FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE SYSTEMS ANALYSIS

12 NOVEMBER,1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
BUILDING SECTOR PHYSICAL PARAMETERS AND DESCRIPTION

12 NOVEMBER, 1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

COMPLEX BUILDING INPUT SUMMARY

Building Name : CCF SUBCONSTRUCT 2/4 FUT — Date : 11-25-86
Site : AURORA,IL FERMI, User Defined — 60117862.0

****

1. ROOM CONDITIONS AND FLOOR AREAS

Thermostat settings : Cooling = 68 F; Heating = 68 F; Setback = 0 F
Warm-up factor = 0 %; Room design relative humidity = 45 %
Floor Areas: Perimeter = 29,760 Sqft; Interior = 0 Sqft
Cooling provided during unoccupied period.

2. WALLS, ROOF, GLASS, SKYLIGHTS:

Exposure	Area (Sqft)	U-Factor BTU/(hr-sqft-F)	Glass Area (Sqft)	Glass U-Factor BTU/(hr-sqft-F)
North Wall	0	0.060	2,060	0.550
Northeast Wall	0	0.060	0	0.550
East Wall	1,630	0.060	690	0.550
Southeast Wall	3,260	0.060	1,380	0.550
South Wall	3,260	0.060	1,380	0.550
Southwest Wall	980	0.060	420	0.550
West Wall	0	0.060	760	0.550
Northwest Wall	0	0.060	1,520	0.550
Perimeter Roof	0	0.050	0	0.001
Interior Roof	0	0.050	0	0.001

WALLS: Color = Light; Wt. = Medium; ROOF: Color = Medium; Wt. = Medium
BUILDING WT. = Medium; VERTICAL GLASS : Double Glazed
Shade Factors : Glass = 0.650 ; Skylights = 0.000
Internal shades are used. ; A ceiling plenum is used.

3. LIGHTS:

Perimeter : 1.000 Watts/Sqft = 29,760 Watts Total
Interior : 0.000 Watts/Sqft = 0 Watts Total
Diversity Factors : Occupied = 100 %; Unoccupied = 90 %
Perimeter Lights : Ballast , recessed
Interior Lights : Ballast , recessed

4. MISCELLANEOUS ELECTRICAL LOADS:

Perimeter : Occupied = 20.161 Watts/Sqft = 600,000 Watts Total
Unoccupied = 20.161 Watts/Sqft = 600,000 Watts Total
Interior : Occupied = 0.000 Watts/Sqft = 0 Watts Total
Unoccupied = 0.000 Watts/Sqft = 0 Watts Total

5. PEOPLE LOADS

Total Occupancy = 1,488 sqft/person = 20 people total
Activity Level: 2. Office or retail
Sensible = 245.0 BTU/hr/person; Latent = 205.0 BTU/hr/person
Diversity Factors : Occupied = 80 %; Unoccupied = 50 %

6. MISCELLANEOUS INTERNAL LOADS:

Sensible : Occupied = 0 BTU/hr; Unoccupied = 0 BTU/hr
Latent : Occupied = 0 BTU/hr; Unoccupied = 0 BTU/hr

7. WALLS ADJACENT TO NON-CONDITIONED REGIONS:

Wall Areas : Perimeter = 8,340 Sqft; Interior = 0 Sqft
Wall U-Factor = 0.380 BTU/(hr-sqft-F)
Adjacent region heating temperature = 65 F
Adjacent region is not cooled

8. INFILTRATION DATA:

Air Flow Rates: Occupied = 149 cfm; Unoccupied = 89 cfm

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
BUILDING LOAD CALCULATIONS

12 NOVEMBER, 1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

LOAD PROFILE SUMMARY

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86

Site Name : AURORA,IL FERMI, User Defined 60117862.0

****

TABLE 1. OCCUPIED PERIOD (Load does not include vent. load, fan heat)

Bin Temp (F)	Bin Hours (hr/yr)	<--------Perimeter Zone------> Sensible (tons)	Latent (tons)	Plenum (tons)	Zone (F)	<---------Interior Zone------> Sensible (tons)	Latent (tons)	Plenum (tons)	Zone (F)
93	0.0	216.19	0.86	3.17	68	0.00	0.00	0.00	--
90	25.8	208.05	0.62	3.17	68	0.00	0.00	0.00	--
85	59.4	203.86	0.57	3.17	68	0.00	0.00	0.00	--
80	145.3	199.67	0.52	3.17	68	0.00	0.00	0.00	--
75	237.7	195.48	0.47	3.17	68	0.00	0.00	0.00	--
70	270.6	191.29	0.43	3.17	68	0.00	0.00	0.00	--
65	264.5	187.10	0.40	3.17	68	0.00	0.00	0.00	--
60	255.0	184.24	0.38	3.17	68	0.00	0.00	0.00	--
55	244.7	181.37	0.35	3.17	68	0.00	0.00	0.00	--
50	232.1	178.50	0.34	3.17	68	0.00	0.00	0.00	--
45	229.5	175.63	0.26	3.17	68	0.00	0.00	0.00	--
40	237.6	172.77	0.19	3.17	68	0.00	0.00	0.00	--
35	238.5	169.90	0.14	3.17	68	0.00	0.00	0.00	--
30	218.2	167.03	0.09	3.17	68	0.00	0.00	0.00	--
25	174.5	164.16	0.04	3.17	68	0.00	0.00	0.00	--
20	122.4	161.30	0.01	3.17	68	0.00	0.00	0.00	--
15	78.1	158.43	-0.02	3.17	68	0.00	0.00	0.00	--
10	46.1	155.56	-0.04	3.17	68	0.00	0.00	0.00	--
5	25.1	152.69	-0.06	3.17	68	0.00	0.00	0.00	--
0	12.7	149.83	-0.07	3.17	68	0.00	0.00	0.00	--
-5	6.2	146.96	-0.08	3.17	68	0.00	0.00	0.00	--
-6	4.6	146.38	-0.09	3.17	68	0.00	0.00	0.00	--

TABLE 2. UNOCCUPIED PERIOD (Load does not include vent. load, fan heat)

90	14.6	207.06	0.38	2.86	68	0.00	0.00	0.00	--
85	36.3	202.90	0.35	2.86	68	0.00	0.00	0.00	--
80	99.3	198.74	0.32	2.86	68	0.00	0.00	0.00	--
75	215.3	194.58	0.29	2.86	68	0.00	0.00	0.00	--
70	357.6	190.42	0.27	2.86	68	0.00	0.00	0.00	--
65	463.3	186.26	0.25	2.86	68	0.00	0.00	0.00	--
60	500.4	183.42	0.23	2.86	68	0.00	0.00	0.00	--
55	482.0	180.58	0.22	2.86	68	0.00	0.00	0.00	--
50	447.6	177.74	0.21	2.86	68	0.00	0.00	0.00	--
45	422.7	174.90	0.16	2.86	68	0.00	0.00	0.00	--
40	413.7	172.06	0.12	2.86	68	0.00	0.00	0.00	--
35	417.0	169.22	0.09	2.86	68	0.00	0.00	0.00	--
30	417.4	166.38	0.06	2.86	68	0.00	0.00	0.00	--
25	395.2	163.54	0.03	2.86	68	0.00	0.00	0.00	--
20	336.9	160.69	0.01	2.86	68	0.00	0.00	0.00	--
15	252.8	157.85	-0.00	2.86	68	0.00	0.00	0.00	--
10	165.7	155.01	-0.02	2.86	68	0.00	0.00	0.00	--
5	96.3	152.17	-0.03	2.86	68	0.00	0.00	0.00	--
0	50.9	149.33	-0.04	2.86	68	0.00	0.00	0.00	--
-5	25.3	146.49	-0.04	2.86	68	0.00	0.00	0.00	--
-6	21.1	145.92	-0.05	2.86	68	0.00	0.00	0.00	--
-6	0.0	-32.62	-0.22	0.00	68	0.00	0.00	0.00	--

SOLAR GAIN SUMMARY

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86

Site Name : AURORA,IL FERMI, User Defined 60117862.0

****

TABLE 1. SOLAR GAINS BY EXPOSURE

Bin Temp (F)	North	NE	East	SE	South	SW	West	NW	Perim Horiz	Inter Horiz
	Solar Gains by Exposure (BTU/(hr-sqft))									
93	9.7	15.0	22.2	23.2	33.9	67.7	66.5	32.0	0.0	0.0
90	6.9	10.7	15.7	16.5	24.1	48.0	47.1	22.6	0.0	0.0
85	6.5	10.1	14.9	15.7	23.0	45.7	44.8	21.5	0.0	0.0
80	6.2	9.6	14.2	14.9	21.8	43.3	42.4	20.3	0.0	0.0
75	5.8	9.0	13.4	14.2	20.7	40.9	40.0	19.1	0.0	0.0
70	5.5	8.5	12.6	13.4	19.6	38.6	37.7	18.0	0.0	0.0
65	5.1	7.9	11.8	12.6	18.5	36.2	35.3	16.8	0.0	0.0
60	4.8	7.4	11.0	11.8	17.4	33.9	32.9	15.6	0.0	0.0
55	4.4	6.8	10.3	11.0	16.2	31.5	30.6	14.4	0.0	0.0
50	4.1	6.3	9.5	10.3	15.1	29.2	28.2	13.3	0.0	0.0
45	3.7	5.7	8.7	9.5	14.0	26.8	25.8	12.1	0.0	0.0
40	3.4	5.2	7.9	8.7	12.9	24.4	23.5	10.9	0.0	0.0
35	3.0	4.6	7.1	7.9	11.8	22.1	21.1	9.8	0.0	0.0
30	2.7	4.1	6.4	7.2	10.6	19.7	18.8	8.6	0.0	0.0
25	2.3	3.5	5.6	6.4	9.5	17.4	16.4	7.4	0.0	0.0
20	2.0	3.0	4.8	5.6	8.4	15.0	14.0	6.3	0.0	0.0
15	1.6	2.4	4.0	4.8	7.3	12.7	11.7	5.1	0.0	0.0
10	1.2	1.9	3.2	4.1	6.2	10.3	9.3	3.9	0.0	0.0
5	0.9	1.3	2.5	3.3	5.0	8.0	6.9	2.8	0.0	0.0
0	0.5	0.8	1.7	2.5	3.9	5.6	4.6	1.6	0.0	0.0
-5	0.2	0.2	0.9	1.7	2.8	3.2	2.2	0.4	0.0	0.0
-6	0.1	0.1	0.7	1.6	2.6	2.8	1.7	0.2	0.0	0.0
-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ETD SUMMARY

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86

Site Name : AURORA,IL FERMI, User Defined 60117862.0

****

TABLE 1. OCCUPIED PERIOD

Bin Temp (F)	Equivalent Temperature Differences (F) By Exposure North	NE	East	SE	South	SW	West	NW	Perim Roof	Inter Roof
93	18.0	19.9	21.2	26.5	30.0	28.5	25.0	19.3	40.4	------
90	15.4	16.7	17.6	21.4	23.9	22.8	20.3	16.3	31.7	------
85	11.0	12.2	13.1	16.7	19.1	18.1	15.7	11.8	26.4	------
80	6.6	7.8	8.6	12.1	14.2	13.4	11.1	7.4	21.1	------
75	2.2	3.3	4.1	7.4	9.4	8.6	6.4	2.9	15.8	------
70	-2.2	-1.2	-0.4	2.7	4.6	3.9	1.8	-1.5	10.5	------
65	-6.6	-5.6	-4.9	-1.9	-0.2	-0.8	-2.8	-5.9	5.1	------
60	-11.0	-10.1	-9.4	-6.6	-5.0	-5.5	-7.5	-10.4	-0.2	------
55	-15.4	-14.5	-13.9	-11.3	-9.8	-10.3	-12.1	-14.8	-5.5	------
50	-19.8	-19.0	-18.4	-15.9	-14.6	-15.0	-16.7	-19.3	-10.8	------
45	-24.2	-23.5	-22.9	-20.6	-19.4	-19.7	-21.4	-23.7	-16.1	------
40	-28.6	-27.9	-27.4	-25.3	-24.2	-24.4	-26.0	-28.1	-21.4	------
35	-33.0	-32.4	-31.9	-29.9	-29.0	-29.2	-30.6	-32.6	-26.7	------
30	-37.4	-36.9	-36.4	-34.6	-33.8	-33.9	-35.3	-37.0	-32.0	------
25	-41.8	-41.3	-40.9	-39.3	-38.7	-38.6	-39.9	-41.5	-37.3	------
20	-46.2	-45.8	-45.4	-43.9	-43.5	-43.4	-44.5	-45.9	-42.6	------
15	-50.5	-50.2	-50.0	-48.6	-48.3	-48.1	-49.2	-50.3	-47.9	------
10	-54.9	-54.7	-54.5	-53.3	-53.1	-52.8	-53.8	-54.8	-53.2	------
5	-59.3	-59.2	-59.0	-57.9	-57.9	-57.5	-58.4	-59.2	-58.6	------
0	-63.7	-63.6	-63.5	-62.6	-62.7	-62.3	-63.1	-63.7	-63.9	------
-5	-68.1	-68.1	-68.0	-67.3	-67.5	-67.0	-67.7	-68.1	-69.2	------
-6	-69.0	-69.0	-68.9	-68.2	-68.5	-67.9	-68.6	-69.0	-70.2	------

TABLE 2. UNOCCUPIED PERIOD

90	15.4	16.7	17.6	21.4	23.9	22.8	20.3	16.3	31.7	------
85	11.0	12.2	13.1	16.7	19.1	18.1	15.7	11.8	26.4	------
80	6.6	7.8	8.6	12.1	14.2	13.4	11.1	7.4	21.1	------
75	2.2	3.3	4.1	7.4	9.4	8.6	6.4	2.9	15.8	------
70	-2.2	-1.2	-0.4	2.7	4.6	3.9	1.8	-1.5	10.5	------
65	-6.6	-5.6	-4.9	-1.9	-0.2	-0.8	-2.8	-5.9	5.1	------
60	-11.0	-10.1	-9.4	-6.6	-5.0	-5.5	-7.5	-10.4	-0.2	------
55	-15.4	-14.5	-13.9	-11.3	-9.8	-10.3	-12.1	-14.8	-5.5	------
50	-19.8	-19.0	-18.4	-15.9	-14.6	-15.0	-16.7	-19.3	-10.8	------
45	-24.2	-23.5	-22.9	-20.6	-19.4	-19.7	-21.4	-23.7	-16.1	------
40	-28.6	-27.9	-27.4	-25.3	-24.2	-24.4	-26.0	-28.1	-21.4	------
35	-33.0	-32.4	-31.9	-29.9	-29.0	-29.2	-30.6	-32.6	-26.7	------
30	-37.4	-36.9	-36.4	-34.6	-33.8	-33.9	-35.3	-37.0	-32.0	------
25	-41.8	-41.3	-40.9	-39.3	-38.7	-38.6	-39.9	-41.5	-37.3	------
20	-46.2	-45.8	-45.4	-43.9	-43.5	-43.4	-44.5	-45.9	-42.6	------
15	-50.5	-50.2	-50.0	-48.6	-48.3	-48.1	-49.2	-50.3	-47.9	------
10	-54.9	-54.7	-54.5	-53.3	-53.1	-52.8	-53.8	-54.8	-53.2	------
5	-59.3	-59.2	-59.0	-57.9	-57.9	-57.5	-58.4	-59.2	-58.6	------
0	-63.7	-63.6	-63.5	-62.6	-62.7	-62.3	-63.1	-63.7	-63.9	------
-5	-68.1	-68.1	-68.0	-67.3	-67.5	-67.0	-67.7	-68.1	-69.2	------
-6	-69.0	-69.0	-68.9	-68.2	-68.5	-67.9	-68.6	-69.0	-70.2	------
-6	-74.0	-74.0	-74.0	-74.0	-74.0	-74.0	-74.0	-74.0	-74.0	------

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
SYSTEM COMPARISON PERFORMANCE SIMULATIONS

12 NOVEMBER, 1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
OPERATIONAL PERFORMANCE SIMULATION

DESIGN BASIS SYSTEM
DX AC UNITS WITH FREE COOLING COILS AND HI EFFICIENCY 4-STEP COMPRESSORS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON2/4F DESIGN SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil
Supply fan total static pressure = 2.50 in. wg.
A return fan is not used.
Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm
Are cooling terminals used for heating ? <Y>
An economizer is not used.
Is a ventilation reclaim device used ? <Y>
Reclaim device: Efficiency = 90 % ; Input power = 0.2 kw
Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON2/4F DESIGN SYS — Page 2
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Date : 11-25-86
Site : AURORA,IL FERMI, User Defined — 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.58 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <N>
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <Y> ; Economizer efficiency = 65 %

****

D. PUMPING SYSTEMS

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw

>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

TOTAL BUILDING ENERGY SUMMARY

Job Name : CCF SUBCON2/4F DESIGN SYS — Period : All
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Zone : Block
Site : AURORA,IL FERMI, User Defined — Serial Number:
Date : 11-25-86 — 60117862.0

****

HVAC ENERGY Component	Annual Cost ($/yr)	Energy or Fuel Units Consumed	DOE RUF (1000 BTU)	DOE RIF (1000 BTU)
Electric (Occ)	23326	466529 kwh/yr	5411737	1592264
Electric (Unocc)	38989	779778 kwh/yr	9045420	2661381
Natural Gas	0	0 therms/yr	0	0
Fuel Oil	0	0 U.S. gal/yr	0	0
Propane	0	0 lb/yr	0	0
Remote Heating	0	0 MBTU/yr	0	0
Remote Cooling	0	0 MBTU/yr	0	0
HVAC Total	62315		14457157	4253645
NON-HVAC ENERGY				
Electric (Occ)	98513	1970267 kwh/yr	22855101	6724522
Electric (Unocc)	176484	3529671 kwh/yr	40944185	12046768
Non-HVAC Total	274997		63799286	18771290
Grand Total	337312		78256443	23024934
Total/Sq.Ft.	11.33		2629.58	773.69

HVAC Summary:

HVAC Total Cost	=	2.09 $/Sq.Ft./yr
	=	18.47 % of Total Cost
Total HVAC Electrical Energy	=	41.88 kwh/Sq.Ft./yr
	=	18.47 % of Total Electrical Energy
Non-Electrical HVAC Energy	=	0.00 % of Total Energy

Key:

1 kwh	= 11600 BTU RUF; 3412 BTU RIF
1 therm nat gas	= 100000 BTU RUF and RIF
1 U.S. gal oil	= 138700 BTU RUF and RIF
1 Imp. gal oil	= 168000 BTU RUF and RIF
1 lb propane	= 21680 BTU RUF and RIF
RUF	= Resource utilization factor (Source value)
RIF	= Resource impact factor (Point of use value)
MBH	= 1000 BTU/hr
MBTU	= Million BTU

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON2/4F DESIGN SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS (ANNUAL FAN OPERATING COST = $34,204)

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil

Supply fan total static pressure = 2.50 in. wg.

A return fan is not used.

Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm

Are cooling terminals used for heating ? <Y>

An economizer is not used.

Is a ventilation reclaim device used ? <Y>

Reclaim device: Efficiency = 90 % ; Input power = 0.2 kw

Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS (ANNUAL HEATING PLANT OPERATING COST = $0)

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON2/4F DESIGN SYS
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS (ANNUAL COOLING PLANT OPERATING COST = $19,632)

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.58 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <N>
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <Y> ; Economizer efficiency = 65 %

****

D. PUMPING SYSTEMS (ANNUAL PUMP OPERATING COST = $8,479)

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS (ANNUAL NON-HVAC OPERATING COST = $274,997)

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw

>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS (GRAND TOTAL ANNUAL OPERATING COST = $337,312)

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

COOLING PLANT COSTS

Job Name : CCF SUBCON2/4F DESIGN SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:

Site Name : AURORA,IL FERMI, User Defined — 60117862.0

Bin Temp (F)	Bin Hours hr/yr	Perimeter Cooling Plant Coil Load MBH	Input KW	Cost $/yr	No Interior Zone Exists
OCCUPIED PERIOD					
90	25.8	2869.8	128.9	166.3	
85	59.4	2805.5	119.4	354.7	
80	145.3	2742.6	110.7	804.0	
75	237.7	2681.1	102.6	1219.4	
70	270.6	2620.8	95.2	1287.6	
65	264.5	2554.1	87.9	1162.2	
60	255.0	2500.5	77.4	986.9	
55	244.7	2447.9	62.5	764.1	
50	232.1	2399.3	43.9	509.8	
45	229.5	2351.9	30.1	344.9	
40	237.6	2304.5	19.3	229.5	
35	238.5	2257.1	10.9	130.1	
30	218.2	2209.7	4.0	43.2	
25	174.5	2162.3	3.3	28.7	
20	122.4	2114.9	3.3	20.1	
15	78.1	2067.5	3.3	12.9	
10	46.1	2020.2	3.3	7.6	
5	25.1	1972.8	3.3	4.1	
0	12.7	1925.4	3.3	2.1	
-5	6.2	1878.0	3.3	1.0	
-6	4.6	1868.5	3.3	0.8	
Total Costs				$8080.1	
UNOCCUPIED PERIOD					
90	14.6	2851.1	127.4	93.0	
85	36.3	2787.3	118.1	214.3	
80	99.3	2725.0	109.5	543.5	
75	215.3	2664.1	101.5	1092.7	
70	357.6	2604.3	94.2	1683.6	
65	463.3	2538.1	87.0	2014.5	
60	500.4	2485.0	76.5	1913.9	
55	482.0	2433.4	61.7	1486.6	
50	447.6	2386.4	43.4	971.0	
45	422.7	2339.3	29.6	626.2	
40	413.7	2292.2	19.0	392.7	
35	417.0	2245.2	10.6	221.6	
30	417.4	2198.1	3.7	76.9	
25	395.2	2151.0	3.3	65.0	
20	336.9	2104.0	3.3	55.4	
15	252.8	2056.9	3.3	41.6	
10	165.7	2009.8	3.3	27.3	
5	96.3	1962.8	3.3	15.8	
0	50.9	1915.7	3.3	8.4	
-5	25.3	1868.7	3.3	4.2	
-6	21.1	1859.2	3.3	3.5	
Total Costs				$11551.8	

COOLING PLANT COSTS

Job Name : CCF SUBCON2/4F DESIGN SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:

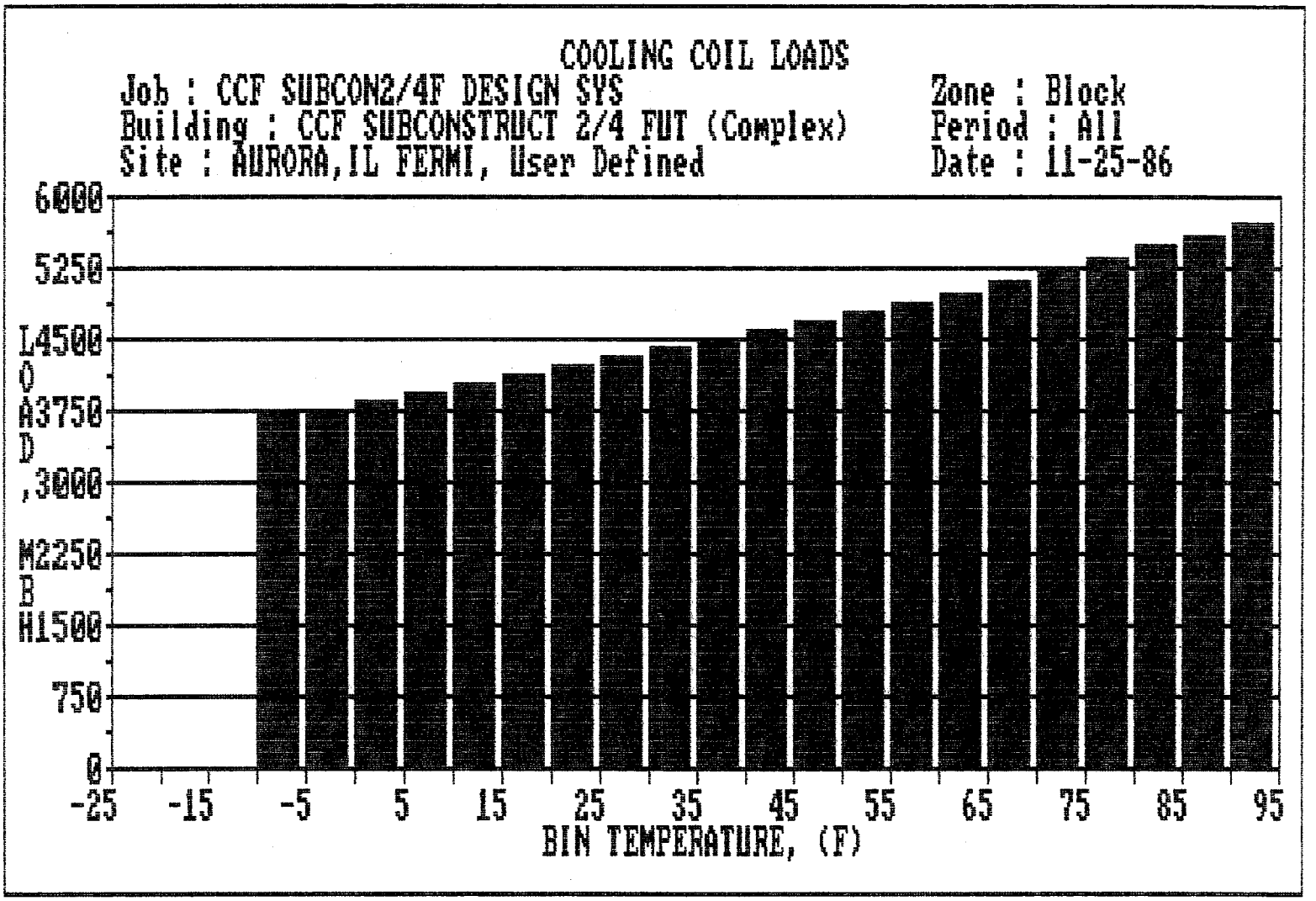
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

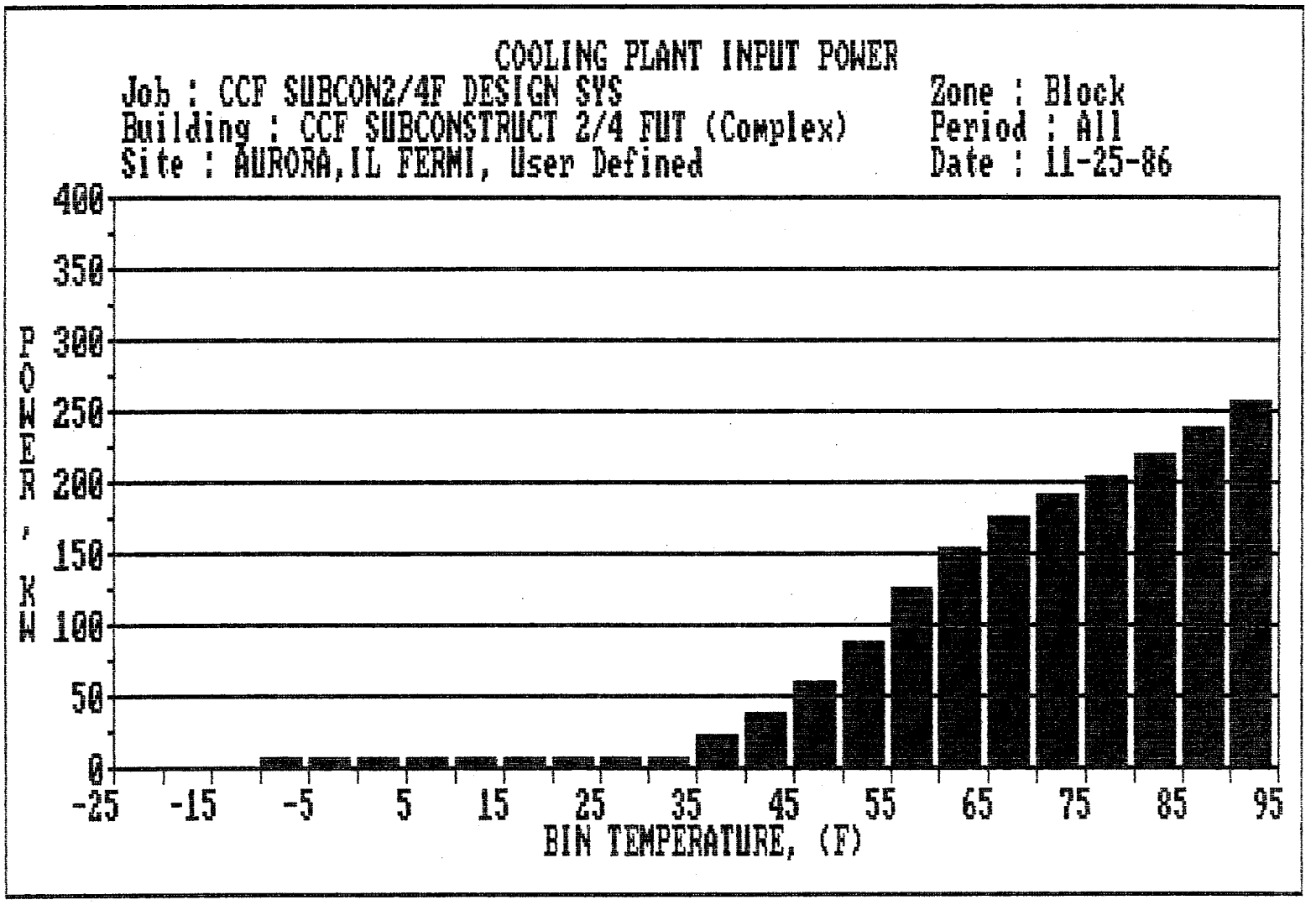
Bin Temp (F)	Bin Hours hr/yr	Perimeter Cooling Plant Coil Load MBH	Input KW	Cost $/yr	No Interior Zone Exists
			OCCUPIED PERIOD		
90	25.8	2869.8	128.9	166.3	
85	59.4	2805.5	119.4	354.7	
80	145.3	2742.6	110.7	804.0	
75	237.7	2681.1	102.6	1219.4	
70	270.6	2620.8	95.2	1287.6	
65	264.5	2554.1	87.9	1162.2	
60	255.0	2500.5	77.4	986.9	
55	244.7	2447.9	62.5	764.1	
50	232.1	2399.3	43.9	509.8	
45	229.5	2351.9	30.1	344.9	
40	237.6	2304.5	19.3	229.5	
35	238.5	2257.1	10.9	130.1	
30	218.2	2209.7	4.0	43.2	
25	174.5	2162.3	3.3	28.7	
20	122.4	2114.9	3.3	20.1	
15	78.1	2067.5	3.3	12.9	
10	46.1	2020.2	3.3	7.6	
5	25.1	1972.8	3.3	4.1	
0	12.7	1925.4	3.3	2.1	
-5	6.2	1878.0	3.3	1.0	
-6	4.6	1868.5	3.3	0.8	
Total Costs				$8080.1	
			UNOCCUPIED PERIOD		
90	14.6	2851.1	127.4	93.0	
85	36.3	2787.3	118.1	214.3	
80	99.3	2725.0	109.5	543.5	
75	215.3	2664.1	101.5	1092.7	
70	357.6	2604.3	94.2	1683.6	
65	463.3	2538.1	87.0	2014.5	
60	500.4	2485.0	76.5	1913.9	
55	482.0	2433.4	61.7	1486.6	
50	447.6	2386.4	43.4	971.0	
45	422.7	2339.3	29.6	626.2	
40	413.7	2292.2	19.0	392.7	
35	417.0	2245.2	10.6	221.6	
30	417.4	2198.1	3.7	76.9	
25	395.2	2151.0	3.3	65.0	
20	336.9	2104.0	3.3	55.4	
15	252.8	2056.9	3.3	41.6	
10	165.7	2009.8	3.3	27.3	
5	96.3	1962.8	3.3	15.8	
0	50.9	1915.7	3.3	8.4	
-5	25.3	1868.7	3.3	4.2	
-6	21.1	1859.2	3.3	3.5	
Total Costs				$11551.8	

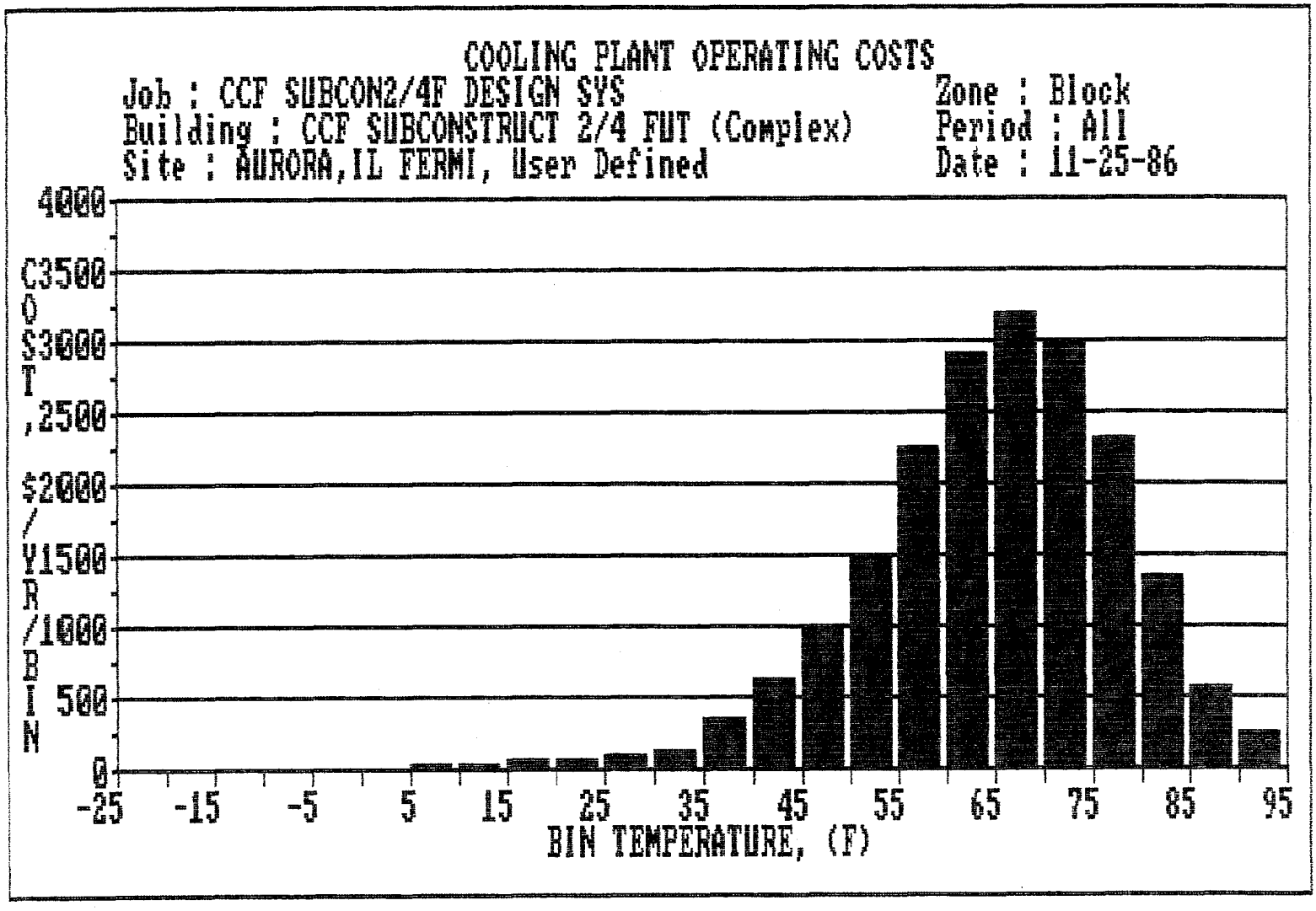
FAN AND PUMP COSTS

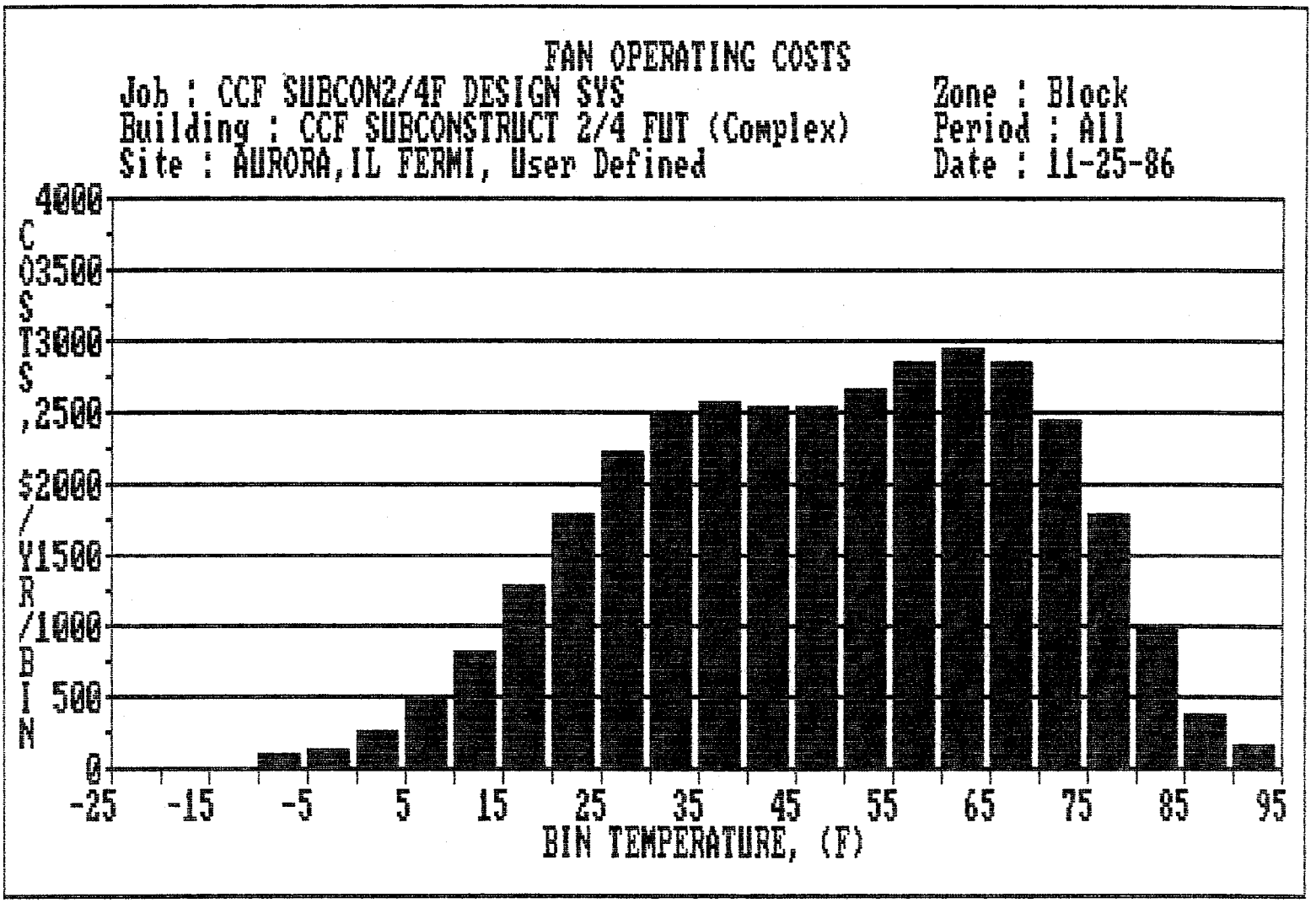
Job Name : CCF SUBCON2/4F DESIGN SYS — Date : 11-25-86
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

Bin Temp (F)	Bin Hours hr/yr	Perimeter Input KW	Fans Cost $/yr	No Interior Zone	All Pumps Input KW	All Pumps Cost $/yr
OCCUPIED PERIOD						
90	25.8	78.1	100.7		19.5	25.2
85	59.4	78.1	231.9		19.5	58.0
80	145.3	78.1	567.3		19.5	141.9
75	237.7	78.1	928.1		19.5	232.1
70	270.6	78.1	1056.6		19.5	264.2
65	264.5	78.1	1032.8		19.3	255.6
60	255.0	78.1	995.7		19.3	246.4
55	244.7	78.1	955.5		19.3	236.4
50	232.1	78.1	906.3		19.3	224.3
45	229.5	78.1	896.1		19.3	221.8
40	237.6	78.1	927.7		19.3	229.6
35	238.5	78.1	931.2		19.3	230.5
30	218.2	78.1	852.0		19.3	210.8
25	174.5	78.1	681.4		19.3	168.6
20	122.4	78.1	477.9		19.3	118.3
15	78.1	78.1	304.9		19.3	75.5
10	46.1	78.1	180.0		19.3	44.5
5	25.1	78.1	98.0		19.3	24.3
0	12.7	78.1	49.6		19.3	12.3
-5	6.2	78.1	24.2		19.3	6.0
-6	4.6	78.1	18.0		19.3	4.4
Total Costs			$12215.9			$3030.5
UNOCCUPIED PERIOD						
90	14.6	78.1	57.0		19.5	14.3
85	36.3	78.1	141.7		19.5	35.4
80	99.3	78.1	387.7		19.5	96.9
75	215.3	78.1	840.7		19.5	210.2
70	357.6	78.1	1396.3		19.5	349.1
65	463.3	78.1	1809.0		19.3	447.7
60	500.4	78.1	1953.9		19.3	483.5
55	482.0	78.1	1882.0		19.3	465.7
50	447.6	78.1	1747.7		19.3	432.5
45	422.7	78.1	1650.5		19.3	408.4
40	413.7	78.1	1615.3		19.3	399.8
35	417.0	78.1	1628.2		19.3	402.9
30	417.4	78.1	1629.8		19.3	403.3
25	395.2	78.1	1543.1		19.3	381.9
20	336.9	78.1	1315.5		19.3	325.5
15	252.8	78.1	987.1		19.3	244.3
10	165.7	78.1	647.0		19.3	160.1
5	96.3	78.1	376.0		19.3	93.1
0	50.9	78.1	198.7		19.3	49.2
-5	25.3	78.1	98.8		19.3	24.4
-6	21.1	78.1	82.4		19.3	20.4
Total Costs			$21988.3			$5448.7


COOLING COIL LOADS
Job : CCF SUBCON2/4F DESIGN SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
6000
5250
L4500
O
A3750
D
,3000
M2250
B
H1500
750
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT INPUT POWER
Job : CCF SUBCON2/4F DESIGN SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
POWER, KW
400
350
300
250
200
150
100
50
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT OPERATING COSTS
Job : CCF SUBCON2/4F DESIGN SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COST $/YR/BIN
4000
3500
3000
2500
2000
1500
1000
500
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


FAN OPERATING COSTS
Job : CCF SUBCON2/4F DESIGN SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COSTS $/YR/BIN
4000
3500
3000
2500
2000
1500
1000
500
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
OPERATIONAL PERFORMANCE SIMULATION

ALTERNATE COMPARISON SYSTEM NUMBER 1
DX AC UNITS WITH HI EFFICIENCY COMPRESSORS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON 2/4F STDAC SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil

Supply fan total static pressure = 2.50 in. wg.

A return fan is not used.

Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm

Are cooling terminals used for heating ? <Y>

An economizer is not used.

Is a ventilation reclaim device used ? <N>

Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON 2/4F STDAC SYS — Page 2
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Date : 11-25-86
Site : AURORA,IL FERMI, User Defined — 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.76 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <Y> ; Minimum percent unloading = 30 %
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <Y>
Are compressors cycled ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <N>

****

D. PUMPING SYSTEMS

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw

>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

TOTAL BUILDING ENERGY SUMMARY

Job Name : CCF SUBCON 2/4F STDAC SYS — Period : All
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Zone : Block
Site : AURORA,IL FERMI, User Defined — Serial Number: 60117862.0
Date : 11-25-86

****

HVAC ENERGY Component	Annual Cost ($/yr)	Energy or Fuel Units Consumed	DOE RUF (1000 BTU)	DOE RIF (1000 BTU)
Electric (Occ)	37451	749012 kwh/yr	8688544	2556379
Electric (Unocc)	66144	1322874 kwh/yr	15345337	4514969
Natural Gas	0	0 therms/yr	0	0
Fuel Oil	0	0 U.S. gal/yr	0	0
Propane	0	0 lb/yr	0	0
Remote Heating	0	0 MBTU/yr	0	0
Remote Cooling	0	0 MBTU/yr	0	0
HVAC Total	103594		24033881	7071348
NON-HVAC ENERGY				
Electric (Occ)	98513	1970267 kwh/yr	22855101	6724522
Electric (Unocc)	176484	3529671 kwh/yr	40944185	12046768
Non-HVAC Total	274997		63799286	18771290
Grand Total	378591		87833167	25842638
Total/Sq.Ft.	12.72		2951.38	868.37

HVAC Summary:

HVAC Total Cost	=	3.48	$/Sq.Ft./yr
	=	27.36	% of Total Cost
Total HVAC Electrical Energy	=	69.62	kwh/Sq.Ft./yr
	=	27.36	% of Total Electrical Energy
Non-Electrical HVAC Energy	=	0.00	% of Total Energy

Key:

1 kwh	= 11600 BTU RUF; 3412 BTU RIF
1 therm nat gas	= 100000 BTU RUF and RIF
1 U.S. gal oil	= 138700 BTU RUF and RIF
1 Imp. gal oil	= 168000 BTU RUF and RIF
1 lb propane	= 21680 BTU RUF and RIF
RUF	= Resource utilization factor (Source value)
RIF	= Resource impact factor (Point of use value)
MBH	= 1000 BTU/hr
MBTU	= Million BTU

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON 2/4F STDAC SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS (ANNUAL FAN OPERATING COST = $34,204)

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil
Supply fan total static pressure = 2.50 in. wg.
A return fan is not used.
Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm
Are cooling terminals used for heating ? <Y>
An economizer is not used.
Is a ventilation reclaim device used ? <N>
Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS (ANNUAL HEATING PLANT OPERATING COST = $0)

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON 2/4F STDAC SYS
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS (ANNUAL COOLING PLANT OPERATING COST = $60,554)

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.76 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <Y> ; Minimum percent unloading = 30 %
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <Y>
Are compressors cycled ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <N>

****

D. PUMPING SYSTEMS (ANNUAL PUMP OPERATING COST = $8,837)

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS (ANNUAL NON-HVAC OPERATING COST = $274,997)

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw
>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS (GRAND TOTAL ANNUAL OPERATING COST = $378,591)

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

COOLING PLANT COSTS

Job Name : CCF SUBCON 2/4F STDAC SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:

Site Name : AURORA,IL FERMI, User Defined — 60117862.0

Bin Temp (F)	Bin Hours hr/yr	Perimeter Cooling Plant Coil Load MBH	Input KW	Cost $/yr	No Interior Zone Exists
			OCCUPIED PERIOD		
90	25.8	2920.7	171.6	221.4	
85	59.4	2844.7	165.5	491.6	
80	145.3	2770.1	161.3	1171.7	
75	237.7	2696.9	157.1	1867.2	
70	270.6	2624.9	153.0	2070.2	
65	264.5	2554.1	149.0	1970.1	
60	255.0	2500.5	145.9	1860.5	
55	244.7	2447.9	142.9	1748.6	
50	232.1	2399.3	140.2	1626.4	
45	229.5	2351.9	137.5	1577.2	
40	237.6	2304.5	134.7	1600.8	
35	238.5	2257.1	132.0	1574.7	
30	218.2	2209.7	129.3	1411.2	
25	174.5	2162.3	126.6	1105.0	
20	122.4	2114.9	123.9	758.6	
15	78.1	2067.5	121.2	473.5	
10	46.1	2020.2	118.5	273.3	
5	25.1	1972.8	115.8	145.4	
0	12.7	1925.4	113.1	71.8	
-5	6.2	1878.0	110.4	34.2	
-6	4.6	1868.5	109.9	25.3	
Total Costs				$22078.8	
			UNOCCUPIED PERIOD		
90	14.6	2902.0	170.4	124.4	
85	36.3	2826.6	164.5	298.6	
80	99.3	2752.6	160.3	795.8	
75	215.3	2679.9	156.1	1680.9	
70	357.6	2608.5	152.1	2719.0	
65	463.3	2538.1	148.1	3429.8	
60	500.4	2485.0	145.0	3628.8	
55	482.0	2433.4	142.1	3424.5	
50	447.6	2386.4	139.4	3120.1	
45	422.7	2339.3	136.7	2889.8	
40	413.7	2292.2	134.1	2772.8	
35	417.0	2245.2	131.4	2739.0	
30	417.4	2198.1	128.7	2685.7	
25	395.2	2151.0	126.0	2489.9	
20	336.9	2104.0	123.3	2077.4	
15	252.8	2056.9	120.6	1524.9	
10	165.7	2009.8	118.0	977.3	
5	96.3	1962.8	115.3	555.1	
0	50.9	1915.7	112.6	286.6	
-5	25.3	1868.7	109.9	139.0	
-6	21.1	1859.2	109.4	115.4	
Total Costs				$38474.8	

PERIMETER HEATING PLANT COSTS

Job Name : CCF SUBCON 2/4F STDAC SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:

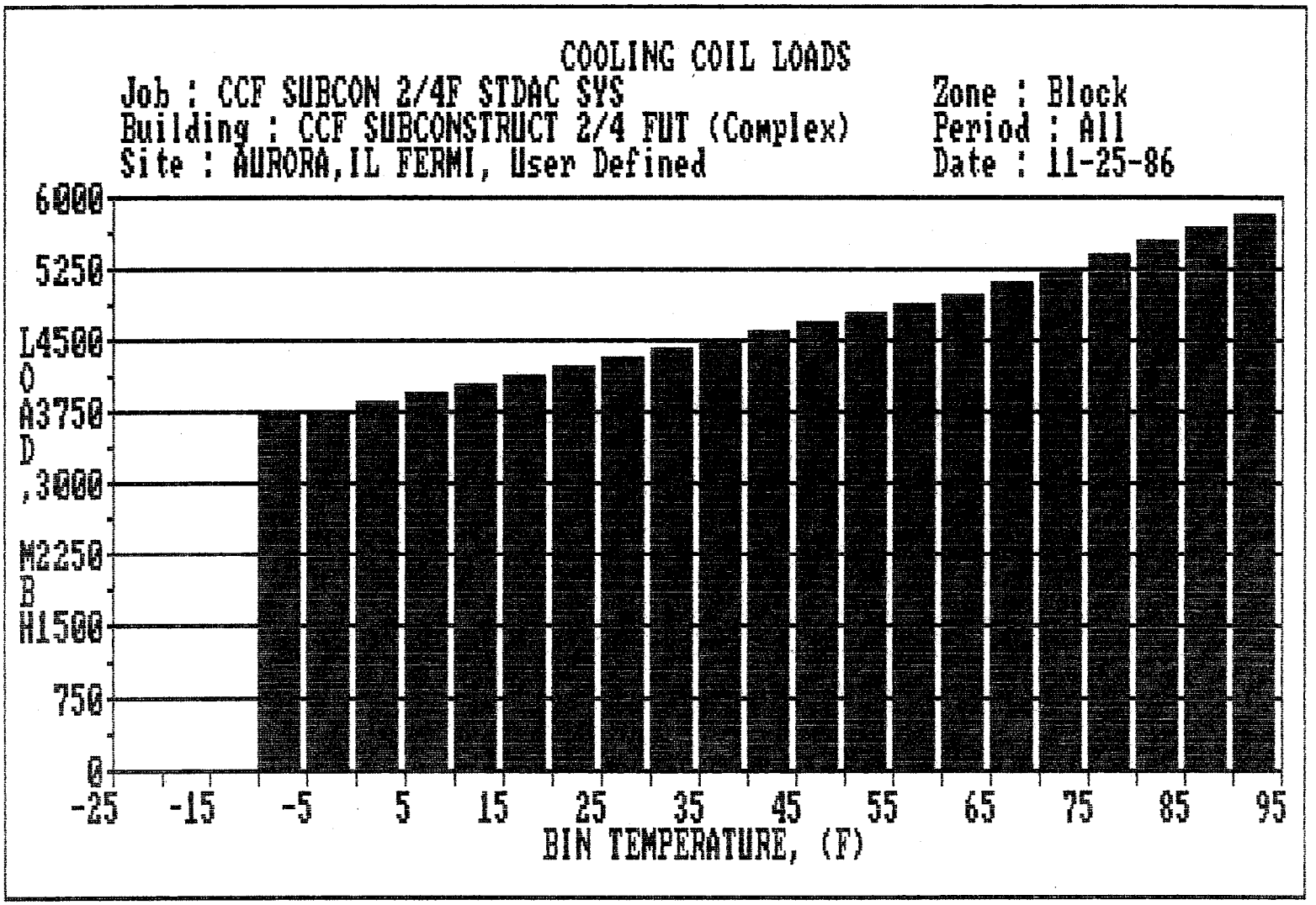
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

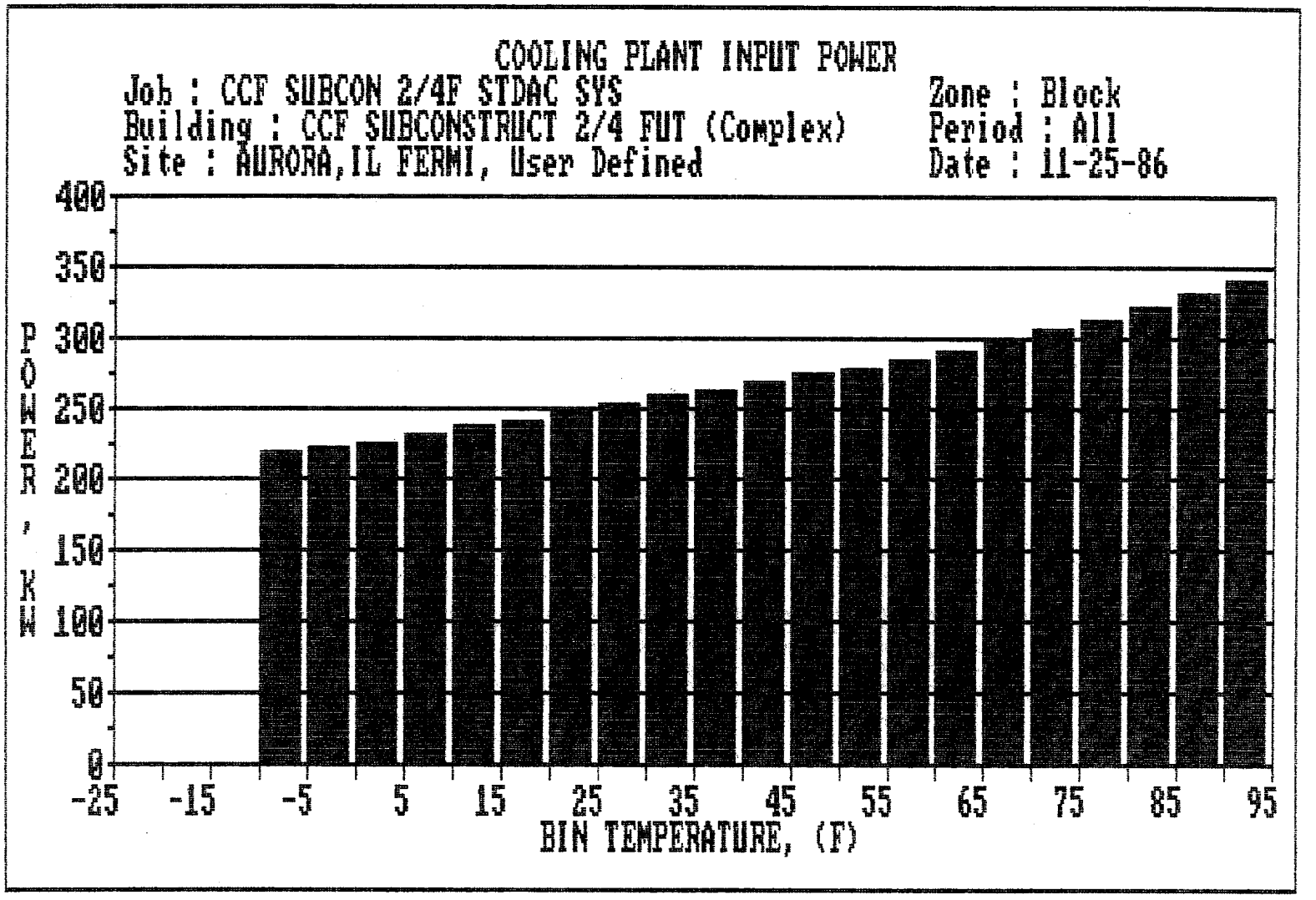
Bin Temp (F)	Bin Hours hr/yr	Coil Load MBH	Primary Plant Output MBH	Input KW	Cost $/yr	No Auxiliary Plant Used
OCCUPIED PERIOD						
90	25.8	0.0	0.0	0.0	0.0	
85	59.4	0.0	0.0	0.0	0.0	
80	145.3	0.0	0.0	0.0	0.0	
75	237.7	0.0	0.0	0.0	0.0	
70	270.6	0.0	0.0	0.0	0.0	
65	264.5	0.0	0.0	0.0	0.0	
60	255.0	0.0	0.0	0.0	0.0	
55	244.7	0.0	0.0	0.0	0.0	
50	232.1	0.0	0.0	0.0	0.0	
45	229.5	0.0	0.0	0.0	0.0	
40	237.6	0.0	0.0	0.0	0.0	
35	238.5	0.0	0.0	0.0	0.0	
30	218.2	0.0	0.0	0.0	0.0	
25	174.5	0.0	0.0	0.0	0.0	
20	122.4	0.0	0.0	0.0	0.0	
15	78.1	0.0	0.0	0.0	0.0	
10	46.1	0.0	0.0	0.0	0.0	
5	25.1	0.0	0.0	0.0	0.0	
0	12.7	0.0	0.0	0.0	0.0	
-5	6.2	0.0	0.0	0.0	0.0	
-6	4.6	0.0	0.0	0.0	0.0	
Total Costs					$0.0	
UNOCCUPIED PERIOD						
90	14.6	0.0	0.0	0.0	0.0	
85	36.3	0.0	0.0	0.0	0.0	
80	99.3	0.0	0.0	0.0	0.0	
75	215.3	0.0	0.0	0.0	0.0	
70	357.6	0.0	0.0	0.0	0.0	
65	463.3	0.0	0.0	0.0	0.0	
60	500.4	0.0	0.0	0.0	0.0	
55	482.0	0.0	0.0	0.0	0.0	
50	447.6	0.0	0.0	0.0	0.0	
45	422.7	0.0	0.0	0.0	0.0	
40	413.7	0.0	0.0	0.0	0.0	
35	417.0	0.0	0.0	0.0	0.0	
30	417.4	0.0	0.0	0.0	0.0	
25	395.2	0.0	0.0	0.0	0.0	
20	336.9	0.0	0.0	0.0	0.0	
15	252.8	0.0	0.0	0.0	0.0	
10	165.7	0.0	0.0	0.0	0.0	
5	96.3	0.0	0.0	0.0	0.0	
0	50.9	0.0	0.0	0.0	0.0	
-5	25.3	0.0	0.0	0.0	0.0	
-6	21.1	0.0	0.0	0.0	0.0	
Total Costs					$0.0	

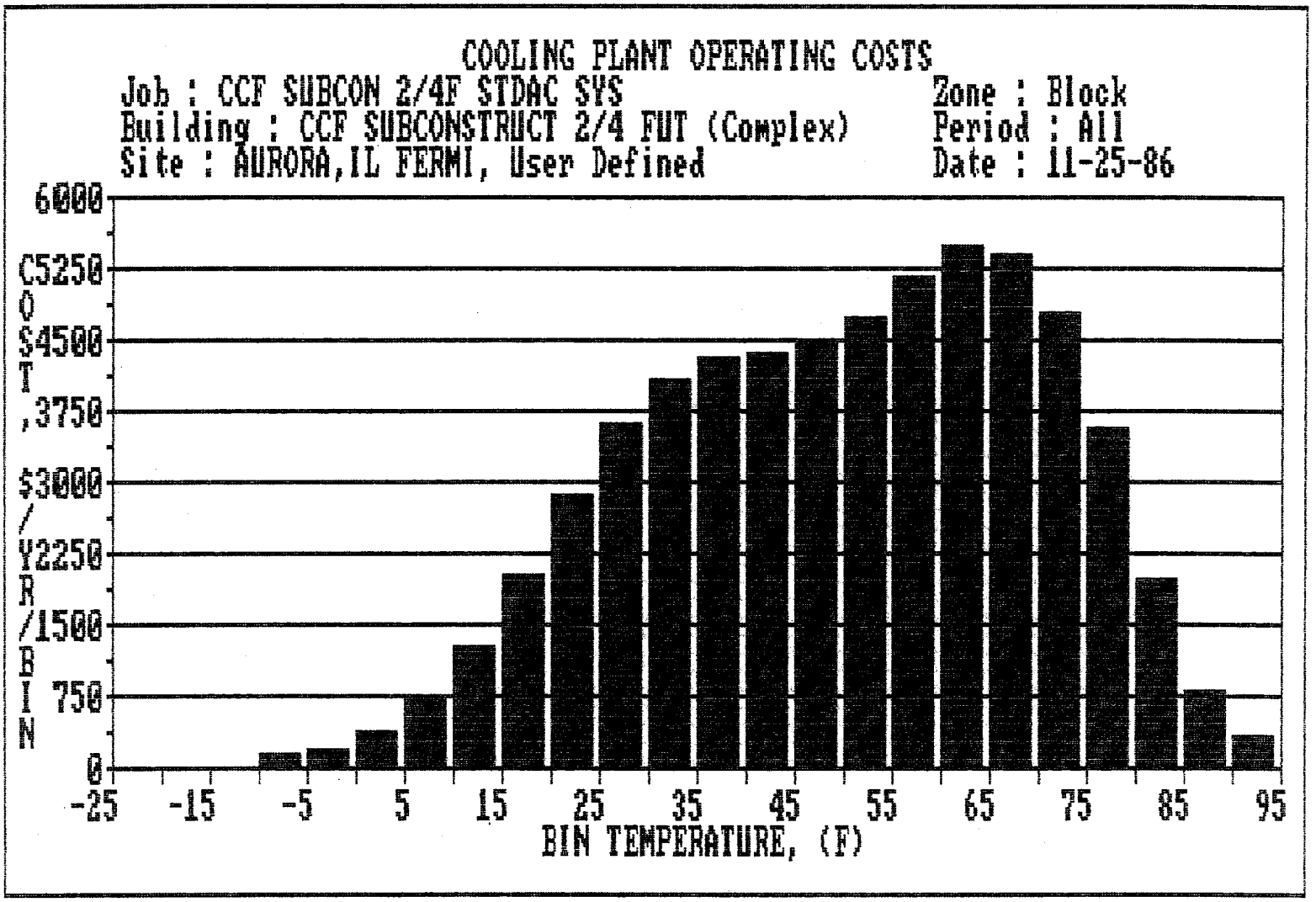
FAN AND PUMP COSTS

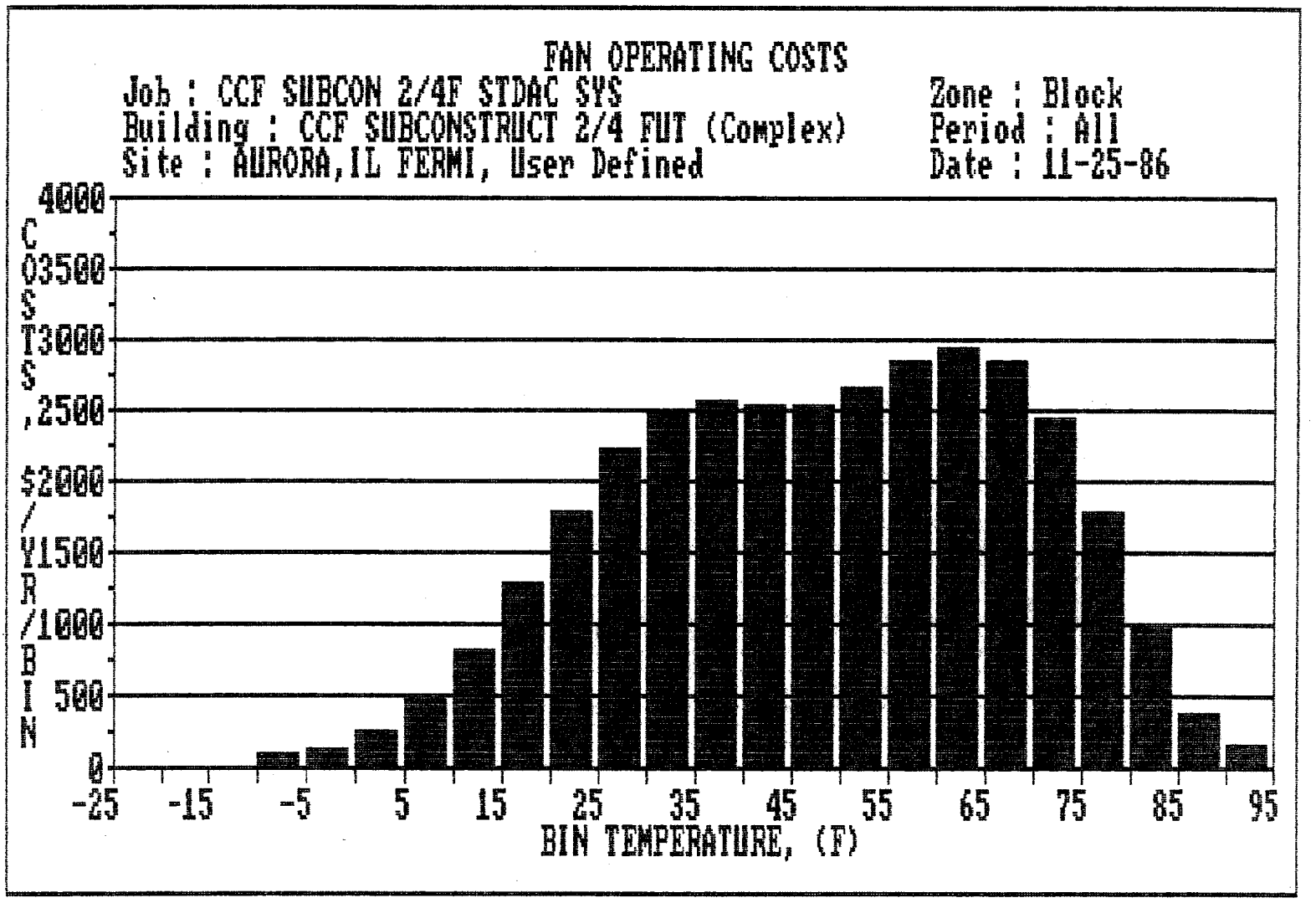
Job Name : CCF SUBCON 2/4F STDAC SYS — Date : 11-25-86
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

Bin Temp (F)	Bin Hours hr/yr	Perimeter Input KW	Fans Cost $/yr	No Interior Zone	All Pumps Input KW	All Pumps Cost $/yr
				OCCUPIED PERIOD		
90	25.8	78.1	100.7		20.2	26.0
85	59.4	78.1	231.9		20.2	59.9
80	145.3	78.1	567.3		20.2	146.6
75	237.7	78.1	928.1		20.2	239.8
70	270.6	78.1	1056.6		20.2	273.0
65	264.5	78.1	1032.8		20.2	266.8
60	255.0	78.1	995.7		20.2	257.2
55	244.7	78.1	955.5		20.2	246.8
50	232.1	78.1	906.3		20.2	234.1
45	229.5	78.1	896.1		20.2	231.5
40	237.6	78.1	927.7		20.2	239.7
35	238.5	78.1	931.2		20.2	240.6
30	218.2	78.1	852.0		20.2	220.1
25	174.5	78.1	681.4		20.2	176.0
20	122.4	78.1	477.9		20.2	123.5
15	78.1	78.1	304.9		20.2	78.8
10	46.1	78.1	180.0		20.2	46.5
5	25.1	78.1	98.0		20.2	25.3
0	12.7	78.1	49.6		20.2	12.8
-5	6.2	78.1	24.2		20.2	6.3
-6	4.6	78.1	18.0		20.2	4.6
Total Costs			$12215.9			$3156.0
				UNOCCUPIED PERIOD		
90	14.6	78.1	57.0		20.2	14.7
85	36.3	78.1	141.7		20.2	36.6
80	99.3	78.1	387.7		20.2	100.2
75	215.3	78.1	840.7		20.2	217.2
70	357.6	78.1	1396.3		20.2	360.7
65	463.3	78.1	1809.0		20.2	467.4
60	500.4	78.1	1953.9		20.2	504.8
55	482.0	78.1	1882.0		20.2	486.2
50	447.6	78.1	1747.7		20.2	451.5
45	422.7	78.1	1650.5		20.2	426.4
40	413.7	78.1	1615.3		20.2	417.3
35	417.0	78.1	1628.2		20.2	420.6
30	417.4	78.1	1629.8		20.2	421.0
25	395.2	78.1	1543.1		20.2	398.7
20	336.9	78.1	1315.5		20.2	339.8
15	252.8	78.1	987.1		20.2	255.0
10	165.7	78.1	647.0		20.2	167.1
5	96.3	78.1	376.0		20.2	97.1
0	50.9	78.1	198.7		20.2	51.3
-5	25.3	78.1	98.8		20.2	25.5
-6	21.1	78.1	82.4		20.2	21.3
Total Costs			$21988.3			$5680.6


COOLING COIL LOADS
Job : CCF SUBCON 2/4F STDAC SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
6000
5250
L4500
O
A3750
D
,3000
M2250
B
H1500
750
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT INPUT POWER
Job : CCF SUBCON 2/4F STDAC SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
POWER, KW
400
350
300
250
200
150
100
50
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT OPERATING COSTS
Job : CCF SUBCON 2/4F STDAC SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COST $/YR/BIN
6000
5250
4500
3750
3000
2250
1500
750
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


FAN OPERATING COSTS
Job : CCF SUBCON 2/4F STDAC SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COSTS $/YR/BIN
4000
3500
3000
2500
2000
1500
1000
500
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
OPERATIONAL PERFORMANCE SIMULATION

ALTERNATE COMPARISON SYSTEM NUMBER 2
TYPICAL FY1975 DESIGN
DX AC UNITS WITH STANDARD COMPRESSORS AND COILS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON 2/4F 1975S SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil

Supply fan total static pressure = 3.00 in. wg.

A return fan is not used.

Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm

Are cooling terminals used for heating ? <Y>

An economizer is not used.

Is a ventilation reclaim device used ? <N>

Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

SYSTEM INPUT SUMMARY

Job Name : CCF SUBCON 2/4F 1975S SYS
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.95 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <Y> ; Minimum percent unloading = 30 %
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <Y>
Are compressors cycled ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <N>

****

D. PUMPING SYSTEMS

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw
>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

TOTAL BUILDING ENERGY SUMMARY

Job Name : CCF SUBCON 2/4F 1975S SYS
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Date : 11-25-86

Period : All
Zone : Block
Serial Number:
60117862.0

****

HVAC ENERGY Component	Annual Cost ($/yr)	Energy or Fuel Units Consumed	DOE RUF (1000 BTU)	DOE RIF (1000 BTU)
Electric (Occ)	46044	920882 kwh/yr	10682234	3142971
Electric (Unocc)	81290	1625804 kwh/yr	18859329	5548870
Natural Gas	0	0 therms/yr	0	0
Fuel Oil	0	0 U.S. gal/yr	0	0
Propane	0	0 lb/yr	0	0
Remote Heating	0	0 MBTU/yr	0	0
Remote Cooling	0	0 MBTU/yr	0	0
HVAC Total	127334		29541563	8691841
NON-HVAC ENERGY				
Electric (Occ)	98513	1970267 kwh/yr	22855101	6724522
Electric (Unocc)	176484	3529671 kwh/yr	40944185	12046768
Non-HVAC Total	274997		63799286	18771290
Grand Total	402331		93340849	27463131
Total/Sq.Ft.	13.52		3136.45	922.82

HVAC Summary:

HVAC Total Cost	=	4.28 $/Sq.Ft./yr
	=	31.65 % of Total Cost
Total HVAC Electrical Energy	=	85.57 kwh/Sq.Ft./yr
	=	31.65 % of Total Electrical Energy
Non-Electrical HVAC Energy	=	-0.00 % of Total Energy

Key:

1 kwh	= 11600 BTU RUF; 3412 BTU RIF
1 therm nat gas	= 100000 BTU RUF and RIF
1 U.S. gal oil	= 138700 BTU RUF and RIF
1 Imp. gal oil	= 168000 BTU RUF and RIF
1 lb propane	= 21680 BTU RUF and RIF
RUF	= Resource utilization factor (Source value)
RIF	= Resource impact factor (Point of use value)
MBH	= 1000 BTU/hr
MBTU	= Million BTU

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON 2/4F 1975S SYS Page 1
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

A. AIR HANDLING SYSTEMS (ANNUAL FAN OPERATING COST = $41,045)

>1. PERIMETER TERMINAL TYPE : CONSTANT VOLUME

Supply fan type : Backward inclined or airfoil
Supply fan total static pressure = 3.00 in. wg.
A return fan is not used.
Design supply air= 144000 cfm @ 52 F; Vent. air= 2360 cfm
Are cooling terminals used for heating ? <Y>
An economizer is not used.
Is a ventilation reclaim device used ? <N>
Are ventilation air dampers closed for unoccupied periods ? <N>

****

B. HEATING PLANTS (ANNUAL HEATING PLANT OPERATING COST = $0)

> 1 . PERIMETER PLANT : ELECTRICAL RESISTANCE

Is hydronic heating used ? <N>

****

ANNUAL OPERATING COSTS

Job Name : CCF SUBCON 2/4F 1975S SYS
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) Date : 11-25-86
Site : AURORA,IL FERMI, User Defined 60117862.0
Scope of Analysis : Cooling and Heating Systems

****

C. COOLING PLANTS (ANNUAL COOLING PLANT OPERATING COST = $77,060)

>1. PERIMETER PLANT : RECIPROCATING WATER COOLED
Capacity @ 85 F entering water = 240.0 tons
KW/Ton @ 85 F entering water = 0.95 kw/ton
Is hydronic cooling used ? <N>
Is hot gas bypass used ? <Y> ; Minimum percent unloading = 30 %
Is condenser performance altitude adjusted ? <Y>
Is there one compressor per condenser circuit ? <Y>
Are compressors cycled ? <N>
Heat sink type : Open cooling tower
Minimum entering water temperature = 35 F
Is a hydronic economizer used ? <N>

****

D. PUMPING SYSTEMS (ANNUAL PUMP OPERATING COST = $9,229)

System	PERIMETER dT, F	PERIMETER dP, ft wg	dT, F	dP, ft wg
Chilled water	0.00	0.00	0.00	0.00
Hot water	0.00	0.00	0.00	0.00
Condenser water	10.00	117.00	0.00	0.00
Ground water	0.00	0.00	0.00	0.00

****

E. NON-HVAC SYSTEMS (ANNUAL NON-HVAC OPERATING COST = $274,997)

>1. NON-HVAC ELECTRICAL ENERGY USE
Lighting kw: Occupied = 29.8 kw; Unoccupied = 26.8 kw
Misc. kw : Occupied = 600.0 kw; Unoccupied = 600.0 kw
Other kw : Occupied = 0.0 kw; Unoccupied = 0.0 kw

>2. DHW SYSTEM (Not utilized in this system)

****

F. FUEL COSTS (GRAND TOTAL ANNUAL OPERATING COST = $402,331)

>1. ELECTRICAL ENERGY USE	Period Occupied ($/kwh)	Period Unoccupied ($/kwh)
Compressor	0.050	0.050
Resistance	0.050	0.050
Inductive	0.050	0.050

>2. OTHER FUELS	Unit Cost
Natural Gas	n/a $/therm
Fuel Oil	n/a $/U.S.gal
Propane	n/a $/lb
Remote Heating	n/a $/MBTU
Remote Cooling	n/a $/MBTU

COOLING PLANT COSTS

Job Name : CCF SUBCON 2/4F 1975S SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number: 60117862.0

Site Name : AURORA,IL FERMI, User Defined

Bin Temp (F)	Bin Hours hr/yr	Perimeter Cooling Plant Coil Load MBH	Input KW	Cost $/yr	No Interior Zone Exists
			OCCUPIED PERIOD		
90	25.8	2975.1	218.0	281.3	
85	59.4	2899.1	210.1	623.9	
80	145.3	2824.6	204.8	1487.7	
75	237.7	2751.4	199.6	2371.8	
70	270.6	2679.4	194.4	2630.7	
65	264.5	2608.6	189.4	2504.7	
60	255.0	2555.0	185.6	2366.1	
55	244.7	2502.5	181.8	2224.7	
50	232.1	2452.6	178.3	2068.9	
45	229.5	2405.2	174.9	2007.0	
40	237.6	2357.8	171.5	2037.7	
35	238.5	2310.4	168.2	2005.2	
30	218.2	2263.0	164.8	1797.7	
25	174.5	2215.6	161.4	1408.2	
20	122.4	2168.2	158.0	967.1	
15	78.1	2120.8	154.6	603.9	
10	46.1	2073.5	151.3	348.7	
5	25.1	2026.1	147.9	185.6	
0	12.7	1978.7	144.5	91.8	
-5	6.2	1931.3	141.1	43.8	
-6	4.6	1921.8	140.5	32.3	
Total Costs				$28088.9	
			UNOCCUPIED PERIOD		
90	14.6	2956.5	216.5	158.1	
85	36.3	2881.1	208.8	379.0	
80	99.3	2807.1	203.5	1010.5	
75	215.3	2734.4	198.4	2135.3	
70	357.6	2663.0	193.3	3455.6	
65	463.3	2592.6	188.3	4360.9	
60	500.4	2539.5	184.5	4615.5	
55	482.0	2486.7	180.7	4355.1	
50	447.6	2439.7	177.4	3969.3	
45	422.7	2392.6	174.0	3677.6	
40	413.7	2345.5	170.7	3530.0	
35	417.0	2298.5	167.3	3488.2	
30	417.4	2251.4	163.9	3421.6	
25	395.2	2204.3	160.6	3173.4	
20	336.9	2157.3	157.2	2648.8	
15	252.8	2110.2	153.9	1945.2	
10	165.7	2063.2	150.5	1247.2	
5	96.3	2016.1	147.2	708.7	
0	50.9	1969.0	143.8	366.1	
-5	25.3	1922.0	140.5	177.7	
-6	21.1	1912.5	139.8	147.5	
Total Costs				$48971.2	

PERIMETER HEATING PLANT COSTS

Job Name : CCF SUBCON 2/4F 1975S SYS — Date : 11-25-86

Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:

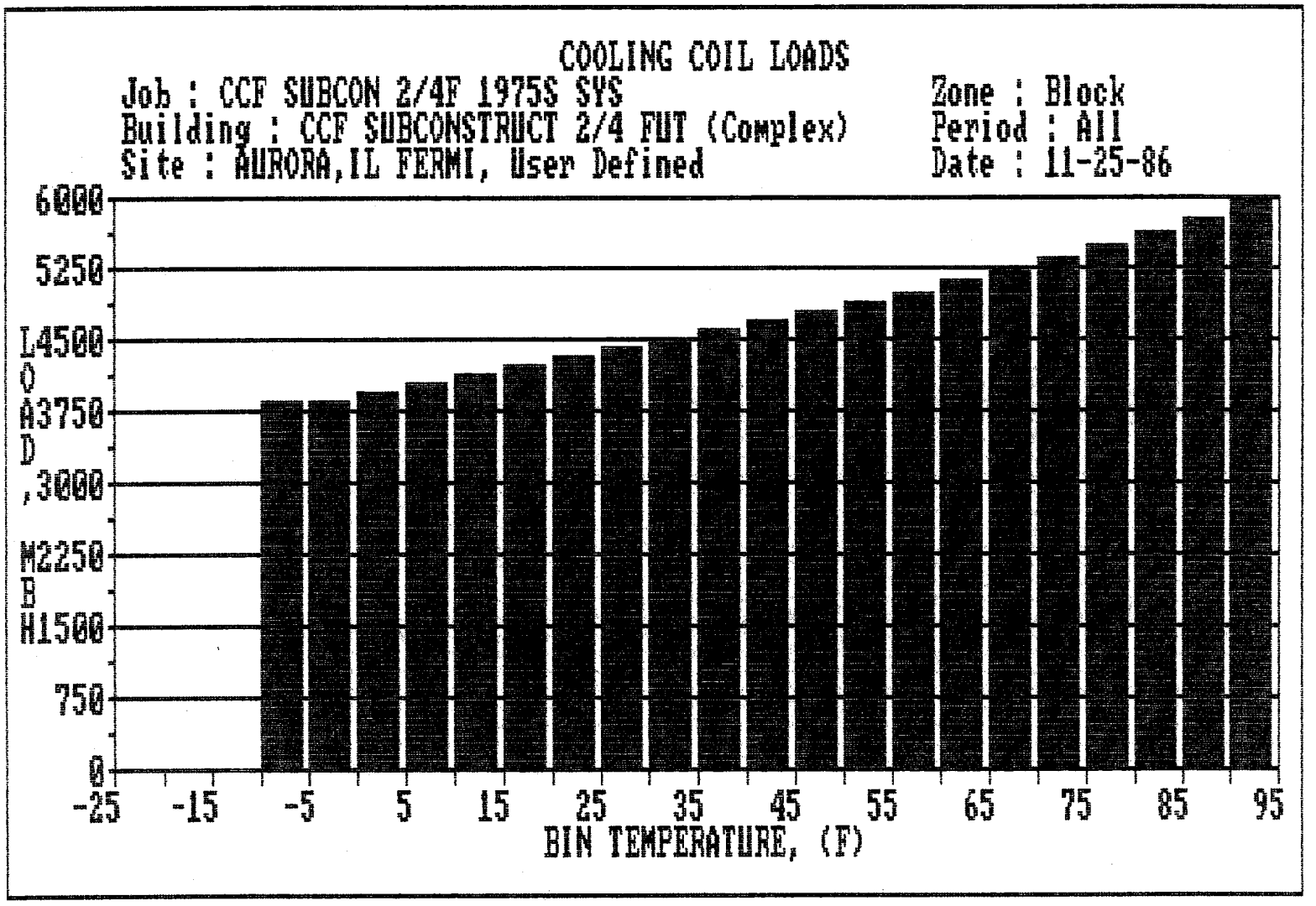
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

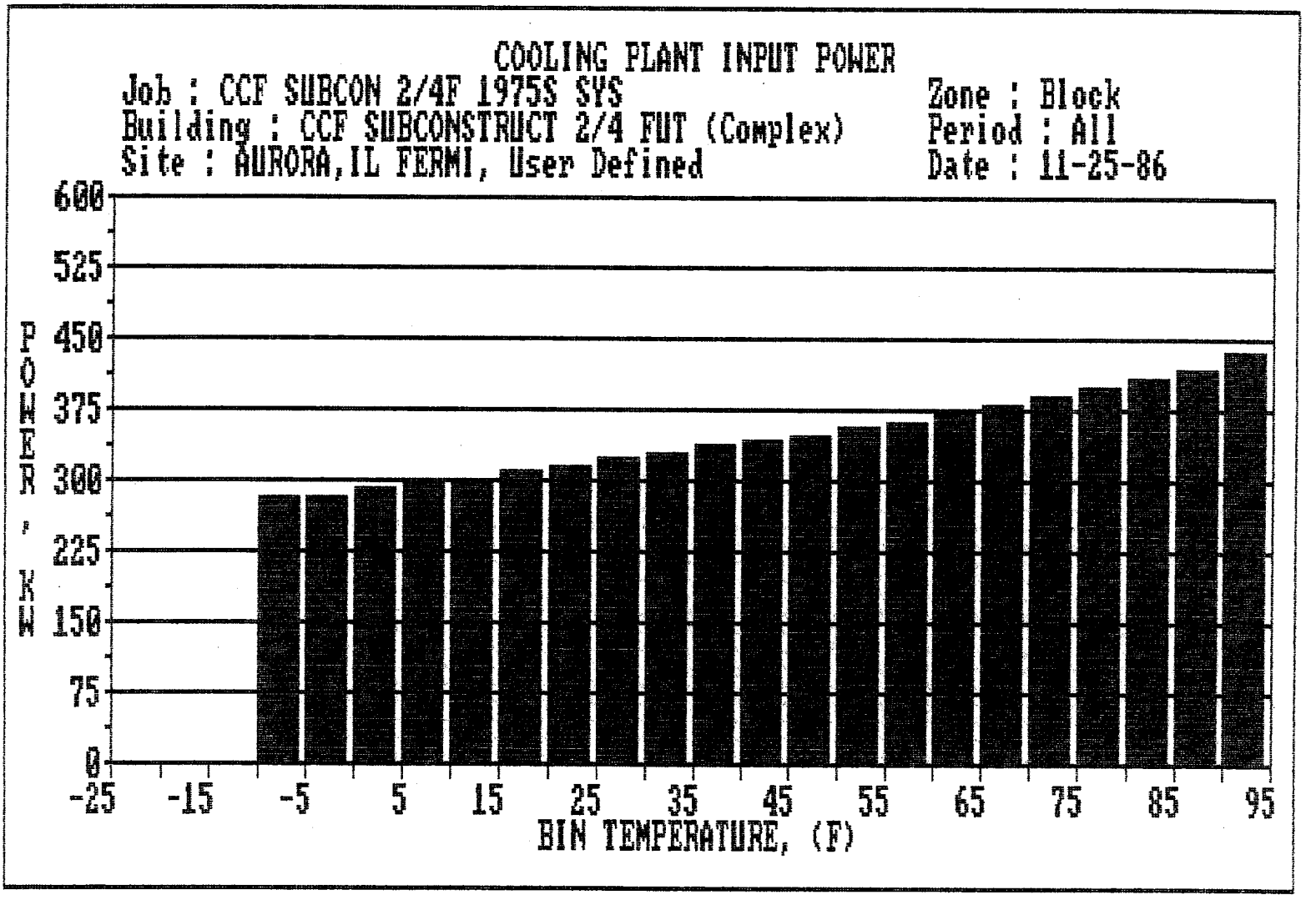
Bin Temp (F)	Bin Hours hr/yr	Coil Load MBH	Primary Plant Output MBH	Input KW	Cost $/yr	No Auxiliary Plant Used
			OCCUPIED PERIOD			
90	25.8	0.0	0.0	0.0	0.0	
85	59.4	0.0	0.0	0.0	0.0	
80	145.3	0.0	0.0	0.0	0.0	
75	237.7	0.0	0.0	0.0	0.0	
70	270.6	0.0	0.0	0.0	0.0	
65	264.5	0.0	0.0	0.0	0.0	
60	255.0	0.0	0.0	0.0	0.0	
55	244.7	0.0	0.0	0.0	0.0	
50	232.1	0.0	0.0	0.0	0.0	
45	229.5	0.0	0.0	0.0	0.0	
40	237.6	0.0	0.0	0.0	0.0	
35	238.5	0.0	0.0	0.0	0.0	
30	218.2	0.0	0.0	0.0	0.0	
25	174.5	0.0	0.0	0.0	0.0	
20	122.4	0.0	0.0	0.0	0.0	
15	78.1	0.0	0.0	0.0	0.0	
10	46.1	0.0	0.0	0.0	0.0	
5	25.1	0.0	0.0	0.0	0.0	
0	12.7	0.0	0.0	0.0	0.0	
-5	6.2	0.0	0.0	0.0	0.0	
-6	4.6	0.0	0.0	0.0	0.0	
Total Costs					$0.0	
			UNOCCUPIED PERIOD			
90	14.6	0.0	0.0	0.0	0.0	
85	36.3	0.0	0.0	0.0	0.0	
80	99.3	0.0	0.0	0.0	0.0	
75	215.3	0.0	0.0	0.0	0.0	
70	357.6	0.0	0.0	0.0	0.0	
65	463.3	0.0	0.0	0.0	0.0	
60	500.4	0.0	0.0	0.0	0.0	
55	482.0	0.0	0.0	0.0	0.0	
50	447.6	0.0	0.0	0.0	0.0	
45	422.7	0.0	0.0	0.0	0.0	
40	413.7	0.0	0.0	0.0	0.0	
35	417.0	0.0	0.0	0.0	0.0	
30	417.4	0.0	0.0	0.0	0.0	
25	395.2	0.0	0.0	0.0	0.0	
20	336.9	0.0	0.0	0.0	0.0	
15	252.8	0.0	0.0	0.0	0.0	
10	165.7	0.0	0.0	0.0	0.0	
5	96.3	0.0	0.0	0.0	0.0	
0	50.9	0.0	0.0	0.0	0.0	
-5	25.3	0.0	0.0	0.0	0.0	
-6	21.1	0.0	0.0	0.0	0.0	
Total Costs					$0.0	

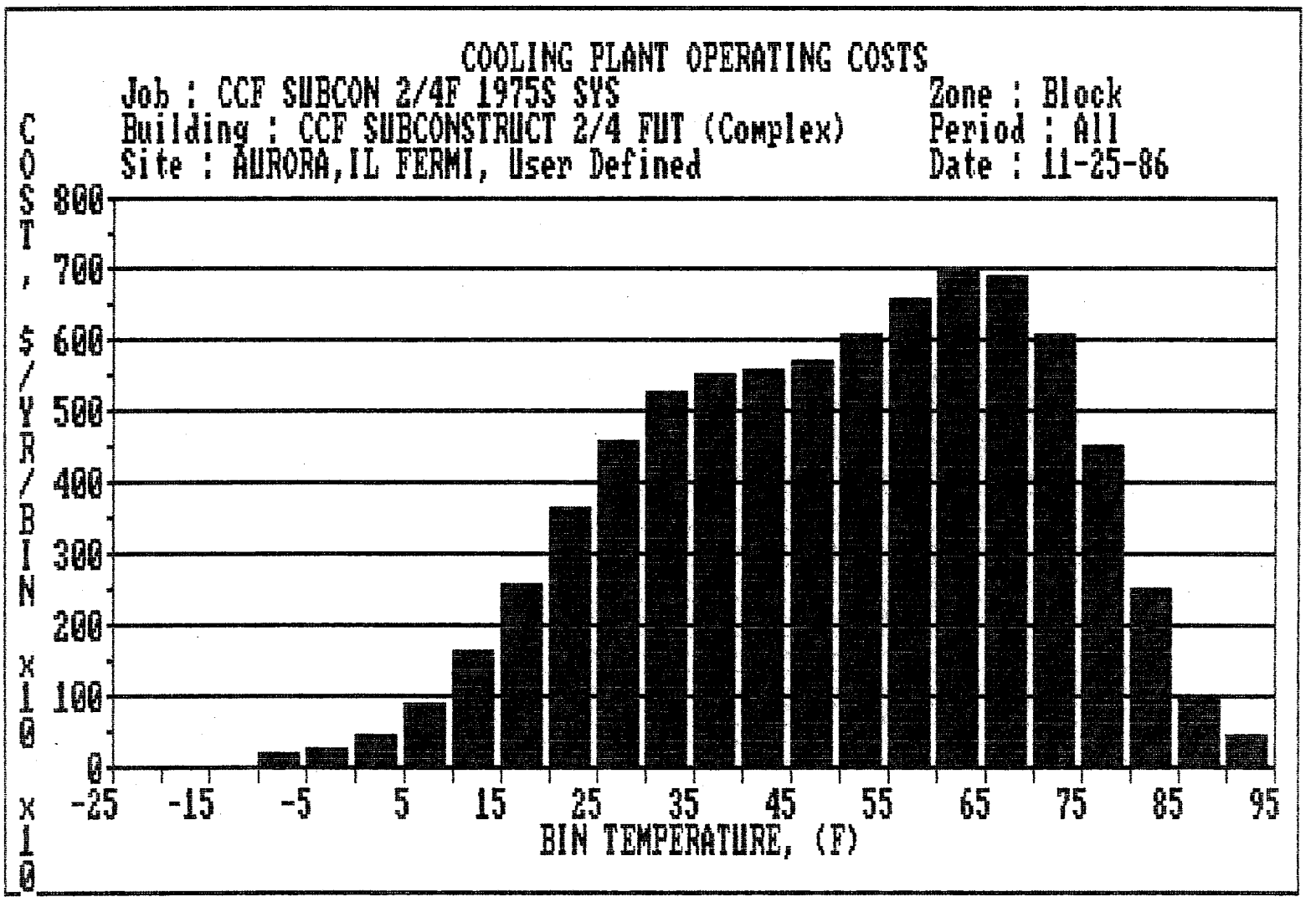
FAN AND PUMP COSTS

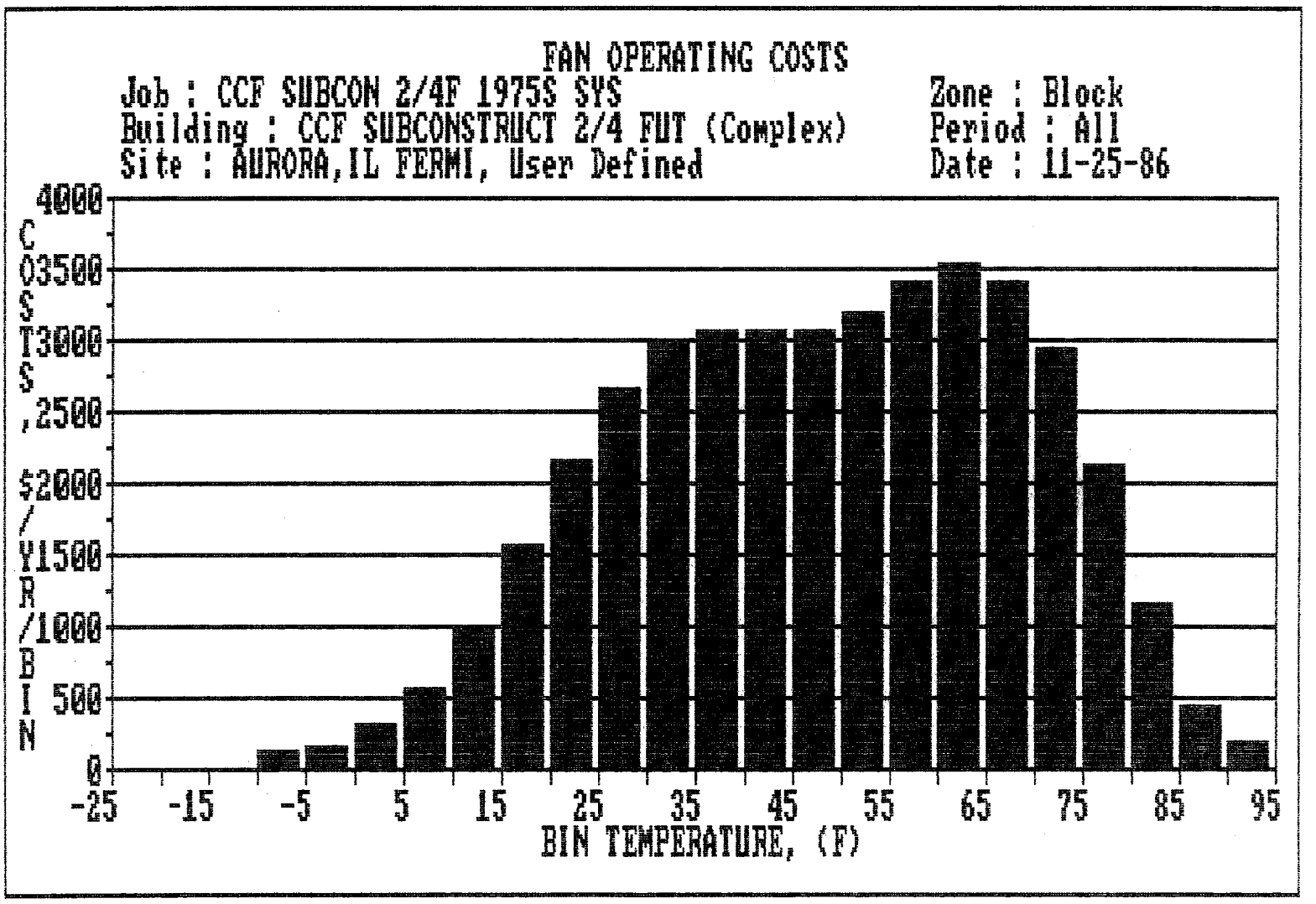
Job Name : CCF SUBCON 2/4F 1975S SYS — Date : 11-25-86
Building Name : CCF SUBCONSTRUCT 2/4 FUT (Complex) — Serial Number:
Site Name : AURORA,IL FERMI, User Defined — 60117862.0

Bin Temp (F)	Bin Hours hr/yr	Perimeter Input KW	Fans Cost $/yr	No Interior Zone	All Pumps Input KW	All Pumps Cost $/yr
OCCUPIED PERIOD						
90	25.8	93.7	120.9		21.1	27.2
85	59.4	93.7	278.3		21.1	62.6
80	145.3	93.7	680.8		21.1	153.1
75	237.7	93.7	1113.7		21.1	250.4
70	270.6	93.7	1267.9		21.1	285.1
65	264.5	93.7	1239.3		21.1	278.7
60	255.0	93.7	1194.8		21.1	268.7
55	244.7	93.7	1146.5		21.1	257.8
50	232.1	93.7	1087.5		21.1	244.5
45	229.5	93.7	1075.3		21.1	241.8
40	237.6	93.7	1113.3		21.1	250.3
35	238.5	93.7	1117.5		21.1	251.3
30	218.2	93.7	1022.4		21.1	229.9
25	174.5	93.7	817.6		21.1	183.8
20	122.4	93.7	573.5		21.1	129.0
15	78.1	93.7	365.9		21.1	82.3
10	46.1	93.7	216.0		21.1	48.6
5	25.1	93.7	117.6		21.1	26.4
0	12.7	93.7	59.5		21.1	13.4
-5	6.2	93.7	29.1		21.1	6.5
-6	4.6	93.7	21.6		21.1	4.8
Total Costs			$14659.1			$3296.2
UNOCCUPIED PERIOD						
90	14.6	93.7	68.4		21.1	15.4
85	36.3	93.7	170.1		21.1	38.2
80	99.3	93.7	465.3		21.1	104.6
75	215.3	93.7	1008.8		21.1	226.8
70	357.6	93.7	1675.5		21.1	376.8
65	463.3	93.7	2170.8		21.1	488.1
60	500.4	93.7	2344.6		21.1	527.2
55	482.0	93.7	2258.4		21.1	507.8
50	447.6	93.7	2097.2		21.1	471.6
45	422.7	93.7	1980.6		21.1	445.3
40	413.7	93.7	1938.4		21.1	435.9
35	417.0	93.7	1953.9		21.1	439.3
30	417.4	93.7	1955.7		21.1	439.8
25	395.2	93.7	1851.7		21.1	416.4
20	336.9	93.7	1578.5		21.1	354.9
15	252.8	93.7	1184.5		21.1	266.3
10	165.7	93.7	776.4		21.1	174.6
5	96.3	93.7	451.2		21.1	101.5
0	50.9	93.7	238.5		21.1	53.6
-5	25.3	93.7	118.5		21.1	26.7
-6	21.1	93.7	98.9		21.1	22.2
Total Costs			$26386.0			$5933.0


COOLING COIL LOADS
Job : CCF SUBCON 2/4F 1975S SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
6000
5250
L4500
O
A3750
D
,3000
M2250
B
H1500
750
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT INPUT POWER
Job : CCF SUBCON 2/4F 1975S SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
POWER, KW
600
525
450
375
300
225
150
75
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


COOLING PLANT OPERATING COSTS
Job : CCF SUBCON 2/4F 1975$ SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COST, $/YR/BIN x10 x10
800
700
600
500
400
300
200
100
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)


FAN OPERATING COSTS
Job : CCF SUBCON 2/4F 1975$ SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
COSTS $/YR/BIN
4000
3500
3000
2500
2000
1500
1000
500
0
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE SYSTEMS LIFE CYCLE COST ANALYSIS AND PAYBACK CALCULATIONS

12 NOVEMBER, 1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
LIFE CYCLE COST ANALYSIS
FOR
DESIGN BASIS SYSTEM
DX AC UNITS WITH FREE COOLING AND FOUR STEP HI-EFF. COMPRESSORS

12 NOVEMBER,1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

PROJECT NAME : CCF SUBCON 2/4F DESIGN SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 598000

ESTIMATE YEAR : 1986
COMMISSION YEAR : 1988
LAST STUDY YEAR : 2008

**** NON-FINANCED CASH DEBITS/CREDITS ****

YEAR	AMOUNT
1986	598000.00

**** FINANCE INSTRUMENTS ****

NOTE 1 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

NOTE 2 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

**** FUEL COSTS ****

1986 EST. OF FUEL 1 = $ 62315.00 (ELEC.)
2 = $ 0.00
3 = $ 0.00

**** MAINTENANCE COST ****

1986 EST. OF MAINT. = $ 2000.00

**** DISCOUNT/INTEREST/ESCALATION RATES ****

		FINANCE %		ESCALATION %			
YEAR	% DISC.	LOAN1	LOAN2	FUEL1	FUEL2	FUEL3	MAIN.
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1987	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1988	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1989	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1990	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1991	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1992	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1993	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1994	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1995	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1996	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1997	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1998	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1999	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2000	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2001	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2002	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2003	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2004	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2005	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2006	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2007	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2008	7.90	0.00	0.00	8.80	0.00	0.00	9.00

**** UNIFIED PRESENT WORTH LIFE CYCLE COST ****

PROJECT NAME : CCF SUBCON 2/4F DESIGN SYS
ANALYST NAME : S.F.KRSTULOVICH
COMMENTS : 598000

YEAR		1986	1987	1988	1989	1990
CASH	$	598000.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	0.00	0.00	62893.86	63418.47	63947.45
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	0.00	0.00	2040.99	2061.79	2082.81
YEAR'S	$	598000.00	0.00	64934.86	65480.25	66030.26
CUM.	$	598000.00	598000.00	662934.88	728415.12	794445.38

YEAR		1991	1992	1993	1994	1995
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	64480.84	65018.68	65561.01	66107.86	66659.27
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2104.05	2125.50	2147.16	2169.05	2191.17
YEAR'S	$	66584.88	67144.18	67708.17	68276.91	68850.44
CUM.	$	861030.25	928174.44	995882.62	1064159.50	1133010.00

YEAR		1996	1997	1998	1999	2000
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	67215.28	67775.93	68341.26	68911.30	69486.09
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2213.51	2236.07	2258.87	2281.90	2305.16
YEAR'S	$	69428.79	70012.01	70600.13	71193.20	71791.25
CUM.	$	1202438.75	1272450.75	1343050.88	1414244.12	1486035.38

YEAR		2001	2002	2003	2004	2005
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	70065.69	70650.11	71239.41	71833.62	72432.79
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2328.66	2352.40	2376.38	2400.61	2425.08
YEAR'S	$	72394.34	73002.51	73615.78	74234.23	74857.87
CUM.	$	1558429.75	1631432.25	1705048.00	1779282.25	1854140.12

YEAR		2006	2007	2008	2009	2010
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	73036.96	73646.16	74260.45	0.00	0.00
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2449.80	2474.78	2500.01	0.00	0.00
YEAR'S	$	75486.76	76120.95	76760.47	0.00	0.00
CUM.	$	1929626.88	2005747.88	2082508.38	2082508.38	2082508.38

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
LIFE CYCLE COST ANALYSIS
FOR
ALTERNATE SYSTEM NUMBER 1
DX AC UNITS WITH HI-EFFICIENCY COMPRESSORS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

PROJECT NAME : CCF SUBCON 2/4F STDAC SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 564000

ESTIMATE YEAR : 1986
COMMISSION YEAR : 1988
LAST STUDY YEAR : 2008

**** NON-FINANCED CASH DEBITS/CREDITS ****

YEAR	AMOUNT
1986	564000.00

**** FINANCE INSTRUMENTS ****

NOTE 1 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

NOTE 2 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

**** FUEL COSTS ****

1986 EST. OF FUEL 1 = $ 103594.00 (ELEC.)
2 = $ 0.00
3 = $ 0.00

**** MAINTENANCE COST ****

1986 EST. OF MAINT. = $ 2000.00

**** DISCOUNT/INTEREST/ESCALATION RATES ****

		FINANCE %		ESCALATION %			
YEAR	% DISC.	LOAN1	LOAN2	FUEL1	FUEL2	FUEL3	MAIN.
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1987	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1988	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1989	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1990	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1991	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1992	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1993	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1994	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1995	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1996	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1997	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1998	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1999	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2000	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2001	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2002	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2003	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2004	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2005	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2006	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2007	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2008	7.90	0.00	0.00	8.80	0.00	0.00	9.00

**** UNIFIED PRESENT WORTH LIFE CYCLE COST ****

PROJECT NAME : CCF SUBCON 2/4F STDAC SYS
ANALYST NAME : S.F.KRSTULOVICH
COMMENTS : 564000

YEAR		1986	1987	1988	1989	1990
CASH	$	564000.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	0.00	0.00	104556.31	105428.43	106307.82
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	0.00	0.00	2040.99	2061.79	2082.81
YEAR'S	$	564000.00	0.00	106597.31	107490.23	108390.63
CUM.	$	564000.00	564000.00	670597.31	778087.56	886478.19

YEAR		1991	1992	1993	1994	1995
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	107194.56	108088.67	108990.26	109899.35	110816.03
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2104.05	2125.50	2147.16	2169.05	2191.17
YEAR'S	$	109298.60	110214.17	111137.42	112068.41	113007.20
CUM.	$	995776.81	1105991.00	1217128.38	1329196.75	1442204.00

YEAR		1996	1997	1998	1999	2000
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	111740.36	112672.40	113612.20	114559.86	115515.41
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2213.51	2236.07	2258.87	2281.90	2305.16
YEAR'S	$	113953.87	114908.47	115871.08	116841.76	117820.58
CUM.	$	1556157.88	1671066.38	1786937.50	1903779.25	2021599.88

YEAR		2001	2002	2003	2004	2005
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	116478.95	117450.50	118430.16	119418.00	120414.07
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2328.66	2352.40	2376.38	2400.61	2425.08
YEAR'S	$	118807.60	119802.91	120806.55	121818.61	122839.15
CUM.	$	2140407.50	2260210.50	2381017.00	2502835.50	2625674.80

YEAR		2006	2007	2008	2009	2010
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	121418.46	122431.23	123452.44	0.00	0.00
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2449.80	2474.78	2500.01	0.00	0.00
YEAR'S	$	123868.27	124906.00	125952.44	0.00	0.00
CUM.	$	2749543.00	2874449.00	3000401.50	3000401.50	3000401.50

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
LIFE CYCLE COST ANALYSIS
FOR
ALTERNATE SYSTEM NUMBER 2
FY1975 DX AC UNITS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

PROJECT NAME : CCF SUBCON 2/4F 1975S SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 535000

ESTIMATE YEAR : 1986
COMMISSION YEAR : 1988
LAST STUDY YEAR : 2008

**** NON-FINANCED CASH DEBITS/CREDITS ****

YEAR	AMOUNT
1986	535000.00

**** FINANCE INSTRUMENTS ****

NOTE 1 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

NOTE 2 PRINCIPAL (1986 EST.) = $ 0.00
(0 EST.) = $ 0.00
INSTRUMENT = NONE

**** FUEL COSTS ****

1986 EST. OF FUEL 1 = $ 127334.00 (ELEC.)
2 = $ 0.00
3 = $ 0.00

**** MAINTENANCE COST ****

1986 EST. OF MAINT. = $ 2000.00

**** DISCOUNT/INTEREST/ESCALATION RATES ****

		FINANCE %		ESCALATION %			
YEAR	% DISC.	LOAN1	LOAN2	FUEL1	FUEL2	FUEL3	MAIN.
1986	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1987	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1988	7.90	0.00	0.00	8.40	0.00	0.00	9.00
1989	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1990	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1991	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1992	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1993	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1994	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1995	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1996	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1997	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1998	7.90	0.00	0.00	8.80	0.00	0.00	9.00
1999	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2000	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2001	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2002	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2003	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2004	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2005	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2006	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2007	7.90	0.00	0.00	8.80	0.00	0.00	9.00
2008	7.90	0.00	0.00	8.80	0.00	0.00	9.00

**** UNIFIED PRESENT WORTH LIFE CYCLE COST ****

PROJECT NAME : CCF SUBCON 2/4F 1975S SYS
ANALYST NAME : S.F.KRSTULOVICH
COMMENTS : 535000

YEAR		1986	1987	1988	1989	1990
CASH	$	535000.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	0.00	0.00	128516.85	129588.82	130669.73
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	0.00	0.00	2040.99	2061.79	2082.81
YEAR'S	$	535000.00	0.00	130557.84	131650.61	132752.55
CUM.	$	535000.00	535000.00	665557.88	797208.50	929961.06

YEAR		1991	1992	1993	1994	1995
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	131759.67	132858.69	133966.88	135084.31	136211.05
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2104.05	2125.50	2147.16	2169.05	2191.17
YEAR'S	$	133863.72	134984.19	136114.05	137253.36	138402.22
CUM.	$	1063824.75	1198809.00	1334923.00	1472176.38	1610578.62

YEAR		1996	1997	1998	1999	2000
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	137347.19	138492.81	139648.00	140812.81	141987.33
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2213.51	2236.07	2258.87	2281.90	2305.16
YEAR'S	$	139560.69	140728.88	141906.88	143094.70	144292.50
CUM.	$	1750139.25	1890868.12	2032775.00	2175869.80	2320162.20

YEAR		2001	2002	2003	2004	2005
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	143171.67	144365.88	145570.03	146784.25	148008.58
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2328.66	2352.40	2376.38	2400.61	2425.08
YEAR'S	$	145500.33	146718.28	147946.41	149184.86	150433.66
CUM.	$	2465662.50	2612380.80	2760327.20	2909512.00	3059945.80

YEAR		2006	2007	2008	2009	2010
CASH	$	0.00	0.00	0.00	0.00	0.00
MORT.1	$	0.00	0.00	0.00	0.00	0.00
MORT.2	$	0.00	0.00	0.00	0.00	0.00
FUEL 1	$	149243.13	150487.98	151743.20	0.00	0.00
FUEL 2	$	0.00	0.00	0.00	0.00	0.00
FUEL 3	$	0.00	0.00	0.00	0.00	0.00
MAINT.	$	2449.80	2474.78	2500.01	0.00	0.00
YEAR'S	$	151692.94	152962.75	154243.22	0.00	0.00
CUM.	$	3211638.80	3364601.50	3518844.80	3518844.80	3518844.80

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
LIFE CYCLE COST ANALYSIS
UNIFIED PRESENT WORTH COMPARISONS
FOR
ALL SYSTEMS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

**** UPW LIFE CYCLE COST COMPARISON ****

FILE NO. : LCC9.DAT
PROJECT : CCF SUBCON 2/4F DESIGN SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 598000

FILE NO. : LCC10.DAT
PROJECT : CCF SUBCON 2/4F STDAC SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 564000

YEAR	(A) FILE 1 $	(B) FILE 2 $	(A-B) YR'S $	(A-B) CUM. $
1986	598000.00	564000.00	34000.00	34000.00
1987	0.00	0.00	0.00	34000.00
1988	64934.86	106597.30	-41662.44	-7662.44
1989	65480.25	107490.20	-42009.95	-49672.39
1990	66030.26	108390.60	-42360.34	-92032.74
1991	66584.88	109298.60	-42713.72	-134746.47
1992	67144.18	110214.20	-43070.02	-177816.50
1993	67708.17	111137.40	-43429.23	-221245.73
1994	68276.91	112068.40	-43791.49	-265037.22
1995	68850.44	113007.20	-44156.77	-309194.00
1996	69428.79	113953.90	-44525.11	-353719.12
1997	70012.01	114908.50	-44896.49	-398615.62
1998	70600.13	115871.10	-45270.97	-443886.59
1999	71193.20	116841.80	-45648.59	-489535.19
2000	71791.25	117820.60	-46029.35	-535564.56
2001	72394.34	118807.60	-46413.26	-581977.88
2002	73002.51	119802.90	-46800.39	-628778.25
2003	73615.78	120806.50	-47190.72	-675969.00
2004	74234.23	121818.60	-47584.38	-723553.38
2005	74857.87	122839.10	-47981.23	-771534.62
2006	75486.76	123868.30	-48381.54	-819916.19
2007	76120.95	124906.00	-48785.05	-868701.25
2008	76760.47	125952.40	-49191.93	-917893.12

*** APPARENT BREAK-EVEN YEAR = 1988 ***

**** UPW LIFE CYCLE COST COMPARISON ****

FILE NO. : LCC9.DAT
PROJECT : CCF SUBCON 2/4F DESIGN SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 598000

FILE NO. : LCC11.DAT
PROJECT : CCF SUBCON 2/4F 1975S SYS
ANALYST : S.F.KRSTULOVICH
COMMENTS : 535000

YEAR	(A) FILE 1 $	(B) FILE 2 $	(A-B) YR'S $	(A-B) CUM. $
1986	598000.00	535000.00	63000.00	63000.00
1987	0.00	0.00	0.00	63000.00
1988	64934.86	130557.80	-65622.94	-2622.94
1989	65480.25	131650.59	-66170.34	-68793.28
1990	66030.26	132752.50	-66722.24	-135515.53
1991	66584.88	133863.70	-67278.82	-202794.38
1992	67144.18	134984.20	-67840.02	-270634.38
1993	67708.17	136114.00	-68405.83	-339040.19
1994	68276.91	137253.41	-68976.50	-408016.69
1995	68850.44	138402.20	-69551.77	-477568.44
1996	69428.79	139560.70	-70131.91	-547700.31
1997	70012.01	140728.91	-70716.90	-618417.25
1998	70600.13	141906.91	-71306.77	-689724.00
1999	71193.20	143094.70	-71901.50	-761625.50
2000	71791.25	144292.50	-72501.25	-834126.75
2001	72394.34	145500.30	-73105.95	-907232.75
2002	73002.51	146718.30	-73715.79	-980948.50
2003	73615.78	147946.41	-74330.63	-1055279.12
2004	74234.23	149184.91	-74950.68	-1130229.75
2005	74857.87	150433.70	-75575.84	-1205805.62
2006	75486.76	151692.91	-76206.15	-1282011.75
2007	76120.95	152962.80	-76841.84	-1358853.50
2008	76760.47	154243.20	-77482.73	-1436336.25

*** APPARENT BREAK-EVEN YEAR = 1988 ***

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
SIMPLE PAYBACK CALCULATIONS
FOR
ALL SYSTEMS

12 NOVEMBER, 1986
ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

CCF SUBCONSTRUCT 2/4F
SIMPLE PAYBACK

INPUT VALUES	DESIGN SYS	STD AC SYS
INITIAL TOTAL COST	$ 598,000	$ 564,000
ANNUAL OPERATING COST	$ 62,315	$ 103,594
ANNUAL MAINTENANCE COST	$ 4,000	$ 4,000
SALVAGE VALUE AT YEAR 20	$ 0	$ 0

	DESIGN SYS EXPENSES		STD AC SYS EXPENSES	
YEAR	ANNUAL	CUMULATIVE	ANNUAL	CUMULATIVE
INITIAL	$ 598,000	$ 598,000	$ 564,000	$ 564,000
1	$ 66,315	$ 664,315	$ 107,594	$ 671,594
2	$ 66,315	$ 730,630	$ 107,594	$ 779,188
3	$ 66,315	$ 796,945	$ 107,594	$ 886,782
4	$ 66,315	$ 863,260	$ 107,594	$ 994,376
5	$ 66,315	$ 929,575	$ 107,594	$1,101,970
6	$ 66,315	$ 995,890	$ 107,594	$1,209,564
7	$ 66,315	$1,062,205	$ 107,594	$1,317,158
8	$ 66,315	$1,128,520	$ 107,594	$1,424,752
9	$ 66,315	$1,194,835	$ 107,594	$1,532,346
10	$ 66,315	$1,261,150	$ 107,594	$1,639,940
11	$ 66,315	$1,327,465	$ 107,594	$1,747,534
12	$ 66,315	$1,393,780	$ 107,594	$1,855,128
13	$ 66,315	$1,460,095	$ 107,594	$1,962,722
14	$ 66,315	$1,526,410	$ 107,594	$2,070,316
15	$ 66,315	$1,592,725	$ 107,594	$2,177,910
16	$ 66,315	$1,659,040	$ 107,594	$2,285,504
17	$ 66,315	$1,725,355	$ 107,594	$2,393,098
18	$ 66,315	$1,791,670	$ 107,594	$2,500,692
19	$ 66,315	$1,857,985	$ 107,594	$2,608,286
20	$ 66,315	$1,924,300	$ 107,594	$2,715,880
SALVAGE	($ 0)	$1,924,300	($ 0)	$2,715,880

PAYBACK FOR DESIGN SYS OCCURS AFTER 0.8 YEARS ($ 652,621)

TOTAL COST OF DESIGN SYS FOR 20 YEARS IS $1,924,300
TOTAL COST OF STD AC SYS FOR 20 YEARS IS $2,715,880

CCF SUBCONSTRUCT 2/4F
SIMPLE PAYBACK

INPUT VALUES	DESIGN SYS	1975S SYS
INITIAL TOTAL COST	$ 598,000	$ 535,000
ANNUAL OPERATING COST	$ 62,315	$ 127,334
ANNUAL MAINTENANCE COST	$ 4,000	$ 4,000
SALVAGE VALUE AT YEAR 20	$ 0	$ 0

	DESIGN SYS EXPENSES		1975S SYS EXPENSES	
YEAR	ANNUAL	CUMULATIVE	ANNUAL	CUMULATIVE
INITIAL	$ 598,000	$ 598,000	$ 535,000	$ 535,000
1	$ 66,315	$ 664,315	$ 131,334	$ 666,334
2	$ 66,315	$ 730,630	$ 131,334	$ 797,668
3	$ 66,315	$ 796,945	$ 131,334	$ 929,002
4	$ 66,315	$ 863,260	$ 131,334	$1,060,336
5	$ 66,315	$ 929,575	$ 131,334	$1,191,670
6	$ 66,315	$ 995,890	$ 131,334	$1,323,004
7	$ 66,315	$1,062,205	$ 131,334	$1,454,338
8	$ 66,315	$1,128,520	$ 131,334	$1,585,672
9	$ 66,315	$1,194,835	$ 131,334	$1,717,006
10	$ 66,315	$1,261,150	$ 131,334	$1,848,340
11	$ 66,315	$1,327,465	$ 131,334	$1,979,674
12	$ 66,315	$1,393,780	$ 131,334	$2,111,008
13	$ 66,315	$1,460,095	$ 131,334	$2,242,342
14	$ 66,315	$1,526,410	$ 131,334	$2,373,676
15	$ 66,315	$1,592,725	$ 131,334	$2,505,010
16	$ 66,315	$1,659,040	$ 131,334	$2,636,344
17	$ 66,315	$1,725,355	$ 131,334	$2,767,678
18	$ 66,315	$1,791,670	$ 131,334	$2,899,012
19	$ 66,315	$1,857,985	$ 131,334	$3,030,346
20	$ 66,315	$1,924,300	$ 131,334	$3,161,680
SALVAGE	($ 0)	$1,924,300	($ 0)	$3,161,680

PAYBACK FOR DESIGN SYS OCCURS AFTER 1.0 YEARS ($ 662,256)

TOTAL COST OF DESIGN SYS FOR 20 YEARS IS $1,924,300
TOTAL COST OF 1975S SYS FOR 20 YEARS IS $3,161,680

FERMILAB CENTRAL COMPUTING FACILITY

SUBCONSTRUCTION 2/4 FUTURE
DX AC UNITS OPERATIONAL DATA

12 NOVEMBER, 1986

ANALYST: S.F.KRSTULOVICH

FERMILAB CONSTRUCTION ENGINEERING SERVICES

TYPICAL OPERATING EFFICIENCIES FOR COMPUTER ROOM AIR CONDITIONERS
(DX SYSTEMS MANDATORY TO ATTAIN 42F DEWPOINT FOR 68F DB AT 45% RH)

TYPICAL STATE-OF-THE-ART UNITS WITH COMPRESSOR UNLOADERS AND A-COIL

COMPRESSOR PERFORMANCE PROFILE

4 STEPS FULL LOADED:	0.76KW/TON	100% CAPACITY
FIRST STEP UNLOADED:	0.67KW/TON	88% CAPACITY
SECOND STEP UNLOADED:	0.54KW/TON	76% CAPACITY
THIRD STEP UNLOADED:	0.57KW/TON	38% CAPACITY

FAN PERFORMANCE PROFILE

STATIC PRESSURE DROP WITH A-COIL CONFIGURATION: 2.50 INCHES WC

TYPICAL STATE-OF-THE-ART UNITS W/ STANDARD HI EFFICIENCY COMPRESSORS AND A-COIL

COMPRESSOR PERFORMANCE PROFILE

COMPRESSORS LOADED:	0.76KW/TON	100% capacity

FAN PERFORMANCE PROFILE

STATIC PRESSURE DROP WITH A-COIL CONFIGURATION: 2.50 INCHES WC

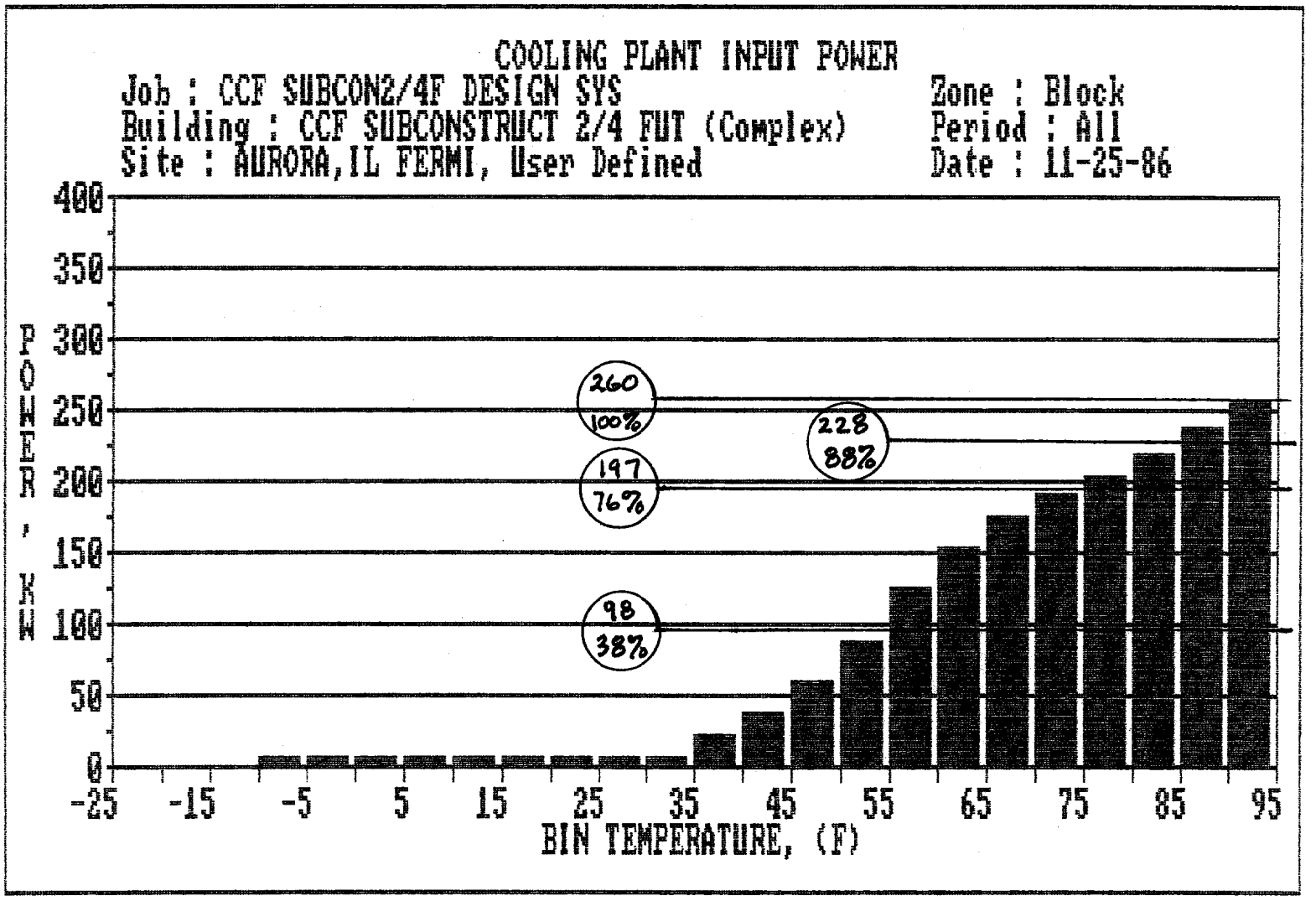
TYPICAL 1975 STYLE UNITS WITH STANDARD COMPRESSORS AND SLAB-COIL

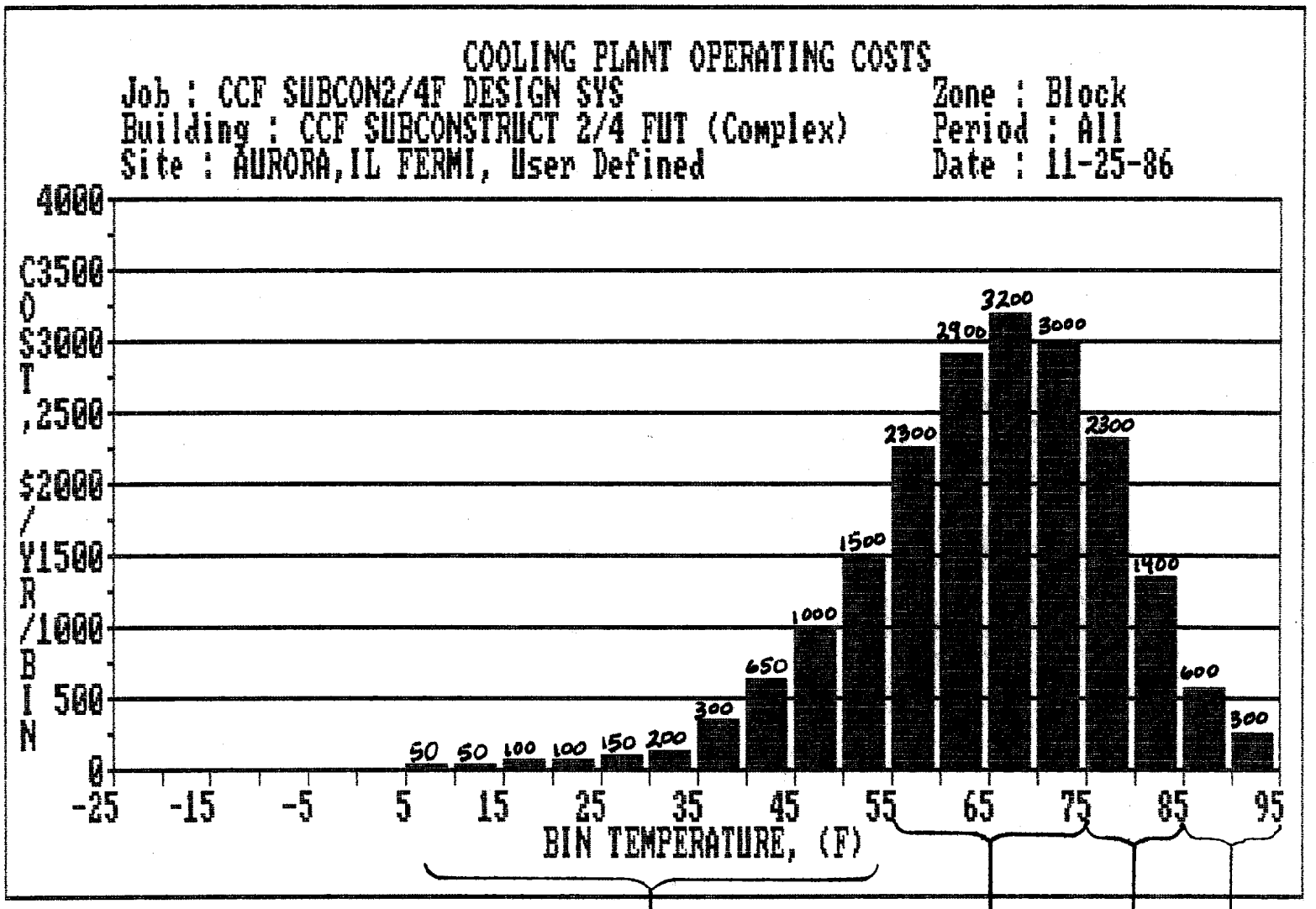
COMPRESSOR PERFORMANCE PROFILE

COMPRESSORS LOADED:	0.95KW/TON	100% CAPACITY

FAN PERFORMANCE PROFILE

STATIC PRESSURE DROP WITH SLAB-COIL CONFIGURATION: 3.00 INCHES WC


COOLING PLANT INPUT POWER
Job : CCF SUBCON2/4F DESIGN SYS
Building : CCF SUBCONSTRUCT 2/4 FUT (Complex)
Site : AURORA,IL FERMI, User Defined
Zone : Block
Period : All
Date : 11-25-86
POWER, KW
400
350
300
250
200
150
100
50
0
260
100%
197
76%
98
38%
228
88%
-25
-15
-5
5
15
25
35
45
55
65
75
85
95
BIN TEMPERATURE, (F)



4000x.57 = 2280

11400x.54=6156

3700x.67= 2479

900x.76=684

TOTAL= 11599 ÷ 20000 = .58 KW/TON AVG.