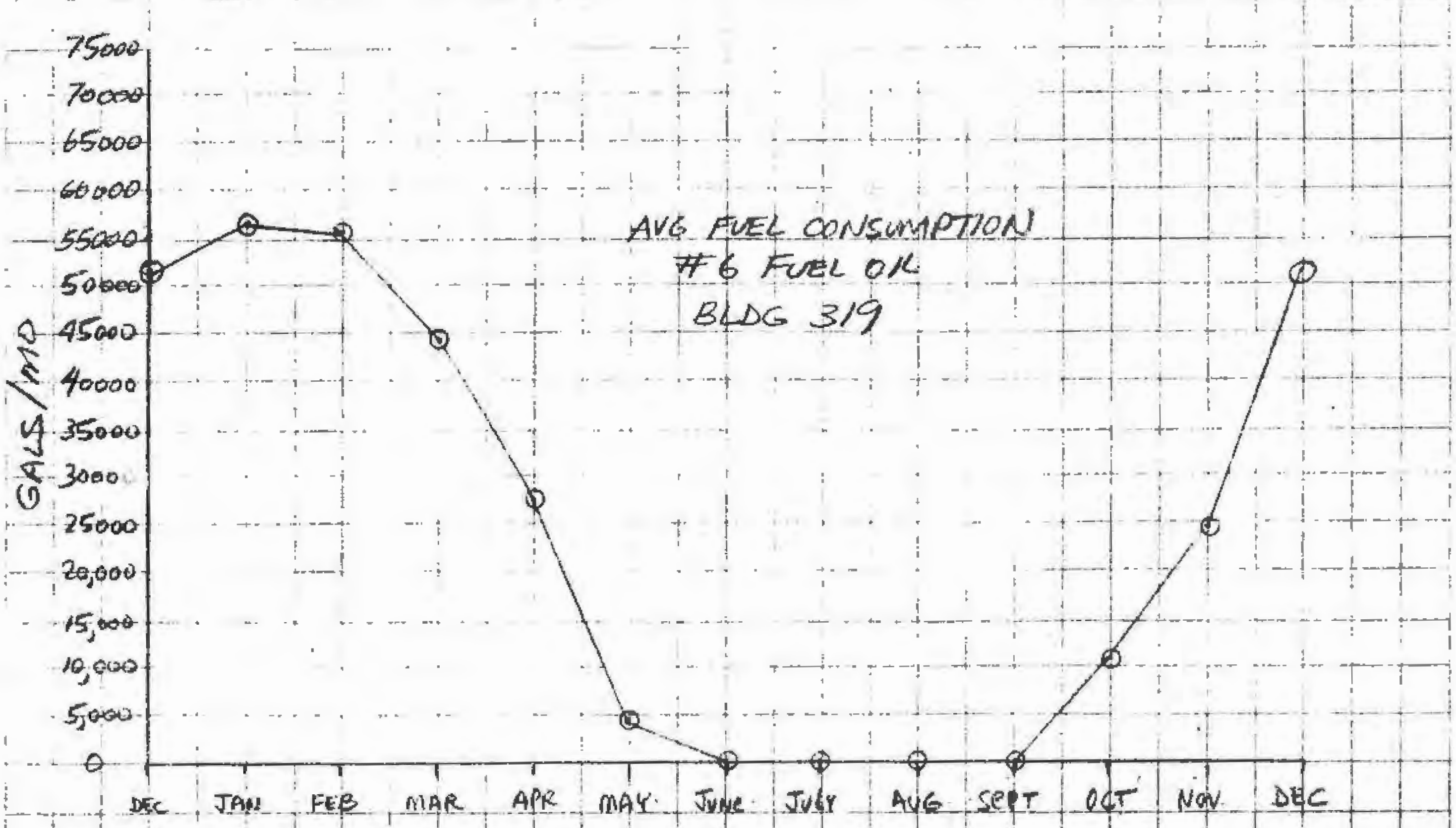
SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA
DESIGNER
CHECKER

AEP NO 80122-000
SHEET OF
DATE
DATE

BOILER TYPE : 5D4ESA — BLDG 319 — #6 FUEL OIL CONSUMPTION (GALLONS)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 31462	49061	64172	66720	68373	63184	57162
FEB	* 53583	45990	52990	60048	61346	59128	55514
MAR	* 39727	44584	40350	46812	54658	34124	43376
APR		42279	27224	20124	20416	27545	27518
MAY		—	—	6780	13466	—	4776
JUNE		—	—	—	—	—	—
JULY		—	—	—	—	—	—
AUG		—	—	—	—	—	—
SEPT		—	—	—	—	—	—
OCT	12011	6075	26661	6339	6526	7050	10777
NOV	18112	13662	40356	27329	21092	27571	24687
DEC	42241	53500	66774	60794	54747	32183	51707
TOTALS	—	255,151	318,527	294,946	300,624	250,785	275,517

* 1980



REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

BLDG HEAT LOAD WEIGHTING

SHEET OF

DESIGNER DATE

CHECKER DATE

BOILER TYPE: 5D4DSA

* Assumed height

#6

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USE GAL
121	60x40x20 * 4500	2400	6400	10	—	—
122	160x77x20 * 9480	12318	OFFICE 5450	10	3.71	4427
			SHOP 16348		11.13	13282
123	60x74x12 * 3266	4436	7652	10	5.21	6217
124	55x28x12 * 1992	1567	3559	10	2.42	2888
125	55x28x12 * 1992	1567	3559	10	2.42	2888
127	110x70x20 * 7200	6517	13,717	10	9.33	11,134
115	10821	13579	24400	10	16.60	19,809
117	280x69x20 * 13,960	19261	33,221	10	22.61	26,981
118	280x68x20 * 13,920	18928	32,848	10	22.35	26,670
119	60x24x20 * 3360	1473	4833	10	3.29	3926
120	20x20x12 * 960	400	1360	10	0.93	1109
		TOTALS	146,947		100.10	119,331

REYNOLDS, SMITH AND HILLS
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SUBJECT Seneca Army Depot AEP NO. 80122-00 0
SHEET OF
DESIGNER SCowen DATE 10-15-80
CHECKER DATE

Bldg 115

wall area = 201'-5" x 20'-1½" x 2 + 67'-5" x 20'-1½" x 2 = 10821 Ft²

Roof Area = 201'-5" x 67'-5" = 13,579 Ft²

total Area = 24,400 Ft²

REYNOLDS, SMITH AND HILLS
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SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA

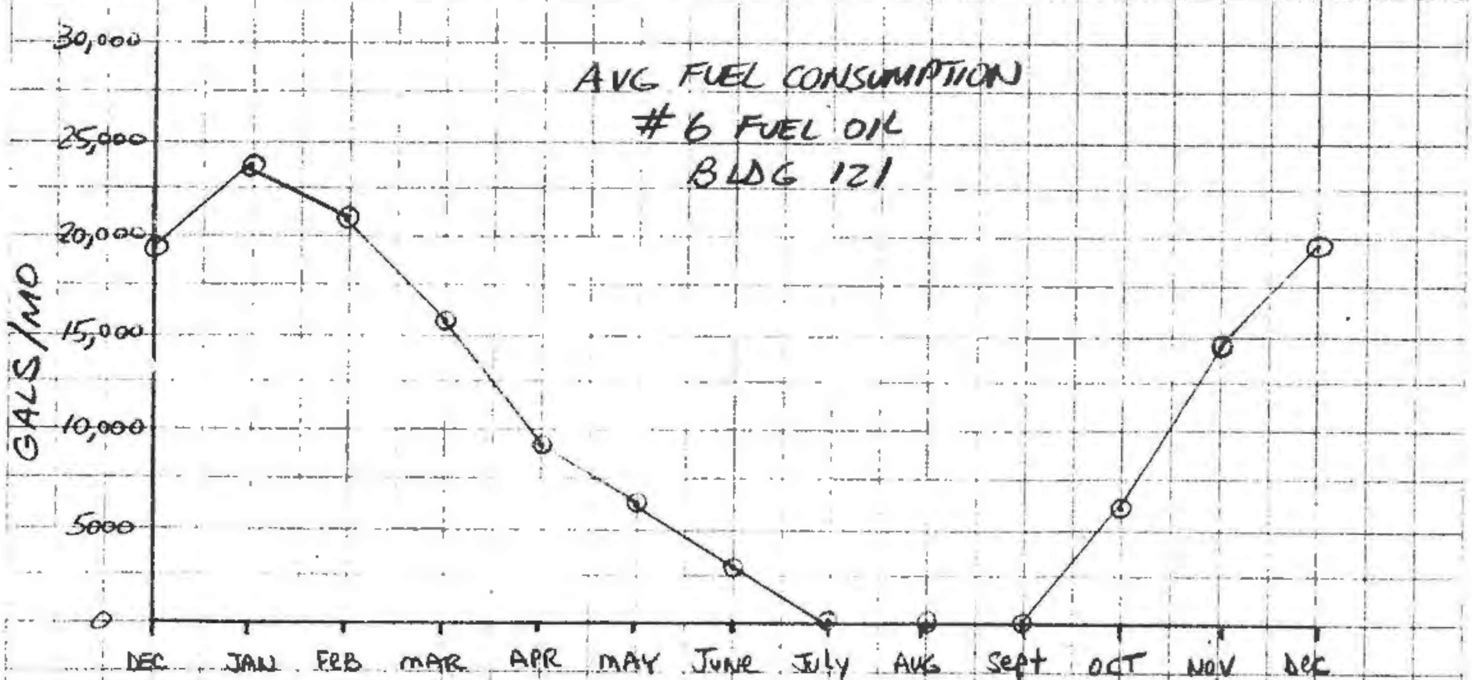
AEP NO. 80122-000
SHEET OF
DESIGNER DATE
CHECKER DATE

BOILER TYPE: 5D4DSA
BLDG 121

#6 FUEL OIL CONSUMPTION (GALLONS)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	* 20290	24068	20418	20016	26662	27968	23237
FEB	* 13606	18850	20418	26688	20473	20839	20146
MAR	* 20088	12049	20418	13398	20540	13287	16630
APR		18905	6806	6672	6818	6592	9159
MAY		—	6343	6780	6561	—	6561
JUNE		—	—	—	13608	—	2722
JULY		—	—	—	—	—	—
AUG		—	—	—	—	—	—
SEPT		—	—	—	—	—	—
OCT	6013	6076	6780	6334	7224	7050	6580
NOV	18100	6831	26904	13654	7224	14079	14465
DEC	18178	20443	26688	19832	21100	12745	19831
TOTALS	—	107,222	134,775	113,374	130,210	—	119331

* 1980



Savings Due to Setback in Buildings

Fuel Type		Savings (MBtu)
#6 oil	~	39,000
#2 oil	~	4,000

Bldg #	Savings (MBTU)		
	#6 Fuel Oil	#2 Fuel Oil	ALL TYPES
121	8,720	–	8,720
319	16,830	–	16,830
718	8,370	–	8,370
OTHERS	–	9,140	9,140
TOTALS	33,920	9,140	43,060

SOUTH BASE

Savings Due to Setback Control for Buildings Independent of Boiler Plants

Bldg #	Est. Annual Fuel Use (#2 gal)	Savings (%)	Savings (MBtu)	ADEQUATE controls?	AUTH TEMP
101	8000	0.15[a]	170	Y	65
103	9200	–	–	–	65
104	7600	–	–	–	65
106	17,100	–	–	–	70
113	17,100	0.56	1330	N	60
114	7,000	0.25	240	Y	50/65
116	4700	0.34	220	Y	65
S-142	16,200	0.65	1460	N	65
710	3400	0.34	160	Y	65
729	5000	0.34	240	Y	65
802	3200	0.34	150	Y	65
~~804~~					~~65~~
805	3700	0.34	170	Y	65
806	4200	0.34	200	Y	65
807	4,300	0.34	200	Y	65
810	17,800	0.34	840	Y	60/65
812	13,500	0.34	640	Y	65
813	7,900	0.34	370	Y	65
814	3,500	0.30	150	Y	60
815]					65
816]	25,200	0.34	1190	Y	65
817	3,200	0.34	150	Y	60/65
819	10,300	0.34	490	Y	65
825	1,800	0.20	50	Y	50
TENNIS BUBBLE	12,300	0.25	430	Y	[illegible]

II-188

continued

Allocation of Fuel Use by Building for Boiler Plant #121

Bldg #	WALL U	WALL A	ROOF U	ROOF A	Σ UA	Annual Fuel Use (gal)	
115	0.24	10,821	0.20	13,579	5312.8	18,100	
117	0.37	13,960	0.10	19,261	7091.3	24,200	29,600
118	0.37	13,920	0.27	18,928	10,261.0	35,000	29,602
119	0.37	3360	0.27	1,473	1640.9	5,600	
120	0.37	960	0.27	400	463.2	1,600	
121	0.37	4000	0.27	2,400	2128.0	7,200	
122	0.24	9,480	0.10	12,318	3507.0	11,900	
123	0.24	3,216	0.05	4,436	993.6	3,400	
124	0.37	1,992	0.10	1,567	893.7	3,000	
125	0.24	1,992	0.05	1,567	556.4	1,900	
127	0.24	7,200	0.10	6,517	2379.7	8,100	
					35,227.7	120,000	

[a] equated due to infiltration problem in 117 in battery charging shop.

3.41 gal / ΣUA

Allocation of Fuel Use by Building
for Boiler Plant #319

Bldg #	Annual Fuel Use (gal)		
316	50,100	112700	37566
317	50,100		37566
318	50,100		37567
320	13,800	13800	
321	13,400	13400	
323	53,700	53700	
TOTAL	231,200		

319 8700

202,300

Savings Due to Setback
Boiler Plant # 121

Bldg #	Est. Annual Fuel Use (#6 gal)	Savings (%)	Savings (MBTU)	Adequate Controls?	AUTH. TEMP. SET.
115	18,100	34[a]	920	Y	65
117	29,600	56	2490	N	60
118	29,600	56[a]	2370	N	60
119	5,600	56	470	N	65
120	1,600	65	160	N	50
121	7,200	–	–	–	–
122	11,900	56	1000	N	50/65
123	3,400	34	170	Y	65
124	3000	56	250	N	65
125	1,900	34	100	Y	65
127	8,100	65	790	N	50
TOTAL	120,000		8720		

[a] calculated, remainder were extrapolated from calculation results on similar buildings

Savings Due to Setback - Boiler Plant #319

Bldg #	Est. Annual Fuel Use (#6 gal)	Savings[a] (%)	Savings (MBtu)	Adequate? Controls?	AUTH. TEMP
316, 317, 318	112,700	0.56	9,470	N	60/65
319	8,700	–	–		–
320	13,800	0.56	1160	N	60/65
321	13,400	0.64	1290	N	50/65
323	53,700	0.61	4910	N	50/65
TOTAL	202,300		16,830		

[a] Calculated

SOUTH BASE

BASE CASE

Boiler plant system #121 operates at 10 psig = 25 psia

@ 25 psia, h_g = 1160.6 Btu/hr
with assumed condensate return @ 5 psig, h_f = 208.52 Btu/lb.

∴ Δh = 1160.6 - 208.52 = 952.08 Btu/lb

Calculate steam flow to bldg. with system operating @ 10 psig

Bldg. 115 $\left(\frac{946{,}900 \text{ Btu}}{\text{hr}}\right)\left(\frac{\text{lb}}{952.08 \text{ Btu}}\right)$ = 995 lb/hr.

117 $\left(\frac{1419{,}500}{952.08}\right)$ = 1491 lb/hr

118 $\left(\frac{1{,}419{,}500}{952.08}\right)$ = 1491 lb/hr.

119 $\left(\frac{293{,}000}{952.08}\right)$ = 308 lb/hr.

120 $\left(\frac{62{,}800}{952.08}\right)$ = 66 lb/hr.

122 $\left(\frac{622{,}600}{952.08}\right)$ = 654 lb/hr.

123 $\left(\frac{177{,}900}{952.08}\right)$ = 187 lb/hr.

124 $\left(\frac{157{,}000}{952.08}\right)$ = 165 lb/hr.

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SUBJECT SENECA - CENTRAL COAL PLANT
DESIGNER J. McMILLIN
CHECKER
AEP NO 80122-000
SHEET 2 OF
DATE 28 NOV 80
DATE

125 $\left(\frac{99,400}{952.08}\right) = 104$ lb/hr

127 $\left(\frac{317,800}{952.08}\right) = 334$ lb/hr.

121 $\left(\frac{376,700}{952.08}\right) = 396$ lb/hr.

Boiler plant system #319 operates at 50 psig, same pressure as new coal plant, therefore steam flow will be the same.

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ARCHITECTS • ENGINEERS • PLANNERS

DESIGNER S. COWEN
DATE 10-23-80

SUBJECT Seneca Army Depot
Building Heat Loss Calculations

MAP AREA: Boiler Plant 121

Revised 11/24/80
per P. Hutchins

BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS #1 OIL	#2 OIL	#6 OIL	DESIGN HOURLY HEAT LOSS ~ BTU/HR X1000 #1 OIL	#2 OIL	#6 OIL	TOTAL HEAT LOSS ~ BTU/HR
115	ADMIN Gen Purp 65°	60			18100 ~~19809~~			946.9 ~~1036.3~~	946900 ~~1,036,300~~
117	MACH. Shop 60°	55			29600 ~~26987~~			1419.5 ~~1293.8~~	1419500 ~~1,293,800~~
118	MOTOR Rep. SHOP 60°	55			29600 ~~26670~~			1419.5 ~~1278.9~~	1419500 ~~1,278,900~~
119	TC Admin BLDG 65°	60			5600 ~~3926~~			293.0 ~~205.38~~	293000 ~~205,380~~
120	GAS STATION 50°	45			1600 ~~1109~~			62.8 ~~43.51~~	62800 43,510
122	FE FAC Shop 50 office 65	60			11900			622.6	622600
123	ADMIN GEN PURP 65	60			3400 ~~6217~~			177.9 ~~325.23~~	177900 ~~325,230~~
124	FE FAC PAINT Shop 65	60			3000 ~~2888~~			157.0 ~~151.08~~	157000 ~~151,080~~
125	ADMIN GEN PURP 65	60			1900 ~~2888~~			99.4 ~~151.08~~	99400 ~~151,080~~
127	RR EQUIP MAIN. Shop 50	45			8100 ~~11134~~			317.8 ~~436.84~~	317800 ~~436,840~~
121		60			7200			376.7	376700
							TOTAL		5893100

$H_L = 5.8126 \times 10^{-6} E_V \Delta T V$ V = 150,000 #6 F.O.

EYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

DESIGNER S. COWEN
DATE 10-23-80

SUBJECT Seneca Army Depot
BUILDING Heat Loss Calculations

MAP AREA: 12

Revised 11/28/80
per P. Hutchins

BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY HEAT LOSS ~ BTU/HR × 000			TOTAL HEAT LOSS ~ BTU/HR
			#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
316	w'hse 65°	60			37566			1965.3	1965300
317	w'hse 65°	60			37566			1965.3	1965300
318	w'hse 65°	60			37567			1965.3	1965300
320	w'hse 55°	50			13800			601.6	601600
321	w'hse 55°	50			13400			584.2	584200
323	w'hse 55°	50			53700			2341.2	2341200
319	65°	60			8700			455.2	455200
							TOTAL		9,878,100

$H_L = 5.8126 \times 10^{-6} E_U \Delta T V$ V: 150,000 #6 F.O.

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS

DESIGNER S. COWEN
DATE 10-23-80

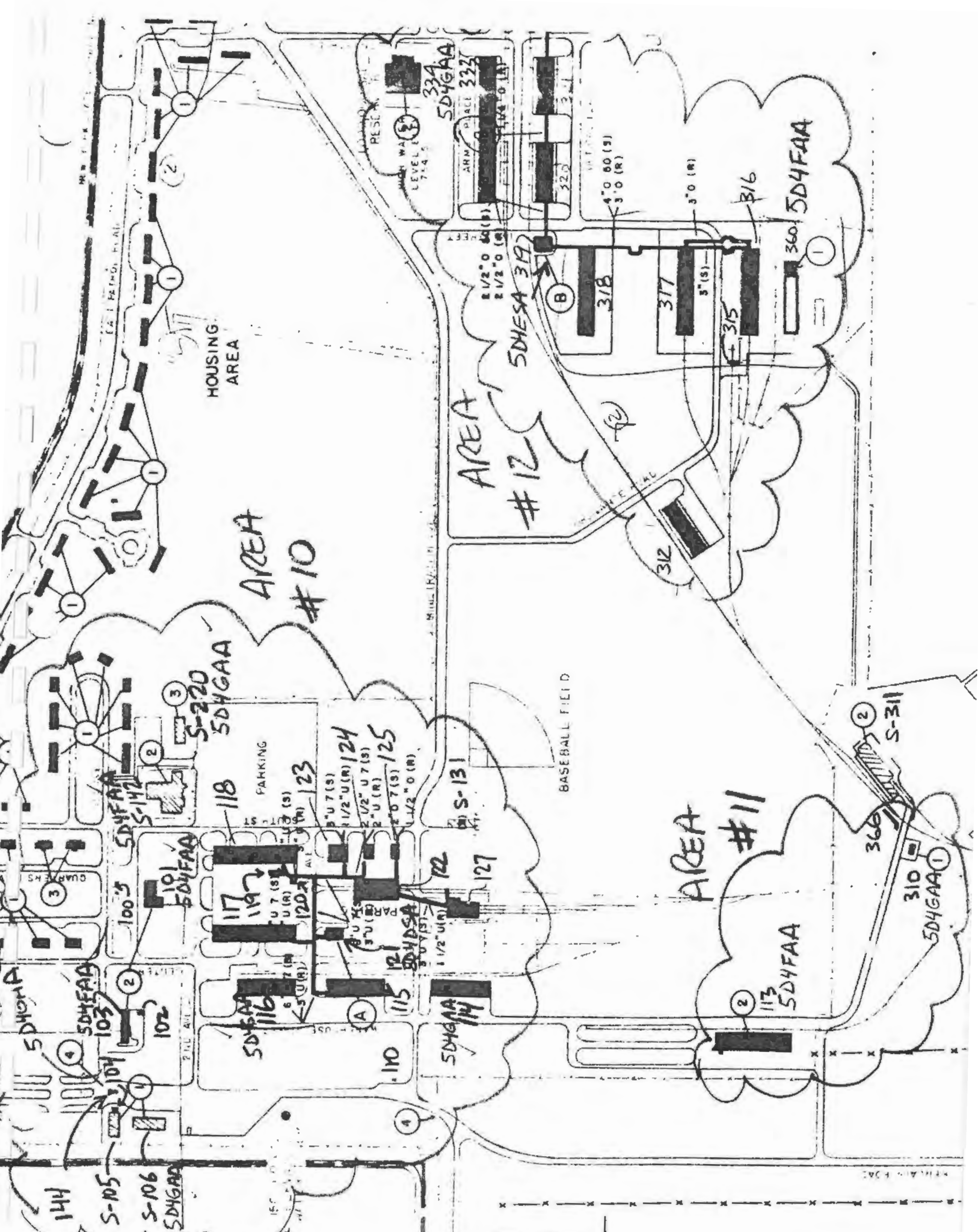
SUBJECT Seneca Army Depot
Building Heat Loss Calculations

MAP AREA: ______

Revised 11/28/80
per P. Hutchins

BLDG No.	BLDG. TYPE	ΔT	ANNUAL FUEL CONSUMPTION ~ GALLONS			DESIGN HOURLY HEAT LOSS ~ BTU/HR			TOTAL HEAT LOSS ~ BTU/HR
			#1 OIL	#2 OIL	#6 OIL	#1 OIL	#2 OIL	#6 OIL	
101	Post HQ 65	60		8000			387.0		387,000
103	Fire Sta 65	60		9200			445.1		445,000
S-142	open Mess 65	60		16200			783.7		783,700
113	60	55		17100			758.3		758,300

$H_L = 5.8126 \times 10^{-6} E_v \Delta T V$ where $V = 138{,}700$ #2 F.O.


AREA #10
AREA #11
AREA #12
HOUSING AREA
BASEBALL FIELD
PARKING
5D4FAA
5D4GAA
5D4ESA
S-220
S-131
S-311
S-105
S-106
312
315
316
317
318
319
320
360
366
310
113
114
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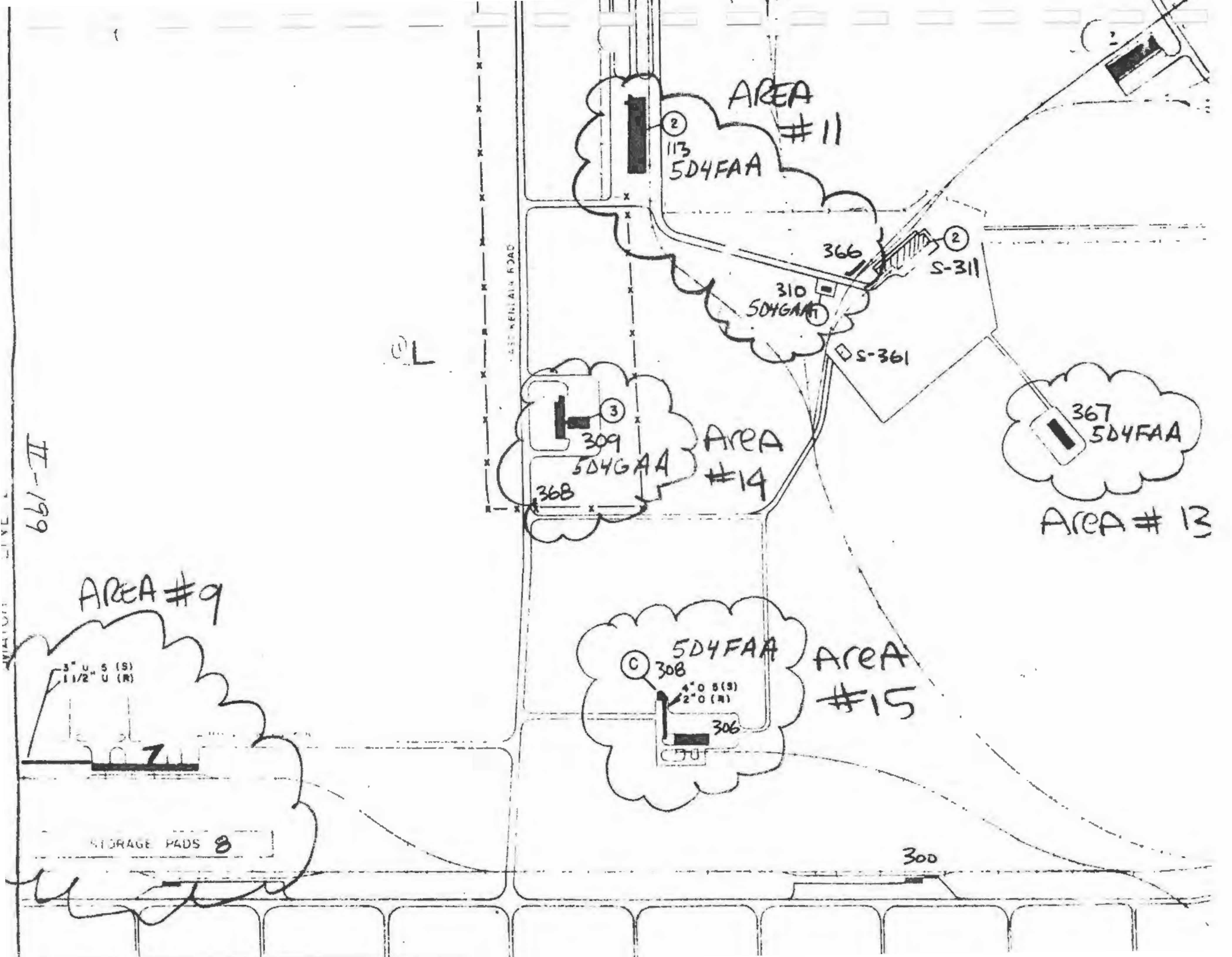
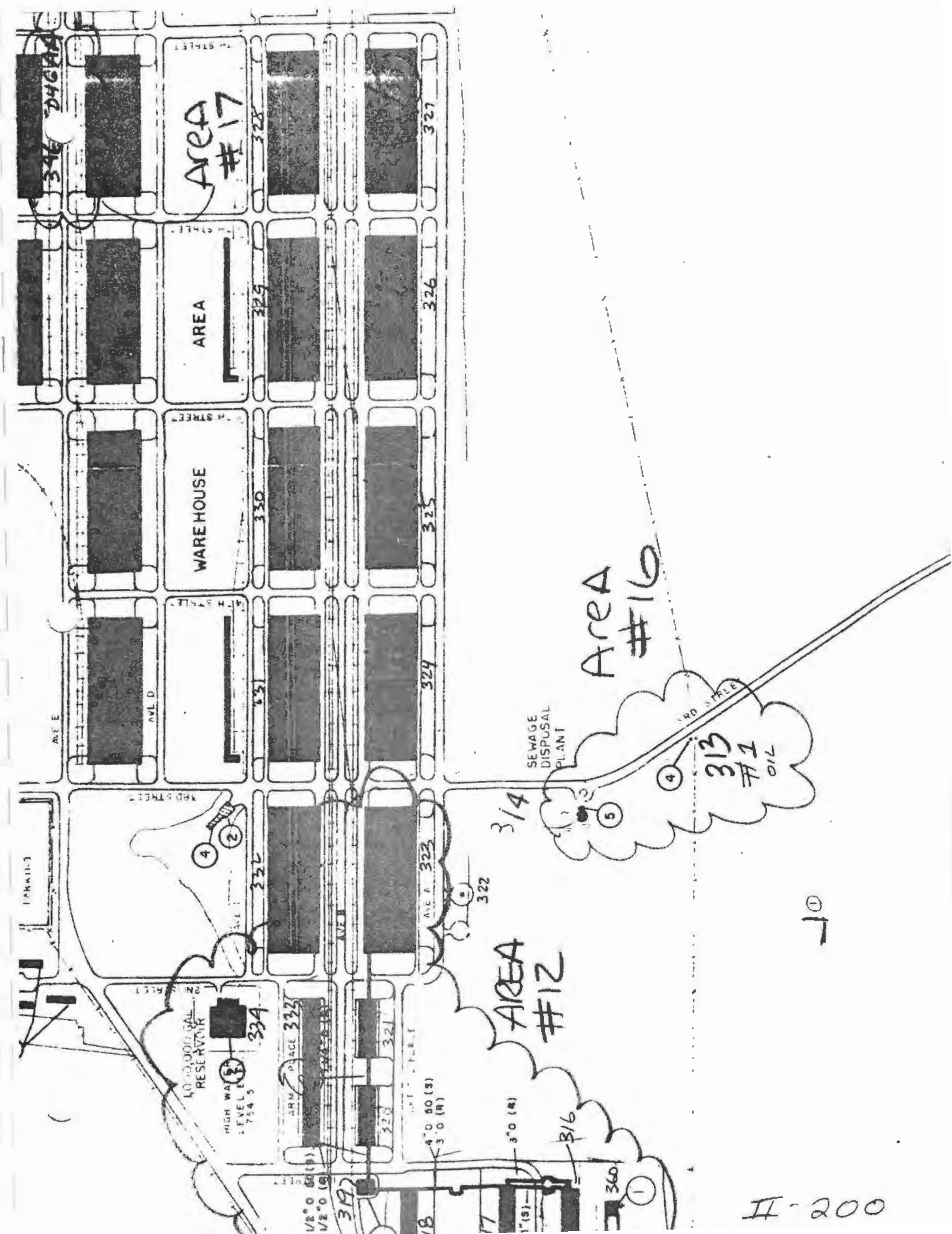
124
125
127
110
144


AREA #11
2
113
5D4FAA
366
2
S-311
310
5D4GAA
1
S-361
367
5D4FAA
AREA #13
3
309
5D4GAA
368
AREA #14
AREA #9
3" U. S (S)
1 1/2" U (R)
7
STORAGE PADS 8
5D4FAA
C
308
4" O S (S)
2" O (R)
306
AREA #15
300


Area #17
WAREHOUSE
AREA
Area #16
AREA #12
SEWAGE DISPOSAL PLANT
313 #1 OIL
322
323
324
325
326
327
328
329
330
331
332
334
HIGH WATER LEVEL
RESERVOIR

BOILER SIZING - SOUTH BASE

Alternate # 1

Bldg 319 - SYSTEM DEMAND (PEAK) = 10,178 lb/HR

Bldg 121 - SYSTEM DEMAND (PEAK) = 5,994 lb/HR

CENTRAL PLANT DEAERATOR LOAD = 446 lb/HR

TOTAL DEMAND = 16,618 lb/HR

BUILDING 121

ANNUAL FUEL USE - BEFORE SET-BACK - AND AFTER REPAIRS AND/OR MODIFICATIONS HAVE BEEN MADE TO THE EXISTING STEAM DISTRIBUTION SYSTEM
= 119,331 GAL/YR

MONTHLY FUEL CONSUMPTION

MONTH	FUEL CONSUMPTION	AVG DAILY FUEL USE	(1) AVG HOURLY FUEL USE	AVG HOURLY SYSTEM DEMAND
JAN	23237	750	31.3	3945
FEB	20146	720	30.0	3781
MAR	16630	536	[redacted] 22.4	2823
APRIL	9159	305	12.7	1601
MAY	6561	212	8.8	1109
JUNE	2722	91	3.8	479
JULY	–	–	–	–
AUG	–	–	–	–
SEPT	–	–	–	–
OCT	6580	212	8.8	1109
NOV	14465	482	20.1	2533
DEC	19831	640	26.7	3365

(1) AVG HOURLY SYST. DEMAND = $\dfrac{(\text{AVG Hourly Fuel use})(150{,}000\ \frac{\text{BTU}}{\text{GAL}})(.80)}{952.08\ \text{BTU/lb}}$

where: (.80) = ASSUMED Boiler efficiency

FROM THE ABOVE TABLE:

MAX AVG Hourly SYSTEM DEMAND FOR BUILDING # 121 SYSTEM = 3945 lb/HR

MIN AVG Hourly SYSTEM DEMAND FOR BUILDING # 121 SYSTEM (excluding shut-down periods) = 479 lb/HR

BUILDING 319

ANNUAL Fuel use - Before Set-BACK - AND AFTER REPAIRS AND/OR MODIFICATIONS HAVE BEEN MADE TO THE EXISTING SYSTEM
= 202,300 GAL/YR

MONTHLY FUEL CONSUMPTION

MONTH	FUEL USE BEFORE REPAIRS	FUEL USE AFTER REPAIRS	AVG DAILY FUEL USE (1)	AVG HOURLY FUEL USE (1)	AVG HOURLY SYSTEM DEMAND (2)
JAN	57162	41972	1354	56.4	6886
FEB	55514	40761	1456	60.7	7411
MAR	43376	31849	1027	42.8	5226
APRIL	27518	20205	674	28.1	3431
MAY	4776	3507	113	4.7	574
JUNE	-	-	-	-	-
JULY	-	-	-	-	-
AUG	-	-	-	-	-
SEPT	-	-	-	-	-
OCT	10777	7913	255	10.6	1294
NOV	24687	18127	604	25.2	3077
DEC	51707	37966	1225	51.0	6227

(1) AFTER MODIFICATIONS AND/OR REPAIRS

(2) AVG HOURLY SYST. DEMAND = $\frac{(\text{AVG Hourly Fuel use})(150,000 \frac{BTU}{GAL})(.80)}{982.83 \text{ BTU/lb}}$ where .80 = ASSUMED Boiler eff.

FROM THE ABOVE TABLE:

MAX AVG Hourly SYSTEM DEMAND = 7411 lb/HR
FOR BUILDING # 319 SYSTEM

MIN AVG Hourly SYSTEM DEMAND = 574 lb/HR
FOR BUILDING # 319 SYSTEM
(excluding shut-down periods)

CENTRAL BOILER PLANT

DEAERATOR LOAD = 446 lb/HR

Bldg # 121 AVG load = 3945 lb/HR

Bldg # 319 AVG load = 7411

Central Plant AVG LOAD = 11,802 lb/HR

Size Boilers for AVG Hourly Demand x Safety Factor = 11,802 x 1.2 = 14162 lb/HR

* SELECT THREE (3) STEAM GENERATORS; TWO (2) 12,500 lb/HR AND ONE (1) 7,000 lb/HR TO BE FIRED AS:

(1) 12,500 lb/HR UNIT → AVG HOURLY DEMAND, 94% FIRING RATE

(1) 12,500 lb/HR UNIT + (1) 7,000 lb/HR UNIT → PEAK DEMAND, 85 % FIRING RATE

(3) UNITS → PROVIDES 193 % CAPACITY

ALTERNATE # 2

Bldg 319 - Peak Demand = 10,178 lb/HR

- Hourly Avg Demand = 7411 lb/HR

Bldg 121 - Peak Demand = 7658 lb/HR

- Avg Hourly Demand = $\frac{7658}{5994} \times 3945$

= 5040 lb/HR

Assumes that the Avg Hourly Rate is proportional to the Peak Rate at the same Ratio as Alt # 1

Deaerator - Demand = 491 lb/HR

Total Hourly Boiler Demand = 12,942 lb/HR

Total Peak Boiler Demand = 18,327 lb/HR

Size Boilers for Hourly Demand x 1.2 Safety factor

12942 x 1.2 = 15530 lb/HR

* SELECT THREE (3) STEAM GENERATORS; TWO (2) rated at 15,000 lb/HR AND ONE (1) rated AT 7,000 lb/HR, to be fired AS:

(1) 15,000 lb/HR unit → AVG Hourly demand, 86 % Firing Rate

(1) 15,000 + (1) 7,000 → Peak demand, 83% Firing Rate

(3) UNITS → Provides 202% CAPACITY

Alternate # 3

BLDG 319 - Peak Demand = 10,178 lb/HR

- Avg Hourly Demand = 7411 lb/HR

BLDG 121 - Peak Demand = 6775 lb/HR

- Avg Hourly Demand = $\frac{6775}{5994} \times 3945$

= 4459 lb/HR

Deaerator - Demand = 468 lb/HR

TOTAL HOURLY BOILER DEMAND = 12338 lb/HR

TOTAL PEAK BOILER DEMAND = 17421 lb/HR

Size Boilers for Hourly Demand x 1.2 Safety Factor

12338 x 1.2 = 14805.6 lb/HR

* SELECT THREE (3) STEAM GENERATORS; TWO (2) RATED AT 15,000 lb/HR AND ONE (1) RATED AT 5,000 lb/HR, To be fired AS:

(1) 15,000 lb/HR UNIT → AVG Hourly Demand, 82% FIRING RATE

(1) 15,000 + (1) 5,000 → Peak Demand, 87% FIRING RATE

(3) UNITS → Provides 201 % CAPACITY

Alternate # 4

Bldg 319 - Peak Demand = 10,178 lb/HR

- Avg Hourly Demand = 7411 lb/HR

Bldg 121 - Peak Demand = 8439 lb/HR

- Avg Hourly Demand = $\frac{8439}{5994} \times 3945$

= 5554 lb/HR

Deaerator - Demand = 513 lb/HR

TOTAL HOURLY BOILER DEMAND = 13,478 lb/HR

TOTAL PEAK BOILER DEMAND = 19,130 lb/HR

Size Boilers for Hourly Demand x 1.2 Safety factor

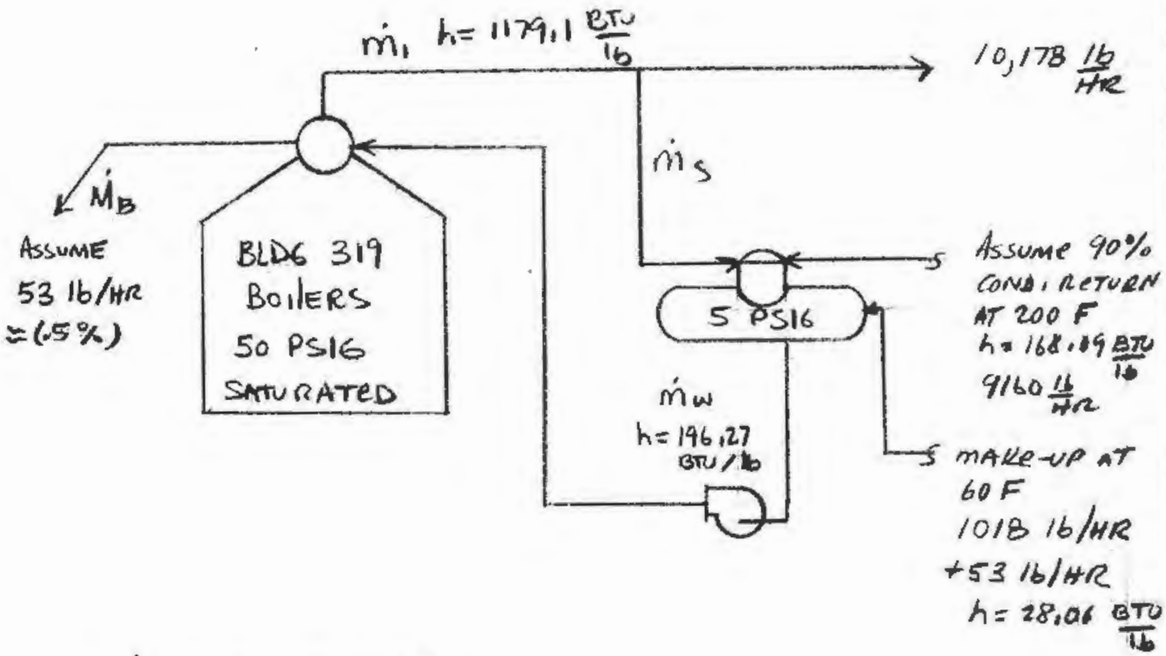
13478 x 1.2 = 16174 lb/HR

* SELECT THREE (3) STEAM GENERATORS; TWO (2) RATED AT 15,000 lb/HR AND ONE (1) ~~TWO~~ RATED AT 8,000 lb/HR, TO BE FIRED AS:

(1) 15,000 lb/HR UNIT → AVG HOURLY DEMAND 90% FIRING RATE

(1) 15,000 + (1) 8,000 → PEAK DEMAND, 83% FIRING RATE

(3) UNITS → PROVIDES 199% CAPACITY



$$\dot m_1 = 10{,}178 + \dot m_s$$

$$\dot m_s + 9160 + 1018 + 53 = \dot m_w$$

$$\dot m_s (1179.1) + 9160(168.09) + (1018+53)(28.06) = \dot m_w (196.27)$$

$$\dot m_s (1179.1) + 9160(168.09) + (1071)(28.06) = (196.27)(\dot m_s) + (9160+1071)(196.27)$$

$$\dot m_s = \frac{(9160+1071)(196.27) - (9160)(168.09) - (1071)(28.06)}{1179.1 - 196.27}$$

2008038.4
-1539704.4
-30052.26

982.83

$\dot m_s =$ 445.9 lb/HR

$\dot m_1 =$ 10623.9 lb/HR

$\dot m_w =$ 10676.9 lb/HR

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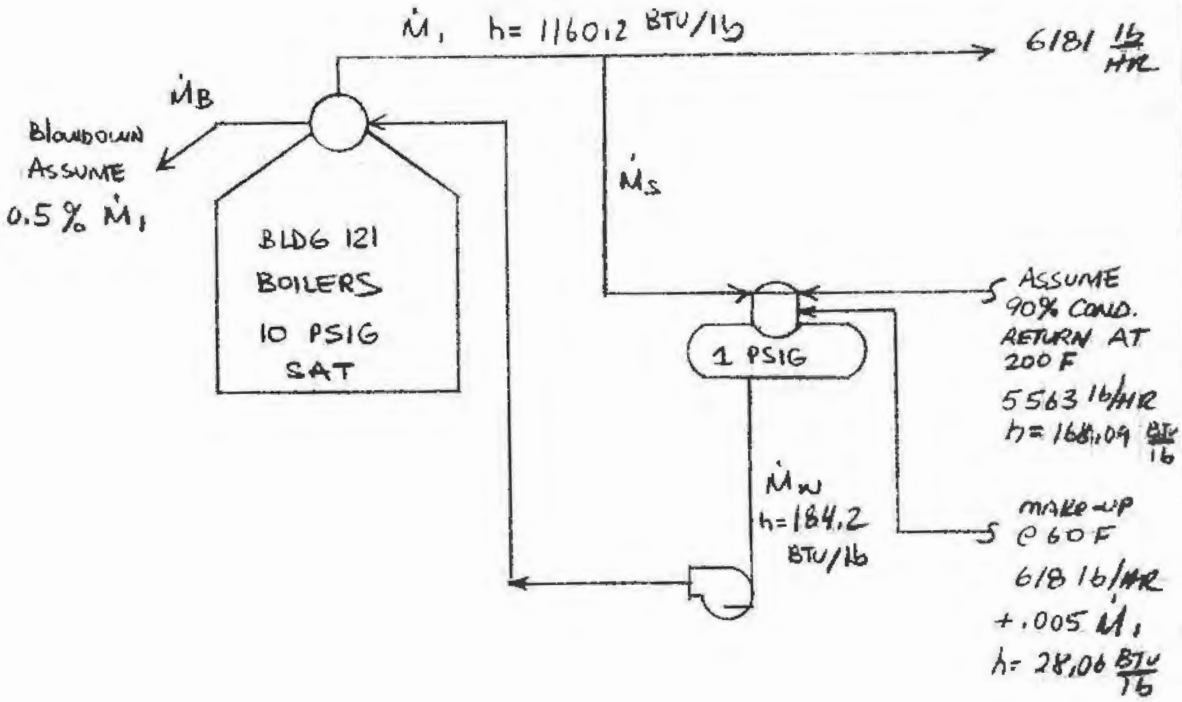
SUBJECT SENECA ARMY DEPOT
BASE CASE – BLDG 121 DA LOAD
DESIGNER S. COWEN
CHECKER

AEP NO. 80122-00U
SHEET OF
DATE 11-28-80
DATE



$$\dot{M}_1 = \dot{M}_S + 6181$$

$$\dot{M}_S + 5563 + 618 + .005\,\dot{M}_1 = \dot{M}_W$$

$$\dot{m}_S(1160.2) + 5563(168.09) + (618 + .005\,\dot{m}_1)(28.06) = \dot{m}_W(184.2)$$

$$\dot{M}_S(1160.2) + 5563(168.09) + (618)(28.06) + (.005)(28.06)(\dot{M}_S) + (.005)(6181)(28.06) = (184.2)\dot{M}_S + (5563+618)(184.2) + (.005)(184.2)\dot{M}_S + (184.2)(.005)(6181)$$

$$\dot{m}_S = \frac{(5563+618)(184.2) + (184.2)(.005)(6181) - (5563)(168.09) - (618)(28.06) - (.005)(6181)(28.06)}{1160.2 + (.005)(28.06) - 184.2 - (.005)(184.2)}$$

.1403 .921

190934.9

975.2193

$\dot{m}_S$ = 195.8 lb/HR $\dot{m}_B$ = 32 lb/HR

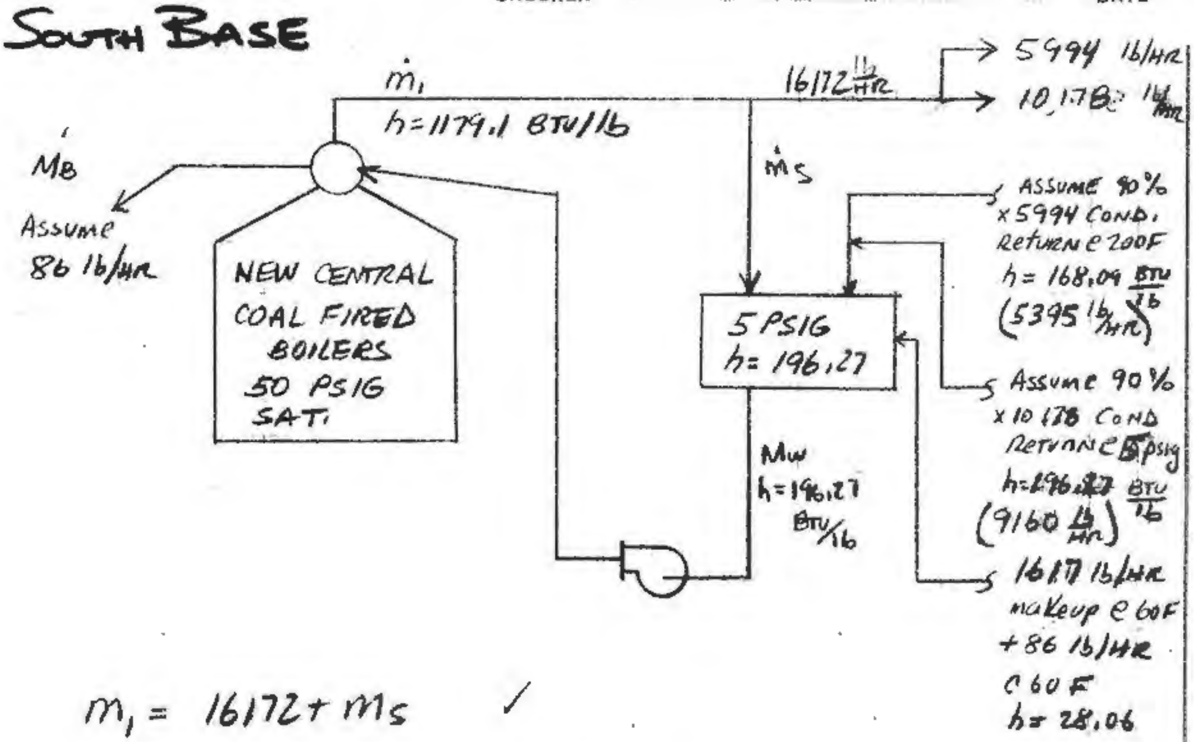
$\dot{m}_1$ = 6377 lb/HR $\dot{m}_W$ = 6409 lb/HR

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT SENECA ARMY DEPOT
ALT-1 COAL BLR D-A LOAD
DESIGNER S. COWEN
CHECKER

AEP NO 80122-000
SHEET OF
DATE 11-28-80
DATE

SOUTH BASE



$m_1 = 16172 + m_S$ ✓

$m_S + 5395 + 9160 + 1617 + 86 = m_w$

$$m_S(1179.1) + 5395 \times 168.09 + 9160 \times 196.27 + (1617+86)(28.06)$$
$$= m_w(196.27) = 16258(196.27) + m_S(196.27)$$

$$m_S = \frac{16258(196.27) - 5395(168.09) - 9160(196.27) - (1703)(28.06)}{1179.1 - 196.27}$$

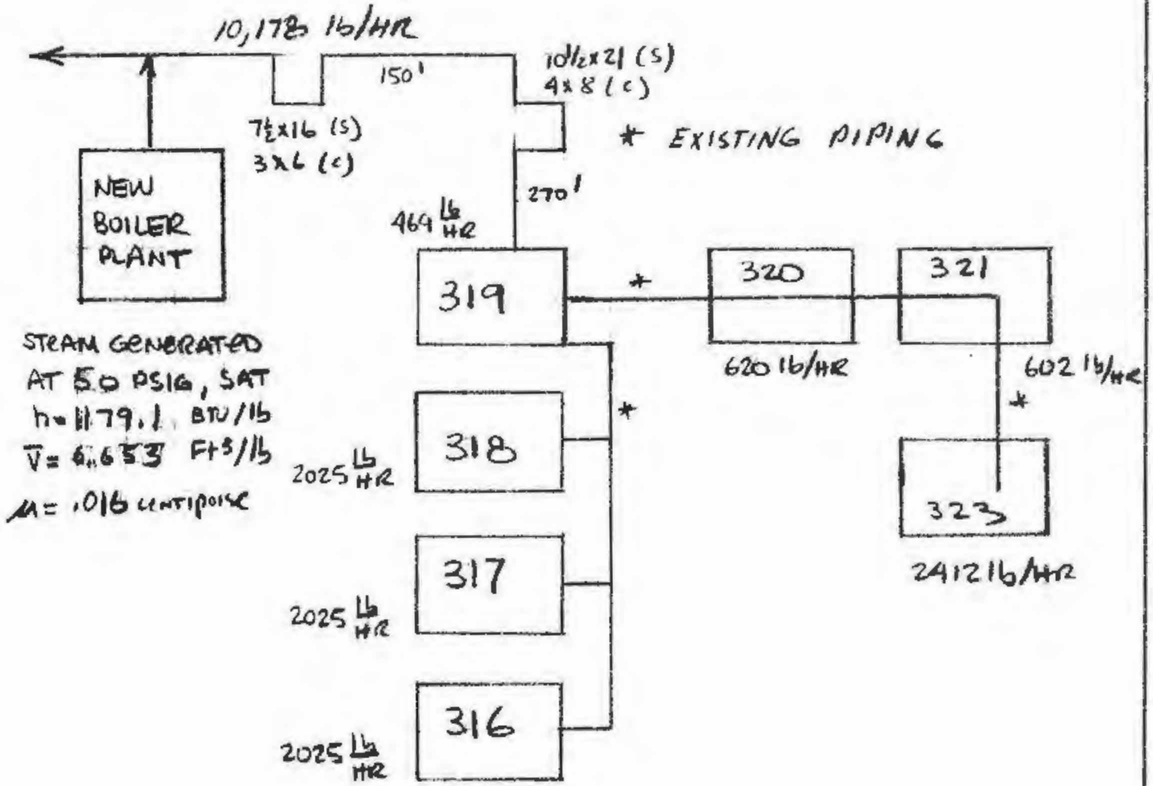
$m_S = 446$ lb/HR ✓

$m_1 = 16618$ lb/HR ✓

$m_w = 16704$ lb/HR

check $m_B = .005\, m_1 = 83.1$ lb/HR ✓ ∴ close enough

PRESSURE DROP/PIPE SIZING Calc's - LONG PIPE RUNS



STEAM GENERATED AT 5.0 PSIG, SAT
h = 1179.1 BTU/lb
$\bar{V}$ = 6.653 Ft³/lb
μ = .016 centipoise

STEAM FLOW 10,178 lb/HR

length OF RUN = 150 + 270 + 32 + 42 = 494 Ft

TRY 8" sch 40 PIPE $d = 7.981"$ $d^5 = 32380$ $A = 0.3474\ Ft^2$

$$Re = \frac{6.31\,W}{d\mu} = \frac{6.31 \times 10178}{7.981 \times .016} = 5.0 \times 10^5 \Rightarrow f = .0159$$

$$\Delta P = \frac{(3.36 \times 10^{-6}) f L W^2 \bar{V}}{d^5} = \frac{(3.36 \times 10^{-6})(.0159)(494)(10178)^2(6.653)}{32380}$$

$\Delta P = 0.56$ PSI

TRY 6" sch 40 PIPE $d = 6.065"$ $d^5 = 8206$ $A = .2006\ Ft^2$

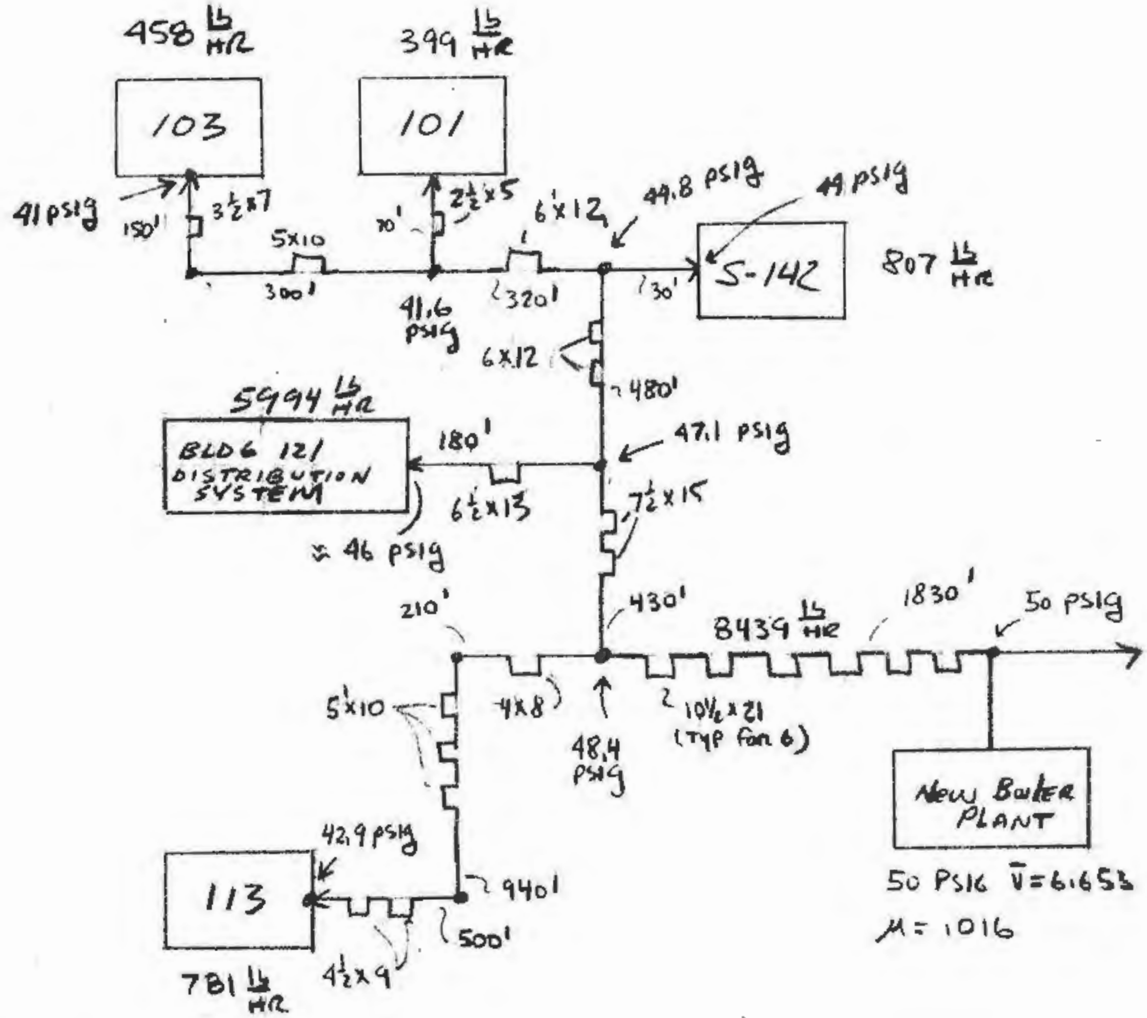
$$Re = \frac{6.31 \times 10178}{6.065 \times .016} = 6.6 \times 10^5 \Rightarrow f = .016$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.016)(494)(10178)^2(6.653)}{8206}$$

$\Delta P = 2.23$ PSI

$$\text{Velocity} = \frac{10178 \frac{lb}{HR} \times 6.653 \frac{Ft^3}{lb}}{60 \frac{MIN}{HR} \times .2006\ Ft^2} = 5626\ \text{FPM}$$

USE 6" sch 40 PIPE for Steam MAIN



MAIN LINE

Steam Flow = 8439 lb/HR

length of RUN = 1830 Ft + 6 x 42 = 2082

TRY 6" sch 40 $\quad d = 6.065 \quad d^5 = 8206 \quad A = .2006\ Ft^2$

$$R_e = \frac{6.31 \times 8439}{6.065 \times .016} = 5.5 \times 10^5 \Rightarrow f = .016$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.016)(2082)(8439)^2(6.653)}{8206}$$

$\Delta P = 6.46$ PSI (HIGH)

TRY 8" sch 40 $d = 7.981"$ $d^5 = 32380$ $A = .3474$

$$Re = \frac{6.31 \times 8439}{7.981 \times .016} = 4.2 \times 10^5 \Rightarrow f = .016$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.016)(2082)(8439)^2(6.653)}{32380}$$

$\Delta P = 1.64$ PSI

USE 8" sch 40

MAIN TO BLDG 113

Steam flow = 781 lb/HR

length of RUN = 1650 + 1×16 + 3×20 + 2×18 = 1762 Ft

TRY 2" sch 40 $d = 2.067"$ $d^5 = 37.72$ $A = .0233\ Ft^2$

$$Re = \frac{6.31 \times 781}{2.067 \times .016} = 1.5 \times 10^5 \Rightarrow f = .0213$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0213)(1762)(781)^2(6.653)}{37.72}$$

$\Delta P = 13.57$ PSI (TOO HIGH)

TRY 2½" sch 40 $d = 2.469$ $d^5 = 91.75$ $A = .03322$

$$Re = \frac{6.31 \times 781}{2.469 \times .016} = 1.3 \times 10^5 \Rightarrow f = .0210$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.021)(1762)(781)^2(6.653)}{91.75}$$

$\Delta P = 5.5$ PSI

$$\text{Velocity} = \frac{781 \text{ lb/HR} \times 6.653 \text{ Ft}^3/\text{lb}}{60 \text{ MIN/HR} \times .03322 \text{ Ft}^2}$$

Vel = 2607 FPM

USE 2½" sch 40

MAIN TO BLDG 121 TAKEOFF

Steam flow = 7658 lb/HR
length of RUN = 430 + 2x30 = 490 Ft

TRY 6" sch 40 — $d = 6.065$ $d^5 = 8206$ $A = .2006$ Ft²

$$Re = \frac{6.31 \times 7658}{6.065 \times .016} = 5.0 \times 10^5 \Rightarrow f = .0166$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0166)(490)(7658)^2(6.653)}{8206}$$

$\Delta P = 1.3$ PSI

USE 6" sch 40

MAIN TO BLDG 121 CONNECTION

Steam flow = 5994 lb/HR
length of RUN = 180 + 26 = 206'

TRY 4" sch 40 $d = 4.026''$ $d^5 = 1058$ $A = .0884$

$$Re = \frac{6.31 \times 5994}{4.026 \times .016} = 5.9 \times 10^5 \Rightarrow f = .0171$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0171)(206)(5994)^2(6.653)}{1058}$$

$\Delta P = 2.67$ PSI

$$VEL = \frac{5994 \times 6.653}{60 \times .0884} = 7518 \text{ FPM}$$

Too High For Heating System

USE 6" sch 40

MAIN TO BLDG S-142 TakeOFF

length of RUN = 480 + 2 × 24 = 528 Ft
Flow rate = 1664 lb/HR

TRY 3" sch 40 $d = 3.068''$ $d^5 = 271.8$ $A = .0513$

$$Re = \frac{6.31 \times 1664}{3.068 \times .016} = 2.1 \times 10^5 \Rightarrow f = .0195$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0195)(528)(1664)^2(6.653)}{271.8}$$

$\Delta P = 2.34$ PSI

$$Vel = \frac{1664 \times 6.653}{60 \times .0513} = 3597 \text{ FPM}$$

USE 3" sch 40

MAIN TO BLDG 101 Takeoff

length of RUN = 320 + 24 = 344 Ft
Flow rate = 857 lb/HR

TRY 2" sch 40 $d = 2.067''$ $d^5 = 37.72$ $A = .0233$

$$R_e = \frac{6.31 \times 857}{2.067 \times .016} = 1.6 \times 10^5 \Rightarrow f = .0212$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.0212)(344)(857)^2(6.653)}{37.72}$$

$\Delta P = 3.17$ PSI

USE 2" sch 40 to Bldg 101

USE 2" sch 40 to Bldg 103

USE 2" sch 40 to S-142

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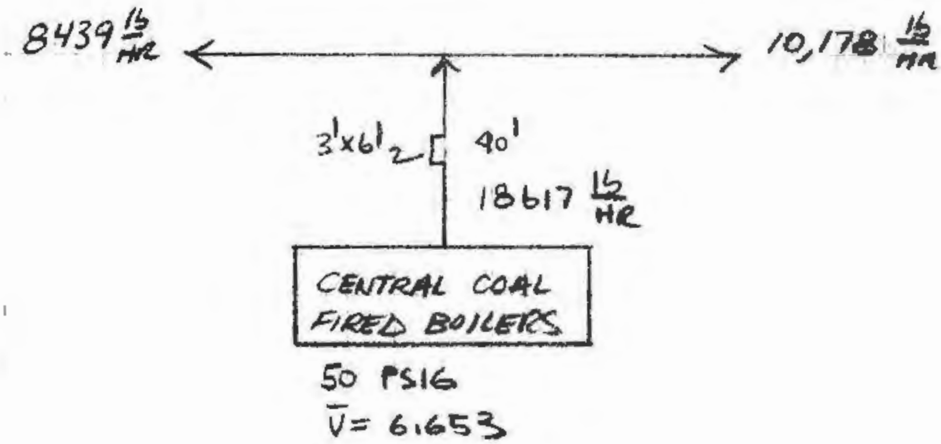
INCORPORATED

SUBJECT: SENECA-SOUTH
DESIGNER: S Cowan
CHECKER:

AEP NO: 80122-000
SHEET: 8 OF 8
DATE: 12-15-80
DATE:



length of Run = 40 + 12 = 52'

Try 8" sch 40 $\quad d = 7.981 \quad d^5 = 32380 \quad A = .3474\ Ft^2$

$$Re = \frac{6.31 \times 18617}{7.981 \times .016} = 9.2 \times 10^5 \Rightarrow f = .015$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.015)(52)(18617)^2(6.653)}{32380}$$

$\Delta P = 0.19$ PSI

$$\text{Velocity} = \frac{18617 \times 6.653}{60 \times .3474} = 5942 \text{ FPM}$$

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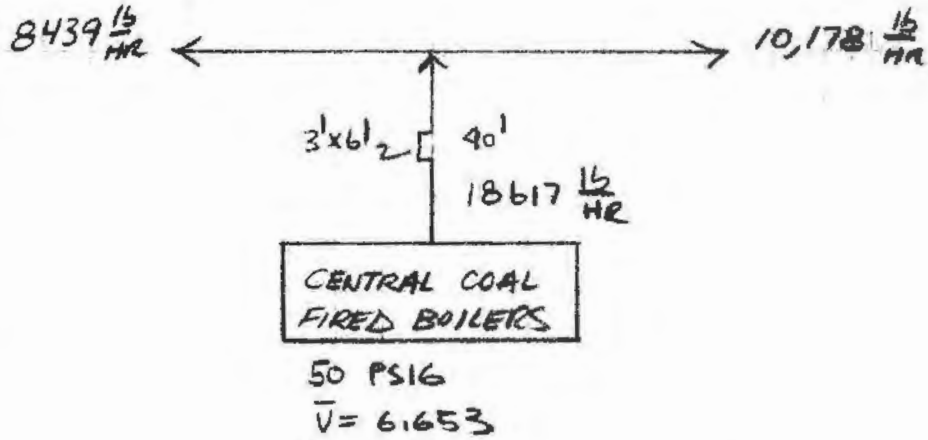
SUBJECT SENECA-SOUTH
DESIGNER S COWAN
CHECKER

AEP NO. 80122-000
SHEET 8 OF 8
DATE 12-15-80
DATE



length of RUN = 40 + 12 = 52'

<u>TRY 8" sch 40</u> $d = 7.981$ $d^5 = 32380$ $A = .3474\ Ft^2$

$$Re = \frac{6.31 \times 18617}{7.981 \times .016} = 9.2 \times 10^5 \Rightarrow f = .015$$

$$\Delta P = \frac{(3.36 \times 10^{-6})(.015)(52)(18617)^2(6.653)}{32380}$$

$\Delta P = 0.19$ PSI

$$\text{Velocity} = \frac{18617 \times 6.653}{60 \times .3474} = 5942 \text{ FPM}$$

SECTION III-1

LIFE CYCLE COST CALCULATIONS

FORMUAL FOR "QUICKSHIFTING" FROM

JANUARY 1984 TO JANUARY 1985 AND 1986

FORMULA FOR QUICKSHIFTING TO JAN '85 & JAN '86

A) From Jan '84 to Jan '85:

Jan '85 Total Life Cycle Cost = (1/84 Initial Cost) + (1/84 Ann. Maint Cost) + (1/84 Cyclical Maint Cost) +

$(1/84 \text{ Operating Cost}_{fuel\,A} \times [1 + DCG_{fuel\,A}]) +$

$(1/84 \text{ Operating Cost}_{fuel\,B} \times [1 + DCG_{fuel\,B}]) +$

$(1/84 \text{ Operating Cost}_{fuel\,C} \times [1 + DCG_{fuel\,C}]) + \ldots$

B) From Jan '84 to Jan '86:

Jan '86 Total Life Cycle Cost = (1/84 Initial Cost) + (1/84 Ann. Maint Cost) + (1/84 Cyclical Maint Cost) +

$(1/84 \text{ Operating Cost}_{fuel\,A} \times [1 + DCG_{fuel\,A}]^2) +$

$(1/84 \text{ Operating Cost}_{fuel\,B} \times [1 + DCG_{fuel\,B}]^2) +$

$(1/84 \text{ Operating Cost}_{fuel\,C} \times [1 + DCG_{fuel\,C}]^2) + \ldots$

SECTION III-2

MISCELLANEOUS CALCULATIONS

SENECA DESIGN CRITERIA

Annual Heating Degree Days (65^{0} F Base) = 6,359 [1]

Winter Outside Design Temperature = 5^{0} F [1]

Winter Inside Design Temperature:[2]

80 degrees F - Hydrotherapy X-ray, nurseries, special wards, clinics, physical examination and similar rooms, and special process rooms, such as paint shops and drying rooms.

72 degrees F - Hospital wards and corridors (may be lowered when directed by Post Surgeon).

68 degrees F - Living quarters, lavatories and showers.

65 degrees F - Offices, hangar lean-tos and warehouses, shops and like areas where personnel work seated or in a standing position involving little or no exercise (reduce to 55 degrees during nonworking hours)

55 degrees F - Supply and equipment issue and similar rooms.

50 degrees F - Shops, hangars, and other buildings or sections of buildings where many employees work in a standing position and exercise moderately.

40 degrees F - Shops, warehouses, and the like where employees do work involving considerable exercise.

ΔT = Design Temperature Difference

= Winter Outside Design Temp. less Winter Inside Design Temp.

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[1] "U.S. Army TM-5-785," July 1, 1978.

[2] "AR 420-49," November 18, 1976, Chapter 2.

ASHRAE Modified Degree Day Method:[3]

Fuel Consumption --

$$E_V = \frac{24 \cdot H_L \cdot HDD \cdot C_D}{\Delta T \cdot \eta \cdot V}$$

Energy Consumption --

$$E = \frac{24 \cdot H_L \cdot HDD \cdot C_D}{\Delta T \cdot \eta}$$

Where --

E = Fuel or Energy Consumption for One Year

H_L = Design Hourly Heat Loss (Btu/Hr)

HDD = Heating Degree Days

ΔT = Design Temperature Difference

η = A correction factor which includes the effects of rated full load efficiency, part load performance, oversizing, and energy conservation devices.

= 0.55 for Standard Boiler or Furnace

= 0.65 for a Newer Boiler or Furnace with energy conservation devices.

V = Heating Value of Fuel (consistent with H_L and E)

= 1,031 Btu/cu.ft. Natural Gas[4]

= 138,700 Btu/Gal. No. 2 Fuel Oil[4]

C_D = Correction Factor for Heating Effect VS Degree Days

= 0.62 [3]

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[3] ASHRAE Handbook and Product Directory - 1980 Systems, p. 43.8

[4] "Energy Conservation Investment Program (ECIP) Guidance - Norfolk District," April 1, 1980.

SENECA

BLDG		HI PRESS OIL 3,500,000	LOW PRESS OIL 3,500,000	750,000/ 3,500,000	UNDER 750,000
4	#1			5D4FAA	5D4GAA
				5D4FAA	
101				5D4FAA	
103				5D4FAA	
104					5D4GAA
106					5D4GAA
113				5D4FAA	
114					5D4GAA
116					5D4GAA
121			5D4DSA		
142				5D4FAA	
220					5D4GAA
308				5D4FAA	
309					5D4GAA
310					5D4GAA
313	#1				
319		5D4ESA			
334					5D4GAA
346					5D4GAA
353					5D4GAA
360				5D4FAA	
367				5D4FAA	
606					5D4GAA
609				5D4FAA	
710					5D4GAA
714					5D4GAA
718		5D4DSB			
729					5D4GAA
740					5D4GAA
742					5D4GAA
800					5D4GAA
802					5D4GAA
805					5D4GAA
806					5D4GAA
807					5D4GAA
810				5D4FAA	
812					5D4GAA
813				5D4FAA	
814					5D4GAA
816				5D4FAA	
817				5D4FAA	
819				5D4FAA	
825					5D4GAA
2086					5D4GAA
2101	#1				
2104					5D4GAA
2113	#1				
2305				5D4FAA	
2306				5D4FAA	
2410					5D4GAA
2411					5D4GAA
Tennis Bubble					5D4GAA
Depot Youth Center					5D4GAA
Swimming Pool Heater					

2443- 1FJ4NS 212½- 1FJ4NJ LAKE QTRS- 1FJ4ZQ CAPEHART- 1FJ4ZH

743 #1

GENERATORS - 5A4FNA

For SEAD — 25,000 lb/hr boiler (coal-fired)

HEAT INPUT:

$$\frac{\left(25000 \frac{lb}{hr}\right)\left(983 \frac{Btu}{lb}\right)}{0.8} = 30.7 \text{ MBtu/hr}$$

ALLOWABLE PARTICULATES:

$E = 1.02 / p^{0.219}$ (where p is heat input rate in MBtu/hr) $(10 < p < 10^4)$

$= (1.02)/(30.7)^{0.219}$

$= 0.48$ lbs / MBtu heat input

ALLOWABLE SULFUR OXIDES:

For installations of 100 MBtu/hr or less CAN BURN COAL WITH SULFUR CONTENT OF 2.8 lb/MBTU gross HEAT CONTENT

ALLOWABLE NITROGEN OXIDES:

NO REQUIREMENTS FOR INSTALLATIONS LESS THAN 250 MBTU/HR

AVERAGE EMISSIONS FROM UNCONTROLLED COAL-FIRED BOILER

FROM "COMPILATION OF AIR POLLUTION EMISSION FACTORS" - U.S. EPA

COAL CHARACTERISTICS: 12,500 BTU/lb
10% ASH
2.5 SULFUR

AVERAGE PARTICULATE EMISSIONS: FOR BOILERS 10 to 100 MBTU/hr

$E_p = 13A$ where A = ASH content in %

$\therefore E_p = (13)(10) = 130$ lbs / ton coal burned

$$E_p = \left(\frac{130\ lb}{ton}\right)\left(\frac{1\ ton}{2000\ lb}\right)\left(\frac{1\ lb}{12{,}500\ Btu}\right)10^6 = 5.2\ \frac{lbs}{MBtu\ heat\ input}$$

Sulfur Oxides:

$$E_{SO_2} = \left(\frac{0.015\ lb\ S}{lb\ coal}\right)\left(\frac{2\ lb\ SO_2}{lb\ S}\right)\left(\frac{lb\ coal}{12{,}500\ Btu}\right)\left(10^6\right)$$

$= 2.4$ lb SO_2 / MBtu heat input

Nitrogen Oxides:

$E_{NO_2} = 15$ lbs / ton coal burned

$$= \left(\frac{15\ lb}{ton}\right)\left(\frac{ton}{2000\ lb}\right)\left(\frac{1\ lb}{12500\ Btu}\right)10^6$$

$= 0.6\ \frac{lbs}{MBtu\ heat\ input}$

Calculate max allowable particulate emissions

NY State Regulations → coal-fired boilers WITH 10×10^6 UP TO $10{,}000 \times 10^6$ BTU/HR HEAT INPUT, USE:

$$E = \frac{1.02}{P^{.22}}$$

where E = Allowable emission Rate, $lb/10^6$ BTU
P = total heat INPUT, 10^6 BTU/HR

Taken FROM Power Magazine June 1980 "Controlling Particulate EMISSIONS"

Assume P = 10,000,000 BTU/HR

$$E = \frac{1.02}{10^{.22}} = 0.615 \ lb/10^6 \ BTU$$

Assume Boiler Capacity = 25,000 lb/HR
" Steam Conditions = 50 psig, SAT; $h = 1179.1 \frac{BTU}{lb}$
" Feedwater Conditions = 5 psig, SAT; $h = 196.3 \frac{BTU}{lb}$
$\Delta h = 982.8$ BTU/lb

Assume Boiler Efficiency = 80%

$$\text{Heat input} = \frac{25{,}000 \ lb/HR \times 982.8 \ BTU/lb}{.80}$$

$$= 30{,}712{,}500 \ BTU/HR$$

$$\therefore \quad E = \frac{1.02}{30.71^{.22}} = 0.480 \ lb/10^6 \ BTU$$

ASSUME WOOD FIRING
" BOILER CAPACITY = 25,000 lb/HR
" Δh = 982.8 BTU/lb
" BOILER EFFICIENCY = 63%

$$\text{Heat input} = \frac{25000 \times 982.8}{.63} = 39{,}000{,}000 \ \frac{BTU}{HR}$$

$$\therefore \quad E = \frac{1.02}{39^{.22}} = 0.456 \ \text{lb}/10^6 \ \text{BTU}$$

Let $E = 0.40 \ \text{lb}/10^6 \ \text{BTU}$

$$\therefore \quad P = \log^{-1} \frac{1}{.22}\left(\log \frac{1.02}{E}\right)$$

$$P = 70{,}454{,}690 \ \text{BTU/HR}$$

ASSUME MAX PARTICULATE EMISSIONS ALLOWABLE = 0.40 lb/10^6 BTU

SENECA ARMY DEPOT

NEW YORK 0.40 /10^6 BTU

PA 0.40 lbs/10^6 BTU

30,000 #/HR
30,000 #/HR
] OPERATING @ 50 psig, SATURATED

Boiler → EPA REQ'TS

- water tube OR Firetube
  - → fired on crushed, sized coal BARLEY up to PEA SIZE
- Boiler trim, such as safety valves, blowoff valves, etc
- feedwater regulator
- Airheater ?
- ID FAN
- SCRUBBER SYSTEM → need NY & PA EPA REQ'TS
- DUST collector / BAGHOUSE
- COMBUSTION CONTROL SYSTEM
- FUEL FEED FROM A ~~DAY TANK~~ (DAY TANK) SURGE BIN Plus SURGE BINS
- stack - steel
- IGNITOR - No. 2 Fuel Oil
- BACKUP FUEL - No. 6 FUEL OIL

PRIMARY FUEL

- COAL, ANTHRACITE
- 13,000 BTU/lb dry basis
- MOISTURE - 4%

COAL COST AND AVAILABILITY

The following four pages show telephone confirmations of conversations with coal suppliers. Although anthracite coal is available in Pennsylvania, it is not as economical as bituminous coal. Therefore, the decision was made to use bituminous coal.

After receiving a number of prices for bituminous coal, it was decided to use Western Penn coal (Jefferson County).

Cost at mine is $40 per ton. Transportation to Seneca is $14 per ton. These 1980 costs were used in fuel cost calculations.

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-000

(Local) L.D. (Placed) Rec'd Date 18 NOV 80

J. McMILLIN Conversed with Jerry Steckloff

Of Plantec Corp. Regarding Coal prices at Letterkenny Army Depot

Jerry had conversations with Richards Coal Co. of McConnellsburg, Pa 717-485-3032 for Letterkenny coal prices in April 1980. Prices were as follows:

Hardcoal $58.50 /ton

Softcoal $28.00 /ton "Run of mine"

Graded "P", small. $32.00 /ton

Graded Nut. $32.00 /ton

Stoker coal. $46.00 /ton

$3.50 /ton delivery charge

Using $58.50 + 3.50 = $62 /ton for "Hardcoal"

Mr Richards 5 PM

Distribution:

III-8

RS&H FORM 102 11/72

Project No. 80122-000

Telephone Call Confirmation

reynolds, smith and hills

Local ___ (L.D.) ___ (Placed) ___ Rec'd ___ Date 26 NOV. 80

J. McMILLIN ___ Conversed with Robert Gerke

Of Reading Coal Co. ___ Regarding Coal prices for Seneca
518-346-2192

The price of $57.00/ton received 24 NOV 80 is for barley through pea sizes.

Discussed delivery charges. Price quoted would be for coal from Reading mines. Mr. Gerke will look into delivery costs for both trucking and by rail. Local railroad is ~~Leg~~ Lehigh Valley Railroad [scribbled out] (Buffalo Division). Call him back next Monday for delivery costs.

Shown below are typical Pennsylvania anthracite as received analysis

	Btu/lb	Fusion Temp	Sulphur	Ash	Moisture	Volatile	Fixed Carbon
Rice	12,500	2880	0.7	11%	5.7	4.2	78.8
Barley	12,000	2880	0.7	12%	7.2	4.1	76.1

Distribution:

RS&H FORM 102 11/72

Telephone Call Confirmation

Project No. 80122-000

reynolds, smith and hills

(Local) (L.D.) (Placed) Rec'd Date 24 NOV 80

J. McMILLIN Conversed with Robert Gerke

Of Reading Coal Co. Regarding Coal prices for Seneca Army Depot Coal Fired Boiler Plants 518-346-2892

Reading Coal Co. is coal brokerage company in Schenectady N.Y.

Rice or barley coal for stoker fired boiler would be approximately $57.00/ton less 2% if paid within 15 days. Freight charge would be approximately $10/ton (probably less).
Heat content of coal is 13,000 Btu/lb.

To get a better handle on freight charges, we will have to talk to some freight companys.

(J&W Fuel Sales Inc. of Phelps, Junction, N.Y. 315-548-8151, referred me to Reading Coal Co.)

Distribution:

RS&H FORM 102 11/72

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122-000

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date 12-18-80

Steve Cowen Conversed with Timothy O'Day

Of MoShannon Mining Co. Regarding Coal Prices @ Seneca

102 Greenaway
Syracuse, NY 315-4710050

Requested Prices for Eastern Bituminous Coal, delivered by Truck to the Seneca Army Depot. Mr O'Day quoted 12,500-13,000 BTU/lb 28% Vol. 10% Ash, 0% Fines, 1.5% S 1 3/4 x 1/4 sized coal from western PA (Jefferson cty) As costing $40 per ton plus $14 per ton shippage.

In addition, Mr O'Day said that the same coal delivered to the Letterkenny Army Depot would be about $40/ton plus $7/ton shippage

Distribution:

RS&H FORM 102 11/72

ADJUSTING EBCO PRICES TO ACCOUNT FOR 18% INCREASE FOR GALVANIZED STEEL AND 5% FOR FREIGHT, WE OBTAIN

	PIPE ⌀	PRICE/FT SYSTEM
STEAM	8"	74.34
	6"	58.23
	4"	43.37
	3"	34.69
COND.	2½"	29.74
	2	28.50
	1½	23.54
	1	21.06

THE PIPE RUN WILL REQUIRE ~50 90° ELS
EQUIVALENT PIPE LENGTH IS

$$50 \times 15' \text{ l.f./large } \phi = 750'$$

$$50 \times 12' \text{ l.f./small } \phi = 600'$$

THUS, WE WILL COMPUTE PRICES FOR 3300 + 750 = 4050' OF LARGE ⌀ STEAM PIPE AND FOR 3300 + 600 = 3900' OF SMALL ⌀ CONDENSATE PIPE

PIPE ⌀	PRICE/FT	FT	TOTAL PRICE
8	74.34	4050	301,077
6	58.23	4050	235,832
4	43.37	4050	175,649
3	34.69	4050	140,495
2½	29.74	3900	115,986
2	28.50	3900	111,150
1½	23.54	3900	91,806
1	21.06	3900	82,134

PRICE DOES NOT INCLUDE FITTING OR WELDING

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT [illegible] UNDERGROUND CONDUIT SYSTEM
DESIGNER [illegible]
CHECKER

AEP NO [illegible]
SHEET 5 OF 9
DATE [illegible]/10/8[illegible]
DATE

COMPUTATION OF TOTAL LABOR COST FOR CONDUIT SYSTEM ASSEMBLY

PIPE Ø	MAN-HRS/FT. SYS	× FT	× COST/MAN-HR	= COST/SYS
1	.53	3300	22[57]	40,000
1½	.53			40,000
2	.565			42,640
2½	.604			45,600
3	.617			46,570
4	.648			48,900
6	.774			58,410
8	.858			64,750

UNDERGROUND PREFAB CONDUIT SYSTEM TOTAL COST

	EXCAVATION	Ø	MATERIAL	LABOR	SYST COST	+ 10% CONT	= TOTAL SYST COST
3300 Ft	20,740	8	301077	64750	386567		425224
		6	235832	58410	314982		346480
		4	175649	48900	245289		269818
		3	140495	46570	207805		228586
		2½	115986	45600	182326		200559
		2	111150	42640	174570		191983
		1½	91806	40000	152546		167801
		1	82134	40000	142874		157161

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80-122-00:
SHEET 7 OF 9

Local ____ L.D. X Placed ____ Rec'd X Date 12/8/80

ALEX LANE Conversed with ED KAISER

Of EBCO Regarding UNDERGROUND, PREFAB, INSULATED PIPING SYS.

PRICES FOR STEAM & CONDENSATE PIPING

STEAM	PRICE/FT (MILL QUAN.)
8"/40/A-53	$60.
6	47
4	35
3	28
2	23
CONDENSATE	
2½/40/A53	24
2/40/A53	23
1½/80/A-106	19
1/80/A-106	17

FOB GLENVIEW
10 GA. BLACK STEEL CASING W/ HOT TAR INSULATED PIPE

SIZE	INSULATION
8"	3"
6	2½"
4	2"
3	2"
<2	1"

EK ADVISES OVERALL 18% INCREASE IF 10GA GALV. STEEL CONDUIT IS TO BE USED.

PRICES ARE FOB GLENVIEW; EK ADVISES 5% INCREASE FOR TRANSPORT TO SYRACUSE

EACH 90° EL <=> 12-15' LF OF PIPE

Distribution:

Project No. 80-122-000

SHEET 8 OF 9

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. 312-724-4500 Placed X Rec'd ______ Date 12/9/80

ALEX LANE Conversed with FRAN SASSO

Of EBCO Regarding LAEOR FOR PREFAB. COND. PIPE SYST. UNDER TRI-SVC. SPEC.

MANHOURS FOR PIPE (FIT & WELD), PER FOOT	MANHOURS FOR CONDUIT CASING, ASTM A 139 PER FOOT	PIPE / CONDUIT Ø
.05	..	1 / 6"
.05	.48	1½ / 6"
.065	.50	2 / 8"
.082	.52	2½ / 10"
.097	.52	3 / 10"
.128	.52	4 / 10"
.194	.58	6 / 14"
.258	.60	8 / 18"

CORRECTION TO KAISER QUOTE OF 12/8 : INSULATION IS AS PER TRI-SVC SPEC.

I.E.

PIPE Ø	INSUL
1-2"	1½"
2½-4"	2"
6-8"	2½"

TRI-SVC SPEC IS USA CE-301.21
USN TS-15P28
USAF 88-007.1

Distribution:

III-15

STEAM PIPING SIZING CRITERIA

1. MAX ΔP = 1.0 PSI / 100 Ft
2. MAX VELOCITY = 4000 FPM
3. 50 PSIG, SAT STEAM $\bar{V} = 6.653\ Ft^3/lb$
4. VISCOSITY Steam = 0.016 Centipoise
5. Minimum Steam Pipe Size = 1½" sch 80

$$\Delta P = 3.36 \times 10^{-6} \frac{f L W^2 \bar{V}}{d^5}$$

$$f = f(Re)$$

$$Re = \frac{6.31\ W}{d \mu}$$

$$\text{VELOCITY} = \frac{W \bar{V}}{A \times 60}\ \text{FPM} \Rightarrow W = \frac{\text{VEL} \times A \times 60}{\bar{V}}$$

1½" sch 80 $\quad d = 1.5" \quad d^5 = 7.594 \quad A = 0.01225\ Ft^2$

$$\text{MAX } W = \frac{4000 \times .01225 \times 60}{6.653} = 442\ \text{lb/HR}$$

check

$$Re = \frac{6.31 \times 442}{1.5 \times .016} = 1.16 \times 10^5 \Rightarrow f = .0228$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0228 \times 100 \times (442)^2 \times 6.653}{7.594}$$

ΔP = 1.31 PSI/100 Ft Too high!

MAX W = 400 lb/HR

$$Re = \frac{6.31 \times 400}{1.5 \times .016} = 1.05 \times 10^5 \Rightarrow f = .0230$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .023 \times 100 \times (400)^2 \times 6.653}{7.594}$$

ΔP = 1.08 PSI/100 Ft Too HIGH !

MAX W = 350 lb/HR

$$Re = \frac{6.31 \times 350}{1.5 \times .016} = 9.2 \times 10^4 \Rightarrow f = .0232$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0232 \times 100 \times (350)^2 \times 6.653}{7.594}$$

ΔP = 0.837 PSI/100 F

USE 1½" sch 80 0-400 lb/HR

2" sch 40 d = 2.067" d^5 = 37.72 A = .02330 Ft^2

$$\text{MAX } W = \frac{4000 \times .02330 \times 60}{6.653} = 840 \text{ lb/HR}$$

check $$Re = \frac{6.31 \times 840}{2.067 \times .016} = 1.6 \times 10^5 \Rightarrow f = .0208$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0208 \times 100 \times (840)^2 \times 6.653}{37.72}$$

ΔP = 0.87 PSI/100 Ft

MAX W = 900 lb/HR

$$Re = \frac{6.31 \times 900}{2.067 \times .016} = 1.72 \times 10^5 \Rightarrow f = .0207$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0207 \times 100 \times (900)^2 \times 6.653}{37.72}$$

ΔP = 0.994 PSI/100 Ft

$$Vel = \frac{900 \times 6.653}{.02330 \times 60} = 4283 \text{ FPM}$$

USE 2" sch 40 400-900 lb/HR

2½" sch 40 $d = 2.469"$ $d^5 = 91.75$ $A = .03322$

$$MAX\ W = \frac{4000 \times .03322 \times 60}{6.653} = 1198 \text{ lb/HR}$$

check $$Re = \frac{6.31 \times 1200}{2.469 \times .016} = 1.9 \times 10^5 \Rightarrow f = .020$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .02 \times 100 \times (1200)^2 \times 6.653}{91.75}$$

ΔP = 0.70 PSI/100 Ft

MAX W = 1500 lb/HR

$$Re = \frac{6.31 \times 1500}{2.469 \times .016} = 2.4 \times 10^5 \Rightarrow f = .0196$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0196 \times 100 \times (1500)^2 \times 6.653}{91.75}$$

$\Delta P =$ 1.07 PSI/100 Ft   Too high!

MAX W = 1350 lb/HR

$$Re = \frac{6.31 \times 1350}{2.469 \times .016} = 2.16 \times 10^5 \Rightarrow f = .020$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .020 \times 100 \times (1350)^2 \times 6.653}{91.75}$$

$\Delta P =$ 0.89 PSI/100 Ft

$$Vel = \frac{1350 \times 6.653}{.03322 \times 60} = 4506 \text{ FPM}$$

USE 2½" sch 40   900 - 1350 lb/HR

3" sch 40 $d = 3.068"$ $d^5 = 271.8$ $A = 0.05130 \text{ Ft}^2$

$$MAX\ W = \frac{4000 \times .05130 \times 60}{6.653} = 1850 \text{ lb/HR}$$

TRY W = 2000 lb/HR

$$Re = \frac{6.31 \times 2000}{3.068 \times .016} = 2.6 \times 10^5 \Rightarrow f = .019$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .019 \times 100 \times (2000)^2 \times 6.653}{271.8}$$

$\Delta P = 0.625$ PSI/100 Ft

$$vel = \frac{2000 \times 6.653}{.0513 \times 60} = 4323 \text{ FPM}$$

USE 3" sch 40 1350-2000 lb/HR

4" sch 40 $d = 4.026''$ $d^5 = 1058$ $A = .0884$ Ft²

$$MAX\ W = \frac{4000 \times .0884 \times 60}{6.653} = 3189 \text{ lb/HR}$$

TRY $W = 3500$ lb/HR

$$Re = \frac{6.31 \times 3500}{4.026 \times .016} = 3.4 \times 10^5 \Rightarrow f = .0188$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0188 \times 100 \times (3500)^2 \times 6.653}{1058}$$

$\Delta P = 0.487$ PSI /100 Ft

$$Vel = \frac{3500 \times 6.653}{.0884 \times 60} = 4390 \text{ FPM}$$

USE 4" sch 40 2000-3500 lb/HR

6" sch 40 $d = 6.065"$ $d^5 = 8206$ $A = 0.2006\ FT^2$

$$\text{MAX } W = \frac{4000 \times .2006 \times 60}{6.653} = 7236\ \text{lb/HR}$$

TRY 8,000 lb/HR

$$Re = \frac{6.31 \times 8000}{6.065 \times .016} = 5.2 \times 10^5 \Rightarrow f = .0162$$

$$\Delta P = \frac{3.36 \times 10^{-6} \times .0162 \times 100 \times (8000)^2 \times 6.653}{8206}$$

$\Delta P = 0.282$ PSI / 100 Ft

$$\text{Vel} = \frac{8000 \times 6.653}{.2006 \times 60} = 4422 \text{ FPM}$$

USE 6" sch 40 3500-8000 lb/HR

8" sch 40 $d = 7.813"$ $d^5 = 29113$ $A = .3329\ FT^2$

$$\text{MAX } W = \frac{4000 \times .3329 \times 60}{6.653} = 12009\ \text{lb/HR}$$

let Vel = 4500 FPM MAX W = 13,500 lb/HR

USE 8" sch 40 8000-13500 lb/HR

10" sch 40 $d = 10.02"$ $d^5 = 101000$ $A = .5475$

$$MAX\ W = \frac{4000 \times .5475 \times 60}{6.653} = 19750\ lb/HR$$

let vel = 4500 FPM, MAX W = 22218 lb/HR

USE 10" sch 40 13500-22500 lb/HR

50 PSIG STEAM PIPING

0-400 lb/HR	1½" sch 80
400-900 "	2" sch 40
900-1350 "	2½" sch 40
1350-2000 "	3" sch 40
2000-3500 "	4" sch 40
3500-8000 "	6" sch 40
8000-13500 "	8" sch 40
13500-22500 "	10" sch 40

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: SENECA - CENTRAL COAL PLANT
AEP NO. 80122-000
SHEET 9 OF
DESIGNER: J. McMILLIN
DATE 21 NOV. 80
CHECKER
DATE

CONDENSATE PIPING SIZES - Use sch 80, size pipe to limit pressure drop to approximately 2' per 100' pipe

Use Cameron Hydraulic Data, Tables entitled "Friction Losses in Pipe ; C=100." Use minimum of 1"φ pipe

✓	Use	1"φ	sch. 80	for 0-3 GPM		0-1500 lb/hr.
		~~1¼"φ~~	~~sch 80~~	~~for 3 - 6 GPM~~		~~1500-3000 lb/hr.~~
✓		1½"φ	sch 80	for 3 - 10 GPM		1500 - 5000 lb/hr.
✓		2"φ	sch. 40	for 10 - 20 GPM		5000 - 10,000 lb/hr.
✓		2½"φ	sch 40	for 20-35 GPM		10,000 - 17,500 lb/hr
✓		3"φ	sch 40	for 35-55 GPM		17,500 - 27,500 lb/hr

REYNOLDS, SMITH AND HILLS
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SUBJECT BLDG HEAT LOAD WEIGHTING
SHEET OF
DESIGNER DATE
CHECKER DATE

BOILER TYPE: 5D4FAA

* ASSUMED HEIGHT

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USAGE - GAL #2 F.O.
810	9220	15,040	24,260	2	8.93	18,862
813	3806	2056	5862	1	2.16	4562
816	10,203	10,703	20,906	1	7.69	16,243
817	1744	1023	2767	1	1.02	2154
819	6178	5435	11,613	3	4.27	9019
103	6580	3224	9804	10	3.61	7625
101	5745	5259	11,004	10	4.05	8554
5-142	540' PERIM x12 * 6480	10,252	16,732	10	6.16	13,011
113	260x63x20 * 12,920	16,504	29,424	11	10.83	22,875
360	50x21x20 * 2840	1024	3864	12	1.42	2999
367	110x33x12 * 3432	3640	7072	13	2.60	5492
308	20x26x12 * 1104	531	1635	15	0.60	1267
306	120x41x12 * 3864	4901	8735	15	3.21	6780
2305	5465	3091	8556	—	3.15	6653
2306	7204	4362	11,566	—	4.26	8998
4	20x27x12 * 1128	540	1668	9	0.61	1288
6	20x30x20 * 2000	607	2607	9	0.96	2028

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT SENECA ARMY DEPOT
BLDG HEAT LOAD WEIGHTING
DESIGNER
CHECKER
AEP NO
SHEET OF
DATE
DATE

BOILER TYPE: 5D4FAA

* ASSUMED HEIGHT

BLDG #	WALL AREA (Ft²)	ROOF AREA (Ft²)	TOTAL AREA ~ (Ft²)	MAP AREA	SF/FUEL FACTOR %	ANNUAL FUEL USAGE-GAL #2 FO.
5	360x33x12 * 9432	11,754	21,186	9	7.80	16,475
7	360x33x12 * 9432	11,754	21,186	9	7.80	16,475
815	160x100x20 10,400 *	11,072	21,472	1	7.90	16,687
609	26x26x12 * 1248	692	1940	20	0.71	1500
608	? *			20		
610	22x23x12 * 1080	513	1593	20	0.59	1246
611	20x20x12 * 960	400	1360	20	0.50	1056
612	135x136x12 * 6504	18,393	24,897	20	9.16	19,348
		TOTALS	271,709		100	211,222

BLDG 819

17'-8" + 21'-11" x 18'-11" x 2 = 1498 Ft²

19'-8" + 21'-6" x 18'-11" x 2 = 1557

99'-2" - (17'-8" + 21'-11") x 14'-3" x 2 = 1698

20' + 20' + 10' x 14'-3" x 2 = 1425

TOTAL WALL AREA = 6178 Ft²

19'-8" + 21'-6" x 99'-2" = 4082

17'-8" x 20'-0" = 353

20'-0" x 20' + 20' + 10' = 1000

TOTAL ROOF AREA = 5435 Ft²

TOTAL AREA = 11,613 Ft²

BLDG 810

150'-2" x 18'-5" x 2 = 5531 Ft²

100'-2" x 18'-5" x 2 = 3689

TOTAL WALL AREA = 9220 Ft²

TOTAL ROOF AREA = 150'-2" x 100'-2" = 15,040 Ft²

TOTAL AREA = 24,260 Ft²

REYNOLDS, SMITH AND HILLS
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SUBJECT SEVENTH ARMY ... AEP NO. ...
SHEET ... OF ...
DESIGNER SCOWEN DATE
CHECKER DATE

BLDG 817

37'-6" × 12'-8" ×2 = 950 Ft²

31'-4" × 12'-8" × 2 = 794 Ft²

TOTAL WALL AREA = 1744 Ft²

37'-6" × 31'-4" − (11'-8" × 13'-0") = 1023 Ft² (TOTAL ROOF AREA)

TOTAL AREA = 2767 Ft²

BLDG 816

Assume 20' Tall Bldg.

141'-4" × 20' × 2 = 5653 Ft²

92'-6" × 20 × 2 = 3700 Ft²

21'-3" × 20 × 2 = 850 Ft²

TOTAL Wall AREA = 10,203 Ft²

141'-4" × 52.5' = 7420 Ft²

31'-3" × 11'-3" = 352

10' × 11'-3" = 113

22.5' × 61'-0" = 1373

22.5' × 64'-2" = 1445

TOTAL ROOF AREA = 10,703 Ft²

TOTAL AREA = 20,906

III-27

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT Seneca Army Depot AEP NO.
SHEET OF
DESIGNER SCowen DATE
CHECKER DATE

BLDG 813

Assume 20' bldg heigth

Wall area = 62×20×2 + 33'-2"×20×2 = 3806 Ft²

Roof area = 62'-0"×33'-2" = 2056 Ft²

TOTAL AreA = 5862 Ft²

BLDG 103

Front & Rear sides [79' x 25' + 12' x 7' + 25' x 16'] x2 = 4918 Ft²

Right & Left sides [31' x 25' + 7' x 8'] x 2 = 1662 Ft²

TOTAL WALL AREA = 6580 Ft²

104' x 31' = 3224 Ft² (ROOF AREA)

TOTAL AREA = 9804 Ft²

BLDG 101

Height = 36'

94' x 36' + 65'-7" x 36' = 5745 Ft² wall area

roof area = 94x42 + 23'-7" x 55'-7" = 5259 Ft²

Total area = 11,004 Ft²

BLDG 2306 Assume 25' height

wall area = 84x25x2 + 60'-1"x25x2 = 7204 Ft²

ROOF AREA = 84x42 + 18'-1" x 46'-1½" = 4362 Ft²

Total area = 11,566

BLDG 2305 — Assume 30' height (1) wall 15' height (1) wall

wall area = 44'-4" x 30 + 36'-8" x 30' = 2430 Ft²

44'-4" x 15 + 21 x 15 x 2 + 18 x 15 x 2 = 1835 Ft²

15 x 18 x 2 + 36'-8 x 18 = 1200 Ft²

Total Wall Area = 5465 Ft²

Roof area = 44'-4" x 57'-4" + 15' x 36'-8" = 3091 Ft²

Total Area = 8556 Ft²

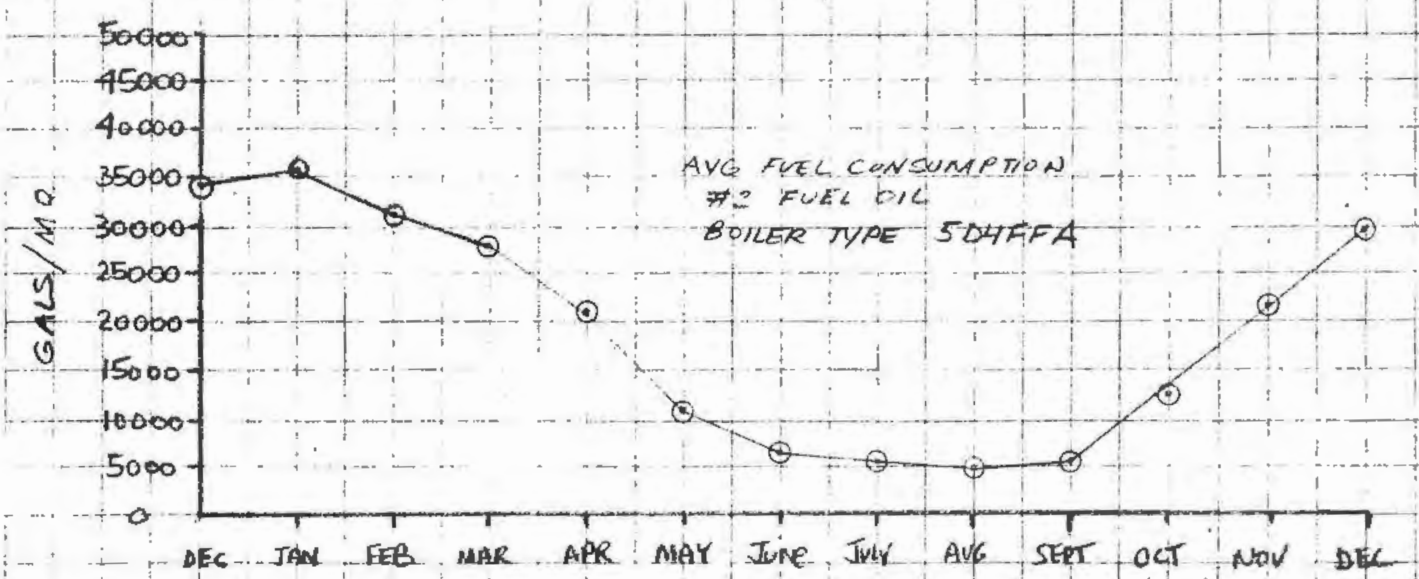
REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS

SUBJECT SENECA ARMY DEPOT
FUEL CONSUMPTION DATA
DESIGNER
CHECKER
AEP NO. 80122-000
SHEET OF
DATE
DATE

Boiler Type: 5D4FAA #2 Fuel Oil Consumption (GALLONS)

MO \ YR	1974	1975	1976	1977	1978	1979	AVERAGE
JAN	*28606	27727	37510	42418	36595	39193	35342
FEB	*41229	21325	26224	32555	29386	38582	31550
MAR	*27262	23911	27847	32212	30144	26488	27977
APR	—	28454	18440	16937	20407	17194	20286
MAY	—	9686	15953	9909	11563	8438	11110
JUNE	—	4952	6852	7034	7049	7736	6725
JULY	6043	4557	6634	4169	6788	4395	5431
AUG	2800	4057	4531	5385	5579	6625	4830
SEPT	7674	4493	6506	4409	4594	3467	5191
OCT	14751	8604	14463	14014	10243	11572	12275
NOV	17999	17245	20873	25683	23586	22794	21363
DEC	24847	31004	33617	27748	30098	27540	29142
TOTALS	—	186,015	219,450	222,473	216,032	214,024	211,222

* 1980



SECTION III-3

SENECA ARMY DEPOT
FEASIBILITY STUDY
BIOMASS FUEL RESOURCES

SENECA ARMY DEPOT

FEASIBILITY STUDY

BIOMASS FUEL RESOURCES

INTRODUCTION

The feasibility of a central coal fired steam plant is being studied for SENECA Army Depot. As part of the investigation, wood biomass is being considered as a supplemental fuel.

This report defines the availability and the cost to procure biomass in the SENECA County area.

DISCUSSION

I. Wood Availability

The timber inventory and growth rates were estimated from data contained in 'Timber Resources of New York' Forest Service Resource Bulletin NE-20 1970. This was the most current data available at the time of this analysis. No great loss of accuracy should be expected from this old data because new, yet unpublished data shows no significant new trends. New data is to be published within the next six months.

Although timber inventory data is available by county, growth rates are only available for regions (10 to 20 counties) of the state. To estimate growth rates of counties, it was assumed that county growth rates were proportional to regional growth rates based on % commercial forest land acreage.

The general procedure for calculating county growth rate is as follows:

1) Determine commercial forest acreage in county.
2) Determine commercial forest acreage in appropriate region.
3) Calculate county's % of its region's total commercial forest acreage.
4) Calculate county's growth rate as a percentage of its region's growth rate.

The growth rate calculated above represents the theoretical average maximum removal rate which would not reduce the overall forest inventory. Since the harvested trees (i.e., the largest trees), represent the predominate contributor to the growth rate, considerably less timber can be harvested than the growth rate calculation would indicate. The percentage of timber removed from each county was assumed to be proportional to the regional removal percentage. The removal percentage equals the ratio of the volume harvested over growth rate.

From an economic viewpoint, not all timber harvested can be used as fuel. Larger straight stemmed logs have a much higher dollar value as saw logs and hence would be unavailable as fuel wood. To determine the amount of fuel wood available, it was assumed that 0% saw logs, 100% stems (saw log tops) and 80% of the pole timber would be available at reasonable prices. This assumption is optimistic and predicts the upper limit on reasonably priced fuel wood.

The total growth rate, harvesting rate and the annual fuel wood amount for the depot area were also calculated by the above method; that is, they were assumed to be proportional to county estimates based on percent commercial forest acreage fraction. On site commercial forest acreage was estimated to be 400 acres by the previous depot forester.

II. Wood Costs

The cost of procuring wood is influenced to a large extent by the distance over which the material must be transported. SENECA Army Depot is located at approximately the center of Seneca County. Seneca County is geogrpahicaly located between Cayuga Lake and Seneca Lake. That is, Seneca County has no ground (trucking) transportation through its eastern and western boundaries.

This fact limits the area of forest land which is within a reasonable (50 miles) trucking distance. See Map A, page 49 for details.

Based on the above geographical restrictions, it was determined that a realistic procurement area would include all of Seneca County, approximately one half of Schuyler County, approximately one-third of Tompkins County and some small percentage of Ontario and Cayuga Counties. For calculation purposes, the procurement area is assumed to equal the sum of the commercial forest land in Seneca and Schuyler Counties or about 147,400 acres. It should be noted that only 37,800 acres of the 147,400 acres lies within Seneca County. This implies that a majority of available timber lies at the outer ranges of the 50 mile reasonable trucking distance.

A second major contributor to the cost of procuring wood is the relative wood harvesting activity of a region. Seneca County has a relatively small amount of commercial forest land, and little or no wood processing. (See Map B, page 50).

Based on these facts and comments from local foresters, it appears that little logging is occuring in Seneca County. Costs to cut, chip and/or haul wood in the Seneca County area should be considered above normal because no competition now exists in the area.

Since no logging industry exists in Seneca County, the cost to procure a ton of biomass can only be estimated from costs in other areas. Previous studies at Letterxenny Army Oepot, Pennsylvania and Fort Oevens, Massachusetts, indicate that wood can be hauled (over limited distances) and chipped for $15 per ton. Stumpage prices for the New York 8th Forest Region are reported to be most commonly $10 per cord. Using a 5,800 lb. cord, this equates to $3.45 per ton. Additional hauling above that which would be included in the above $15/ton price is assumed to be 25 miles. Previous studies have shown (see Map C, page 51) that transportation cost can be $.065 per ton per mile. Additional hauling expenses would then be equal to $.065 x 25 miles or $1.63 per ton. For calculation purposes, the cost of biomass delivered to the depot from off-site locations is assumed to be $20 per ton. This cost represents a lower bound estimate. During initial years, procurement costs may exceed this amount in order to attract producers into a non-existent industry. That is, costs may have to be higher to finance the purchase of capital equipment.

SUMMARY AND CONCLUSION

Based on this limited scope investigation, the following data should be used for the preliminary investigation of utilizing wood biomass for fuel at Seneca Army Depot.

On Depot Sources - 67 Tons/yr @ $15/ton

Off Depot Sources - 24900 Tons/yr @ $20+/Ton

It should be noted that the above volumes represent upper limits while the costs represent lower limits. That is, the above data is now conservative and tends to make wood fuel more economically attractive.

SITUATION: ESTIMATE THE COST AND AMOUNT OF AVAILABLE WOOD FUEL ON & AROUND SENECA ARMY DEPOT

98
-28
79

$$\frac{\text{forest AREA of Sen \& Sch Co.}}{\text{forest AREA of Region (sw)}} = \frac{37.8 + 109.6}{5,698.} = .0258687$$

INVENTORY — EST. FUE WOOD

TAB. 35		SW Region		SW Region
.3928	SAW LOGS	1891.8 (10^6) ft³		1891.8 × .00 = 0
.08768	STEMS	422.3 " "		422.3 × 1.00 = 422.3 (10^6) ft³
.5194	POLES	2501.9 "		2501.9 × .80 = 2001.5 (10^6) ft³
1.000		4816	→ ≈50% →	2423.8 (10^6) ft³

ASSUME REGIONAL GROWTH RATES Proportional to Inventory

GROWTH = % × Total Region Growth × % Land in County

Saw Logs:	1.0984 =	.3928 × 108.1 × .0258687
Stems:	.2451 =	.08768 × 108.1 × .0258687
Poles:	1.4524 =	.5194 × 108.1 × .0258687
	2.7959 (10^6) ft³ growth per YEAR in SENECA & Schuyler Counties	

USING 70 lbs/ft³

$$\frac{2.7959 (10^6) ft^3}{yr} \cdot \frac{70 \text{ lbs}}{ft^3} \cdot \frac{\text{Ton}}{2000 \text{ lbs}} = 97,856 \text{ Tons/year}$$

↑ ALL GROWTH

CURRENT PRACTICE INDICATES

TAB 76

$$.5087 = \frac{55.0(10^6)\,ft^3 \text{ HARVESTED}}{108.1(10^6) \text{ GROWTH}}$$

50.87 % REMOVAL RATE

HENCE IF ALL HARVESTING COULD BE DIVERTED TO FUEL WOOD

$$97{,}856 \text{ TON/yr.} \,(.5087) = 49{,}787 \text{ TON/yr}$$

WOULD BE AVAILABLE

BACAUSE ECONOMICS REQUIRE high grade logs TO BE USED AS SAW TIMBER ASSUME 50% OF HARVEST WOULD BE AVAILABLE AS FUEL.

$$\frac{49{,}787 \text{ TON}}{\text{yr}} \Big| .50 = 24\,893.5 \frac{\text{TON}}{\text{yr}}$$ for FUEL (MAX VALUE)

SINCE NO CHIPPING OR HAULING IS BEING DONE IN THE SENECA CO. AREA, LOW EST. FOR CHIPPING & HAULING WOULD BE \$20/TON. THIS AMOUNT COULD BE MUCH HIGHER!

TIMBER ON SITE AVAILABLE AS FUEL

$$24\,893.5 \Big| \frac{.4\,(10^3) \text{ ACRE ON BASE}}{147.4\,(10^3) \text{ ACRE IN AREA}} = 67.55 \text{ TON/yr.}$$

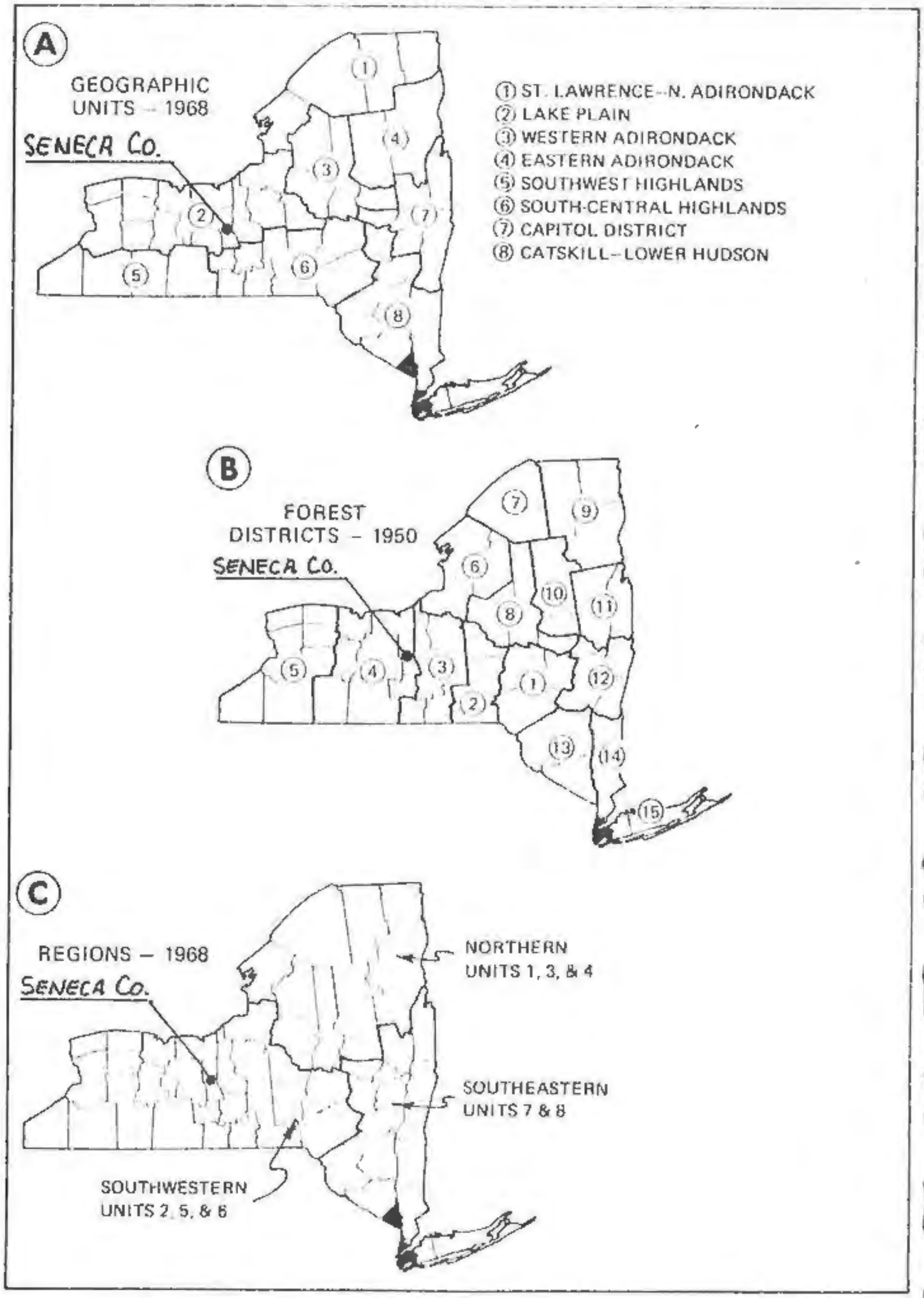


Figure 1.—Sampling units of the two forest surveys: A, geographic units for the resurvey; B, forest districts for the initial survey; and C, regional grouping of geographic units.

Table 32.—*Area of commercial forest land by site class, geographic unit, and region, 1968*

(In thousands of acres)

Unit and region	Site class (*cubic feet per acre*)				Total
	Over 120	85 to 120	50 to 85	Under 50	
SOUTHWESTERN:					
Lake Plain	118.7	276.7	607.4	885.8	1,888.6
Southwest Highlands	128.4	268.1	650.9	608.5	1,655.9
South-central Highlands	80.1	310.2	793.5	969.7	2,153.5
Total	327.2	855.0	2,051.8	2,464.0	5,698.0
NORTHERN:					
St. Lawrence-N. Adirondack	174.0	234.8	1,102.1	994.1	2,505.0
Western Adirondack	131.4	247.3	732.4	376.9	1,488.0
Eastern Adirondack	132.5	211.4	472.9	477.8	1,294.6
Total	437.9	693.5	2,307.4	1,848.8	5,287.6
SOUTHEASTERN:					
Capitol District	68.2	133.6	502.8	535.6	1,240.2
Catskill-Lower Hudson	49.3	154.8	689.0	1,162.2	2,055.3
Total	117.5	288.4	1,191.8	1,697.8	3,295.5
State total	882.6	1,836.9	5,551.0	6,010.6	14,281.1
	Sampling errors, in percent				
Southwestern	13	8	5	4	1
Northern	11	12	5	5	1
Southeastern	21	13	6	4	2
State total	8	6	3	3	1

Table 35.—*Volume of timber on commercial forest by class of timber, geographic unit, and region, 1968*

(In millions of cubic feet)

Unit and region	Sawtimber trees: Sawlogs	Sawtimber trees: Upper stems	Sawtimber trees: Total	Pole-timber trees	Total growing stock	Rough trees	Rotten trees	Total, all timber
SOUTHWESTERN:								
Lake Plain	591.1	130.9	722.0	737.7	1,459.7	142.0	113.8	1,715.5
Southwest Highlands	527.4	121.7	649.1	716.2	1,365.3	158.6	80.9	1,604.8
South-central Highlands	773.3	169.7	943.0	1,048.0	1,991.0	213.1	134.9	2,339.0
Total	1,891.8	422.3	2,314.1	2,501.9	4,816.0	513.7	329.6	5,659.3
NORTHERN:								
St. Lawrence-N. Adirondack	672.4	142.1	814.5	929.3	1,745.8	199.9	247.4	2,191.1
Western Adirondack	525.5	103.8	629.3	586.5	1,215.8	163.9	165.3	1,545.0
Eastern Adirondack	665.5	121.6	787.1	555.9	1,343.0	163.5	158.2	1,664.7
Total	1,863.4	367.5	2,230.9	2,071.7	4,302.6	527.3	570.9	5,400.8
SOUTHEASTERN:								
Capitol District	482.0	93.6	575.6	523.5	1,099.1	168.3	61.1	1,328.5
Catskill-Lower Hudson	781.1	167.1	948.2	1,033.9	1,982.1	276.0	106.6	2,364.7
Total	1,263.1	260.7	1,523.8	1,557.4	3,081.2	444.3	167.7	3,693.2
State total	5,018.3	1,050.5	6,068.8	6,131.0	12,199.8	1,485.3	1,068.2	14,753.3
Sampling errors, in percent								
Southwestern	—	—	3	3	2	5	5	2
Northern	—	—	2	2	1	4	4	1
Southeastern	—	—	3	3	2	4	6	2
State total	—	—	2	2	1	3	3	1

Table 76.—Average annual net growth, timber removal, and mortality of growing stock and sawtimber, by species, in the Southwestern Region, 1950-67

Species	Growing stock (In thousands of cubic feet)			Sawtimber (In thousands of board feet)[1]		
	Net growth	Removal	Mortality	Net growth	Removal	Mortality
White pine	7,249	645	1,253	25,633	2,397	3,559
Red pine	5,266	955	1,292	13,273	—	1,473
Spruce	528	136	2,001	544	—	1,255
Balsam fir	48	—	55	—	—	—
Hemlock	7,697	2,956	1,637	16,739	12,554	1,780
Other softwoods	221	—	151	427	—	67
All softwoods	21,009	4,692	6,389	56,616	14,951	8,134
Select white oaks	2,024	2,593	244	8,167	10,390	678
Select red oaks	7,595	4,516	1,239	23,856	15,754	1,377
Other oaks	1,184	492	1,148	3,212	1,426	1,477
Hickory	4,689	561	856	9,987	2,618	762
Yellow birch	400	747	2,467	1,283	2,920	1,379
Sweet birch	1,692	1,624	233	1,598	6,693	214
Paper birch	131	—	36	351	—	26
Sugar maple	19,934	18,754	2,993	43,099	82,637	3,552
Soft maples	17,425	5,029	2,648	17,502	20,713	3,483
Beech	7,856	6,380	1,866	16,320	24,406	762
Ash	13,106	2,058	1,609	31,778	4,296	1,595
Basswood	5,772	4,351	1,497	15,024	14,939	1,150
Aspen	5,730	242	1,921	5,636	—	354
Black cherry	2,624	1,403	1,561	6,749	2,980	1,998
Elm	−4,456	1,014	10,465	−15,135	3,841	18,939
Other hardwoods	1,390	605	674	4,033	1,516	1,487
All hardwoods	87,096	50,369	31,457	173,460	195,129	39,233
All species	108,105	55,061	37,846	230,076	210,080	47,367

[1] Internat[illegible] ¼-in[illegible]

Table [illegible]—Av[illegible] ann[illegible] gr[illegible], timbe[illegible]moval, [illegible] mor[illegible] of g[illegible] sto[illegible] saw[illegible]er, by species, in the Northern Region, 1950-67

Elm	-202	342	1,770	1,137	491	1,749
Other hardwoods	976	17	1,475	1,802	—	596
All hardwoods	41,856	10,851	18,240	118,174	15,635	13,756
All species	59,358	18,816	24,677	175,188	48,276	24,026

[1] International ¼-inch rule.

Table 79.—Area of New York, by land class, county, unit, and region, 1968

County and unit	Total land area[1]	Nonforest land area	Forest-land area[2]			
			Noncommercial	Commercial		Sampling error
	Thousand acres				*Percent*	*Percent*
Cayuga	446.8	313.5	2.5	130.8	29	10
Erie	677.4	471.2	2.5	203.7	30	8
Genesee	320.6	227.1	1.3	92.2	29	13
Livingston	408.4	283.9	17.3	107.2	26	11
Madison	422.9	231.2	.3	191.4	45	7
Monroe	432.1	363.7	6.7	61.7	14	19
Niagara	340.7	282.6	.1	58.0	17	20
Onondaga	507.8	342.8	3.3	161.7	32	9
Ontario	416.5	297.8	1.3	117.4	28	11
Orleans	253.4	202.5	1.2	49.7	20	20
Oswego	617.2	227.3	.9	389.0	63	4
Seneca	211.2	172.4	1.0	37.8	18	22
Wayne	388.0	289.4	1.7	96.9	25	13
Wyoming	382.5	259.6	6.6	116.3	30	10
Yates	219.7	143.7	1.2	74.8	34	12
Lake Plain	6,045.2	4,108.7	47.9	1,888.6	31	2
Allegany	670.2	258.9	2.5	408.8	61	5
Cattaraugus	853.9	325.6	61.3	467.0	55	5
Chautauqua	691.6	343.4	1.8	346.4	50	6
Steuben	902.6	466.0	2.9	433.7	48	5
Southwest Highlands	3,118.3	1,393.9	68.5	1,655.9	53	2

Continued

Table 79—Continued

County and unit	Total land area[1]	Nonforest land area	Forest-land area[2] Noncommercial	Forest-land area[2] Commercial		Sampling error
	Thousand acres				Percent	Percent
Broome	456.6	214.1	1.7	240.8	53	7
Chemung	265.6	126.6	.4	138.6	53	8
Chenango	581.5	281.0	—	300.5	52	6
Cortland	321.3	162.7	.1	158.5	49	7
Delaware	933.4	317.6	62.3	553.5	59	4
Otsego	648.5	313.8	2.6	332.1	51	6
Schuyler	211.0	100.4	1.0	109.6	52	9
Tioga	335.4	160.2	—	175.2	52	7
Tompkins	308.5	162.1	1.7	144.7	46	8
South-central Highlands	4,061.8	1,838.5	69.8	2,153.5	53	2
Southwestern Region	13,225.3	7,341.1	186.2	5,698.0	43	1
Clinton	677.6	194.0	33.4	450.2	66	4
Franklin	1,071.2	181.5	234.9	654.8	61	3
Jefferson	828.1	476.5	37.2	314.4	38	8
St. Lawrence	1,771.4	529.7	156.1	1,085.6	61	3
St. Lawrence-N. Adirondack	4,348.3	1,381.7	461.6	2,505.0	38	2
Fulton	318.8	73.8	71.1	173.9	55	4
Herkimer	918.2	232.2	290.8	395.2	43	3
Lewis	826.4	204.3	60.8	561.3	68	3
Oneida	783.0	392.3	33.1	357.6	46	4
Western Adirondack	2,846.4	902.6	455.8	1,488.0	52	2
Essex	1,166.7	98.7	479.4	588.6	50	3
Hamilton	1,110.5	29.8	713.9	366.8	33	3
Warren	567.8	43.9	184.7	339.2	60	3
Eastern Adirondack	2,845.0	172.4	1,378.0	1,294.6	46	1
Northern region	10,039.7	2,456.7	2,295.4	5,287.6	53	1
Albany	336.4	203.1	2.8	130.5	39	11
Columbia	413.0	204.9	4.5	203.6	49	8
Montgomery	261.2	196.0	1.7	63.5	24	18
Rensselaer	425.8	179.7	2.3	243.8	57	6
Saratoga	523.5	189.8	18.7	315.0	60	5
Schenectady	132.4	85.5	1.2	45.7	35	18
Washington	535.0	272.5	24.4	238.1	45	7
Capitol District	2,627.3	1,331.5	55.6	1,240.2	47	3
Dutchess	520.5	255.9	13.5	251.1	48	8
Greene	418.1	126.1	71.0	221.0	53	7
Orange	532.9	279.4	15.2	238.3	45	8
Putnam	148.0	49.7	13.6	84.7	57	11
Schoharie	399.3	184.2	10.1	205.0	51	8
Suffolk	594.5	394.9	32.3	167.3	28	13
Sullivan	627.4	179.5	25.7	422.2	67	5
Ulster	730.4	194.9	152.5	383.0	52	5
Westchester	283.5	183.2	17.6	82.7	29	18

Net Annual Growth and Timber Removals

Average annual net growth of growing stock.—The change (resulting from natural causes) in volume of sound wood in sawtimber and poletimber trees during the period between surveys, divided by the length of the period. (Components of net annual growth of growing stock include the increment in net volume of trees present at the beginning of the period and surviving to its end, plus net volume of trees reaching poletimber size during the period, minus the net volume of trees that died during the period, minus the net volume of trees that became rough or rotten trees during the period.)

Average annual ingrowth of growing stock.—The net cubic-foot volume of trees now classed as growing stock that were not tallied as such on the initial survey, divided by the length of the period between surveys.

Average annual mortality of growing stock.—The net cubic-foot volume removed from the growing stock through death from natural causes during the period between surveys, divided by the length of the period.

Average annual growing-stock removals.—The net cubic foot volume of live growing-stock trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys and converted to an annual basis.

Net annual growth of growing stock.—The increase in net cubic-foot volume of growing stock for a specific year (i.e., 1967 for New York) rather than for a period of years.

Annual removals of growing stock.—The net cubic-foot volume of live growing-stock trees removed from the inventory for a specific year (1967 for New York) by harvesting, killing, land-clearing, or changing of land use. Note: Softwood and hardwood removals for 1967 shown in table 17 were from a trend curve and were not exactly the same as the estimated removals for that year.

Average annual net growth of sawtimber.—The change (resulting from natural causes) in net board-foot volume of sawtimber during the period between surveys, divided by the length of the period. (Components of net annual growth of sawtimber include the increment in net volume of sawtimber trees present at the beginning of the period and surviving to its end, plus the net volume of trees reaching sawtimber size during the period, minus the net volume of sawtimber trees that died during the period, minus the net volume of sawtimber trees that became rough or rotten during the period.)

Average annual ingrowth of sawtimber.—The net board-foot volume of trees now classed as sawtimber that were not tallied as such on the initial survey, divided by the length of the period between surveys.

Average annual mortality of sawtimber.—The net board-foot volume removed from live sawtimber through death from natural causes during the period between surveys, divided by the length of the period.

Average annual sawtimber removals.—The net board-foot volume of live sawtimber trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys, converted to an annual basis.

Net annual growth of sawtimber.—The increase in net board-foot volume of sawtimber for a specific year (1967 for New York) rather than for a period of years.

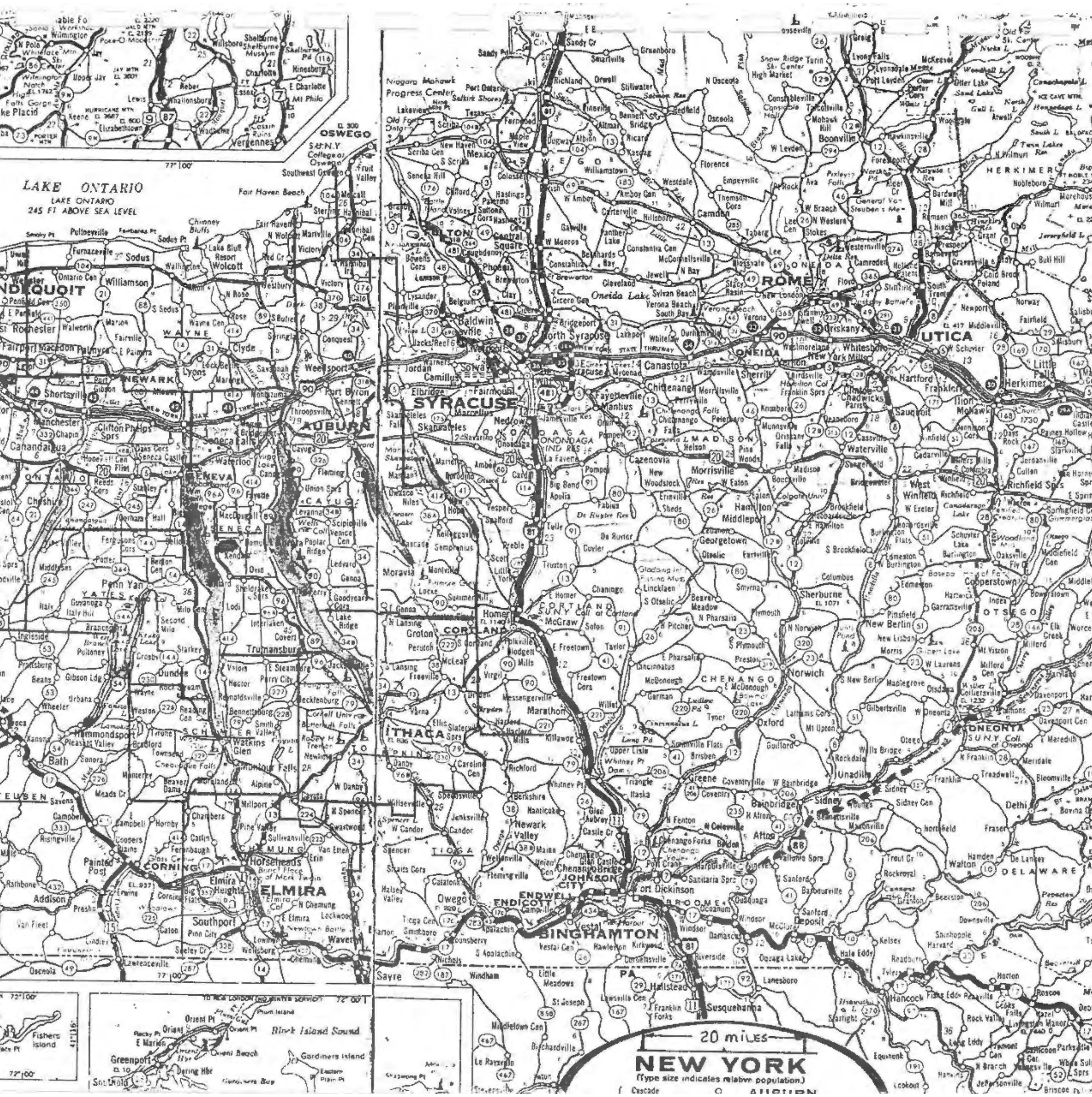
Annual removals of sawtimber.—The net board-foot volume of live sawtimber trees removed from the inventory for a specific year (1967 for New York) by harvesting, killing, land-clearing, or changing of land use. Note: Softwood and hardwood removals for 1967 shown in table 18 were from a trend curve and were not exactly the same as the estimated removals for that year.

Timber Volume

Growing-stock volume.—Net volume, in cubic feet, of live growing-stock trees that are 5.0 inches d.b.h. and over, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. Net volume equals gross volume less deduction for rot.

Standard cord.—A unit of measure for stacked bolts of wood encompassing 128 cubic feet of wood, bark, and air space. Cord estimates can be derived from cubic-foot estimates by applying an average factor of 80 cubic feet of wood (inside bark) per rough cord.

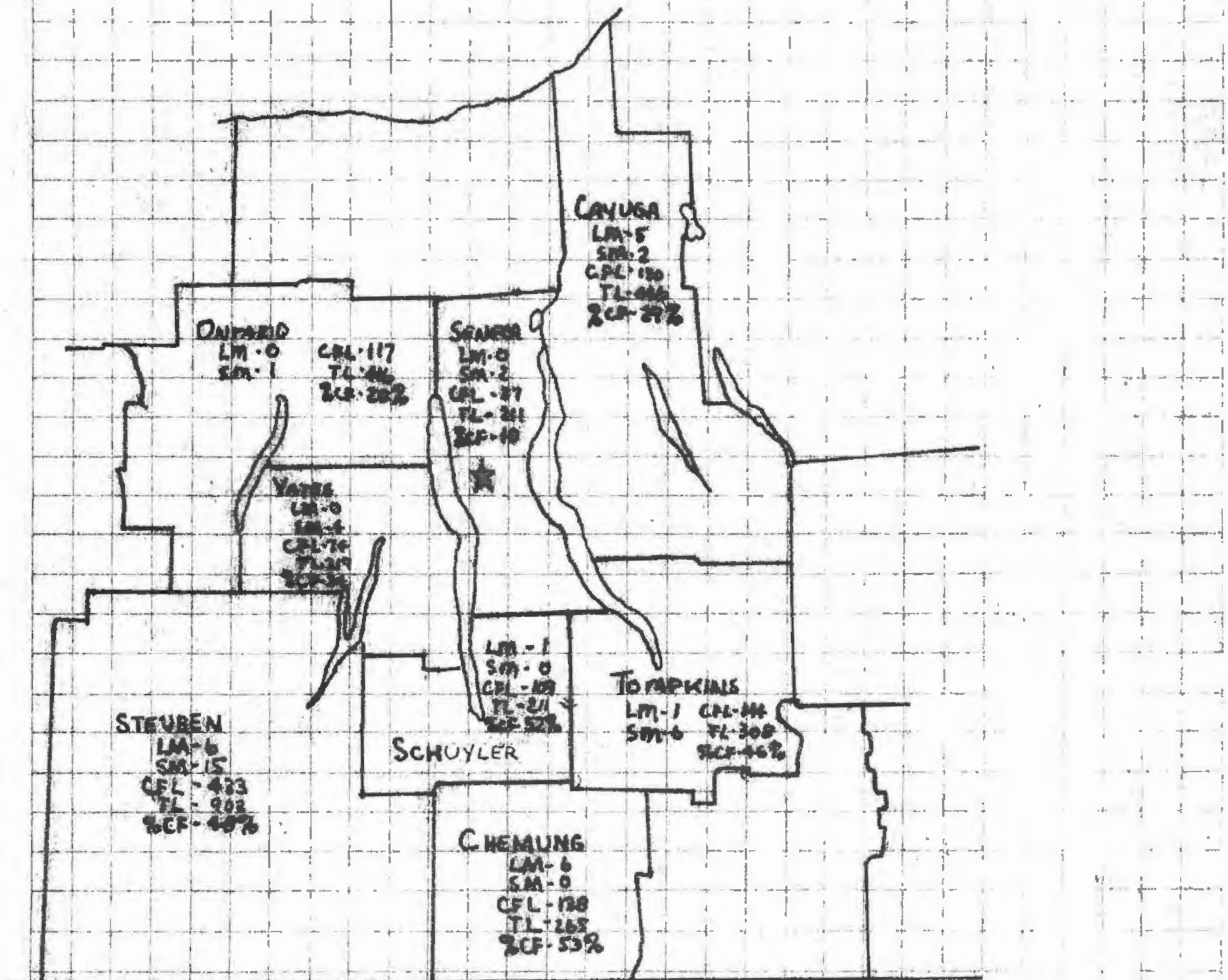
Sawtimber volume.—Net volume in board feet, International ¼-inch rule, of merchantable sawlogs in live sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.



LAKE ONTARIO
LAKE ONTARIO 245 FT ABOVE SEA LEVEL
OSWEGO
SYRACUSE
AUBURN
UTICA
ROME
ONEIDA
ITHACA
CORTLAND
ELMIRA
CORNING
BINGHAMTON
JOHNSON CITY
ENDICOTT
ONEONTA
NEWARK
GENEVA
Oneida Lake
20 miles
NEW YORK
(Type size indicates relative population)

REYNOLDS, SMITH AND HILLS
ARCHITECTS · ENGINEERS · PLANNERS
INCORPORATED

SUBJECT: FOREST PRODUCTS ACTIVITY "MAP 6"
AEP NO.
SHEET 1 OF 1
DESIGNER S. HINTON 12-11-80
DATE
CHECKER
DATE



* { LM - LARGE SAWMILLS
SM - SMALL SAWMILLS (LESS THAN 500 MBF) }

CFL - COMMERICAL FOREST LAND (10^3 ACRES)

TL - TOTAL LAND IN COUNTY (10^3 ACRES)

%CF - PERCENT COMMERICAL FOREST

0 5 10 20

* ABSTRACTED FROM 'DIRECTORY OF PRIMARY WOOD-USING PLANTS IN NEW YORK STATE'

NOTE: NO VENEER, PULP, OR OTHER LARGE WOOD USERS ARE LOCATED IN AREA.

..., electric mo-
...acilities; im-
... instruments;
... optimization
...finery equip-

...s summer on
...p's (R-Wyo.)

50,000 barrels a day.

Steenberg added that since the proposal is not limited to small refiners and could benefit all domestic refiners, the actual energy savings from the tax credit might be three to four times as great.

FUEL PRICES

...42-gallon barrel for tank cars going to ... of entitlement allowances and voluntary

	Current	10/80	9/80	11/79
...York	$32.24	$30.83	$30.64	$26.67
...lelphia	32.15	30.15	28.90	26.70
...on	31.71	29.90	29.71	26.09
...lelphia	31.55	29.15	27.90	26.15
...ston area	30.03	26.53	26.53	22.23
...imore	30.43	25.02	24.83	24.23
...lelphia	30.40	24.90	23.90	24.25
...cago area	26.67	22.47	22.47	21.63
...go area	—	21.63	21.63	21.63
...Detroit	24.36	21.00	20.16	19.74
...area	29.50	23.00	24.50	23.00
...lo	21.00	20.48	20.48	18.90
...alo	22.18	20.53	20.53	20.57
...area	24.25	20.40	20.20	19.45
...folk	29.31	22.90	21.26	19.56
...ston area	26.43	20.93	20.93	17.43
...York	28.80	22.25	21.00	18.70
...imore	34.58	29.29	29.10	25.50
...cago area	30.24	26.04	26.04	23.94
...Detroit	28.52	26.00	26.00	21.80
...area	26.83	23.63	22.83	21.33
...folk	33.74	30.83	29.64	24.42
...York	36.18	32.38	32.19	27.17
...delphia	33.40	32.10	30.85	27.20

Go Slow On Wood Switch, Industries Tol...

By BOB DEANS

ATLANTA—In the hope of saving big dollars in fuel costs, southeastern industries are taking a hard look at wood as a boiler fuel. But those hopes are tempered by concern over the future price and availability of wood, according to William S. Bulpitt, chief of the wood energy systems (WES) branch of the Georgia Institute of Technology here.

Speakers at a recent Georgia Tech seminar on wood energy agreed that the feasibility of burning wood for industrial, commercial and agricultural users must be evaluated on a site-specific basis with wood availability being the first consideration since it affects both the fuel's supply and its price.

One study delivered at the workshop, for example, showed that transportation of wood residue adds approximately 6.5 cents per ton to its cost over each mile. Unless a potential user is located near a supplier, the switch to wood probably would not be cost-effective.

B.S. Dixit, senior research engineer for WES said that the use of wood as an industrial fuel has heretofore beeo largely confined to the wood products manufacturing industry. He cited the brick industry and a few textile mills as notable exceptions, and pointed to increased interest in wood burning among other users.

Bulpitt said the reason for users' reluctance to invest in wood-burning equipment is the uncertainty of the future supply.

"The average man still doesn't feel confident enough in the supply to take that jump. What is lacking is a network of wood-procurement businesses that will sign a long-term (3-year) contract that will assign a guaranteed price (for wood)," he said.

Bulpitt later indicated that a lack of confidence in the future supply of wood is justified. He acknowledged that the amount of sawdust, shavings, bark, chips and other residue the wood products manufacturers can produce is limited. If demand for that residue outstrips the supply in a given region, the "waste wood" becomes a valuable commodity whose price would rise with competition, Bulpitt explained.

He said that "in some areas, such as Brunswick and Savannah in Georgia, much of the timberland is owned or leased by pulp and paper companies which use wood residue and are not encouraging its use as a fuel by other industries.

"I don't really advocate pushing for a company to use wood in an area where they will be in competition for the wood residue," Bulpitt said.

He said that despite competition considerations, there are areas in Georgia where wood waste is available as a l... industrial fuel.

The recent wood energ... shop at Georgia Tech, ai... demonstrating the feasib... wood energy for industria... mercial and agricultural... drew about 50 attende... Bulpitt and other speake... those interested in inves... wood-burning equipment... investigate thoroughly th... market in their area.

Feasibility Report

A feasibility study of a ... rendering plant in G... showed that the plant cou... nearly $9 million over a ... projected life-cycle by usi... fuel instead of its present... 52.8 percent natural gas ... percent No. 2 fuel oil. Th... made by the Georgia Tec... neering Experiment ... (EES), estimated that th... could replace its annual ... ment of 60,737 million cu... of natural gas and 388,600... of No. 2 fuel oil with 17.... of wood residues ha... moisture content of up... percent.

The workshop at Geor... was funded by the Depar... Energy through the Geo... fice of Energy Resource... er seminar will be held i... nah on Nov. 25 at th... towner, 201 West Oglethо...

PRICE WATCH

One measure of what No. 2 heating oil costs is the buying and selling of future-delivery fuel on the New York Mercantile Exchange. These transactions normally occur at several cents per gallon above New York harbor spot quotations.

The prices below, in cents per gallon, are for December delivery of 1,000-barrel lots. The latest week, ended Friday, Nov. 14, saw an increase of...

VIEWS ON PRICE OUTLOOK ANALYZED BY REGION

Each month, EUN asks some energy users to offer th... best percentage estimates of price increases likely to... encountered in the coming 12 months. To supplement ... story and table that appear on page 1, the median estima... are shown below by respondents' regions. Estimates ... tained from large companies whose nationwide estima... can't be subdivided by region affect only the nationw... analysis. Some of the lower estimates on distillate... consequently affected the nationwide results only. A d... means too few observations were available. This mon... survey involved 48 persons estimating price changes for... 12 months ending October 1981...

Telephone Call Confirmation

reynolds, smith and hills

Project No. 80122

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date ______

S Hinton 10/27/80 Conversed with Joe Barnard [illegible]

Of Resource Eval. Research Regarding [illegible] Forest [illegible] Data

Barnard will send today

1) NY State Survey for 1967 (i.e. NE-20)
2) Timber [illegible] Activity in N.Y.
3) [illegible] REVIEW DRAFT, FOR STAT OF U.S. 1977

Barnard noted that although NE-20 was old (1967) data in it could be used for a first cut analysis since new (1980) unpublished data indicates no new trends in usage.

Distribution:

RS&H FORM 102 11/72

Project No. 80722

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date ______

S Hinton 10/?/80 Conversed with Don Cole 309-794-4232

Of Rock Island Army Base Regarding Seneca Forest Growth Rates

DON COLE WAS PREVIOUSLY THE DEPOT FORESTER FOR BOTH SENECA & LETTERKENNY.

COLE MADE THE FOLLOWING COMMENTS

1) VERY LITTLE TIMBER ON SENECA DEPOT. APPROX 300-400 ACRES OF MERCHANDISEBLE TIMBER. MUCH LESS TIMBER THAN LETTERKENNY.
2) NEAREST SAWMILL APPROXIMATELY 60 MILES AWAY
3) NOT MUCH LOGGING IN THIS AREA.
4) SOIL TYPE DOES NOT PROMOTE TREE GROWTH BECAUS OF GLACIER ACTION IN THE PAST. THIS IS BASICLY TRUE OF THE "LAKE AREA" REGION.
5) ONLY TWO HARVESTS SINCE ≈1965. APPROX 100 MBF OF SAW TIMBER AND 30 ACRES OF UNDERSIZED GROWTH. THE SECOND CUT WAS A CLEARCUT FOR BUILDING PURPOSES.
6) DURING BOTH HARVESTS, LOGGING CONTRACTORS WERE NOT READILY AVAILABLE. (SEE COMMENTS 2 & 3 ABOVE) WHEN THE 30 ACRES WAS CLEARCUT, NO CONTRACTOR WOULD TAKE SMALL DIA MATERIAL FOR CHIPS.
7) THERE IS A SEPERATE MGR. & HARVEST PLAN FOR SENECA & JAKE NOWAK, FACILITY ENGR. @ LETTERKENNY WOULD KNOW WHERE IT IS KEPT (IN WORKING FILE?). INVENTORY DATA ALSO IN THIS FILE.
8) COTTON-HANLON IS THE ONLY SAWMILL TO PURCHASE TIMBER IN PAST. LOCATED NEAR WATKINS GLEN.
9) DISTRICT FORESTER FOR N.Y. STATE SHOULD BE LOCATED @ COUNTY SEAT (WATERLOO OR SENECA FALLS). JAKE NOWAK SHOULD HAVE NAME.

Distribution:

RS&H FORM 102 11/72

Project No. 80122

Telephone Call Confirmation

reynolds, smith and hills

Local ____ L.D. ✓ Placed ✓ Rec'd ____ Date 607-292-3251 / 607-776-2166 [illegible]

S Hinton 10/24/80 Conversed with Paul Higgins - Regional Forester

Of NY. STATE FORESTRY Regarding SENECA Wood Residue Potential

1) ONLY two mills IN OR NEAR (≈50 miles) TO SENECA County. WEDRO WOOD CRAFT – 100 MBF/year
Ed NELSON owner
ALL WASTE IS UTILIZED
[illegible] – 5000 MBF/yr
WASTE USAGE UNKNOWN

2) LAND IS ONLY SPARSELY FORESTED IN SENECA Co

3) ONLY HARVESTING TO SPEAK OF IS TIMBER STAND IMPROVEMENT (ie THINNING. ALL OF THIS [illegible] LOCAL FIRE WOOD MARKET

(margin note: 2) Seneca Co →)

4) MAJOR WOOD PROD ACTIVITY IS IN ~~SCHUYLER~~ STEUBEN CO. (SOUTH OF SENECA Co). THERE COULD BE FROM 10-20 STATIONARY MILLS IN THIS AREA.

5) NO NEW PLANTATIONS BEING PLANTED. ONLY IMPROVEMENT OF EXISTING STANDS OF LOCAL STOCKS (ie maples)

Distribution:

Telephone Call Confirmation

Project No. 80122

reynolds, smith and hills

Local ______ L.D. ✓ Placed ✓ Rec'd ______ Date ______

S HINTON 12-11-80 Conversed with EVERT SOCHIA 518-457-7431

Of NY STATE DEPT OF ENV. CONSV. Regarding STUMPAGE PRICES FOR REGION 8 (GENEV- BUREAU OF FOREST MARKETING

SPECIES	MIN	MAX	MOST COMMON
MIXED HRD PULPWOOD	1	10	$10/CORD
SFT PULPWOOD	NONE	QUOTED/SOLD	
ASH SAWLOGS	50	90	$125/MBF Doyle
RED OAK "	60	125	$90/ "
W. OAK "	50	200	$100/ "
HICKORY "	40	90	$75/ "
W. PINE "	40	125	$80/ "
HEMLOCK "	60	100	$80/ "
HARD MAPLE	70	125	$90/ "
SOFT MAPLE	50	90	$75 "
AMER BEECH	25	50	$40/ "
ASPEN	15	40	$40/ "
Chestnut OAK	40	80	$65/ "
YELLOW POPLAR	60	90	$80/ "
BASSWOOD	60	90	$80/ "

Distribution:

NOTE: [illegible]

RS&H FORM 102

11/72

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Robert F. Flacke
Commissioner

October 23, 1980

Mr. Steve Hinton
Reynolds, Smith & Hill
4019 Blvd. Center
Jacksonville, Florida 32207

Dear Mr. Hinton:

Enclosed is a copy of The Timber Resources of New York, 1970. This information was updated and should be available this winter from the U.S. Forest Service. On page 169, Table 83 shows that Seneca County has a net cubic-foot volume of 16.5 million in sawtimber and 16.0 million in poletimber. Page 171, Table 84, shows 17.9 million cubic feet is in sawtimber stands, 8.0 million cubic feet is in poletimber stands, and the remaining 6.6 million cubic feet is in sapling-seedling stands. Seneca County has 37.8 thousand acres of commercial forest land, of which 10.7 thousand acres are sawtimber stands, 6.0 thousand acres are poletimber stands, 17.8 thousand acres are seedling-sapling stands, and 3.3 thousand acres do not meet minimum stocking requirements. (Page 162, Table 80 and page 164, Table 81).

Also enclosed is a Directory of Primary Wood-Using Plants in New York State, 1979, with updates. On page 38, two small sawmills are listed under Seneca County. They produce less than 1/2 million board feet each annually. The majority of the sawtimber harvested in Seneca County is processed outside the County.

According to the report, Sawmill Residues and Their Use - New York State - 1979, the eleven-county regional area (with 53 sawmills reporting) has a surplus of 1,068 tons of slabs and edgings, 893 tons of sawdust, and 1,221 tons of bark annually. However, the two mills in Seneca County reported markets for all of their residues.

Our 1979 survey of secondary wood-using plants identified two firms which both reported a modest surplus of wood residues in Seneca County. No residue volumes were reported; however, both firms use well under one-million board feet annually in their manufacturing process.

To find out more about the availability of standing timber and local market conditions in Seneca County, I suggest you contact Bob Morrison, Regional Forester, New York State Department of Environmental Conservation, 115 Liberty Street, Bath, New York 14810, phone (607) 776-2165.

Please write or call if you require further assistance.

Very truly yours,

J. O. Preston, Director
Bureau of Forest Marketing
and Economic Development

Thomas H. Wahl

By: Thomas H. Wahl
Sr. Utilization & Marketing Forester

Enclosures

hemung, Genesee,
Montgomery,
eans, Schuyler,
ben, Wayne, Yates

53

	Total Tons Produced	Tons Utilized For: Pulp Chips	Fuel	Mulch	Livestock Bedding	Poultry Litter	Other
Hwd.	58,591	9,118	47,321	--	630	--	500
Swd.	4,939	440	4,353	100	--	--	--
Total	63,530	9,558	51,674	100	630	--	500
Hwd.	31,150	--	6,090	9,012	15,155	--	--
Swd.	2,221	--	263	398	1,560	--	--
Total	33,371	--	6,353	9,410	16,715	--	--
Hwd.	19,502	--	13,720	4,704			
Swd.	786	--	500	143			
Total	20,288	--	14,220	4,847			

Bureau of Forest Marketing and Economic Development

STUMPAGE PRICE REPORT

Number 17
July 1980

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

LF-R20 (6/80)

III - 59

The STUMPAGE PRICE REPORT is published semiannually (January and July) by:

Bureau of Forest Marketing and Economic Development
Division of Lands and Forests
N.Y.S. Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233

The prices contained in this publication are collected from harvesters and wood processors in 14 price-reporting areas throughout New York State, and are intended to serve only as a guide in the marketing of standing timber.

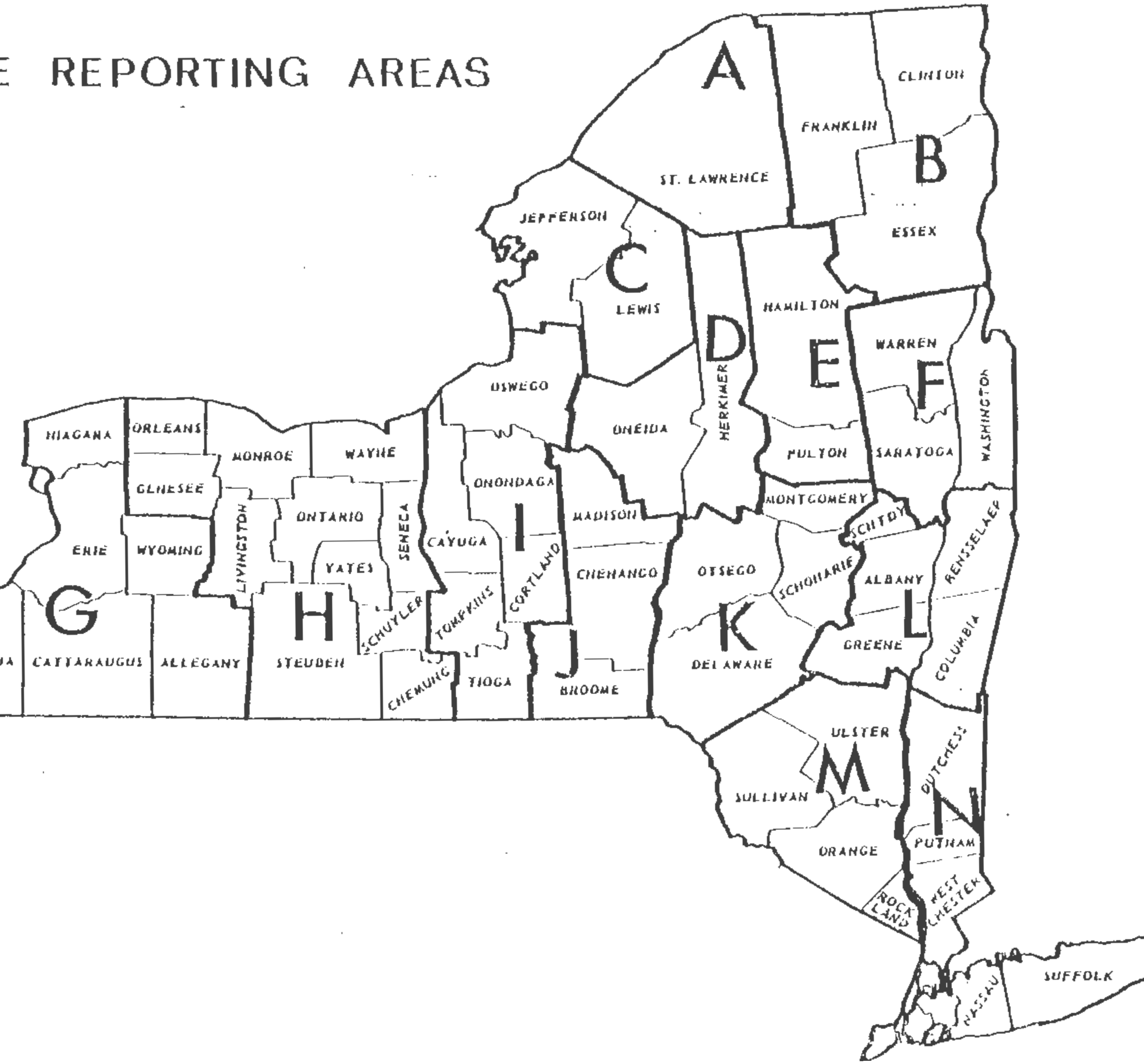
The actual market value of a specific stand of timber may be influenced by the following factors:

1. Timber quality
2. Volume to be cut per acre
3. Logging terrain
4. Market demand
5. Distance to market
6. Season of year
7. Distance to public roads
8. Woods labor costs
9. Size of the average tree to be cut
10. Type of logging equipment
11. Percentage of timber species in the area
12. End product of manufacture
13. Landowner needs
14. Landowner knowledge of market value
15. Property taxes
16. Capital gains aspect of Internal Revenue Code

Any one of the above factors can have a highly significant effect on stumpage prices for a species in one given area, while it may have a less significant effect in another area.

TREES ARE AMERICA'S <u>RENEWABLE</u> RESOURCE.

E REPORTING AREAS



SAWLOGS

Average Price Range and (Most Common Price)/MBF, Doyle Rule Except As Noted

Price Reporting Areas

Species	A	B	C	D	E*	F**	G
Ash, White	80-100(90)*	70-125(85)	40-140(100)	50-120(100)	25-190(100)	35-180(115)	150-230(17
Aspen	20-25(20)	20-30(25)	15-45(20)	25-30(25)	15-35(20)	--	20-40(25)
Basswood	50-70(60)	45-60(50)	50-85(65)	40-55(40)	30-100(60)	25-70(55)	45-95(75)
Beech	20-25(20)	20-30(25)	10-35(25)	20-35(25)	20-50(25)	25-50(30)	25-55(40)
Birch, Black	--	--	--	--	--	30-140(80)	--
Birch, White	--	40-75(50)	--	--	--	25-85(50)	--
Birch, Yellow	110-120(120)	60-85(70)	60-85(75)	60-135(75)	30-135(80)	30-135(85)	30-60(50)
Butternut	--	--	20-45(35)	40-50(50)	35-55(45)	--	35-85(50)
Cherry, Black	120-150(120)	60-100(85)	100-150(130)	100-225(150)	30-200(90)	45-220(140)	150-230(170
Elm, American	--	40-60(45)	25-50(40)	20-50(30)	20-65(40)	30-80(40)	30-65(45)
Hemlock	20-25(20)*	25-40(35)	15-30(25)	25-35(25)	15-40(25)	25-35(30)	35-75(55)
Hickory	--	--	20-35(25)	20-40(30)	20-50(25)	25-40(30)	30-60(45)
Maple, Hard	90-120(110)	65-100(80)	40-80(65)	50-100(70)	30-135(80)	40-120(90)	70-125(100
Maple, Soft	50-60(55)	45-75(60)	25-70(60)	40-60(50)	30-115(60)	30-95(65)	40-60(50)
Oak, Chestnut	--	--	--	--	--	20-90(60)	--
Oak, Red	--	40-125(100)	60-100(80)	75-130(100)	30-190(100)	80-240(160)	130-220(17
Oak, White	--	--	60-100(80)	50-120(90)	30-190(90)	30-170(100)	70-200(14
Pine, White	50-50(50)*	40-60(55)	20-35(30)	25-50(35)	25-50(35)	30-60(40)	40-85(65)
Poplar, Yellow	--	--	--	40-40(40)	--	--	40-80(65)
Spruce, Red	20-25(25)*	30-60(45)	15-40(30)	25-30(25)	25-45(30)	--	--

*Scribner Rule

**International 1/4" Rule

PULPWOOD

Average Price Range and (Most Common Price)/Standard Cord

	A	B	C	D	E	F	G
Aspen	3-5(4)	3-5½(4)	4-6(5)	2-4(4)	3-6(5)	3-6(4)	2-4(2)
Birch, Gray	2-2½(2)	--	5-5(5)	--	--	--	--
Birch, White	--	3-7(5)	--	--	--	3-8(5)	--
N. Hardwoods	2-2½(2)	3-7(5)	5-5(5)	3-6(3)	4-10(6)	3-6(4)	2-15(6)
Pine	2-2½(2)	3-6½(5)	2½-4(3)	3-5(3)	2-7(6)	3-5(4)	2-4(2)
Spruce & Fir	7-9(8)	5-8(7)	4-15(8)	4-8(6)	4-10(7)	3-8(6)	4-6(5)

SAWLOGS

Average Price Range and (Most Common Price)/MBF, Doyle Rule Except As Noted

Price Reporting Areas

Species	H	I**	J**	K**	L**	M	N**
Ash, White	50-125(90)	75-150(100)	80-150(100)	50-150(100)	20-150(90)	50-155(75)	60-120(90
Aspen	15-40(40)	20-30(25)	10-20(20)	-- --(20)	10-40(20)	30-50(30)	--
Basswood	60-90(80)	75-150(100)	60-80(70)	20-80(50)	10-100(50)	40-65(50)	--
Beech	25-50(40)	20-40(30)	20-50(25)	10-40(25)	10-30(25)	20-35(30)	--
Birch, Black	--	--	--	--	20-125(50)	--	40-90(50)
Birch, White	--	--	--	20-65(40)	10-125(45)	30-65(45)	--
Birch, Yellow	--	50-150(100)	40-80(50)	20-80(50)	10-200(75)	30-65(45)	--
Butternut	--	50-100(75)	--	--	10-100(40)	--	--
Cherry, Black	60-150(100)	100-200(150)	125-250(150)	45-140(90)	20-150(90)	35-135(75)	--
Elm, American	--	20-40(30)	--	20-70(50)	10-125(35)	--	--
Hemlock	60-100(80)	30-60(40)	30-50(40)	20-60(35)	10-50(25)	25-35(30)	15-35(20)
ickory	40-90(75)	30-75(50)	30-70(50)	20-70(40)	10-40(25)	20-40(30)	40-50(40)
Maple, Hard	70-125(90)	75-150(100)	100-150(125)	30-120(80)	20-110(75)	45-80(65)	50-100(80)
Maple, Soft	50-90(75)	50-125(75)	50-100(60)	20-85(50)	10-100(45)	25-60(30)	20-60(40)
Oak, Chestnut	40-80(65)	50-150(100)	20-60(30)	--	10-100(50)	45-100(80)	40-100(80)
Oak, Red	60-125(90)	100-200(150)	100-250(125)	50-150(100)	35-180(120)	50-140(85)	50-170(120
Oak, White	50-200(100)	100-200(150)	30-150(50)	40-125(85)	25-120(85)	45-140(80)	50-140(90)
Pine, White	40-125(80)	25-75(40)	30-50(40)	25-50(40)	10-55(35)	20-55(30)	15-35(25)
Poplar, Yellow	60-90(80)	50-100(75)	--	--	10-100(40)	--	25-90(50)
Spruce, Red	--	--	--	--	10-35(25)	--	--

*Scribner Rule **International 1/4" Rule

PULPWOOD

Average Price Range and (Most Common Price)/Standard Cord

A n	--	1-4(3)	--(4)	2-4(3)	2-5(3)	--	--
rch, Gray	--	--	--	--	1-4(3)	--	--
Birch, White	--	--	--	--	4-8(5)	--	--
N. Hardwoods	1-10(10)	3-10(7½)	4-9(7)	6-10(10)	4-10(5)	--	5-20(10)
Pine	--	1-2(1)	1-10(4)	2-6(3)	2-8(4)	--	--
Spruce & Fir	--	2-4(3)	--(4)	2-5(3)	4-8(5)	--	--