REVISION OF
THE
PRELIMINARY PROPOSAL
FOR

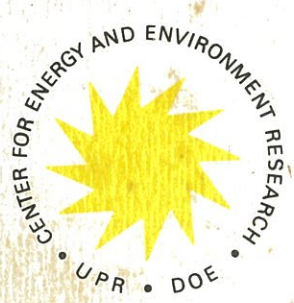
UPRATING THE AIR CONDITIONING UNIT, NEW WING, BIO-MEDICAL BUILDING

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
RIO PIEDRAS, PUERTO RICO

February, 1979

Prepared by;

SOLAR DIVISION
CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
CAPARRA HEIGHTS STATION
SAN JUAN, PUERTO RICO



CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
UNIVERSITY OF PUERTO RICO — U.S. DEPARTMENT OF ENERGY

CEER - PS-24

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I. Purpose and Source of Funds

The purpose of this revised proposal is to describe the requirements to upgrade the Air Conditioning System in the New Wing of the Bio-medical building, Center for Energy and Environment Research (C.E.E.R.), Río Piedras, Puerto Rico; to define the facilities in engineering terms and establish a reasonable budget cost estimate and time schedule, and to recommend an appropriate method of accomplishment.

Three main items will be addressed with this proposal:

1. Provide a reliable air conditioning system that will meet the needs of the laboratory and office building.
2. Use the thermal waste heat available from a 50,000 ft^2 Solar Photovoltaic Concentrator Array to be installed at the C.E.E.R. under a nation wide program sponsored by the U. S. Department of Energy.
3. Upgrade the building envelope and building ventilation and air handling systems to be in accordance with the present energy conservation regulations now being implemented in Puerto Rico.

As a final result of this proposal a dramatic reduction in operating cost for the air conditioning system in the New Wing of the C.E.E.R. will be obtained.

We propose that the design and construction for this work will be charged to General Plant Project FY-1978 under Sub-program 39-RT.

II. Justification of Basic Needs

A. C.E.E.R. New Wing present air conditioning system.

The air conditioning installation in the new wing of the Center for Energy and Environment Research (C.E.E.R.) was originally designed in 1968.

#6. Power Flow Diagram during the Peak Hour Insolation, including Solar Cooling

#7. General Information for Economic Analyses

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Although some energy conservation features were included in the original design, application of more advanced know-how, and new technology can reduce the energy consumption in the building significantly.

The building houses basically laboratory facilities and office areas.

The actual components of the building envelope are:

Windows:

Solar bronze glass (22 percent of wall area).

Walls:

a) Combination of insulated glass with concrete block back wall.

b) Concrete with cement plaster.

Roof Area:

Concrete with 2" rigid insulation.

The main component of the actual air conditioning load is the fresh air load. In accordance with the original drawings, 20,600 CFM of outside air is supplied to the building as ventilation. This constitutes 65 percent of the total air circulation.

The peak design load was 200 TR and 50 percent of this load was outside air load.

A terminal reheat with hot water was included in the original design to maintain room conditions.

The existing air conditioning system consists of two chiller units, each having two 60-ton reciprocating compressors and two condenser fan units with a total installed capacity of 240 TR. The chiller provides chilled water to the air handling units and circulating system which comprise the remainder of the air conditioning system.

B. Existing system operation

The fresh air intake to the main air handling unit was blocked in order to reduce the outside air load. Actual building internal conditions, due to this action, are unpleasant, because the necessary fresh air for the laboratory hoods enters the building across windows, open doors, cracks and return duct openings as infiltration with a resulting high humidity room condition. The terminal reheat system is out of service completely. The central chilled water plant is always partially or totally out of service. The four existing compressors are Worthington Model EVC6-S2 and are of poor design. They have had a history of unreliability since first installed, being subject to multiple, internal breakdowns causing complete destruction of their interior mechanism. This has resulted in partial or complete loss of chilled water for the system, for periods of three to four months while parts were procured and repairs made.

The maintenance history of this plant shows that on an average two compressors have been down continuously, awaiting spare parts and repair over the past five years. Major plant breakdowns occurred in 1972 and in 1976 when all compressors were down for a period of four months each due to compresor failure. At that time it was necessary to augment the system with window-type air conditioners in laboratories where temperature-humidity sensitive equipment was being used.

The compressors have required the constant service of an air conditioning mechanic and the expenditure of large sums of money for maintenance and replacement parts to keep the system operational over the past six years. Maintenance problems have been compounded by the fact that the compressors are no longer manufactured, making spare parts difficult to find.

The following is a breakdown of expenditures made by the C.E.E.R. from operating funds to keep the chiller unit operational:

Fiscal Year	Materials & Supplies	Air Cond. Tech. Salary
1972	$ 2,833	$ 9,100
1973	8,628	9,100
1974	3,022	9,100
1975	9,933	9,100
1976	5,952	9,100
1977	9,232	4,500
Total	$ 39,600	$ 50,000
Grand Total	$89,600	

The annual cost of maintenance of this unit has taken such a large portion of the maintenance budget for the Bio-Medical building that it has been necessary to cut back on essential maintenance of the physical plant in order to have sufficient funds to keep the chiller unit operational. It is not considered economical or feasible to keep expending large amounts of money to repair a chiller system which is of inherently poor design and incapable of reliable operation.

The real loss is to the laboratory and treatment areas for the Nuclear Medicine Programs which require a continuous and reliable source of air conditioning in order to promote scientific research and patient comfort.

C. Electric energy consumption of the existing central chilled water plant.

An estimate of more than 40,000 KW H per month is actually used to operate just the central chilled water plant in the New Wing of the C.E.E.R. This electric energy with a total cost of more than $2,800.00 per month is

used to operate a non-reliable system with the result of an uncomfortable environmental condition inside the building.

III. General Description of the Proposed Revision

A. Building upgrade for energy conservation.

In order to reduce the air conditioning load the following energy conservation measures seem to be imperative and are strongly recommended:

1) Provide all glass areas with Schochtint solar control film to minimize radiation load.
2) Provide inside venetian blinds for all windows.
3) Provide additional insulation at roof level with a three inch fiberglass matt above the hung ceiling at second floor.
4) Reduce the ventilation to the building. This can be accomplished by several ways as follows:
   4.1) Rebalance all supply and exhaust systems to the laboratory hoods to reduce the total air each system exhausts to the exterior.
   4.2) Reducing the ventilation air to other areas to the minimum recommended per the ASHRAE 90-75 and 62-73 standards.
   4.3) Provide an automatic control of the fresh air intake with static pressure sensors.
5) Make a total air rebalance and upgrading of the air side and controls.

6) Make a psychrometric study and provide controls as necessary in order to eliminate the reheat and maintain room conditions.

Items No. 1 and No. 2 above are already completed under an in-house conservation program.

Additional engineering is necessary to define the work of upgrading the building and the air conditioning system to provide a reduction to the refrigeration load.

B. Cooling load estimates for the "New Wing"

Using as a base the original set of construction drawings and considering the energy conservation features outlined in Section III, cooling load calculations for each month were performed. Load profiles were also prepared. The maximum hourly load was 113 TR at 4:00 p.m. for the average day in August. These calculations were prepared using the Automatic Procedures for Engineering Consultants, Inc. (APEC) program HCC-III. Attachment #1 and Attachment #2 include the computer print-out and the cooling load profiles, respectively. As indicated in the load profile chart for September 1978, a total of 917 TR x H/day are required to maintain building comfort conditions. The working day was considered from 8:00 a.m. to 5:00 p.m.

If we assume 250 working days per year and estimate the refrigeration work for the average day by the September data (i.e. 971 TR x H/day) the total yearly refrigeration work will be 197,750 TR x H/year or 697,941 KWH.

C- Concentrating Photovoltaic for the Tropics and its relation to the proposed revision

This project consists of a Solar Photovoltaic Concentrator Application for the Commonwealth of Puerto Rico. The application is unique in several aspects. First, it represents a total energy system designed to provide the electrical, cooling and thermal energy requirements of the Center for Energy and Environment Research (CEER) and hot water requirements of the adjacent Oncological and University Children's Hospitals, all located in the Medical Complex in San Juan. Second, the application will serve as a demonstration to Caribbean and Latin American Nations that solar energy in general and photovoltaics specifically can help them meet their energy needs while affording simultaneous relief from economic stress due to rising energy costs.

The project team consists of the Energy Office of the Commonwealth of Puerto Rico, Center for Energy and Environment Research of the University of Puerto Rico, TEAM, Inc. BHMG/Engineers, the AAI Corporation and Solarex Corporation.

The proposed system consists of a 20/1 concentrating first stage and a compound parabolic second stage with a concentration of about 2/1 to give an overall concentration ratio of 40/1. Solarex cells designed to operate with an efficiency of 10.9% at 100°C and 40 suns are to be incorporated into the second stage with a water cooling loop. The first stage utilizes flat segmented second surface glass mirrors in horizontal single axis east-west tracking mode. The expected overall array efficiency will be in the range 7.2-7.6%. The array has been sized at about 34,000 square feet of collectors to produce about 150 kW_e and about 1200 kW_{th} in form of hot water at 190°F.

The total electric peak power demand of CEER is about 425 KW_e. The major part of the load is the airconditioning (~85%). The electric and thermal energy generated by the photovoltaic array will be utilized to run a 70 ton electric direct expansion split system and two 120 ton absorption chillers respectively to meet the airconditioning demand of the CEER and to supply the hospitals with 110°F hot water.

The photovoltain array will be interfaced in parallel with the utility (PRWRA) power grid through a line-commutated inverter to supply electrical power when there is not enough solar radiation. Excess power generated on holidays or otherwise will be fed back into the power grid and credited to CEER. This mode of operation eliminates the large investment and the maintenance cost associated with conventional batteries and represents a very useful and practical system where the utility grid replaces the storage.

This project in its first phase is one of the six projects of the concentrating type funded by DOE under the "Photovoltaics Technology Development and Applications Program." The overall objective of this program is "to bring the photovoltaic energy systems to the point where they are able to supply a significant portion of the nations energy requirements thus to reduce systems costs while at the same time resolving the technical, environmental and social issues involved in fostering widespread adoption of photovoltaic power systems."

D. Conceptual design schematic

In the solar collector piping diagram (Attachment #3) all elements indicated by single lines are parts of the photovoltaic project. These are:

PHVA	-	Photovoltaic collector array
HWT	-	Hot water storage tank
P1	-	Solar collector water recirculation pump
SCS	-	Solar collector supply lines
SCR	-	Solar collector return lines
ACFC	-	Air cooled fluid cooler
SH	-	Steam heating coil

—Surge tank and hot water services to hospitals.

All elements indicated by double lines in the same diagram as well as all elements included in the chilled water and condensing water piping diagram (Attachment #4) are parts of this revision. These are:

ACH-1	-	Absorption chiller #1
ACH-2	-	Absorption chiller #2
P2-1	-	Hot water supply pump
P2-2	-	Hot water supply pump
HWS	-	Hot water supply lines
HWR	-	Hot water return lines
CT	-	Cooling tower
P3-1	-	Condensing water pump
P3-2	-	Condensing water pump
CHS	-	Chilled water supply lines

CHR	-	Chilled water return lines
CS	-	Condensing water supply lines
CR	-	Condensing water return lines
ACRCH	-	Air cooled reciprocating chiller

To provide a reliable system two (2) backup units are included as follows:

1. A steam heating coil (SH) will be included as part of the photovoltaic project inside the hot water storage tank (HWT) to provide hot water services to the hospitals in case of any failure in the solar array hot water system. This steam heating coil will also provide the back-up for the absorption air conditioning system when necessary.

2. One single air cooled reciprocating chiller (ACRCH) will be included as part of this project to provide the back-up based on electric energy in case of a failure in any of the absorption chillers or in the steam supply to the area.

E. Alternatives in case the Photovoltaic Project is not funded

In the case CEER does not receive the funding for the solar project the absorption chiller will be operated via a direct connection to the steam lines of the Medical Center. The existing steam distribution lines of the Central Steam Plant provide a simple connection port close to the location of the proposed absorption chillers. In this case a small modification of the generator will be necessary to operate the absorption chillers with steam. The use of absorption chillers energized by a steam supply from a large central steam plant is standard in the mainland U. S. A. The existing central steam plant at the Puerto Rico Medical Center is one of the largest in the Caribbean and has plenty excess capacity available.

The absorption chillers capacity will go up to 148 TR each when operated by direct steam. With this alternative one single absorption chiller will be able to handle the air conditioning load of the New Wing and the second unit will be ready for back-up purposes. In addition, the reciprocating chiller (ACRCH) will provide a second back-up in case of a failure in the steam supply to the area.

Based on the actual cost Medical Center charges CEER for the steam, the use of electrical cooling systems is in general more cost effective than using steam systems. However, for large uses of steam a new contract can be negotiated with the Medical Center to obtain a lower cost for the steam purchased.

F. System main components and their location

The main components of the photovoltaic project and of this project are shown in the plan of Attachment #5. The absorption chillers (ACH-1 and ACH-2), the hot water supply pumps (P2-1 and P2-2), all the controls for the chilled water system and the condensing water system will be located inside the existing mashine shop building in an area to be prepared for this purpose. The cooling tower (CT), the condensing water pumps (P3-1 and P3-2), and the air cooled reciprocating chiller will be located inside the existing chiller area.

G. Thermal Energy available from the photovoltaic array to operate the absorption chillers.

1. Peak Hour Considerations:

As indicated in the Energy Flow diagram of Attachment #6, the thermal power available from the collector array at the peak average hour is 1021 KW. (3.47×10^6 BTU/H). If the proposed solar cooling system is utilized, 594 KW of this thermal power can be used to operate the absorption

chillers. With the use of this thermal power 126.8 Tons of refrigeration output can be obtained from an absorption chiller with a C.O.P. of 0.70. This is 112% of the peak hourly air conditioning load indicated in Section III-8 (113 T.R.).

2. Daily and Yearly Average Considerations:

Considering an average total direct radiation of 1300 BTU/sq. ft. per day, and a collector area of 3179.8 m^2 operating at 44% efficiency the available thermal energy per day is

$$T_{TD} = 5754 \text{ KW.H/day}$$

During the weekdays the hot water demand for the Oncologic and Pedriatric Hospitals can be estimated as

$$T_{HD} = 2324 \text{ KW.H/day}$$

Thus the available thermal energy to operate the absorption chillers during a weekday is

$$T_{AD} = T_{TD} - T_{HD}$$

$$T_{AD} = 3430 \text{ KW.H/day}$$

For an estimated 250 working days per year the total available thermal energy to operate the air conditioning of the New Wing is:

$$T_{AY1} = 857,500 \text{ KW.H per year}$$

Additional energy will be available from the hot water storage tank (20,000 gallons) on monday mornings. During the weekend the photovoltaic array will operate without the thermal load of the solar cooling system and will maintain an average tank temperature close to 190°F. Thus a minimum of 83 KW.H will be available per weekend. For the 52 weekends of the year the energy available from the storage tank will be:

$$T_{AY2} = 33,124 \text{ KW H}$$

And the total for the year

$$T_{AY} = T_{AY1} + T_{AY2}$$

$$T_{AY} = 890,624 \text{ KW H per year}$$

In Section III-B the total energy necessary for a year of refrigeration in the New Wing was computed to be 697941 KW H/year. The Thermal Energy necessary for an absorption chiller system to provide this refrigeration can be estimated to be 897,000 KW.H/year. Thus the thermal waste energy from the photovoltaic array should provide 99% of the necessary refrigeration in accordance with above figures. However, some reduction in the solar contribution to the air conditioning system has to be considered because the air conditioning load profile and the profile of the energy available from the photovoltaic array are not identical. An 85% solar contribution to the air conditioning system can be considered as a reasonable estimate.

IV. Analysis of Safety and Pollution Aspects

The major safety hazards for this installation are fire and personal injuries. The origin of a fire could be from the electric motors of pumps and the air cooled chiller and associated electrical wiring and control panels. The control of a fire would be handled by providing CO_2 fire extinguishers in quick release mounts close to the equipment. Frequent inspections and checks by maintenance personnel would be made in this area to ensure all equipment is in good operating condition. These persons would be instructed in the method of shutting down the equipment and in the use of fire extinguishers for electrical fires. In addition, there are telephones available in the adjacent offices for calling the Fire Department, if needed.

Personnel injuries will be controlled by providing safety shields and guards around moving parts of the equipment. Personnel will be thoroughly instructed in the operation of the equipment, safety procedures and first aid.

The potential pollutants in this area would consist of liquid lithium bromide solution used as the absorbent in the absorption chiller unit and oil and grease used to service the pump and motors.

The lithium bromide is a non-toxic salt at standard atmospheric pressure and temperature. The refrigerant in the absorption cycle is distilled water. The charging of this system with lithium bromide would be done by trained personnel using proper equipment. Should an inadvertent spill happen, it will be quickly dispersed with a wash-down with soap and water and disposed of through the floor drain to the sewage system.

The proposed air cooled reciprocating chiller is a factory charged unit, and no freon leakage is expected from this one.

Oils and grease are kept in approved metal containers and stored in a metal locker when not being used. Oil spills will be cleaned with degreaser and washed down the floor drain with soap and water.

The proposed absorption chiller operation will reduce substantially the electric energy consumption of the system by the use of a non-polluting energy, i.e. solar energy. The overall effect on the environment of the island of Puerto Rico will be a reduction in pollution.

V. Consideration Given to the Use of Existing Facilities

The existing chiller units will be eliminated. The rest of the existing air conditioning installation will be maintained in service with small modifications to upgrade the operation.

VI. Proposed equipment specifications

ACH-1, ACH-2 ABSORPTION CHILLER

A) Nominal capacity: 148 TR

B) Actual capacity for low temperature application: 63.4 TR

C) Generator:

Passes: 2

Flow: 320 GPM

Inlet Temperature: 190°F

Outlet Temperature: 182.5°F

D) Condensing Water:

Flow: 353 GPM

Inlet Temperature: 85°F

Outlet Temperature: 95°F

E) Chilled Water:

Flow: 160 GPM

Inlet Temperature: 55°F

Outlet Temperature: 45°F

F) Power Input: (4.2 kw)

Trane model ABSC-01E or similar

CT COOLING TOWER

A) Capacity to cool 353 GPM of water from 95°F to 85°F at 80°F wet bulb outside temperature.

B) Power input 7-1/2 HP (6.6 kw)

Baltimore Air Coil (BAC) CFT 2413 or similar

ACRCH AIR COOLED RECIPROCATING CHILLER

A) Capacity 69.9 TR with 90°F entering air at condenser and 45°F leaving chilled water temperature.

B) Total power input 83.1 KW.

C) Trane CG AA 7506 E or similar.

VII. Preliminary Cost Estimate

Project C.E.E.R. New Wing Air Conditioning Upgrading

I- Mechanical Equipment

1	Absorption chillers	ea.	2	38,000.-	76,000.00
2	Air cooled chiller	ea.	1	21,000.-	21,000.00
3	Cooling Tower	ea.	1	9,000.-	9,000.00
4	Hot water supply powers	ea.	2	1,500.-	3,000.00
4	Condensing water supply pumps	ea.	2	2,000.-	4,000.00
	Mechanical Equipment Total				$ 113,000.00

II- Mechanical-Electrical Contract

No.	Description	Unit	Quantity	Unit Price	Total
1	Equipment installation	LS	1	5,000.00	5,000.00
2	5" chilled water lines with 1" methane insulation	LF	200	25.00	5,000.00
3	5" Condensing water lines	LF	200	19.00	3,800.00
4	8" Condensing water lines	LF	100	30.00	3,000.00
5	4" Hot water lines with 2" methane insulation	LF	120	20.00	2,400.00
6	Connections to existing chilled water lines	LS			1,000.00

II- Mechanical-Electrical Contract

No.	Description	Unit	Quantity	Unit Price	Total
7	Cooling tower and c.w. pumps connection	LS			1,000.00
8	Absorption chillers and hot water pumps connections	LS			2,000.00
9	Upgrade existing air conditioning installation	LS			10,000.00
10	Modifications in shop Building	LS			5,000.00
11	Insulation addition to roof level. 3" Fiber glass	SF	10,000	1.00	10,000.00
12	Safety switch and power electrical conn. for absorption units	EA	2	500.00	10,000.00
13	Safety switch and power electrical conn. for reciprocating chiller	EA	1	$1,000.00	$ 1,000.00
14	Combination magnetic starters and power electrical conn. for hot water pumps	EA	2	700.00	1,400.00
15	Combination magnetic starters and power electrical conn. for cooling tower and cond. water pumps	EA	3	1,000.00	3,000.00
16	Air handling unit and duct work upgrading	LS	1		5,000.00

II- Mechanical-Electrical Contract

No.	Description	Unit	Quantity	Unit Price	Total
17	Hot water and chilled water system upgrading	LS	1		5,000.00
18	Systems balance and test	LS			4,000.00
19	Air conditioning system control upgrading	LS	1		8,000.00
20	Control chilled water plant controls	LS	1		2,000.00
		Subtotal			$ 78,600.00
	30% Overhead, Profit and Taxes				23,500.00
		Total			$102,180.00

SUMMARY OF PRELIMINARY COST ESTIMATE

No.	Description	Unit	Quantity	Unit Price	Total
I	Mechanical Equipment				$ 113,000.00
II	Mechanical Electrical Contract				102,180.00
	Sub-total				$ 215,180.00
III	10% Contingencies on Mechanical Equipment				11,300.00
IV	20% Contingencies on Mechanical Electrical Contract				20,436.00
	Sub-total				$ 246,916.00
V	Engineering and Project management at 12% of items #1 & #2				25,814.00
	Total				$ 272,730.00

VIII. Comparative Economic Analysis between the Previous Proposal of April, 1977 and the Present Proposal.

This economic analysis is included in order to underline the cost effectiveness of the present revised proposal.

The initial investment for this project is higher than the estimated investment for the previous proposal. However, "Uniform Annual Cost" is substantially lower due to the use of the waste thermal energy from the photovoltaic array.

Basic Data for the Preliminary Proposal of April 1977 (Alternative A)

- New oil-cooled centrifugal chiller (270 TR) with steam terminal reheat
- Estimated design and inspection cost: $ 17,629.00
- Estimated project cost (investment): 164,000.00
- Escalation two years at 5% per year: 16,450.00

- Upgrading of air distribution system, reheat system and controls: $ 12,500.00

- Estimated Steam Cost, 526,000 lb/year at $17/1000 lb: 3,682.00

- Estimated yearly refrigeration: 3.5×10^5 TR.H

- Estimated electric energy to operate the air cooled centrifugal chiller to provide this refrigeration set 1.3 KW per TR: 4.55×10^5 KWH

- Estimated first year cost at $.07 per KW H: $ 31,850.00

- Estimated first year cost for maintenance, spare parts, etc.: $ 4,000.00

- Calculated uniform annual cost without terminal value over 20 years life time. For more detail see computer print out "Alternative A" : $ 140,292.40

Basic Data for the Revised Proposal, February 1979 (Alternative B)

- Solar energized absorption chillers each 148 TR

- Estimated design and project management cost: $ 25,814.00

- Estimated project cost (investment): $ 246,916.00

- Upgrading of air distribution system and controls:

- Estimated steam cost, 263,000 lb/year at $7/1000 lb: $ 1,841.00

- Estimated electrical energy to operate the absorption chillers auxiliary equipment and the air cooled refrigeration chiller to provide 15% of the cooled: 1.06×10^5 KWH

- Estimated first year cost at $.07 per KW.H: $ 7,420.00

- Estimated first year cost for maintenance, spare parts, etc.: $ 4,000.00

- Calculated Uniform annual cost without terminal value over 20 years life time. For more detail see computer print out for "Alternative B": $ 63,488.61

Computations on both alternatives (A and B) show clearly the significant economical advantage of the solar cooling. The uniform annual cost difference is about $76,804. Over a life time of twenty years without the terminal value the relative savings will be $1,536.080 in 1978 dollars.

In terms of relative pay back* the solar system will pay back in less than 3 years.

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* We define relative pay back as follows:

The time during which the summation of the difference in recurring costs equals the difference in non-recurring cost of the first year.

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E C O N O M I C A N A L Y S I S

DATE= FEBRUARY 5, 1979
PROJECT= CEER CMA -8495
SUBJECT= ADDING AIR CONDITIONING UP GRADING
DESCRIPTION= COMPARATIVE ANALYSIS BETWEEN 1977 AND 1979 PROPOSALS
ALTERNATIVE= A-PROPOSAL OF APRIL 1977

ECONOMIC CONSIDERATIONS= 20 YEAR LIFE
10.0 PERCENT INTEREST RATE
12.0 PERCENT STEAM ESCALATION RATE
15.0 PERCENT ELECTRICAL ENERGY ESCALATION RATE
2.0 PERCENT OTHER ESCALATION RATE
$ 0.00 TERMINAL VALUE

YEAR	NON-RECURRING COSTS: E&G/PROJECT MANAGEMENT	NON-RECURRING COSTS: INVESTMENT	RECURRING COSTS: STEAM	RECURRING COSTS: ELECTRICAL ENERGY	RECURRING COSTS: OTHER	RECURRING COSTS: TOTAL	TOTAL: ALL COSTS	DISCOUNT FACTOR	DISCOUNTED COST
1	17628.00	183010.00	3690.00	31850.00	2000.00	37540.00	238168.00	0.9545	227342.14
2	0.00	0.00	4121.60	36627.50	2040.00	42789.10	42789.10	0.8677	37131.19
3	0.00	0.00	4616.19	42121.62	2080.80	48818.61	48818.61	0.7888	38512.05
4	0.00	0.00	5170.13	48439.86	2122.41	55732.41	55732.41	0.7171	39968.29
5	0.00	0.00	5790.55	55705.84	2164.86	63661.26	63661.26	0.6519	41505.36
6	0.00	0.00	6485.41	64061.72	2208.16	72755.30	72755.30	0.5926	43121.89
7	0.00	0.00	7263.66	73670.98	2252.32	83186.97	83186.97	0.5388	44822.47
8	0.00	0.00	8135.30	84721.63	2297.37	95154.31	95154.31	0.4898	46613.69
9	0.00	0.00	9111.54	97429.87	2343.31	108884.74	108884.74	0.4453	48496.64
10	0.00	0.00	10204.92	112044.35	2390.18	124639.47	124639.47	0.4048	50456.63
11	0.00	0.00	11429.52	128851.01	2437.98	142718.52	142718.52	0.3680	52523.17
12	0.00	0.00	12801.06	148179.66	2486.74	163466.47	163466.47	0.3345	54683.79
13	0.00	0.00	14337.19	170406.44	2536.48	187279.13	187279.13	0.3041	56966.51
14	0.00	0.00	16057.65	195966.28	2587.21	214611.15	214611.15	0.2764	59339.51
15	0.00	0.00	17984.57	225361.22	2638.95	245984.75	245984.75	0.2513	61831.13
16	0.00	0.00	20142.72	259165.41	2691.73	281999.86	281999.86	0.2285	64439.95
17	0.00	0.00	22559.84	298040.22	2745.57	323345.64	323345.64	0.2077	67177.82
18	0.00	0.00	25267.03	342746.25	2800.48	370813.76	370813.76	0.1888	70047.69
19	0.00	0.00	28299.07	394159.19	2856.49	425313.75	425313.75	0.1716	73019.3
20	0.00	0.00	31694.96	453281.92	2913.62	487890.50	487890.50	0.1560	76147.9[illegible]

DISCOUNTED TOTAL COST ..... $ 1254107.73
DISCOUNTED TERMINAL VALUE ... $ 0.00

NET DISCOUNTED TOTAL COST ... $ 1254107.73

UNIFORM ANNUAL COST WITHOUT TERMINAL VALUE ... $ 140292.40
UNIFORM ANNUAL COST WITH TERMINAL VALUE ..... $ 140292.40

CAPACETE, MARTIN & ASSOCIATES ENGINEERS-ARCHITECTS
POST OFFICE BOX 9684
SANTURCE, PUERTO RICO 00908 (809) 782-4144

E C O N O M I C A N A L Y S I S

DATE= FEBRUARY 5, 1979
PROJECT= CEER CVA -8495
SUBJECT= NEW WING AIR CONDITIONING UP GRADING
ALTERNATIVE= B-REVISED PROPOSAL OF FEBRUARY 1979

ECONOMIC CONSIDERATIONS= 20 YEAR LIFE
10.0 PERCENT INTEREST RATE
12.0 PERCENT STEAM ESCALATION RATE
15.0 PERCENT ELECTRICAL ENERGY ESCALATION RATE
2.0 PERCENT OTHER ESCALATION RATE
$ 0.00 TERMINAL VALUE

	NON-RECURRING COSTS		RECURRING COSTS				TOTAL		
YEAR	F&G/PROJECT MANAGEMENT	INVESTMENT	STEAM	ELECTRICAL ENERGY	OTHER	TOTAL	ALL COSTS	DISCOUNT FACTOR	DISCOUNTED COST
1	25814.00	246916.00	1841.00	7457.00	4000.00	13298.00	286028.00	0.9545	273026.72
2	0.00	0.00	2061.92	8575.55	4080.00	14717.47	14717.47	0.8677	12771.35
3	0.00	0.00	2309.35	9861.89	4161.60	16332.83	16332.83	0.7888	12884.66
4	0.00	0.00	2586.47	11341.16	4244.83	18172.46	18172.46	0.7171	13032.64
5	0.00	0.00	2896.94	13042.33	4329.72	20268.01	20268.91	0.6519	13214.47
6	0.00	0.00	3244.47	14098.69	4416.32	22659.48	22659.48	0.5926	13430.22
7	0.00	0.00	3633.80	17248.49	4504.64	25386.95	25386.95	0.5388	13679.99
8	0.00	0.00	4069.86	19835.76	4594.74	28500.37	28500.37	0.4898	13964.41
9	0.00	0.00	4558.24	22811.13	4686.63	32056.01	32056.01	0.4453	14274.62
10	0.00	0.00	5105.23	26232.80	4780.37	36118.41	36118.41	0.4048	14621.47
11	0.00	0.00	5717.86	30167.72	4875.97	40761.56	40761.56	0.3680	15001.91
12	0.00	0.00	6404.01	34692.88	4973.49	46070.39	46070.39	0.3345	15413.41
13	0.00	0.00	7172.49	39896.81	5072.96	52142.27	52142.27	0.3041	15858.94
14	0.00	0.00	8033.19	45881.33	5174.42	59088.95	59088.95	0.2764	16337.96
15	0.00	0.00	8997.17	52763.53	5277.91	67038.62	67038.62	0.2513	16850.93
16	0.00	0.00	10076.83	60678.06	5383.47	76138.37	76138.37	0.2285	17398.42
17	0.00	0.00	11286.05	69779.77	5491.14	86556.97	86556.97	0.2077	17981.07
18	0.00	0.00	12640.38	80246.74	5600.96	98488.09	98488.09	0.1888	18599.64
19	0.00	0.00	14157.22	92283.75	5712.98	112153.96	112153.96	0.1716	19254.97
20	0.00	0.00	15856.09	106126.31	5827.24	127809.65	127809.65	0.1560	19947.99

DISCOUNTED TOTAL COST ..... $ 567540.09
DISCOUNTED TERMINAL VALUE ... $ 0.00
NET DISCOUNTED TOTAL COST ... $ 567540.09

UNIFORM ANNUAL COST WITHOUT TERMINAL VALUE ... $ 63488.61
UNIFORM ANNUAL COST WITH TERMINAL VALUE ..... $ 63488.61

IX. Design and construction schedule

The U. S. DOE will announce the winners of the Second Phase of the Concentrating Photovoltaic Projects around the first of May, 1979. It is imperative for the C.E.E.R. to receive the final decision by the Oak Ridge Operations Offices on the revision at least one month prior to that date, i.e. by April 1, 1979.

The proposed design and construction schedule for the uprating of the New Wing air conditioning system follows:

April 2	-	April 16	-	Choose an Engineering/Architect firm to perform the design and project management.
April 16	-	April 23	-	Complete final equipment selection. Request equipment quotations.
April 23	-	April 30	-	Select equipment supplier and prepare purchase orders.
April 16	-	May 7	-	Prepare final construction drawings and prepare bidding documents.
May 7	-	May 28	-	Contractor bidding time and contract award
May 28	-	August 6	-	Construction time
August 6	-	August 20	-	Receive chillers and install
August 20	-	September 3	-	System balance, test and acceptance. Ready to interface with photovoltaic array.

X. Conclusions

A. Reliability

The proposed revision will provide a more reliable system than the proposal of April 1977. The absorption refrigeration units have practically no moving parts. One small hermetic pump is the only moving part in these

chillers. In contrast to that the proposal of April 1977 involves a large centrifugal chiller with a rotor-impeller assembly moving at 8000 RPM.

The revised proposal as detailed in section III-d will include two different back-up systems. The proposal of April 1977 considered the re-use of the existing reciprocating units as back-up. According to the same proposal this equipment is of poor design, and has had a history of unreliability since the first day it was installed. The compressors for these units are no longer manufactured and to find parts is almost impossible.

B. Cost effectiveness

The comparative "Economic Analysis" included in Section VIII indicates that the new proposal is more cost effective than the previous proposal.

C. Energy conservation

A dramatic reduction in electric energy consumption of C.E.E.R. will be obtained with the revised proposal.

D. Pollution aspects

The use of non-polluting solar energy to operate the system will be a step towards improving the overall environmental condition on the island of Puerto Rico.

E. System completeness

With the provisions included in the proposal of April, 1977 the attempt of upgrading the C.E.E.R. New Wing air conditioning system would be incomplete. An improvement of the existing conditions inside the building should be a part of the overall effort. This revised proposal includes the improvement of the conditions inside the building.

F. Energy savings

Substantial energy savings will be obtained with the revised proposal. A yearly total of 3.44×10^5 KW H of electrical energy can be saved

with the solar air conditioning.

G. Total savings over the 20 years life time

Total savings over the 20 years life time of the solar equipment will exceed 1.5 Millions in 1978 dollars.

ATTACHMENT #1

C.E.E.R. NEW WING BUILDING
HOURLY COOLING LOAD ESTIMATES

C.E.E.R. New Wing

Building Hourly Cooling Load Estimates

Summary

C.E.E.R. NW-1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) -CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8486 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 2

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	WB
	139	149	159	159	167	166	162	157	156	154	159	157	HR X 10000

MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	WB
	139	149	159	159	167	166	162	157	156	154	159	157	HR X 10000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	5.00

INWARD FLOW FRACTIONS

NI	NIU	NIB
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D — 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	83.0
TEMPERATURE,WB	0.0	74.6
MONTH	1	1

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION (HCC-1111(82) CARAC-TERISTIC AND ASS. SAN JUAN, PR.

PROJECT = 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/79 PAGE

ZONE DESCRIPTION DATA

ZONE NUMBER 100 CENTER FOR ENERGY

INSIDE DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE TEMPERATURE	76.0	76.0
RELATIVE HUM.	50.0	55.0
HUMIDITY RAT	0.0086	0.0106

MASTER ZONE DATA

WALL HEIGHT	26.80 FEET
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
CIRCN. RATE	0.00 AC/HR, MIN
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	9.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTORS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
SAFETY FAC.	1.00
DUCT HEAT	1.00

VENTILATION

FIXED CFM	13000.00
CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

SYSTEM ANALYSIS

SUPPLY FAN STATIC	2.50 IN. W.G.
RETURN FAN STATIC	0.00 IN. W.G.
O.A. FAN STATIC	0.00 IN. W.G.

AIR SYSTEM TYPE = MIXED AIR

FAN LOCATION = DRAW THRU

COIL BYPASS FACTOR 0.10

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC-CALCULATION-HCC-IBM(72) CARPENTER-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

INTERNAL LOAD PROFILES -- PER CENT OF PEAK VALUE

PROFILE NO. 1

HOUR	1	2	3	4	5	6	7	8	9	10	11	12
LOAD	0.	0.	0.	0.	0.	0.	0.	100.	100.	100.	100.	85.

HOUR	13	14	15	16	17	18	19	20	21	22	23	24
LOAD	100.	100.	100.	100.	100.	0.	0.	0.	0.	0.	0.	0.

PROFILE NO. 2

HOUR	1	2	3	4	5	6	7	8	9	10	11	12
LOAD	0.	0.	0.	0.	0.	0.	0.	100.	100.	100.	100.	85.

HOUR	13	14	15	16	17	18	19	20	21	22	23	24
LOAD	100.	100.	100.	100.	100.	0.	0.	0.	0.	0.	0.	0.

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(-2) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

EXTERIOR WALLS

TYPE NUMBER	WALL DESCRIPTION	DECREMENT FACTOR	TIME LAG	COLOR	U-FACTOR SUMMER	U-FACTOR WINTER	BELOW GRAD BTU/SF
1	8 IN CONCRETE WALL	0.31	6.	L	0.51	0.51	0.0
2	WALL COMBINATION	0.20	8.	L	0.06	0.06	0.0

ROOFS

TYPE NUMBER	ROOF DESCRIPTION	DECREMENT FACTOR	TIME LAG	COLOR	U-FACTOR SUMMER	U-FACTOR WINTER
1	6 IN CONCRETE-5IN INSU	0.20	8.	L	0.06	0.06

CEILINGS

TYPE NUMBER	CEILING DESCRIPTION	CEILING U-FACTOR	ROOF ABOVE TYPE	FLOOR ABOVE TYPE	FLOOR ABOVE SUM TEMP	FLOOR ABOVE WIN TEMP

PARTITIONS

TYPE NUMBER	PARTITION DESCRIPTION	U-FACTOR	UN-CONDITIONED SPACE TEMPERATURE SUMMER	UN-CONDITIONED SPACE TEMPERATURE WINTER

FLOORS

TYPE NUMBER	FLOOR DESCRIPTION	U-FACTOR	TEMP.UN-COND.SPACE SUMMER	TEMP.UN-COND.SPACE WINTER	BELOW GRD BTU/SF	ON GR BTU/LF

EXTERIOR DOORS

TYPE NUMBER	DOOR DESCRIPTION	U-FACTOR	AREA SF	INFILTRATION CFM(WINTER)

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITF-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WINDOWS

TYPE NUMBER	WINDOW DESCRIPTION	GLASS DIMENSIONS TYPE	HGT	WTH	U-FACTORS SHADE	SUN	WNTR	PCT. OPEN	DEGS VERT	SKL PCT DA
1	SOLAR BRONZE-SCOTCH TINT	15	5.0	9.0	0.81	1.10	0.81	82.	90.	0
2	SOLAR BRONZE-SCOTCH TINT	15	6.0	9.0	0.81	1.10	0.81	82.	90.	0

TYPE NUMBER	SHADE COEFFICIENTS		AIR SUPPLY	OVERHANG AND FINS TOTAL DEPTH	ABOVE TOP	BEYOND LEFT	BEYOND RIGHT	VERT. PROJ.	ABOVE BOTTOM	SHADE TYPE
1	0.31	GL	0 U	0.0	0.00	0.00	0.00	0.0		OV
	0.00	INS	0 R	0.0	0.00	0.00			0.0	LF
	0	SCR		0.0	0.00		0.00		0.0	RF
2	0.31	GL	0 U	0.0	0.00	0.00	0.00	0.0		OV
	0.00	INS	0 R	0.0	0.00	0.00			0.0	LF
	0	SCR		0.0	0.00		0.00		0.0	RF

CODES

GL	SPECIAL GLASS SHADING COEFFICIENT
INS	INSIDE SHADING COEFFICIENT(1.00=NO SHADING)
SCR	EXTERIOR SUNSCREEN TYPE
AIR SUPPLY	U=AIR SUPPLIED UNDER WINDOW(1=YES)
	R=AIR SUPPLIED BETWEEN WINDOW AND DRAPES
VERT. PROJ.	DEPTH OF OVERHANG VERTICAL PROJECTION
ABOVE BOTTOM	DISTANCE ABOVE BOTTOM OF WINDOW TO BOTTOM OF FIN
LF AND RF	LEFT FIN AND RIGHT FIN(VIEWED FROM OUTSIDE)
OV	ROOF OVERHANG

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) -CARACRTE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT		HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	12866.			0.	
WINDOW SOLAR	46103.				0.
WALL	11475.			0.	
ROOF/CEILING	764.			0.	
PARTITION	0.			0.	
FLOOR	0.			0.	
DOOR	0.			0.	
INFILTRATION	0.	0.		0.	
LIGHTS	267076.				267076.
PEOPLE(31)	8423.	8423.			8423.
APPLIANCES	87000.	0.			87000.
TOTALS	433710.	8423.		0.	362499.
			PLNM HT	0.	
TOTAL HEAT	442133.		VENT.	136136.	
AT PEAK HOUR	13				
SENS. HEAT RATIO	0.98		TOTAL	136136.	13.6 BTUH/SF
			HUMID	227656.	
LIGHT HEAT TO R.A.		0.			
SKYLIGHT HEAT TO R.A.		0.		363792.	HEATING+HUMID
VENTILATION CFM	13000.			-226363.	LOSS LESS INT. GAIN
EXHAUST CFM	0.			-226363.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR			1.00		
BUILDING REFRIGERATION LOAD		1025493.			
TONS OF REFRIGERATION			85.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	102.7		3.8		117.5		2.7
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	102.7	13.6	3.8	0.5	117.5	73.4	2.7

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(02) CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - BASE CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-9190.	-5514.	0.	7352.	11029.	12866.
WIN SOLAR	41431.	57107.	61184.	59463.	54503.	46103.
WALL	14236.	12960.	11485.	11490.	11475.	11475.
ROOF/CEILING	1201.	1092.	982.	873.	764.	764.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	410178.	428045.	436152.	441669.	385896.	433710.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	418601.	436469.	444575.	450092.	393056.	442133.
BLDG REFG. *	681323.	777493.	843846.	940956.	946260.	1025493.
	57	65	70	79	78	85

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	12866.	12866.	12866.	11029.	9190.	7352.
WIN SOLAR	34905.	22488.	11662.	4652.	0.	0.
WALL	31912.	40130.	43972.	46935.	48446.	50407.
ROOF/CEILING	764.	764.	1854.	3332.	4706.	5889.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	442948.	438750.	432855.	427849.	62344.	63648.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	451371.	447173.	441279.	436272.	62344.	63648.
BLDG REFG. *	1017351.	994738.	971235.	937299.	356401.	331737.
	84	82	81			

$\sum_{14}^{8} = 681$ TC, H.

C.E.E.R. NW-2

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC=1111(02)- CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.6	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
	139	140	153	159	167	166	162	157	156	154	159	157	HR X 1000
MONTH 2	73.	76.	78.	81.	83.	84.	84.	84.	84.	83.	82.	81.	DB
	71.3	72.7	72.9	73.3	74.4	74.9	74.9	75.0	74.1	73.4	73.6	73.3	WB
	162	166	163	159	164	166	166	167	159	156	160	159	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D = 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	84.0
TEMPERATURE,WB	0.0	75.0
MONTH	1	7

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(4.2) COMPACT E-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/75 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	14704.		0.	
WINDOW SOLAR	15414.			0.
WALL	47218.		0.	
ROOF/CEILING	2052.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	441891.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT	450314.	VENT.	309452.	
AT PEAK HOUR	15			
SENS. HEAT RATIO	0.98	TOTAL	309452.	31.0 BTUH/SF
		HUMID	377520.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		686972.	HEATING+HUMID
VENTILATION CFM	13000.		-53047.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		-53047.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1059002.			
TONS OF REFRIGERATION	88.			

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	106.0		4.0		113.5		2.7
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	106.0	31.0	4.0	1.2	113.5	32.3	2.7

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(92) CAPACETE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/79 PAGE 1

BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	5514.	0.	3676.	9190.	12866.	14704.
WIN SOLAR	40758.	52505.	55237.	52447.	46443.	37340.
WALL	14871.	13491.	13486.	13480.	13480.	17982.
ROOF/CEILING	2235.	2017.	1908.	1799.	1799.	1799.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	414852.	430614.	436808.	439417.	392715.	434326.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	423275.	439037.	445231.	447840.	399875.	442750.
BLDG REFG. *	829208.	906203.	930302.	963191.	944174.	1042933.
TONS	69	75	77	80	73	87

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	14704.	14704.	14704.	12866.	11028.	9190.
WIN SOLAR	26020.	15416.	9095.	6969.	1881.	0.
WALL	38952.	47218.	49227.	49908.	49690.	51675.
ROOF/CEILING	1799.	2052.	3433.	5079.	6389.	7498.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	443976.	441891.	438961.	437322.	68980.	68366.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	452400.	450314.	447384.	445745.	69980.	68366.
BLDG REFG. *	1056605.	[illegible]	1012003.	977304.	394639.	[illegible]
TONS	88	99	84			

$\sum_{14}^{8} = 726$ TR.H

C.E.E.R NW-3

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	81.	80.	78	DB
	67.5	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	WB
	139	140	153	159	167	166	162	157	155	154	159	157	HR X 10000
MONTH 3	77.	79.	81.	83.	84.	84.	84.	84.	83.	82.	81.	80.	DB
	73.3	74.6	74.2	74.3	74.1	75.1	74.6	74.2	73.6	72.9	72.4	72.6	WB
	169	175	167	163	159	168	163	160	157	154	152	156	HR X 10000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D — 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	84.0
TEMPERATURE,WB	0.0	75.1
MONTH	1	3

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. COPR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	265.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	9.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.60
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8496 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	14704.		0.	
WINDOW SOLAR	24517.			0.
WALL	34900.		0.	
ROOF/CEILING	3263.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	439883.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT	448309.	VENT.	410696.	
AT PEAK HOUR	12			
SENS. HEAT RATIO	0.98	TOTAL	410696.	41.1 BTUH/SF
		HUMID	477047.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		887743.	HEATING+HUMID
VENTILATION CFM	13000.		48196.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		48196.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1060598.			
TONS OF REFRIGERATION		88.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	106.2		4.0		113.5		2.8
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	106.2	41.1	4.0	1.5	113.5	24.3	2.8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITY-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 4485 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 13

BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	1938.	5514.	9190.	12866.	14704.	14704.
WIN SOLAR	36224.	43804.	44708.	40558.	33367.	24517.
WALL	21474.	20099.	20099.	21464.	22834.	24060.
ROOF/CEILING	3372.	3263.	3263.	3154.	3154.	3263.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	425406.	435181.	439761.	440543.	382185.	430896.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	433832.	443604.	448185.	448966.	389344.	439319.
BLDG REFG. *	929557.	1010245.	1005148.	1018325.	930850.	1060598.
TONS	77	84	84	85	77	88

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	14704.	14704.	12866.	11028.	9190.	7352.
WIN SOLAR	16353.	12750.	13222.	13602.	6166.	0.
WALL	49689.	54928.	56313.	55260.	51991.	52467.
ROOF/CEILING	3372.	3879.	5499.	7016.	8295.	9258.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	446620.	448763.	450601.	449408.	75643.	69077.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	455043.	457186.	459024.	457831.	75643.	69077.
BLDG REFG. *	1043373.	1030222.	1000096.	966195.	364009.	334604.
TONS	87	86	83			

$\sum_{19}^{4} = 751$ T.H.

C.E.E.R NW/-4

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS (HCC-III(82)) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 3408 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	81.	80.	DB	
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	WB
	139	149	153	159	167	166	162	157	156	154	158	157	HR X 1000
MONTH 4	73.	75.	77.	79.	82.	84.	84.	84.	84.	84.	83.	82.	DB
	70.2	70.6	71.6	72.7	74.0	75.0	75.1	75.9	75.7	76.0	75.6	75.4	WB
	153	153	155	161	171	174	177	175	173	176	175	175	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D
0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	84.0
TEMPERATURE,WB	0.0	76.1
MONTH	1	4

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.00 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUM	NO
CIRC. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.50
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, ICC-III(-2) --CARACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT = 8486 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/79 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	14794.		0.	
WINDOW SOLAR	21310.			0.
WALL	47140.		0.	
ROOF/CEILING	7306.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	452962.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT	461385.	VENT.	252823.	
AT PEAK HOUR	17			
SENS. HEAT RATIO	0.98	TOTAL	252823.	25.3 BTUH/SF
		HUMID	281424.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		534248.	HEATING+HUMID
VENTILATION CFM	13000.		-109675.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		-109675.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1121846.			
TONS OF REFRIGERATION		93.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	8080.	267732.	112.3		4.2		107.4		2.8
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	8080.	267732.	112.3	25.3	4.2	0.9	107.4	39.5	2.8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 17

BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-5514.	-1838.	1838.	3676.	11028.	14704.
WIN SOLAR	26610.	31197.	30825.	26475.	20691.	16713.
WALL	25101.	23725.	23720.	22345.	22345.	36926.
ROOF/CEILING	4122.	4018.	3904.	3795.	3795.	3686.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	412819.	419598.	422799.	418792.	365985.	434531.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	421242.	428021.	431211.	427215.	373144.	442954.
BLDG REFG. *	776224.	807619.	850351.	896578.	932617.	1084151.
TONS	65	67	71	74	77	90
HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	14704.	14704.	14704.	14704.	12866.	11028.
WIN SOLAR	16572.	19003.	21780.	21310.	10671.	0.
WALL	44315.	46508.	49566.	47140.	47541.	49873.
ROOF/CEILING	3686.	4541.	5885.	7306.	8489.	9257.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	441778.	449258.	454437.	452962.	79569.	70159.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	450201.	457681.	462861.	461385.	79569.	70159.
BLDG REFG. *	1110773.	1111047.	1107787.	1121946.	490142.	437661.
TONS	93	93	93			

$\sum_{12}^{8} = 723$ TC. H

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHER PROFILES

HOURS		8	9	10	11	12	13	14	15	16	17	18	19	
MONTH	1	71.	73.	76.	80.	82.	83.	83.	82.	82.	82.	81.	80.	DB
		67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
		139	149	159	159	167	166	162	157	156	154	158	157	HR X 1000
MONTH	5	75.	77.	79.	82.	84.	86.	87.	87.	87.	87.	86.	85.	DB
		70.9	71.0	71.0	72.3	73.9	75.4	76.3	76.3	76.7	77.1	76.7	76.4	WB
		154	150	145	149	157	166	171	171	175	179	178	177	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX. SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D
0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE, DB	0.0	87.0
TEMPERATURE, WB	0.0	77.1
MONTH	1	5

MASTER BUILDING DATA

BLDG. ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX. NO. OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOVATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION-HCC-III(82) - CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT		HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	30210.			0.	
WINDOW SOLAR	26070.				0.
WALL	58058.			0.	
ROOF/CEILING	8617.			0.	
PARTITION	0.			0.	
FLOOR	0.			0.	
DOOR	0.			0.	
INFILTRATION	0.	0.		0.	
LIGHTS	267076.				267076.
PEOPLE(31)	8423.	8423.			8423.
APPLIANCES	87000.	0.			87000.
TOTALS	475465.	8423.		0.	362499.
			PLNM HT.	0.	
TOTAL HEAT	483888.		VENT.	287716.	
AT PEAK HOUR	17				
SENS. HEAT RATIO	0.98		TOTAL	287716.	28.8 BTUH/SF
			HUMID	291147.	
LIGHT HEAT TO P.A.	0.				
SKYLIGHT HEAT TO P.A.	0.			578864.	HEATING+HUMID
VENTILATION CFM	13000.			-74783.	LOSS LESS INT. GAIN
EXHAUST CFM	0.			-74783.	LOSS LESS INT.+SOLAR
DUCT HEAT FACTOR			1.00		
BUILDING REFRIGERATION LOAD	1216750.				
TONS OF REFRIGERATION			101.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	121.8		4.5		98.9		2.9
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	121.8	28.8	4.5	1.1	98.9	34.7	2.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS,HCC-III(02) - CARACETE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	1838.	1838.	5514.	11028.	14704.	18381.
WIN SOLAR	19868.	23035.	22731.	20040.	17754.	18667.
WALL	33203.	31827.	30452.	30447.	30789.	45707.
ROOF/CEILING	5221.	5112.	5003.	4894.	4784.	4784.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	418954.	424313.	426201.	428910.	376158.	450040.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	427377.	432737.	434624.	437333.	383317.	458463.
BLDG REFG. *	810033.	825369.	836132.	909876.	910526.	1094124.
TONS	67	69	70	76	75	92

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	20219.	20219.	20219.	20219.	18381.	16542.
WIN SOLAR	21608.	25471.	27757.	26070.	14472.	0.
WALL	52713.	56494.	57531.	58058.	56023.	60597.
ROOF/CEILING	4796.	5905.	7281.	8617.	9724.	10650.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	461836.	470590.	475280.	475465.	98601.	87790.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	470259.	479003.	483712.	483889.	98601.	87790.
BLDG REFG. *	1153873.	1164034.	1194532.	1216750.	692787.	647352.
TONS	96	97	99			

$\sum_{14}^{8}$ = 711 T.H.

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) - CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/82 DATE

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
	139	149	159	169	167	156	152	157	156	154	159	157	HR X 1000
MONTH 6	78.	80.	83.	85.	87.	88.	88.	87.	87.	86.	85.	84.	DB
	74.2	75.1	76.1	77.2	78.8	79.0	78.7	78.0	78.2	78.0	77.3	77.2	WB
	174	177	179	184	185	184	182	187	189	190	185	187	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX. SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG.	J	F	M	A	M	J	J	A	S	O	N	D
IN EFFECT	0	0	0	0	0	0	0	0	0	0	0	0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE, DB	0.0	88.0
TEMPERATURE, WB	0.0	79.0
MONTH	1	6

MASTER BUILDING DATA

BLDG. ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRC. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX. NO. OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION-HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	22057.		0.	
WINDOW SOLAR	23719.			0.
WALL	59071.		0.	
ROOF/CEILING	5292.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	472640.	8423.	0.	362499.

		PLNM HT	0.	
TOTAL HEAT	481063.	VENT.	456455.	
AT PEAK HOUR	14			
SENS. HEAT RATIO	0.98	TOTAL	456455.	45.7 BTUH/SF
		HUMID	503931.	
LIGHT HEAT TO P.A.	0.			
SKYLIGHT HEAT TO P.A.	0.		960387.	HEATING+HUMID
VENTILATION CFM	13000.		93956.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		93956.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1298632.			
TONS OF REFRIGERATION	109.			

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	130.0		4.9		92.5		2.9
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	130.0	45.7	4.9	1.7	92.5	21.9	2.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) - CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	3674.	7352.	12026.	16542.	20219.	22057.
WIN SOLAR	17342.	20463.	20752.	19284.	19433.	20239.
WALL	37750.	36374.	36369.	34904.	35243.	50549.
ROOF/CEILING	5720.	5611.	5502.	5393.	5393.	5284.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	426989.	432301.	437991.	438714.	387413.	460630.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	435412.	440724.	446414.	447137.	394573.	469053.
BLDG REFG. *	968836.	1027438.	1098645.	1159739.	1168429.	1296779.
TONS	81	86	92	97	98	108

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	22057.	20219.	20219.	18381.	16542.	14704.
WIN SOLAR	23719.	27602.	29756.	28150.	17962.	0.
WALL	59071.	63094.	65798.	65255.	64910.	66989.
ROOF/CEILING	5292.	6462.	7915.	9228.	10435.	11257.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	472640.	479878.	486189.	483515.	109851.	92951.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	481063.	488301.	494612.	491938.	109851.	92951.
BLDG REFG. *	1298639.	1365315.	1285471.	1270619.	613455.	566512.
TONS	108	107	107			

$\frac{8}{14}$ = 33 TC. H

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

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WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.2	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
	139	149	153	159	167	166	162	157	156	154	159	157	HR X 1000
MONTH 7	80.	81.	83.	84.	86.	86.	86.	86.	86.	85.	84.	84.	DB
	74.3	76.7	77.1	77.5	78.6	78.9	78.9	78.7	78.5	77.8	77.4	77.5	WB
	188	198	198	199	195	198	198	196	194	190	189	190	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	IU	MIR
0.33	0.00	0.00

DAYLIGHT SVG. J F M A M J J A S O N D
IN EFFECT 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	86.0
TEMPERATURE,WB	0.0	78.9
MONTH	1	7

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.00 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PIPE HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) CAPACITE-VARTI AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	18381.		0.	
WINDOW SOLAR	25427.			0.
WALL	64086.		0.	
ROOF/CEILING	6360.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	476754.	8423.	0.	362499.
TOTAL HEAT	485177.		PLNM HT 0.	
AT PEAK HOUR	15		VENT. 573144.	
SENS. HEAT RATIO	0.98		TOTAL 573144.	57.4 BTUH/SF
			PUMID 593736.	
LIGHT HEAT TO R.A.		0.		
SKYLIGHT HEAT TO R.A.		0.	1166880.	HEATING+HUMID
VENTILATION CFM	13000.		210644.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		210644.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1299257.			
TONS OF REFRIGERATION	108.			

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	130.1		4.9		92.5		2.9
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	130.1	57.4	4.9	2.1	92.5	17.4	2.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) --CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	7352.	9190.	12866.	14704.	18381.	18381.
WIN SOLAR	19612.	22427.	22772.	20599.	18314.	15939.
WALL	36863.	35493.	35488.	36853.	36853.	51370.
ROOF/CEILING	5461.	5461.	5352.	5243.	5243.	5352.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	430789.	435073.	438979.	439900.	386917.	456542.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	439213.	443496.	447403.	448323.	394076.	464966.
BLDG REFG. *	1090266.	1110111.	1146550.	1175648.	1148541.	1278140.
TONS	90	92	95	98	96	106

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	18381.	18381.	18381.	16542.	14704.	14704.
WIN SOLAR	21612.	25427.	27901.	26799.	17383.	0.
WALL	60998.	64086.	65628.	63798.	62058.	62586.
ROOF/CEILING	5352.	6360.	7841.	9079.	10211.	10958.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	468844.	476754.	482251.	478719.	104357.	88249.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	477267.	485177.	490674.	487142.	104357.	88249.
BLDG REFG. *	1287578.	1299257.	1296903.	1253307.	594453.	565964.
TONS	108	108	103			

8
∴ = 901 TR.H
14

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, I.C.

HVAC CALCULATION, HCC-III(83) CARACETE-MARTIN AND ASS. SAN JUAN, PR.

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WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.5	74.6	74.7	73.6	73.4	72.9	73.2	72.8	WB
	130	149	153	160	167	166	162	157	156	154	150	157	BTU X 1000
MONTH 8	78.	80.	82.	83.	85.	86.	87.	87.	87.	87.	86.	85.	DB
	75.8	76.0	76.3	76.6	77.7	79.0	79.0	79.5	79.5	79.3	79.2	79.2	WB
	188	185	193	194	198	198	197	202	202	200	201	203	BTU X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	AIR
0.33	0.00	0.20

DAYLIGHT SVG.	J	F	M	A	M	J	J	A	S	O	N	D
IN EFFECT	0	0	0	0	0	0	0	0	0	0	0	0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	87.0
TEMPERATURE,WB	0.0	79.5
MONTH	1	8

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
ONIT WINTR SUN	NO
CIRC. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO P.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.60
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION ,HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT		HEAT LOSS HEATING	WINTER GAIN	
WINDOW TRANS	20219.			0.		
WINDOW SOLAR	22383.				0.	
WALL	66047.			0.		
ROOF/CEILING	7615.			0.		
PARTITION	0.			0.		
FLOOR	0.			0.		
DOOR	0.			0.		
INFILTRATION	0.	0.		0.		
LIGHTS	267076.				267076.	
PEOPLE(31)	8423.	8423.			8423.	
APPLIANCES	87000.	0.			87000.	
TOTALS	478765.	8423.		0.	362499.	
			PLNM HT	0.		
TOTAL HEAT	487188.		VENT.	544544.		
AT PEAK HOUR	16					
SENS. HEAT RATIO	0.98		TOTAL	544544.	54.5 BTUH/SF	
			HUMID	554267.		
LIGHT HEAT TO R.A.		0.				
SKYLIGHT HEAT TO R.A.		0.		1099811.	HEATING+HUMID	
VENTILATION CFM	13000.			182044.	LOSS LESS INT. GAIN	
EXHAUST CFM	0.			182044.	LOSS LESS INT.+SOLAR	
PUMP HEAT FACTOR		1.00				
BUILDING REFRIGERATION LOAD	1352234.					
TONS OF REFRIGERATION	113.					

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	135.4		5.1		88.4		2.9
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	135.4	54.5	5.1	2.0	88.4	18.3	2.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(02) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

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BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	3676.	7352.	11028.	12866.	16542.	18381.
WIN SOLAR	25456.	30323.	30294.	26345.	21006.	17600.
WALL	37542.	37537.	36162.	36162.	37526.	50900.
ROOF/CEILING	5598.	5488.	5379.	5379.	5270.	5270.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	434773.	443202.	445364.	443254.	388471.	454552.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	443196.	451625.	453787.	451677.	395630.	462975.
BLDG REFG. *	1051655.	1096186.	1114352.	1133461.	1108455.	1280917.
TONS	88	91	93	95	93	107

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	20219.	20219.	20219.	20219.	18381.	16542.
WIN SOLAR	17554.	19888.	22383.	21453.	10524.	0.
WALL	60169.	64713.	66047.	63861.	61794.	62542.
ROOF/CEILING	5379.	6185.	7615.	9014.	10179.	10939.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	465822.	473506.	478765.	477048.	100879.	90024.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	474245.	481930.	487188.	485471.	100879.	90024.
BLDG REFG. *	1305165.	1349964.	1352234.	1338759.	673111.	633038.
TONS	109	112	113			

$\frac{8}{10} = 90$ TON. H

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS--CC-III(82) --CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.8	69.7	71.1	72.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	WB
	139	149	153	159	167	166	162	157	156	154	159	157	HR X 10000
MONTH 9	78.	80.	83.	86.	87.	88.	89.	88.	87.	86.	85.	85.	DB
	75.1	76.3	76.9	78.0	79.0	79.6	79.0	78.6	78.8	78.1	78.5	78.4	WB
	182	188	186	190	197	200	194	191	196	191	197	196	HR X 10000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. J F M A M J J A S O N D

IN EFFECT 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	88.0
TEMPERATURE,WB	0.0	79.6
MONTH	1	9

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	9.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS,HCC-III(02) - CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	22057.		0.	
WINDOW SOLAR	22561.			0.
WALL	49604.		0.	
ROOF/CEILING	4771.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	461594.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT AT PEAK HOUR	470017. 13	VENT.	506792.	
SENS. HEAT RATIO	0.98	TOTAL	506792.	50.7 BTUH/SF
		HUMID	573144.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		1079936.	HEATING+HUMID
VENTILATION CFM	13000.		144292.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		144292.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1332872.			
TONS OF REFRIGERATION	111.			

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	133.4		5.0		90.0		2.9
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	133.4	50.7	5.0	1.9	90.0	19.7	2.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	3676.	7352.	12966.	18381.	20219.	22057.
WIN SOLAR	27358.	43452.	43338.	38556.	31284.	22661.
WALL	36095.	35620.	35615.	34239.	34239.	49604.
ROOF/CEILING	5208.	5099.	4980.	4880.	4880.	4771.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	445738.	454024.	459309.	458559.	399748.	461594.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	454161.	462447.	467732.	466981.	406908.	470017.
BLDG REFG. *	1041251.	1120418.	1170149.	1241056.	1203527.	1332872.
	87	94	97	103	100	111
HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	22057.	22057.	20219.	18381.	16542.	16542.
WIN SOLAR	15499.	13215.	13793.	12733.	855.	0.
WALL	61258.	65666.	67995.	68124.	66412.	68041.
ROOF/CEILING	4771.	5573.	7157.	8591.	9880.	10847.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	466086.	469012.	471665.	470330.	93691.	95431.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	474509.	477435.	480088.	478754.	93691.	95431.
LDG REFG. *	1307688.	1280913.	1344860.	1244517.	621653.	622030.
	104	102	107			

$\frac{8}{12} = 917 \text{ ft}^2$

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS,HCC-III(02) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

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WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.8	69.7	71.1	72.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
	139	149	153	159	167	166	162	157	156	154	159	157	HR X 1000
MONTH 10	75.	77.	80.	83.	85.	86.	86.	86.	85.	85.	84.	83.	DB
	72.6	73.3	74.2	75.5	77.4	78.4	78.5	77.6	78.0	77.7	77.2	77.5	WB
	169	169	169	174	186	193	194	186	192	189	187	192	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	AIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D
0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	86.0
TEMPERATURE,WB	0.0	78.5
MONTH	1	10

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) - CAPACITE-STARTING AND ASS. SAN JUAN, PR.

PROJECT - 8408 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	18221.		0.	
WINDOW SOLAR	20472.			0.
WALL	52757.		0.	
ROOF/CEILING	3414.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	87000.	0.		87000.
TOTALS	457526.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT	465949.	VENT.	375803.	
AT PEAK HOUR	14			
SENS. HEAT RATIO	0.98	TOTAL	375803.	37.6 BTUH/SF
		HUMID	410696.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		786499.	HEATING+HUMID
VENTILATION CFM	13000.		13304.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		13304.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD	1263399.			
TONS OF REFRIGERATION	105.			

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	126.5		4.7		95.1		2.8
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	126.5	37.6	4.7	1.4	95.1	26.6	2.8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(02) CAPACETE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE I

BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	1838.	1838.	7352.	12866.	16542.	18381.
WIN SOLAR	46022.	53133.	53245.	48993.	41738.	31608.
WALL	30720.	29345.	29340.	27965.	27965.	41397.
ROOF/CEILING	3851.	3742.	3632.	3523.	3523.	3414.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	441256.	450559.	456071.	455749.	397895.	457291.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	449679.	458982.	464494.	464172.	405055.	465714.
BLDG REFG. *	919417.	967955.	1021923.	1098059.	1109474.	1257693.
TONS	77	80	85	92	92	105

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	18381.	18381.	16542.	16542.	14704.	12866.
WIN SOLAR	20472.	11927.	8273.	5806.	0.	0.
WALL	52757.	57137.	59274.	59215.	61659.	63154.
ROOF/CEILING	3414.	3969.	5431.	6853.	8119.	9050.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	457526.	453915.	452022.	450918.	84483.	85071.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	465949.	462338.	460445.	459341.	84483.	85071.
BLDG REFG. *	1263399.	1215163.	1227107.	1209505.	548136.	539836.
TONS	105	101	102			

$\sum_{14}^{8}$ = 93172, Hr

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) - CARACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8486 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
	139	149	153	159	167	166	162	157	156	154	159	157	HR X 1000
MONTH 11	74.	76.	79.	82.	84.	85.	85.	85.	85.	84.	83.	82.	DB
	70.6	71.5	72.4	74.3	75.6	76.3	76.3	75.6	75.3	75.3	75.1	75.2	WB
	154	156	157	166	172	176	176	170	167	170	170	173	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX.SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIR
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT

J	F	M	A	M	J	J	A	S	O	N	D
0	0	0	0	0	0	0	0	0	0	0	0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DB	0.0	85.0
TEMPERATURE,WB	0.0	76.3
MONTH	1	11

MASTER BUILDING DATA

BLDG.ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P.FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX.NO.OF PEOPLE	40

LIGHTING

WATTS/SF	0.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82) CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8498 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/79 PAGE 1

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT	HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	16542.		0.	
WINDOW SOLAR	29362.			0.
WALL	46906.		0.	
ROOF/CEILING	2165.		0.	
PARTITION	0.		0.	
FLOOR	0.		0.	
DOOR	0.		0.	
INFILTRATION	0.	0.	0.	
LIGHTS	267076.			267076.
PEOPLE(31)	8423.	8423.		8423.
APPLIANCES	97000.	0.		97000.
TOTALS	457477.	8423.	0.	362499.
		PLNM HT	0.	
TOTAL HEAT	465900.	VENT.	273416.	
AT PEAK HOUR	14			
SENS. HEAT RATIO	0.98	TOTAL	273416.	27.4 BTUH/SF
		HUMID	314600.	
LIGHT HEAT TO R.A.	0.			
SKYLIGHT HEAT TO R.A.	0.		588016.	HEATING+HUMID
VENTILATION CFM	13000.		-88083.	LOSS LESS INT. GAIN
EXHAUST CFM	0.		-88083.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR		1.00		
BUILDING REFRIGERATION LOAD		1144506.		
TONS OF REFRIGERATION		95.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	114.6		4.3		105.2		2.8
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	114.6	27.4	4.3	1.0	105.2	36.5	2.8

AUTOVATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(82) - CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

BUILDING HOURLY COOLING LOADS (*=BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-2476.	0.	5514.	11028.	14704.	16542.
WIN SOLAR	49143.	59880.	60239.	57142.	50811.	41218.
WALL	24210.	24835.	24830.	23455.	23455.	21543.
ROOF/CEILING	2602.	2492.	2383.	2274.	2274.	2165.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	436779.	449708.	455467.	456400.	399371.	453970.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	445202.	457132.	463890.	464823.	406530.	462393.
BLDG REFG. *	925514.	975712.	940516.	1039458.	1024796.	1139425.
TONS	69	73	78	87	85	95
HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	16542.	16542.	16542.	14704.	12866.	11028.
WIN SOLAR	29362.	17365.	8204.	2662.	0.	0.
WALL	46906.	52196.	54730.	55364.	59255.	60772.
ROOF/CEILING	2165.	2402.	3787.	5182.	6432.	7358.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	457477.	450907.	445764.	440413.	78555.	79159.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	465900.	459420.	454187.	448836.	78555.	79159.
BLDG REFG. *	1144506.	1102752.	1079108.	1071060.	462767.	450081.
TONS	95	92	90			

$\frac{8}{14} = 764$ M.H.

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(02) CARACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8499 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHER PROFILES

HOURS		8	9	10	11	12	13	14	15	16	17	18	19	
MONTH 1		71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	DB
		67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WB
		130	140	153	160	167	166	162	157	156	154	159	157	HR X 1000
MONTH 12		75.	77.	78.	79.	81.	81.	81.	81.	81.	80.	79.	78.	DB
		70.8	71.9	72.0	71.9	72.1	72.3	72.2	72.1	72.1	71.9	70.9	70.7	WB
		153	157	156	152	149	151	150	149	149	150	144	145	HR X 1000

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44
GROUND REFLECTIVITY	0.20
CLEARNESS FACTOR	1.00
MAX. SOLAR GAIN, BTUH/SF	80.00
DEGS. FROM STD. MERIDIAN	-5.00

INWARD FLOW FRACTIONS

NI	NIU	NIB
0.33	0.00	0.00

DAYLIGHT SVG. IN EFFECT: J F M A M J J A S O N D
0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	76.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE, DB	0.0	81.0
TEMPERATURE, WB	0.0	72.3
MONTH	1	12

MASTER BUILDING DATA

BLDG. ORIENT.	65.0 DEG. CORR. FACT.
WALL HEIGHT	26.80 FEET
HOUR AVERAGE	5
COOLING D.T.	20.0 DEG.
HEATING D.T.	50.0 DEG.
HEATING LOAD	NO
COOLING LOAD	YES
OMIT WINTR SUN	NO
CIRCN. RATE	0.00 AC/HR, MIN
COIL B.P. FAC.	0.10
R.A. PLENUMS	NO
CALC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX. NO. OF PEOPLE	40

LIGHTING

WATTS/SF	9.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

LIGHTS	0.90
APPLIANCES	0.50
PEOPLE	0.80
PUMP HEAT	1.00

AIR QUANTITY FACTORS

JOB SITE ALTITUDE	0 FT
BAROMETRIC PRESSURE	29.921
AIR DENSITY FACTOR	1.000

VENTILATION

CFM/SF	0.50
CFM/PERSON	10.00
AIR CHANGE/HR	2.60
PCT. FAN CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

	1	2	3	4	5	6	7	8
RUN OPTIONS USED	0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION,HCC-III(82)--CAPACITE-MARTIN AND ASS. SAN JUAN,PR.

PROJECT - 8495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE	LATENT		HEAT LOSS HEATING	WINTER GAIN
WINDOW TRANS	8190.			0.	
WINDOW SOLAR	35360.				0.
WALL	36032.			0.	
ROOF/CEILING	376.			0.	
PARTITION	0.			0.	
FLOOR	0.			0.	
DOOR	0.			0.	
INFILTRATION	0.	0.		0.	
LIGHTS	267076.				267076.
PEOPLE(31)	8423.	8423.			8423.
APPLIANCES	87000.	0.			87000.
TOTALS	443459.	8423.		0.	362499.
			PLNM HT	0.	
TOTAL HEAT	451882.		VENT.	281424.	
AT PEAK HOUR	14				
SENS. HEAT RATIO	0.98		TOTAL	281424.	29.2 BTUH/SF
			HUMID	335191.	
LIGHT HEAT TO R.A.		0.			
SKYLIGHT HEAT TO R.A.		0.		616615.	HEATING+HUMID
VENTILATION CFM	13000.			-81075.	LOSS LESS INT. GAIN
EXHAUST CFM	0.			-81075.	LOSS LESS INT.+SOLAR
PUMP HEAT FACTOR			1.00		
BUILDING REFRIGERATION LOAD		921072.			
TONS OF REFRIGERATION			77.		

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF COOL	BTUH/SF HEAT	BTUH/CF COOL	BTUH/CF HEAT	SF PER TON	SF PER MBH	CFM/SF COOL
COOLING	9990.	267732.	92.2		3.4		129.7		2.7
HEATING	0.	0.		0.0		0.0		0.0	
TOTAL BLDG	9990.	267732.	92.2	28.2	3.4	1.1	129.7	35.5	2.7

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, HCC-III(02) CAPACITY-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 848F CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 13

BUILDING HOURLY COOLING LOADS (*-BLDG. REFG. INCLUDES VENTILATION)

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-1838.	-1838.	3676.	5514.	9190.	9190.
WIN SOLAR	45478.	59377.	62605.	60651.	55337.	46672.
WALL	10783.	9408.	10778.	10773.	12148.	15240.
ROOF/CEILING	376.	267.	267.	158.	267.	267.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	417299.	433391.	439827.	439596.	385068.	433870.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	425722.	441814.	448250.	448019.	392228.	442293.
BLDG REFG. *	805218.	877201.	899140.	898436.	834713.	913226.
TONS	67	73	75	74	70	76

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	9190.	9190.	9190.	7352.	5514.	3676.
WIN SOLAR	35360.	22844.	11502.	3525.	0.	0.
WALL	36032.	43175.	43744.	41754.	45740.	46099.
ROOF/CEILING	376.	509.	1798.	3210.	4286.	5053.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RM	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	443459.	439759.	429976.	419342.	55540.	54829.
LATENT						
INFILT	0.	0.	0.	0.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	451882.	448182.	437240.	427765.	55540.	54829.
BLDG REFG. *	921072.	895676.	895706.	869975.	264487.	241567.
TONS	77	75	74			

$\frac{8}{12}$ = 0.67 T.E. H.

ATTACHMENT #2

C.E.E.R. NEW WING

COOLING LOAD PROFILES

C.E.E.R. - New Wing

Cooling Load Profiles

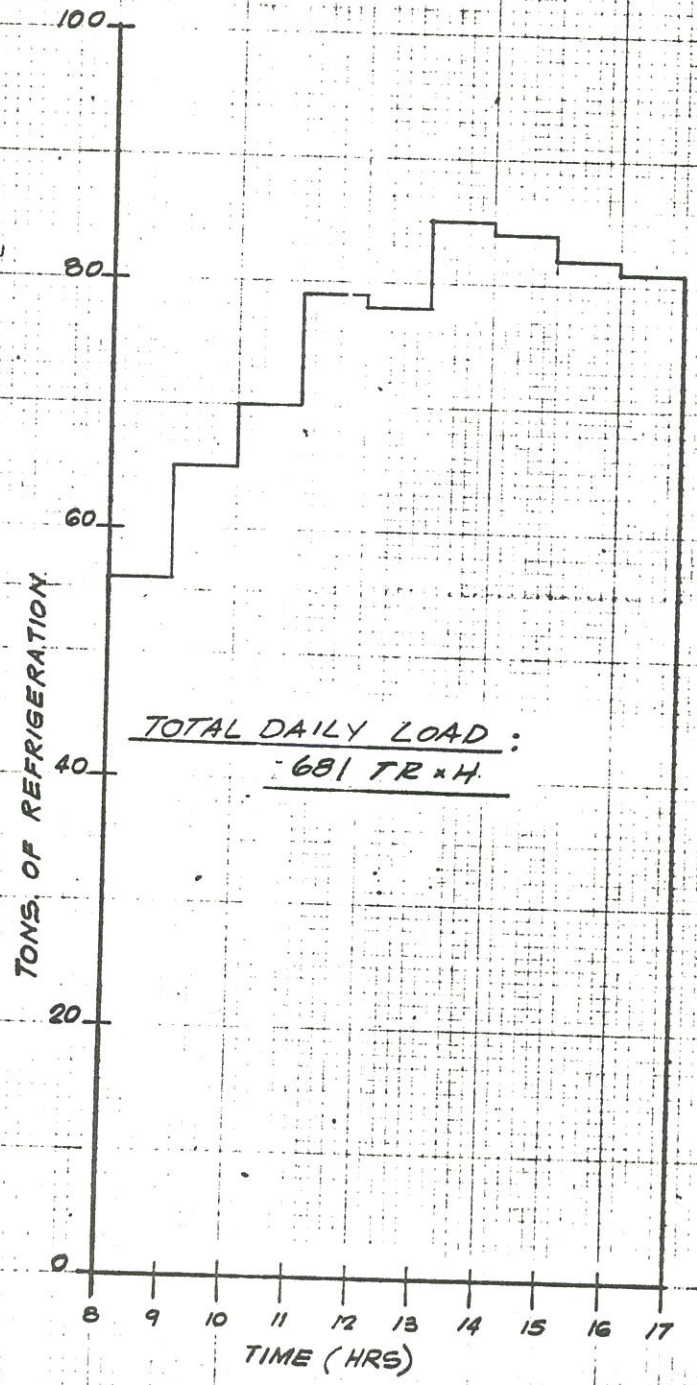
Summary

C.E.E.R NEW WING

BUILDING HOURLY COOLING LOAD

PROFILE FOR JANUARY (1)

(TYPICAL DAY)



TOTAL DAILY LOAD :

681 TR x H.

BY R.M DATE 11/24/70

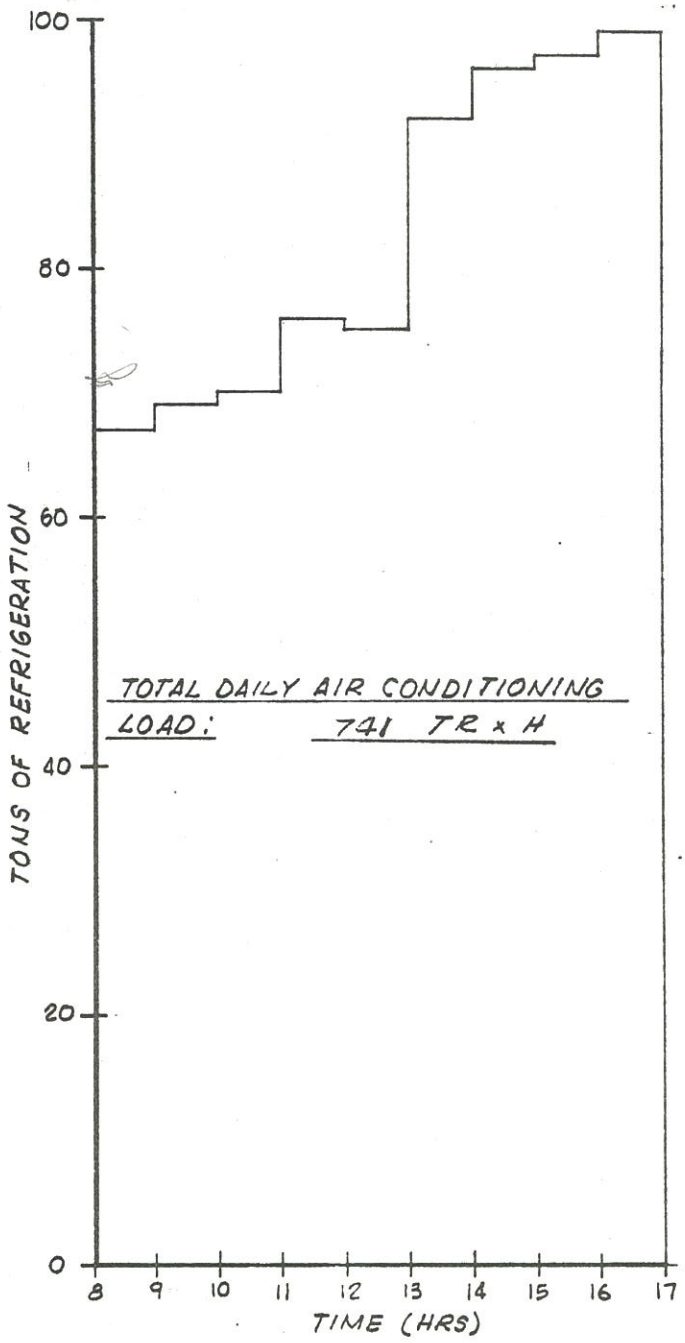
CHKD. BY FML DATE 11/24/70

SUBJECT

SHEET NO. 1 OF 4

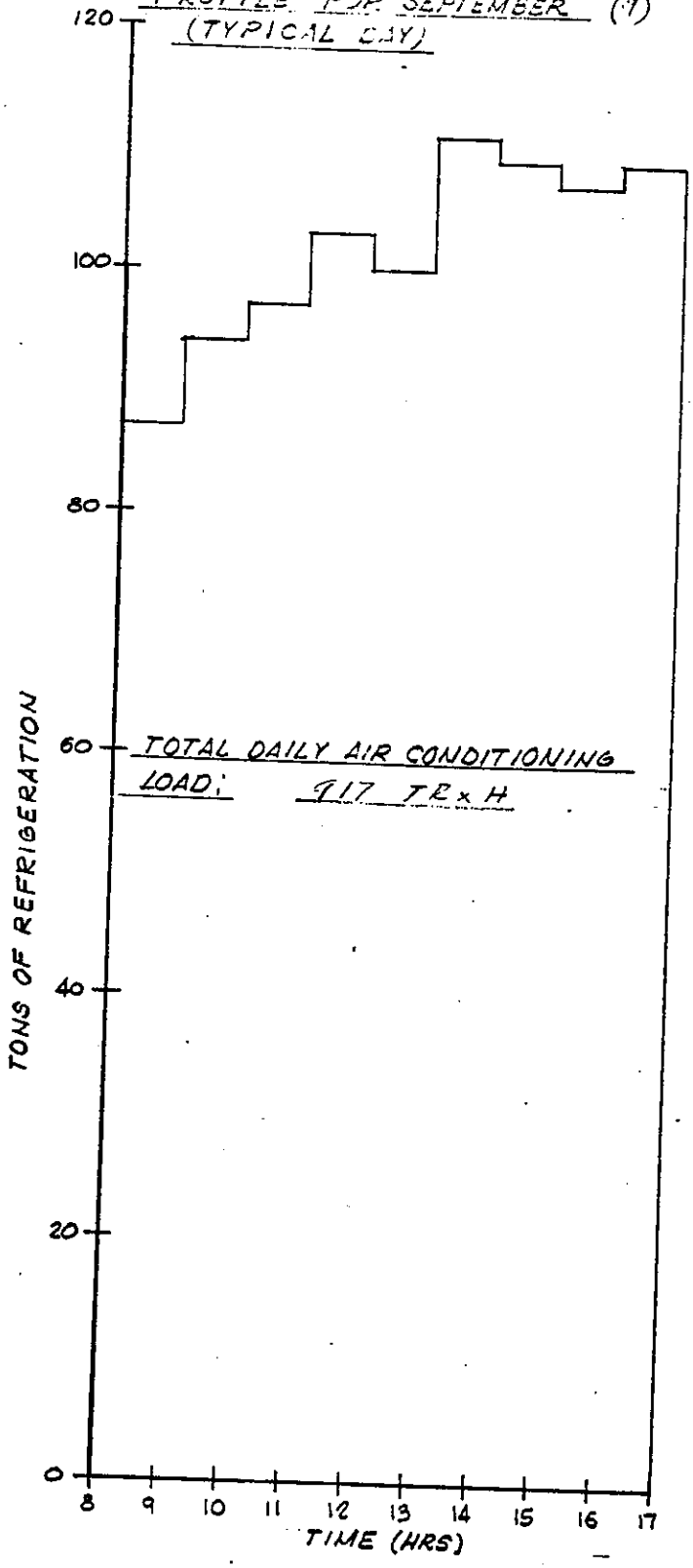
JOB NO. 8415

C.E.E.R. NEW WING BUILDING
HOURLY COOLING LOAD
PROFILE FOR MAY (5)
(TYPICAL DAY)



SHEET NO. 2 OF 4
JOB NO. 8495
SUBJECT
BY R M DATE
CHKD. BY F.M.L. DATE 11/24/76

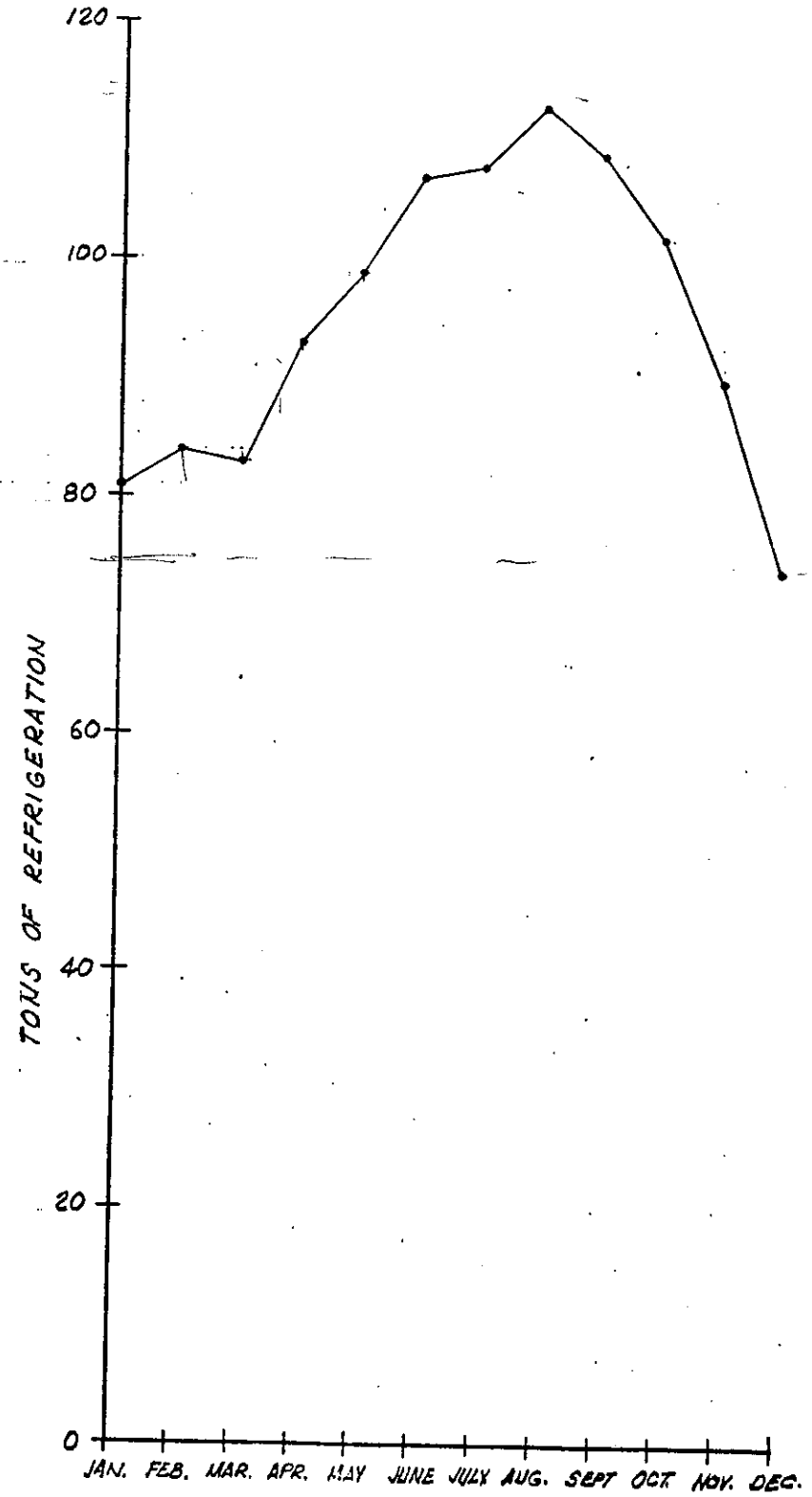
C.E.E.R. NEW WING BUILDING
HOURLY COOLING LOAD
PROFILE FOR SEPTEMBER (1)
(TYPICAL DAY)



TOTAL DAILY AIR CONDITIONING LOAD: 917 TR x H

BY R.M. DATE
CHKD. BY E.M.L. DATE 11/21/79
SUBJECT
SHEET NO. 3 OF 4
JOB NO. 8495

C.E.E.R. HEN WINS BUILDING
YEAR COOLING LOAD PROFILE
AT 4:00 P.M. (HOUR 16)



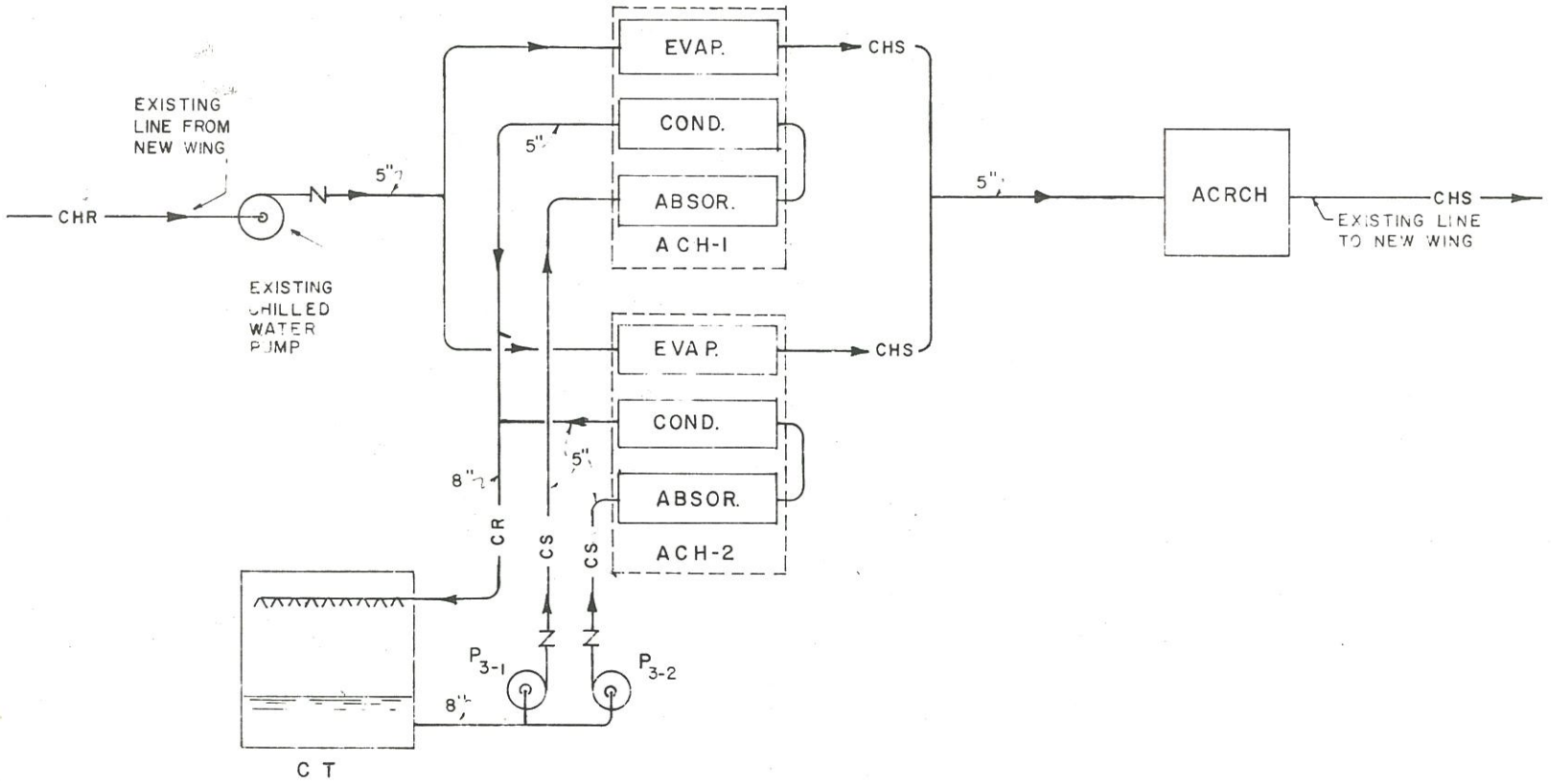
BY R.M. DATE
CHKD. BY F.M.L. DATE 11/24/86
SUBJECT
SHEET NO. 4 OF 4
JOB NO. 5425

ATTACHMENT #3

SCHEMATIC OF THE SOLAR ARRAY
PIPING SYSTEM IN CONJUNCTION
WITH THE ABSORPTION CHILLERS

JOB NO. 8495
SHEET NO

SCHEMATIC OF THE CHILLED WATER AND CONDENSING WATER PIPING SYSTEM



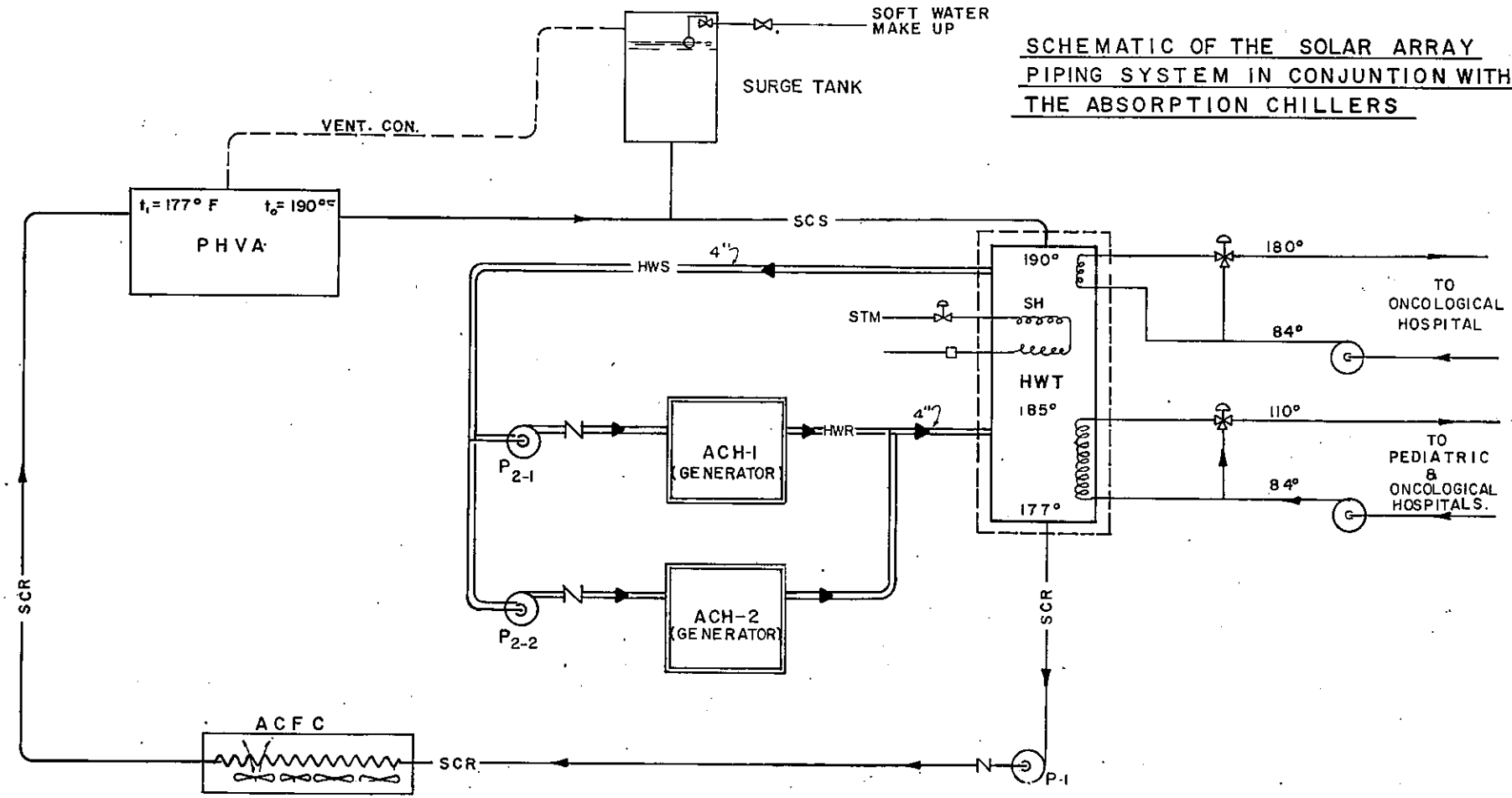
CAPACETE - MARTIN & ASSOCIATES ARCHITECTS - ENGINEERS 509, F.D. ROOSEVELT AVE., SAN JUAN, P.R.	2-5-79 F.M.L. REVISIONS	NONE DATE 10/13/78	CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

ATTACHMENT #4

SCHEMATIC OF THE CHILLED WATER
AND CONDENSING WATER PIPING
SYSTEM

JOB NO. 8495
SHEET NO.

SCHEMATIC OF THE SOLAR ARRAY PIPING SYSTEM IN CONJUNTION WITH THE ABSORPTION CHILLERS



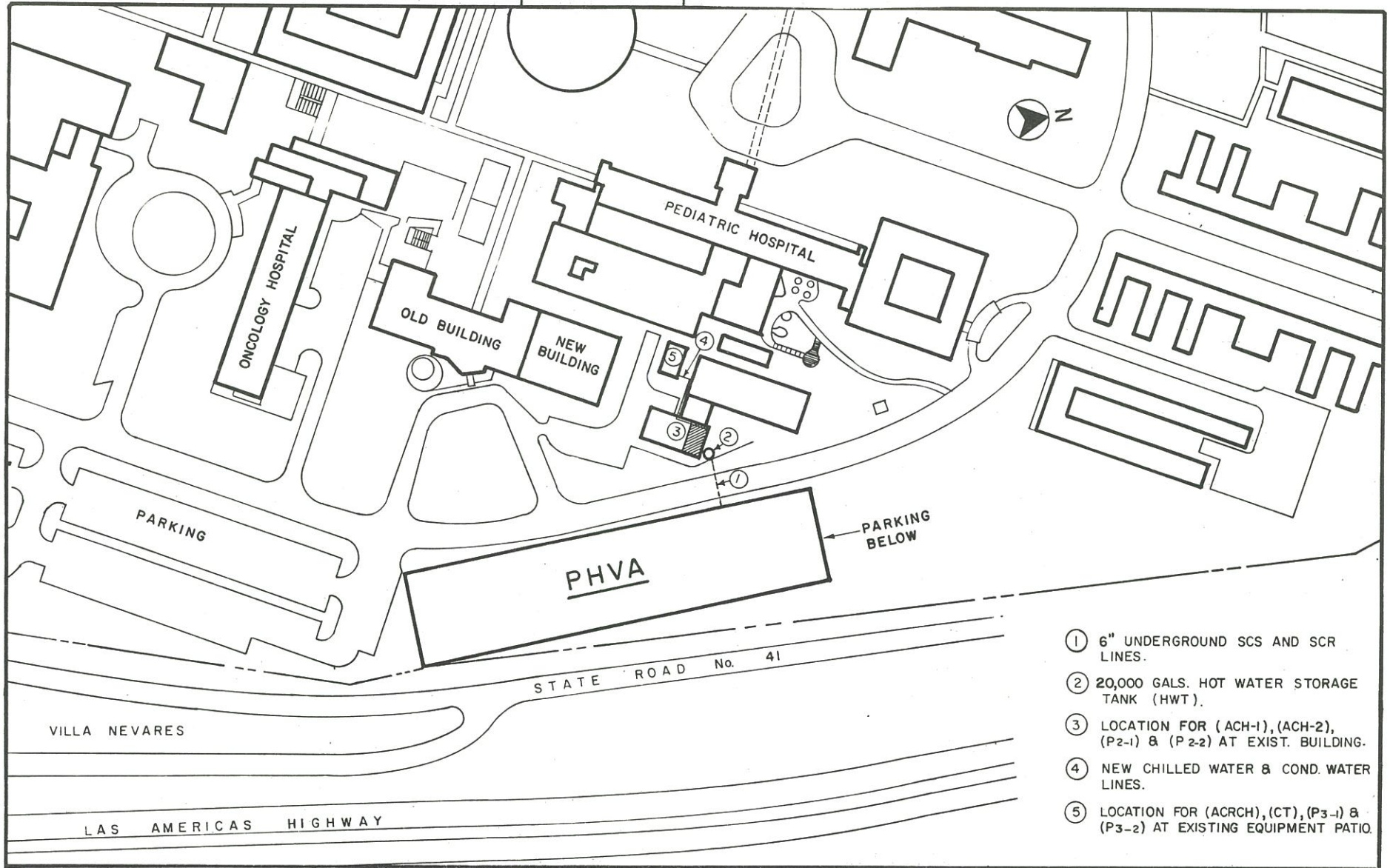
CAPACETE - MARTIN & ASSOCIATES ARCHITECTS - ENGINEERS 1509 F.D. ROOSEVELT AVE., SAN JUAN, P.R.	10-17-78	2-5-79				SCALE NONE DATE 10/13/78
	F.M.L.	F.M.L.				CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
	REVISIONS					

ATTACHMENT #5

GENERAL PLAN

JOB NO. 8495

SHEET NO.



1. 6" UNDERGROUND SCS AND SCR LINES.
2. 20,000 GALS. HOT WATER STORAGE TANK (HWT).
3. LOCATION FOR (ACH-1), (ACH-2), (P2-1) & (P2-2) AT EXIST. BUILDING.
4. NEW CHILLED WATER & COND. WATER LINES.
5. LOCATION FOR (ACRCH), (CT), (P3-1) & (P3-2) AT EXISTING EQUIPMENT PATIO.

CAPACETE - MARTIN & ASSOCIATES
ARCHITECTS - ENGINEERS
1509 F.D. ROOSEVELT AVE., SAN JUAN, P.R.

10-17-78					
F.M.L.					
REVISIONS					

SCALE 1" = 100'

DATE 10/13/78

CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS

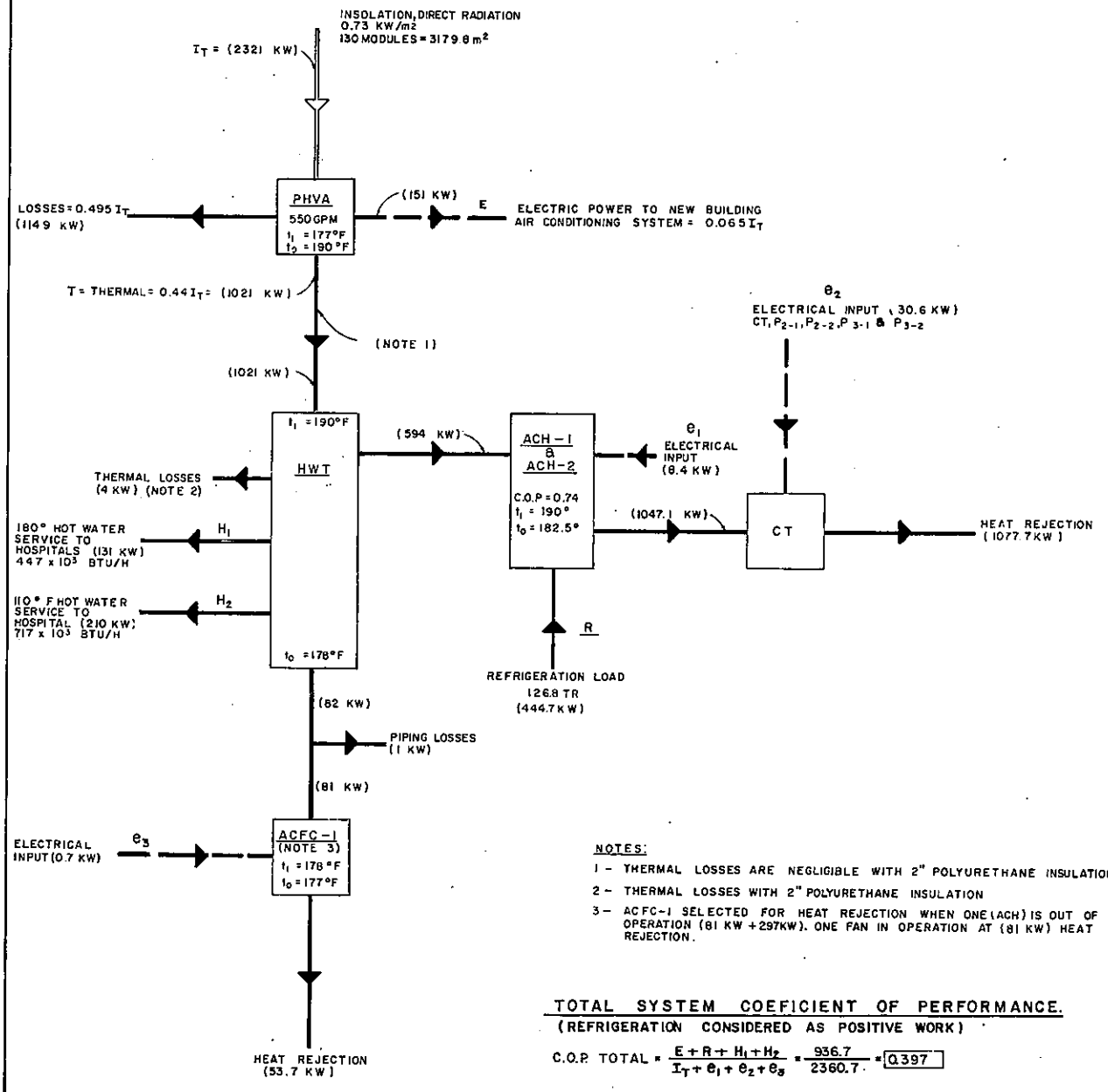
CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

ATTACHMENT #6

POWER FLOW DIAGRAM DURING
THE PEAK HOUR INSOLATION

JOB NO. 8495
SHEET NO

CO-GENERATION
POWER FLOW DIAGRAM DURING THE PEAK HOUR
INSOLATION INCLUDING SOLAR COOLING



NOTES:

1 - THERMAL LOSSES ARE NEGLIGIBLE WITH 2" POLYURETHANE INSULATION.

2 - THERMAL LOSSES WITH 2" POLYURETHANE INSULATION

3 - ACFC-1 SELECTED FOR HEAT REJECTION WHEN ONE (ACH) IS OUT OF OPERATION (81 KW + 297 KW). ONE FAN IN OPERATION AT (81 KW) HEAT REJECTION.

TOTAL SYSTEM COEFICIENT OF PERFORMANCE.
(REFRIGERATION CONSIDERED AS POSITIVE WORK)

$$C.O.P\ TOTAL = \frac{E + R + H_1 + H_2}{I_T + e_1 + e_2 + e_3} = \frac{936.7}{2360.7} = \boxed{0.397}$$

$$C.O.P\ THERMAL = \frac{R + H_1 + H_2}{T + e_1 + e_2 + e_3} = \frac{787.7}{1060.7} = \boxed{0.743}$$

CAPACETE-MARTIN & ASSOCIATES ARCHITECTS - ENGINEERS 1508 F.D. ROOSEVELT AVE., SAN JUAN, P.R.	10-17-78 F.M.L. REVISIONS	DRAWN BY HERMAN RAMOS DATE OCT. 13, 1978	CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

ATTACHMENT #7

GENERAL INFORMATION FOR ECONOMIC ANALYSIS

GENERAL INFORMATION FOR ECONOMIC ANALYSES

RECURRING COST

Expenses for electric energy, fuel (or steam purchased from a central plant), material consumed in operation, maintenance services and other items incurred in an annual basis.

DISCOUNT RATE-INTEREST RATE

That rate which is used to transform future investment costs into a value of equivalent worth (see "Present Value"). It enables one to compare investments which have dissimilar cost streams.

DISCOUNTING

The discounted cost of an investment represent the return that would be earned if the money obtained through taxation and spent by the Government were retained by the private sector and allowed to earn a return on its investment opportunities.

PRESENT VALUE

Each year's expected yearly cost multiplied by its discount factor and then summed over all years of the planning period.

DISCOUNT FACTOR-PRESENT VALUE FACTOR

Present value of one (1) dollar. Factors are based on continuous compounding of interest at stated effective rate per annum, assuming uniform cash flow throughout stated one (1) year periods. These factors are equivalent to an arithmetic average of beginning and end of the year compound amount factors found in standard present value tables.

GENERAL INFORMATION FOR ECONOMIC ANALYSIS (cont'd.)

TERMINAL VALUE

The expected value of assets at the end of their economic life.

UNIFORM ANNUAL COST

The average cost per year for those years in which benefits accrue. It is obtained by dividing the total present value cost by the sum of the present value factors of the years in which benefits accrue.