

REVISION OF
THE
PRELIMINARY PROPOSAL
FOR

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

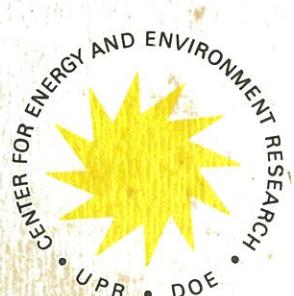
**CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
RIO PIEDRAS, PUERTO RICO**

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**

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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.), Rio 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 ft² 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.

W.D. 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 compressor 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:

<u>Fiscal Year</u>	<u>Materials & Supplies</u>	<u>Air Cond. Tech. Salary</u>
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	<u>9,232</u>	<u>4,500</u>
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 photovoltaic 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 machine 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 Pediatric 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 CO₂ 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 connec- tion	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 mag- netic 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 up- grading	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 con- trols	LS	1		2,000.00
<hr/>					
	Subtotal			\$ 78,600.00	
	30% Overhead, Profit and Taxes			<u>23,500.00</u>	
	Total			<u>\$102,100.00</u>	
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SUMMARY OF PRELIMINARY COST ESTIMATE

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

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.

* 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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ECONOMIC ANALYSIS

DATE- FEBRUARY 5, 1979
 PROJECT- CEFER CVA -3495
 SUBJECT- NEW HANGAR CONDITIONING UP GRADING
 DESCRIPTION- COMPARATIVE ANALYSIS BFTWEEN 1977 AND 1979 PROPOSALS
 ALTERNATIVE- A-PROPOSAL OF APRIL 1977

ECONOMIC CONSIDERATIONS- 20 YEAR LIFE

10.0 PERCENT INTEREST RATE
 12.0 PERCENT STEAVY ESCALATION RATE
 15.0 PERCENT ELECTRICAL ENERGY ESCALATION RATE
 2.0 PERCENT OTHER FISCALITY ESCALATION RATE
 \$ 0.00 TERMINAL VALUE

ITEM	FAC/PROJECT	WAGE/UNIT	INVESTMENT	STAFF	EFFECTUATING COSTS-----/-----		EFFECTUATING COSTS-----/-----		TOTAL-----/-----	
					ENERGY	OTHERS	ALL COSTS	DISCOUNTED COST	FACTCR	
1	1	1762.00	18301.00	3600.00	21850.00	2000.00	37530.00	239168.00	0.9545	77342.14
2	2	0.00	0.00	4121.60	36627.50	2040.00	42789.50	42789.50	0.9767	37151.02
3	3	0.00	0.00	4616.19	42121.62	2080.00	44818.61	46818.61	0.9768	38512.75
4	4	0.00	0.00	5170.13	48439.86	2122.41	505732.41	55732.41	0.7171	39962.29
5	5	0.00	0.00	5790.55	5575.94	2164.86	63661.26	63661.26	0.7171	41575.36
6	6	0.00	0.00	6495.41	64161.72	2209.16	72755.30	72755.30	0.5926	43121.49
7	7	0.00	0.00	7263.66	73670.98	2252.22	81186.97	83186.97	0.5348	44422.47
8	8	0.00	0.00	8135.39	84721.62	2297.37	95154.31	95154.31	0.4298	45652.03
9	9	0.00	0.00	9111.64	87429.87	2343.31	104994.74	104994.74	0.4453	49466.54
10	10	0.00	0.00	10204.62	112044.35	2390.18	126639.47	126639.47	0.4048	50456.53
11	11	0.00	0.00	11429.52	12951.01	2437.98	142718.52	142718.52	0.3670	52523.7
12	12	0.00	0.00	12601.06	148178.66	2456.74	163456.47	163456.47	0.3345	54630.34
13	13	0.00	0.00	14337.10	17745.46	2536.46	187279.13	187279.13	0.3041	55644.51
14	14	0.00	0.00	16157.65	19566.24	2687.21	214511.15	214511.15	0.2764	59323.51
15	15	0.00	0.00	17084.57	22531.22	2524.05	246984.75	246984.75	0.2513	61831.13
16	16	0.00	0.00	20142.72	259165.41	2591.73	281999.86	281999.86	0.2245	64437.95
17	17	0.00	0.00	22559.94	29840.22	2745.57	323345.64	323345.64	0.2077	67177.82
18	18	0.00	0.00	25267.03	342746.25	2900.48	375813.76	375813.76	0.1888	70075.67
19	19	0.00	0.00	28299.07	354159.16	2956.49	425313.75	425313.75	0.1716	73014.3
20	20	0.00	0.00	31694.96	453281.92	2913.62	497993.50	497993.50	0.1560	76147.94
21										
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DISCOUNTED TOTAL COST *** \$ 1254107.73
 DISCOUNTED TERMINAL VALUE *** \$ 6.00
 UNIFORM ANNUAL CCOST WITHOUT TERMINAL VALUE *** \$ 146292.40
 UNIFORM ANNUAL COST WITH TERMINAL VALUE *** \$ 140292.40

*** BFT DISCOUNTED TOTAL COST *** \$ 1254107.73

CAPACETE, VAPITI, & ASSOCIATES ENGINEERS-ARCHITECTS
P.O. BOX 2000, SAN FRANCISCO, CALIFORNIA

BEST OFFICE FOX 9694

SAY TURCF! PLEAS TIC el CIO GACE 1800

ECONOMIC ANALYSIS

DATE - FEBRUARY 5, 1979
 PROJECT - CEER CVA - 3495
 SUBJECT - NEW KING AIR CONDITIONING UP GRADING
 ALTERNATIVE - A-REVISED PROPOSAL OF FEBRUARY 1979

CONSIDERATIONS - 20 YEAR LIFE
 10.0 PERCENT INTEREST RATE
 12.0 PERCENT STEAM ESCALATION RATE
 15.0 PERCENT ELECTRICAL ENERGY ESCALATION RATE
 7.0 PERCENT OTHER FISCALIZATION RATE

ECONOMIC CONSIDERATIONS-	20 YEAR LIFE
10.0	PERCENT INTEREST RATE
12.0	PERCENT STEAM ESCALATION RATE
15.0	PERCENT ELECTRICAL ENERGY ESCALATION RATE
7.0	PERCENT OTHER FISCALATION RATE
5	0.32 TERMINAL VALUE

PROJECT		MANAGEMENT		INVESTMENT		STEAM		ELECTRICAL		RECURRING COSTS		TOTAL	
AG	PROJECT	AG	PROJECT	AG	PROJECT	AG	PROJECT	AG	PROJECT	AG	PROJECT	AG	PROJECT
250	1,000	24,691,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
0.00	0.00	2,061.92	0.00	2,061.92	0.00	2,061.92	0.00	74,673.30	0.00	2,061.92	0.00	2,061.92	0.00
0.00	0.00	2,069.35	0.00	2,069.35	0.00	2,069.35	0.00	8575.55	0.00	2,069.35	0.00	2,069.35	0.00
0.00	0.00	2,586.47	0.00	2,586.47	0.00	2,586.47	0.00	9861.84	0.00	2,586.47	0.00	2,586.47	0.00
0.00	0.00	2,956.44	0.00	2,956.44	0.00	2,956.44	0.00	11341.16	0.00	2,956.44	0.00	2,956.44	0.00
0.00	0.00	3,244.47	0.00	3,244.47	0.00	3,244.47	0.00	13062.33	0.00	3,244.47	0.00	3,244.47	0.00
0.00	0.00	3,633.80	0.00	3,633.80	0.00	3,633.80	0.00	16705.69	0.00	3,633.80	0.00	3,633.80	0.00
0.00	0.00	4,069.46	0.00	4,069.46	0.00	4,069.46	0.00	17244.49	0.00	4,069.46	0.00	4,069.46	0.00
0.00	0.00	4,558.24	0.00	4,558.24	0.00	4,558.24	0.00	19814.76	0.00	4,558.24	0.00	4,558.24	0.00
0.00	0.00	5,105.23	0.00	5,105.23	0.00	5,105.23	0.00	22911.13	0.00	5,105.23	0.00	5,105.23	0.00
0.00	0.00	5,717.86	0.00	5,717.86	0.00	5,717.86	0.00	26232.80	0.00	5,717.86	0.00	5,717.86	0.00
0.00	0.00	6,664.01	0.00	6,664.01	0.00	6,664.01	0.00	31617.72	0.00	6,664.01	0.00	6,664.01	0.00
0.00	0.00	7,172.64	0.00	7,172.64	0.00	7,172.64	0.00	34692.44	0.00	7,172.64	0.00	7,172.64	0.00
0.00	0.00	7,932.19	0.00	7,932.19	0.00	7,932.19	0.00	39896.41	0.00	7,932.19	0.00	7,932.19	0.00
0.00	0.00	8,997.17	0.00	8,997.17	0.00	8,997.17	0.00	5072.95	0.00	8,997.17	0.00	8,997.17	0.00
0.00	0.00	10,076.83	0.00	10,076.83	0.00	10,076.83	0.00	5174.42	0.00	10,076.83	0.00	10,076.83	0.00
0.00	0.00	11,246.04	0.00	11,246.04	0.00	11,246.04	0.00	5174.42	0.00	11,246.04	0.00	11,246.04	0.00
0.00	0.00	12,640.38	0.00	12,640.38	0.00	12,640.38	0.00	5174.42	0.00	12,640.38	0.00	12,640.38	0.00
0.00	0.00	14,157.22	0.00	14,157.22	0.00	14,157.22	0.00	5172.95	0.00	14,157.22	0.00	14,157.22	0.00
0.00	0.00	15,556.04	0.00	15,556.04	0.00	15,556.04	0.00	5172.95	0.00	15,556.04	0.00	15,556.04	0.00
0.00	0.00	16,157.22	0.00	16,157.22	0.00	16,157.22	0.00	5172.95	0.00	16,157.22	0.00	16,157.22	0.00
0.00	0.00	17,761.92	0.00	17,761.92	0.00	17,761.92	0.00	5172.95	0.00	17,761.92	0.00	17,761.92	0.00
0.00	0.00	19,464.92	0.00	19,464.92	0.00	19,464.92	0.00	5172.95	0.00	19,464.92	0.00	19,464.92	0.00
0.00	0.00	21,268.92	0.00	21,268.92	0.00	21,268.92	0.00	5172.95	0.00	21,268.92	0.00	21,268.92	0.00
0.00	0.00	23,172.92	0.00	23,172.92	0.00	23,172.92	0.00	5172.95	0.00	23,172.92	0.00	23,172.92	0.00
0.00	0.00	25,176.92	0.00	25,176.92	0.00	25,176.92	0.00	5172.95	0.00	25,176.92	0.00	25,176.92	0.00
0.00	0.00	27,280.92	0.00	27,280.92	0.00	27,280.92	0.00	5172.95	0.00	27,280.92	0.00	27,280.92	0.00
0.00	0.00	29,484.92	0.00	29,484.92	0.00	29,484.92	0.00	5172.95	0.00	29,484.92	0.00	29,484.92	0.00
0.00	0.00	31,788.92	0.00	31,788.92	0.00	31,788.92	0.00	5172.95	0.00	31,788.92	0.00	31,788.92	0.00
0.00	0.00	34,192.92	0.00	34,192.92	0.00	34,192.92	0.00	5172.95	0.00	34,192.92	0.00	34,192.92	0.00
0.00	0.00	36,706.92	0.00	36,706.92	0.00	36,706.92	0.00	5172.95	0.00	36,706.92	0.00	36,706.92	0.00
0.00	0.00	39,320.92	0.00	39,320.92	0.00	39,320.92	0.00	5172.95	0.00	39,320.92	0.00	39,320.92	0.00
0.00	0.00	42,034.92	0.00	42,034.92	0.00	42,034.92	0.00	5172.95	0.00	42,034.92	0.00	42,034.92	0.00
0.00	0.00	44,848.92	0.00	44,848.92	0.00	44,848.92	0.00	5172.95	0.00	44,848.92	0.00	44,848.92	0.00
0.00	0.00	47,762.92	0.00	47,762.92	0.00	47,762.92	0.00	5172.95	0.00	47,762.92	0.00	47,762.92	0.00
0.00	0.00	50,776.92	0.00	50,776.92	0.00	50,776.92	0.00	5172.95	0.00	50,776.92	0.00	50,776.92	0.00
0.00	0.00	53,800.92	0.00	53,800.92	0.00	53,800.92	0.00	5172.95	0.00	53,800.92	0.00	53,800.92	0.00
0.00	0.00	56,924.92	0.00	56,924.92	0.00	56,924.92	0.00	5172.95	0.00	56,924.92	0.00	56,924.92	0.00
0.00	0.00	60,148.92	0.00	60,148.92	0.00	60,148.92	0.00	5172.95	0.00	60,148.92	0.00	60,148.92	0.00
0.00	0.00	63,472.92	0.00	63,472.92	0.00	63,472.92	0.00	5172.95	0.00	63,472.92	0.00	63,472.92	0.00
0.00	0.00	66,896.92	0.00	66,896.92	0.00	66,896.92	0.00	5172.95	0.00	66,896.92	0.00	66,896.92	0.00
0.00	0.00	70,420.92	0.00	70,420.92	0.00	70,420.92	0.00	5172.95	0.00	70,420.92	0.00	70,420.92	0.00
0.00	0.00	74,044.92	0.00	74,044.92	0.00	74,044.92	0.00	5172.95	0.00	74,044.92	0.00	74,044.92	0.00
0.00	0.00	77,768.92	0.00	77,768.92	0.00	77,768.92	0.00	5172.95	0.00	77,768.92	0.00	77,768.92	0.00
0.00	0.00	81,592.92	0.00	81,592.92	0.00	81,592.92	0.00	5172.95	0.00	81,592.92	0.00	81,592.92	0.00
0.00	0.00	85,416.92	0.00	85,416.92	0.00	85,416.92	0.00	5172.95	0.00	85,416.92	0.00	85,416.92	0.00
0.00	0.00	89,240.92	0.00	89,240.92	0.00	89,240.92	0.00	5172.95	0.00	89,240.92	0.00	89,240.92	0.00
0.00	0.00	93,164.92	0.00	93,164.92	0.00	93,164.92	0.00	5172.95	0.00	93,164.92	0.00	93,164.92	0.00
0.00	0.00	97,188.92	0.00	97,188.92	0.00	97,188.92	0.00	5172.95	0.00	97,188.92	0.00	97,188.92	0.00
0.00	0.00	101,212.92	0.00	101,212.92	0.00	101,212.92	0.00	5172.95	0.00	101,212.92	0.00	101,212.92	0.00
0.00	0.00	105,336.92	0.00	105,336.92	0.00	105,336.92	0.00	5172.95	0.00	105,336.92	0.00	105,336.92	0.00
0.00	0.00	109,460.92	0.00	109,460.92	0.00	109,460.92	0.00	5172.95	0.00	109,460.92	0.00	109,460.92	0.00
0.00	0.00	113,684.92	0.00	113,684.92	0.00	113,684.92	0.00	5172.95	0.00	113,684.92	0.00	113,684.92	0.00
0.00	0.00	117,908.92	0.00	117,908.92	0.00	117,908.92	0.00	5172.95	0.00	117,908.92	0.00	117,908.92	0.00
0.00	0.00	122,132.92	0.00	122,132.92	0.00	122,132.92	0.00	5172.95	0.00	122,132.92	0.00	122,132.92	0.00
0.00	0.00	126,356.92	0.00	126,356.92	0.00	126,356.92	0.00	5172.95	0.00	126,356.92	0.00	126,356.92	0.00
0.00	0.00	130,580.92	0.00	130,580.92	0.00	130,580.92	0.00	5172.95	0.00	130,580.92	0.00	130,580.92	0.00
0.00	0.00	134,804.92	0.00	134,804.92	0.00	134,804.92	0.00	5172.95	0.00	134,804.92	0.00	134,804.92	0.00
0.00	0.00	139,028.92	0.00	139,028.92	0.00	139,028.92	0.00	5172.95	0.00	139,028.92	0.00	139,028.92	0.00
0.00	0.00	143,252.92	0.00	143,252.92	0.00	143,252.92	0.00	5172.95	0.00	143,252.92	0.00	143,252.92	0.00
0.00	0.00	147,476.92	0.00	147,476.92	0.00	147,476.92	0.00	5172.95	0.00	147,476.92	0.00	147,476.92	0.00
0.00	0.00	151,700.92	0.00	151,700.92	0.00	151,700.92	0.00	5172.95	0.00	151,700.92	0.00	151,700.92	0.00
0.00	0.00	155,924.92	0.00	155,924.92	0.00	155,924.92	0.00	5172.95	0.00	155,924.92	0.00	155,924.92	0.00
0.00	0.00	160,148.92	0.00	160,148.92	0.00	160,148.92	0.00	5172.95	0.00	160,148.92	0.00	160,148.92	0.00
0.00	0.00	164,372.92	0.00	164,372.92	0.00	164,372.92	0.00	5172.95	0.00	164,372.92	0.00	164,372.92	0.00
0.00	0.00	168,596.92	0.00	168,596.92	0.00	168,596.92	0.00	5172.95	0.00	168,596.92	0.00	168,596.92	0.00
0.00	0.00	172,820.92	0.00	172,820.92	0.00	172,820.92	0.00	5172.95	0.00	172,820.92	0.00	172,820.92	0.00
0.00	0.00	177,044.92	0.00	177,044.92	0.00	177,044.92	0.00	5172.95	0.00	177,044.92	0.00	177,044.92	0.00
0.00	0.00	181,268.92	0.00	181,268.92	0.00	181,268.92	0.00	5172.95	0.00	181,268.92	0.00	181,268.92	0.00
0.00	0.00	185,492.92	0.00	185,492.92	0.00	185,492.92	0.00	5172.95	0.00	185,492.92	0.00	185,492.92	0.00
0.00	0.00	189,716.92	0.00	189,716.92	0.00	189,716.92	0.00	5172.95	0.00	189,716.92	0.00	189,716.92	0.00
0.00	0.00	193,940.92	0.00	193,940.92	0.00	193,940.92	0.00	5172.95	0.00	193,940.92	0.00	193,940.92	0.00
0.00	0.00	198,164.92	0.00	198,164.92	0.00	198,164.92	0.00	5172.95	0.00	198,164.92	0.00	198,164.92	0.00
0.00	0.00	202,388.92	0.00	202,388.92	0.00	202,388.92	0.00	5172.95	0.00	202,388.92	0		

DISCOUNTED TOTAL COST \$ 567540.09
DISCOUNTED TERMINAL VALUE 0.00

UNIFORM ANNUAL COST WITHOUT TERMINAL VALUE	•••	63488.61
UNIFORM ANNUAL CCST 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

	<u>Page</u>
C.E.E.R. - NW-1 January	1
C.E.E.R. - NW-2 February	8
C.E.E.R. - NW-3 March	11
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C.E.E.R. - NW-5 May	17
C.E.E.R. - NW-6 June	20
C.E.E.R. - NW-7 July	23
C.E.E.R. - NW-8 August	26
C.E.E.R. - NW-9 September	29
C.E.E.R. - NW-10 October	32
C.E.E.R. - NW-11 November	35
C.E.E.R. - NW-12 December	38

C.E.E.R. NW-1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS, HCC-III(2) - CAPACIT-E-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 9408 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 13/12/78 PAGE 1

WEATHER PROFILES

HOURS	8	9	10	11	12	13	14	15	16	17	18	19	20
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	83.	82.	81.	80.	88
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	W.H.
	139	149	153	156	157	156	162	157	156	154	159	157	HR X 10000
MONTH 1	71.	73.	76.	80.	82.	83.	83.	83.	82.	81.	80.	88	
	67.8	69.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	W.H.
	139	149	153	156	157	156	162	157	156	154	159	157	HR X 10000

GEOGRAPHIC/SOLAR DATA

INWARD FLOW FRACTIONS

LATITUDE	18.44	NI	NIU	AIR				
GROUND REFLECTIVITY	0.20	-	-	0.33	-	0.600	-	0.001
CLEARNESS FACTOR	1.00							
MAX. SOLAR GAIN, BTUH/SF	80.00							
DEGS. FROM STD. MERIDIAN	5.00							

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

WINTER SUMMER

MASTER BUILDING DATA

INSIDE			BLDG. ORIENT.	65.0 DEG. CORR. FACT.
TEMPERATURE	76.0	76.0	WALL HEIGHT	26.80 FEET
RELATIVE HUM	50.0	55.0	HOTIR-AVERAGE	5
HUMIDITY RAT	0.0006	0.0106	COOLING D.T.	20.0 DEG.
OUTSIDE			HEATING D.T.	50.0 DEG.
TEMPERATURE, DB	80.0	83.0	HEATING LOAD	NO
TEMPERATURE, WP	70.0	74.6	COOLING LOAD	YES
MONTH	1	1	OMIT WINTR SUN	NO

CIRCN. RATE	0.00 AC/HR, MIN
COIL R.P. FAC.	0.10
R.A. PLENUMS	NO
CALCS. APP	NO

OCCUPANCY

LIGHTING

BTU/PERSON, SFNS.	255.	WATTS/SF	9.80
BTU/PERSON, LAT.	255.	LOAD PROFILE NO.	2
LOAD PROFILE NO.	1	PERCENT TO R.A.	0.
SF/PERSON	0.00		
MAX. NO. OF PEOPLE	40		

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

LOAD FACTOR MULTIPLIERS

AIR QUANTITY FACTORS

LIGHTS	0.80
APPLIANCES	0.50
PEOPLE	2.80
PUMP LOAD	1.00

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

VENTILATION

INFILTRATION

CFM/SF	0.50
CFM/PERSON	12.00
AIR CHANGE/HR	2.60
PCT. FAH CFM	0.00

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

1	2	3	4	5	6	7	8
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RUN OPTIONS USED	0	0	1	0	0	1	0
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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION (HCC-IIIN2) CAPAC. TE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - R405 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	0.0006	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. APP	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/SE	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-1.HP(1.2) CAPACITY-MATING AND ASS. SAN JUAN, PR.

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

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 CALCULATIONS-HCC-III(1-2) - CAPACETE-HARTIN AND ASS. SAN JUAN, PR.
 PROJECT - 8495 CHARTS FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

EXTERIOR WALLS

TYPE NUMBER	WALL DESCRIPTION	DECREMENT FACTOR	TIME LAG	U-FACTOR COLOR	BELOW GRD SUMMER WINTER	BTU/SF
1	9 IN CONCRETE WALL	0.31	6.	L	0.51 0.51	9.0
2	WALL COMPOSITION	0.20	8.	L	0.06 0.06	0.0

ROOFS

TYPE NUMBER	ROOF DESCRIPTION	DECREMENT FACTOR	TIME LAG	U-FACTOR COLOR	BELOW GRD SUMMER WINTER	BTU/SF
1	6 IN CONCRETE-5IN INSU	0.20	8.	L	0.06 0.06	0.0

CEILINGS

TYPE NUMBER	CEILING DESCRIPTION	CEILING U-FACTOR	ROOF ABOVE TYPE	FLOOR ABOVE TYPE	BELOW GRD SUM TEMP WIN TEMP	BTU/SF
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PARTITIONS

TYPE NUMBER	PARTITION DESCRIPTION	U-FACTOR	UN-CONDITIONED SPACE TEMPERATURE SUMMER WINTER	BTU/SF
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FLOORS

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

TYPE NUMBER	DOOR DESCRIPTION	U-FACTOR	AREA SF	INFILTRATION CFM(WINTER)	BTU/LF
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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC-CALCULATION, HCC-II (P2) - CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8406 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WINDOWS

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

OVERHANG AND FINS

TYPE NUMBER	SHADE	AIR COEFFICIENTS	SUPPLY	TOTAL DEPTH	ABOVE BEYOND BEYOND VERT.		PROJ.	BOTTON	TYPE
					TOP	LEFT			
1	0.31 GL	0.00	S U	0.0	0.00	0.00	0.00	0.0	OV
	0.00 INS		O P	0.0	0.00	0.00	0.00	0.0	LF
	0 SCR			0.0	0.00	0.00	0.00	0.0	RF
2	0.31 GL	0.00	S U	0.0	0.00	0.00	0.00	0.0	OV
	0.00 INS		O P	0.0	0.00	0.00	0.00	0.0	LF
	0 SCR			0.0	0.00	0.00	0.00	0.0	RF

CODES

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

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

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

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING		HEAT LOSS	
	SENSIBLE	LATENT	HEATING	WINTER GAIN
WINDOW TRANS	-12864.		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.	352499.

PLNM HT 0.
VENT. 136136.TOTAL 136136. 13.6 BTUH/SF
HUMID 227656.

LIGHT HEAT TO P.A.

SKYLIGHT HEAT TO P.A.

363792. HEATING+HUMID

VENTILATION CFM 13000.

EXHAUST CFM 0. -226363. LOSS LESS INT.+SOLAR

PUMP HEAT FACTOR 1.00

BUILDING REFRIGERATION LOAD 1025493.

TONS OF REFRIGERATION

85.

REFRIGERANCE VALUES

	AREA	VOLUME	BTUH/SF COOL HEAT	BTUH/CF COOL HEAT	SF PER TON	CFY/SF COOL
COOLING	9990.	267732.	102.7	3.8	117.5	2.7
HEATING	0.	0.	0.0	0.0	0.0	0.0
TOTAL RIG	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 - 84EF CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

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

HOURLY	8	9	10	11	12	13
SEPARABLE						
WIN TRANS	9190.	6514.	0.	7352.	11028.	12866.
WIN SOLAR	41431.	57107.	61184.	59463.	54503.	46103.
WALL	14236.	12960.	11485.	11400.	11475.	11475.
ROOF/CEILING	1201.	1092.	982.	973.	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.	385996.	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	410601.	436469.	444575.	450092.	393056.	442133.
BLDG REFG. *	681323.	777493.	843846.	940056.	646260.	1025493.
	57	66	70	79	78	85
HOURLY	14	15	16	17	18	19
SEPARABLE						
WIN TRANS	12966.	12866.	12866.	11028.	9190.	7352.
WIN SOLAR	34005.	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)	442949.	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.	447172.	441770.	436272.	62344.	63648.
BLDG REFG. *	1017351.	884738.	971235.	637239.	356401.	331737.
	89	82	81			

$$\sum = 681 \text{ TC, H.}$$

C.E.C. NW-2

8

AUTOMATED PROCESSES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS-HCC-III(102)-CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - #495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

WEATHER PROFILES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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DESIGN CONDITIONS

WINTER	SUMMER	LIGHTING	AIR QUANTITY FACTORS
TEMPERATURE	76.0	76.0	JCR SITE ALTITUDE 0 FT
RELATIVE HUM	50.0	LOAD PROFILE NO. 2	BAROMETRIC PRESSURE 29.921
HUMIDITY RAT	0.0006	PERCENT TO R.A. 0.	AIR DENSITY FACTOR 1.000
OUTSIDE			
TEMPERATURE,DR	84.0	COOLING LOAD YES	
TEMPERATURE,WP	75.0	OMIT WINTR SUN NO	
MONTH	1	CIRCU. RATE 0.00 AC/Hr, MIN	
	2	COIL R.P.FAC. 0.10	
		R.A. PLNUMS NO	
		CALC. ADP NO	
OCCUPANCY			
STL/PERSON, SENS.	255.	WATTS/SF 9.80	
RTU/PERSON, LAT.	255.	LOAD PROFILE NO. 2	
LOAD PROFILE NO.	1	PERCENT TO R.A. 0.	
SE/PERSON	0.00		
MAX. NO. OF PEOPLE	40		
LOAD FACTOR MULTIPLIERS			
LIGHTS	0.80	AIR CHANGE/HR 0.00	
APPLIANCES	0.50	DIVERSITY FACTOR 0.80	
PEOPLE	0.80		
PUMP HEAT	1.00		
VENTILATION			
CFM/SF	0.50	INFILTRATION	
CFM/PERSON	10.00		
AIR CHANGE/Hr	2.60		
PCT. FAN CFM	0.00	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-1111-72 CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - P405 CENTER FOR FIRE & ENVIRONMENT RESEARCH 10/12/75 PAGE 12

BUILDING LOADS SUMMARY

HEAT GAIN = COOLING SENSIBLE LATENT	HEAT LOSS HEATING WINTER GAIN
--	----------------------------------

WINDOW TRANE	14704.	0.
WINDOW SOLAR	15416.	0.
WALL	47218.	0.
ROOF/CEILING	2052.	0.
PARTITION	0.	0.
FLOOR	0.	0.
DOOR	0.	0.
INFILTRATION	0.	0.
LIGHTS	267076.	267076.
PEOPLE	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	441891.	2423.

TOTAL HEAT	450214.	PLNY HT	0.
AT PEAK HOUR	15	VENT.	309452.
SENS. HEAT RATIO	7.0	TOTAL	309452.
LIGHT HEAT TO R.A.	0.	HUMID	377520.
SKYLIGHT HEAT TO R.A.	0.	686972.	HEATING+HUMID
VENTILATION CFM	13000.	-53047.	LOSS LFSS INT.+GAIN
EXHAUST CFM	0.	-53047.	LOSS LFSS INT.+SOLAR
PUMP HEAT FACTOR	1.00		
BUILDING REFRIGERATION LOAD	1059022.		

TONS OF REFRIGERATION

88.

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF	BTUH/CF	SF PFR	CFM/SF		
			COOL HEAT	COOL HEAT	TON	NPH	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	1.2	113.5	32.3	2.7

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC-CALCULATION-HCC-III(12) CAPACITATE-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)

HOURL	8	9	10	11	12	13
<u>SENSIBLE</u>						
WIN TRANS	5514.	0.	3676.	2190.	12966.	14704.
WIN SOLAR	40750.	52505.	55237.	52447.	46443.	37340.
WALL	14871.	13491.	13486.	13480.	13480.	17982.
ROOF/CEILING	2235.	2017.	1908.	1798.	1798.	1798.
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	9423.	9423.	9423.	9423.	7159.	3423.
APPLIANCE	87000.	87000.	87000.	87000.	73949.	87000.
TOTAL (INCL. PARTITIONS)	414852.	430514.	426808.	439417.	392715.	434326.

LATENT	14	15	16	17	18	19
<u>INFILT</u>						
PEOPLE	9423.	9423.	9423.	9423.	7159.	9423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	9423.	9423.	9423.	9423.	7159.	9423.

TOTAL LOAD	423275.	430037.	445231.	447840.	389975.	442750.
BLDG REFG. *	829208.	9062703.	930307.	663191.	844174.	1047433.

TONS	69	75	77	80	73	87
<u>HOURL</u>						
<u>SENSIBLE</u>	14	15	16	17	18	19
WIN TRANS	14704.	14704.	14704.	12866.	11029.	9190.
WIN SOLAR	26020.	15416.	9095.	6969.	1881.	0.
WALL	38952.	47218.	49227.	49908.	49690.	51675.
ROOF/CEILING	1798.	2052.	3423.	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	9423.	9423.	9423.	9423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	443976.	441291.	438961.	437222.	38980.	442368.

LATENT	14	15	16	17	18	19
<u>INFILT</u>						
PEOPLE	9423.	9423.	9423.	9423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	9423.	9423.	9423.	9423.	0.	0.

TOTAL LOAD	452400.	450314.	447394.	445745.	69980.	64366.
BLDG REFG. *	3256605.	3256602.	1012009.	977304.	394639.	367590.

8
14 = 726 TR.H

C.E.R NW-3

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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

ANNUAL CALCULATION, HCC-III(62) CARACAS-MARTIN AND ASSOCIATES, SAN JUAN, PR.
 PROJECT = 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

WEATHER PROFILES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MONTH 1	71.	72.	73.	74.	75.	76.	77.	78.	79.	80.	81.	82.	83.	84.	85.	86.	87.	88.	89.	90.	91.	92.	93.	94.
	67.8	68.7	71.1	72.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9	73.0	72.6	72.0	71.6	71.2	70.8	70.4	70.0	69.6	69.2	68.8	68.4
	139	140	143	150	157	167	166	162	157	155	154	154	159	157	157	156	154	154	152	156	152	150	148	146
	HR X 10000																							
MONTH 3	77.	78.	79.	81.	83.	84.	84.	84.	84.	84.	84.	84.	83.	83.	82.	81.	80.	80.	80.	80.	80.	80.	80.	80.
	73.3	74.6	74.2	74.3	74.1	74.1	74.1	74.1	74.6	74.2	73.6	72.9	72.4	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6	72.6
	160	175	167	163	159	148	153	160	157	154	154	152	156	152	150	148	146	144	142	140	138	136	134	132
	HR X 10000																							

GEOGRAPHIC/SOLAR DATA

LATITUDE	18.44	INWARD FLOW FRACTIONS		
GROUND REFLECTIVITY	0.20	NI	NIW	NIR
CLEARNESS FACTOR	1.00	0.33	0.00	0.00
MAX. SOLAR GAIN, BTUH/SF	80.00	DAYLIGHT SVG. J F M A M J J A S O N D		
DEGS. FROM STD. MERIDIAN	-5.00	IA-EFFECT	0	0

DESIGN CONDITIONS

	WINTER	SUMMER	MASTER BUILDING DATA
INSIDE			BLDG. ORIENT. 65.0 DEG. COPR. FACT.
TEMPERATURE, DB	74.0	76.0	WALL HEIGHT 26.82 FTET
RELATIVE HUM.	50.0	55.0	HOURLY AVERAGE 5
HUMIDITY RAT.	0.0096	0.0106	COOLING D.T. 20.0 DEG.
OUTSIDE			HEATING D.T. 50.0 DEG.
TEMPERATURE, DB	80.0	84.0	HEATING LOAD NO
TEMPERATURE, WB	60.0	75.1	COOLING LOAD YES
MONTH	1	3	OMIT WINTR SUN NO
		CIPEN. RATE 0.00 AC/HP, MIN	
		COIL R.P.FAC. 0.10	
		R.A. PLENUMS NO	
		CALC. ADD. NO	

OCCUPANCY

BTU/PERSON, SENS.	26.6	LIGHTING
BTU/PERSON, LAT.	25.5	HAWTS/SF 9.80
LOAD PROFILE NO.	1	LOAD PROFILE NO. 2
SE/PERSON	0.00	PERCENT TO R.A. 0.
MAX. NO. OF PEOPLE	40	

LOAD FACTOR MULTIPLIERS

	AIR QUANTITY FACTORS	
LIGHTS	0.80	JOB SITE ALTITUDE 0 FT
APPLIANCES	0.50	BAROMETRIC PRESSURE 29.921
PEOPLE	0.60	AIR DENSITY FACTOR 1.000
SUPPLY HEAT	1.00	

VENTILATION

	INFILTRATION	
CFM/SF	0.50	AIR CHANGE/HR 0.00
CFM/PERSON	10.00	DIVERSITY FACTOR 0.80
AIR CHANGE/HR	2.40	
PCT. FAH CFM	0.00	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(12) CAPACETE-MARTIN AND ASS. SAN JUAN, P.R.

PROJECT - 8498 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE LATENT	HEAT LOSS HEATING WINTER GAIN
WINDOW FRAMES	-14704.	0.
WINDOW SOLAR	24517.	0.
WALL	34900.	0.
ROOF/CEILING	3262.	0.
PARTITION	0.	0.
FLOOR	0.	0.
DOOR	0.	0.
INFILTRATION	0.	0.
LIGHTS	267076.	267076.
PEOPLE (31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	438896. 8423.	0. 362499.
TOTAL HEAT AT PEAK HOUR	448300.	PLNM HT 0. VENT. 410696.
SENS. HEAT RATIO	0.62	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 HEAT	BTUH/CF COOL HEAT	SF PER TON	CFV/SF COOL
COOLING	9990.	267732.	106.2	4.0	113.5	2.8
HEATING	0.	0.	0.0	0.0	0.0	0.0
TOTAL PLNG	9990.	267732.	106.2	41.1	1.5	113.5 24.3 2.8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 442F 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	16380.	55140.	91900.	128660.	147040.	147040.
WIN SOLAR	36224.	43804.	44708.	40558.	33367.	24517.
WALL	21474.	20099.	20099.	21464.	22834.	34900.
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)	425409.	435191.	439761.	440543.	382185.	438996.

LATENT	8	9	10	11	12	13
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 BLDG REFG. *	433832.	442604.	449195.	448066.	399344.	448309.
TONS	929557.	1010245.	1005148.	1019325.	930850.	1060508.

HOUR	14	15	16	17	18	19
SENSIBLE						
WIN TRANS	14704.	14704.	12866.	11028.	9190.	7352.
WIN SOLAR	16353.	12750.	13222.	13602.	6165.	0.
WALL	40680.	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.	449763.	450401.	449408.	75643.	69077.

LATENT	14	15	16	17	18	19
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 BLDG REFG. *	455043.	457156.	458824.	457031.	75643.	69077.
TONS	1043373.	1030222.	980096.	966195.	364009.	334604.

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AUTOMATED PROCESURES FOR ENGINEERING CONSULTANTS, INC.

ENVIRONMENTAL CALCULATIONS, MCC-III(42) CAPER-CRTE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 340F CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/73 PAGE 1

WEATHER PROFILES

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258	1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275	1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292	1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309	1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326	1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343	1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, UCC-III (62) - CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 1495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

HEAT GAIN - COOLING		HEAT LOSS
SENSIBLE	LATENT	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 97000.	0.	97000.
TOTALS 462062.	9423.	362499.

TOTAL HEAT 462062.	PLNM HT 0.
AT PEAK HOUR 17	VENT. 252823.
SEAS. HEAT RATIO 0.9	
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 1121646.	

TONS OF REFRIGERATION 93.

REFERENCE VALUES

	APFA	VOLUME	BTUH/SF	BTUH/CF	SF PER	CFM/SF
COOLING 0990.		267732.	112.3	4.2	107.4	2.8
HEATING 0.		0.	0.0	0.0	0.0	
TOTAL PLDG 9990.		267732.	112.3	25.3	4.2	0.9

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, EEC-III(EP) CAPACATE-MARTIN AND ASS. SA: JUAN, DR.

PROJECT - 6405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 17

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

	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	5514.	1829.	1829.	3676.	11028.	14734.
WIN SOLAR	26610.	31197.	30825.	26475.	20691.	16713.
WALL	25101.	23725.	23720.	22345.	22345.	36926.
ROOF/CEILING	4122.	4013.	3994.	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.	422790.	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.
PLDG REFG. *	776224.	807619.	850351.	896572.	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.	13671.	3.
WALL	44315.	48508.	49566.	47140.	47541.	49973.
ROOF/CEILING	3686.	4541.	5885.	7306.	5489.	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.	469258.	454497.	452962.	79569.	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	450201.	457621.	462261.	461385.	70569.	70159.
PLDG REFG. *	1110773.	1111047.	1107747.	1121446.	480142.	437561.

TONS	93	93	93

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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

----- HVAC CALCULATION, HCC-III(92) CAPACETE-MARTIN AND ASS. SAN JUAN, PR.
PROJECT - 8405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHERED PROFILES

GEOGRAPHIC/SOLAR DATA

INWARD FLOW FRACTIONS

INWARD FLOW FRACTIONS

LATITUDE	18.44	NI	NIU	NIR
GROUNDO REFLECTIVITY	0.20	0.33	0.00	0.00
CLEARNESS FACTOR	1.00			
MAX. SOLAR GAIN, BTUH/SF	80.00	DAYLIGHT SVG.	J F M A M J J A S O N D	
DEGS. FROM STD. MERIDIAN	-5.68	IN EFFECT	0 0 0 0 0 0 0 0 0 0 0 0	

DESIGN CONDITIONS

MASTER BUILDING DATA

	WINTER	SUMMER	OUTER FACING WALL DATA
INSIDE TEMPERATURE	74.0	76.0	BLDG. ORIENT. 65.0 DEG. COPR. FACT.
RELATIVE HUM	50.0	55.0	WALL HEIGHT 26.80 FEET
HUMIDITY RAT	0.00096	0.0106	HOUR-AVERAGE 5
OUTSIDE			COOLING D.T. 20.0 DEG.
TEMPERATURE,DR	8.0	87.0	HEATING D.T. 50.0 DEG.
TEMPERATURE,WR	0.0	77.1	HEATING LOAD NO
MONTH	1	5	COOLING LOAD YES
		OMIT WINTR SUN NO	
		CIPEN. RATE 0.00 AC/HP, MIN	
		COIL R.P.FAC. 0.10	
		R.A. PLENUMS NO	
		CALC. ADP NO	

OCCUPANCY

LIGHTING

RTU/PERSON, SFNS.	255.	WATTS/SF	9.80
RTU/PERSON, LAT.	255.	LOAD PROFILE NO.	2
LOAD PROFILE NO.	1	PEPCENT TO R.A.	0.
SE/PERSON	0.60		
MAX-NO-OF-PERSON		42	

LOAD FACTOR MULTIPLIERS

~~AIR QUANTITY FACTORS~~

AIR QUANTITY FACTORS			
LIGHTS	0.80	FOR SITE ALTITUDE	0 FT
APPLIANCES	0.50	BAROMETRIC PRESSURE	29.921
PEOPLE	0.80	AIR-DENSITY FACTOR	1.000
PUMP, HEAT	1.00		

VENTILATION

~~INFECTION~~

CFM/SF	0.50	AIR CHANGF/HR	0.00
CFM/PERSON	10.00	DIVERSITY FACTOR	0.80
AIR CHANGE/HRS	2.60		
PCT. EXH CFM	6.00		

1	2	3	4	5	6	7	8
0	0	1	0	0	1	0	1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION-HCC-III(12)-CAPACITE-MARTIN AND ASSOC., SAN JUAN, PR.

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

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING	
	SENSIBLE LATENT	
WINDOW TRANS	20210.	0.
WINDOW SOLAR	26070.	0.
WALL	58050.	0.
ROOF/CEILING	8617.	0.
PARTITION	0.	0.
FLOOR	0.	0.
DOOR	0.	0.
INFILTRATION	0.	0.
LIGHTS	267076.	267076.
PEOPLE (31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	475465.	362499.
TOTAL HEAT	493889.	PLNM HT. 0.
AT PEAK HOUR	17	VENT. 287716.
SENS. HEAT RATIO	0.99	TOTAL 287716. 28.8 BTUH/SF
LIGHT HEAT TO P.A.	0.	HUMID 291147.
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
PUMP HEAT FACTOR	1.00	
BUILDING REFRIGERATION LOAD	1216750.	
TONS OF REFRIGERATION	101.	

REFERENCE VALUES

	ARFA	VOLUME	BTUH/SF	BTUH/CF	SF PER	CFM/SF	
			COOL	HEAT	TON	MBH	COOL
COOLING	0000.	267732.	121.8	4.5	98.9	34.7	2.9
HEATING	0.	0.	0.0	0.0	0.0	0.0	0.0
TOTAL PLDG	9990.	267732.	121.8	28.8	4.5	1.1	98.9

19

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS-HCG-111HOP1 - CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

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

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

1 HOUR	2 8	3 9	4 10	5 11	6 12	7 13
SENSIBLE						
WIN TRANS	1938.	1939.	5514.	11028.	14704.	13381.
WIN SOLAR	19868.	23035.	22731.	20040.	17754.	18667.
WALL	22202.	21927.	20452.	20447.	20789.	45707.
ROOF/CEILING	5221.	5112.	5003.	4994.	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.	428810.	376158.	450048.

1 LATENT	2 8	3 9	4 10	5 11	6 12	7 13
INFILT						
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD BLDG PFFG. *	427377.	432737.	434624.	437233.	383317.	450463.
TONS	67	69	70	76	75	72

1 HOUR	2 14	3 15	4 16	5 17	6 18	7 19
SENSIBLE						
WIN TRANS	20219.	20219.	20219.	20219.	18381.	16542.
WIN SOLAR	21608.	25471.	27757.	26070.	14472.	0.
WALL	52713.	56444.	57531.	58058.	56023.	60567.
ROOF/CEILING	4796.	5005.	7281.	8617.	9724.	12658.
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)	441836.	470590.	475299.	475465.	98601.	87790.

1 LATENT	2 8	3 9	4 10	5 11	6 12	7 13
INFILT						
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD BLDG PFFG. *	470250.	470703.	493712.	493980.	98601.	87790.
TONS	96	97	99	101	97	95

8
 $\sum = 241 \text{ TONS}$

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AUTOMATED PROCESSURES FOR ENGINEERING CONSULTANTS, INC.

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

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

WEATHER PROFILES

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
MONTH	1	71.0	72.0	74.0	80.0	82.0	83.0	83.0	83.0	82.0	81.0	80.0	79.0	78.0	74.0	74.0	73.0	73.0	73.0	73.0
		67.8	68.7	71.1	73.0	74.5	74.6	74.6	74.2	73.4	73.4	72.9	73.2	72.8	72.8	72.8	72.8	72.8	72.8	72.8
		130	140	149	153	159	167	168	162	157	156	154	154	154	154	154	154	154	154	154
																				X 1000
MONTH	6	79.0	80.0	83.0	85.0	87.0	88.0	88.0	87.0	87.0	86.0	85.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0
		74.2	75.1	76.1	77.2	78.8	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0	79.0
		174	177	179	184	185	184	184	182	187	188	189	189	189	189	189	189	189	189	X 1000

GEOPGRAPHIC/SOLAR DATA

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

INWARD FLOW FRACTIONS

NI NIU NIR

0.93 0.00 0.00

DAYLIGHT SVG. J F M A M J J A S O N S
IN EFFECT 0 0 0 0 0 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	80.0	88.0
TEMPERATURE, WB	80.0	79.0
MONTH	1	6

MASTER BUILDING DATA

BLDG. ORIENT.	65.0 DEG.	COPR. FACT.
WALL HEIGHT	26.80 FT	
HEAT-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/HP, MIN	
COIL R.P.FAC.	0.10	
R.A. PLENUMS	NO	
CAEC. ADD	NO	

OCCUPANCY

BTU/PERSON, SEHS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SE/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

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

VENTILATION

CFM/SE	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(52) - CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 2495 CENTER FOR ENERGY & ENVIRONMENTAL RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING	HEAT LOSS
	SENSIBLE LATENT	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.
LIGHTS	267076.	267076.
PEOPLE (31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	472640.	362499.

PLMN HT	0.
VENT.	456455.
TOTAL HUMID	456455.
HUMID	503931.

TOTAL 456455. 45.7 BTUH/SF

HUMID 503931.

45.7 BTUH/SF

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - F400 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

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

	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	3674.	7352.	12866.	19842.	20219.	22057.
WIN SOLAR	17342.	20463.	20752.	19284.	14433.	20239.
WALL	37750.	26374.	26369.	24994.	35243.	50549.
FLOOR/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 RV	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.	469630.

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
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	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.
FLOOR/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 RV	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	472640.	479978.	496189.	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.	499301.	494612.	491038.	109851.	92951.
BLDG REFG. *	1296779.	1264315.	1285471.	1270619.	613455.	566512.

TONS	108	107	107

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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 8408 CF.TEP FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHER PROFILES

MONTH	8	9	10	11	12	13	14	15	16	17	18	19
MONTH 1	71.7	72.7	76.0	80.0	82.0	83.0	83.0	83.0	82.0	81.0	80.0	80.0
	57.8	60.7	71.1	72.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.9
	120	140	150	150	167	166	162	157	156	154	159	157
	180	180	190	190	195	195	198	198	196	194	190	189
	180	180	190	190	195	195	198	198	196	194	190	189

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	NIR
0.35	0.00	0.00

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

DESIGN CONDITIONS

	WINTER	SUMMER
INSIDE		
TEMPERATURE	74.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0096	0.0106
OUTSIDE		
TEMPERATURE,DR	0.0	86.0
TEMPERATURE,WB	0.0	78.9
MONTH	1	7

MASTER BUILDING DATA

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

OCCUPANCY

BTU/PERSON, SFAC.	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. FAH CFM	0.00

INFILTRATION

AIR CHANGE/HR	0.00
DIVERSITY FACTOR	0.80

RUN OPTIONS USED 0 0 1 0 0 1 0 1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 9495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING	HEAT LOSS
	SENSIBLE LATENT	HEATING WINTER GAIN
WINDOW TRAVS	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.
LIGHTS	267076.	267076.
PEOPLE(31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	476754.	362499.
TOTAL HEAT AT PEAK HOUR	486177.	573144.
SENS. HEAT RATIO	0.99	TOTAL 573144. 57.4 RTUH/SF
NIGHT HEAT TO R.A.	0.	HUMID 593736.
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
DIMD. HEAT FACTOR	1.00	
BUILDING REFRIGERATION LOAD	1299257.	
TONS OF REFRIGERATION	108.	

REFERENCE VALUES

	AREA	VOLUME	BTUH/SF	PTUH/CF	SF PER	CFM/SF	
			COOL + HEAT	COOL + HEAT	TON	MBH	COOL
COOLING	9990.	267732.	130.1	4.9	92.5	0.0	2.9
HEATING	0.	0.	0.0	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-II (E2) - CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 13

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

HOUR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	7352.	9190.	12866.	14704.	19381.	19381.
WIN SOLAR	18612.	22427.	22772.	20599.	18314.	18339.
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)	430780.	435073.	438979.	439900.	386017.	456542.

LATENT	8	9	10	11	12	13
INFILT						
PEOPLE	0.	0.	0.	0.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	7159.	8423.
TOTAL LOAD	439213.	443496.	447403.	448323.	394076.	464956.
BLDG PFFG. *	1080255.	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.	492251.	478719.	104357.	82249.

LATENT	14	15	16	17	18	19
INFILT						
PEOPLE	0.	0.	0.	0.	0.	0.
APPLIANCE	0.	0.	0.	0.	0.	0.
TOTAL	8423.	8423.	8423.	8423.	0.	0.
TOTAL LOAD	477267.	485177.	490674.	497142.	104357.	82249.
BLDG PFFG. *	1227578.	12300257.	1206693.	1253307.	594453.	565964.
TONS	108	108	109			

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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, I.C.

HVAC CALCULATION, HCC-III (CR) - CHAPMAN-MARTIN AND ASS. SAN JUAN, PR.

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

WEATHER PROFILES

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099	80100	80101	80102	80103	80104	80105	80106	80107	80108	80109	80110	80111	80112	80113	80114	80115	80116	80117	80118	80119	80120	80121	80122	80123	80124	80125	80126	80127	80128	80129	80130	80131	80132	80133	80134	80135	80136	80137	80138	80139	80140	80141	80142	80143	80144	80145	80146	80147	80148	80149	80150	80151	80152	80153	80154	80155	80156	80157	80158	80159	80160	80161	80162	80163	80164	80165	80166	80167	80168	80169	80170	80171	80172	80173	80174	80175	80176	80177	80178	80179	80180	80181	80182	80183	80184	80185	80186	80187	80188	80189	80190	80191	80192	80193	80194	80195	80196	80197	80198	80199	80200	80201	80202	80203	80204	80205	80206	80207	80208	80209	80210	80211	80212	80213	80214	80215	80216	80217	80218	80219	80220	80221	80222	80223	80224	80225	80226	80227	80228	80229	80230	80231	80232	80233	80234	80235	80236	80237	80238	80239	80240	80241	80242	80243	80244	80245	80246	80247	80248	80249	80250	80251	80252	80253	80254	80255	80256	80257	80258	80259	80260	80261	80262	80263	80264	80265	80266	80267	80268	80269	80270	80271	80272	80273	80274	80275	80276	80277	80278	80279	80280	80281	80282	80283	80284	80285	80286	80287	80288	80289	80290	80291	80292	80293	80294	80295	80296	80297	80298	80299	80300	80301	80302	80303	80304	80305	80306	80307	80308	80309	80310	80311	80312	80313	80314	80315	80316	80317	80318	80319	80320	80321	80322	80323	80324	80325	80326	80327	80328	80329	80330	80331	80332	80333	80334	80335	80336	80337	80338	80339	80340	80341	80342	80343	80344	80345	80346	80347	80348	80349	80350	80351	80352	80353	80354	80355	80356	80357	80358	80359	80360	80361	80362	80363	80364	80365	80366	80367	80368	80369	80370	80371	80372	80373	80374	80375	80376	80377	80378	80379	80380	80381	80382	80383	80384	80385	80386	80387	80388	80389	80390	80391	80392	80393	80394	80395	80396	80397	80398	80399	80400	80401	80402	80403	80404	80405	80406	80407	80408	80409	80410	80411	80412	80413	80414	80415	80416	80417	80418	80419	80420	80421	80422	80423	80424	80425	80426	80427	80428	80429	80430	80431	80432	80433	80434	80435	80436	80437	80438	80439	80440	80441	80442	80443	80444	80445	80446	80447	80448	80449	80450	80451	80452	80453	80454	80455	80456	80457	80458	80459	80460	80461	80462	80463	80464	80465	80466	80467	80468	80469	80470	80471	80472	80473	80474	80475	80476	80477	80478	80479	80480	80481	80482	80483	80484	80485	80486	80487	80488	80489	80490	80491	8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

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BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING	HEAT LOSS
	SENSIBLE LATENT	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.
LIGHTS	267076.	267076.
PEOPLE	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	479765.	9423.
TOTAL HEAT	487188.	PLNM HT
AT PEAK HOUR	16	VENT.
SENS. HEAT RATIO	0.99	544544.
LIGHT HEAT TO P.A.	0.	TOTAL
SKYLIGHT HEAT TO P.A.	0.	HUMID
VENTILATION CFM	13000.	544544. 54.5 BTUH/SF
EXHAUST CFM	0.	182044. LOSS LESS INT. GAIN
PIPE'S HEAT FACTOR	1.00	182044. LOSS LESS INT.+SOLAR
BUILDING REFRIGERATION LOAD	1357224.	
TONS OF REFRIGERATION	113.	

REFERENCE VALUES

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

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - #495 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/17/78 PAGE 1

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

HOUR	8	9	10	11	12	13
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SENSIBLE

WIN TRANS	3676.	7352.	11028.	12866.	16542.	18381.
WIN SOLAR	25456.	30323.	30294.	26345.	21006.	17500.
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.	1096196.	1114352.	1133461.	1108455.	1280917.

TONS	88	91	93	95	93	103
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HOUR	14	15	16	17	18	19
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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)	445922.	472506.	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.	1343964.	1352234.	1338759.	673111.	633038.

TONS	104	112	113			
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10
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C.E.E.R NW-9

29

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HEVAC CALCULATION-HCC-TII(02) - CAPACETE-MARTIN AND ASS. SAN JUAN, PR.
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WEATHER PROFILES

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	8010	8011	8012	8013	8014	8015	8016	8017	8018	8019	8020	8021	8022	8023	8024	8025	8026	8027	8028	8029	8030	8031	8032	8033	8034	8035	8036	8037	8038	8039	8040	8041	8042	8043	8044	8045	8046	8047	8048	8049	8050	8051	8052	8053	8054	8055	8056	8057	8058	8059	8060	8061	8062	8063	8064	8065	8066	8067	8068	8069	8070	8071	8072	8073	8074	8075	8076	8077	8078	8079	8080	8081	8082	8083	8084	8085	8086	8087	8088	8089	8090	8091	8092	8093	8094	8095	8096	8097	8098	8099	80100	80101	80102	80103	80104	80105	80106	80107	80108	80109	80110	80111	80112	80113	80114	80115	80116	80117	80118	80119	80120	80121	80122	80123	80124	80125	80126	80127	80128	80129	80130	80131	80132	80133	80134	80135	80136	80137	80138	80139	80140	80141	80142	80143	80144	80145	80146	80147	80148	80149	80150	80151	80152	80153	80154	80155	80156	80157	80158	80159	80160	80161	80162	80163	80164	80165	80166	80167	80168	80169	80170	80171	80172	80173	80174	80175	80176	80177	80178	80179	80180	80181	80182	80183	80184	80185	80186	80187	80188	80189	80190	80191	80192	80193	80194	80195	80196	80197	80198	80199	80200	80201	80202	80203	80204	80205	80206	80207	80208	80209	80210	80211	80212	80213	80214	80215	80216	80217	80218	80219	80220	80221	80222	80223	80224	80225	80226	80227	80228	80229	80230	80231	80232	80233	80234	80235	80236	80237	80238	80239	80240	80241	80242	80243	80244	80245	80246	80247	80248	80249	80250	80251	80252	80253	80254	80255	80256	80257	80258	80259	80260	80261	80262	80263	80264	80265	80266	80267	80268	80269	80270	80271	80272	80273	80274	80275	80276	80277	80278	80279	80280	80281	80282	80283	80284	80285	80286	80287	80288	80289	80290	80291	80292	80293	80294	80295	80296	80297	80298	80299	80300	80301	80302	80303	80304	80305	80306	80307	80308	80309	80310	80311	80312	80313	80314	80315	80316	80317	80318	80319	80320	80321	80322	80323	80324	80325	80326	80327	80328	80329	80330	80331	80332	80333	80334	80335	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AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 8496 CF TER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/79 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING SENSIBLE LATENT	HEAT LOSS HEATING WINTER GAIN
WINDOW TRNS	2057.	0.
WINDOW SOLAR	22661.	0.
WALL	49604.	0.
ROOF/GFILING	4771.	0.
PARTITION	0.	0.
FLOOR	0.	0.
DOOR	0.	0.
INFILTRATION	0.	0.
LIGHTS	267076.	267076.
PEOPLE(31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	441594.	9423.

TOTAL HEAT AT PEAK HOUR	470017.	PLNM HT VENT.	0.	506792.	50.7 BTUH/SF
SENS. HEAT RATIO	0.48	TOTAL HUMID	506792.	573144.	
LIGHT HEAT TO P.A.	0.			1079936.	HEATING+HUMID
SKYLIGHT HEAT TO P.A.	0.				
VENTILATION CFM	13000.		144292.	LOSS LESS INT. GAIN	
EXHAUST CFM	0.		144292.	LOSS LESS INT.+SOLAR	
DHW HEAT FACTOR	1.00				
BUILDING REFRIGERATION LOAD	1332872.				

TONS OF REFRIGERATION

111.

REFERENCE VALUES

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

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 9405 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 19

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

	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	3674.	7352.	12966.	19391.	20219.	22057.
WIN SOLAR	27258.	43452.	43338.	38556.	31284.	27661.
WALL	36995.	35620.	35615.	34239.	34239.	49674.
ROOF/CEILING	5262.	5099.	4980.	4980.	4840.	4771.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO PV	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.	458558.	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.	405908.	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	15490.	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 PV	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	466086.	469912.	471655.	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	474500.	477435.	4800080.	474754.	93691.	95431.
BLDG REFG. *	1307688.	1290313.	1204860.	1245170.	621653.	622030.
	161	107	104			

$$\sum = 91770.4$$

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

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

WEATHER PROFILES

	8	9	10	11	12	13	14	15	16	17	18	19
MONTH	1	71.	73.	76.	80.	82.	83.	83.	82.	81.	80.	80.
		67.8	69.7	71.1	72.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2
		139	140	153	159	167	166	162	157	156	154	159
MONTH	10	75.	77.	80.	83.	85.	86.	86.	86.	85.	85.	84.
		72.6	73.3	74.2	75.5	77.4	78.4	78.5	77.6	78.0	77.7	77.2
		169	169	174	186	193	194	186	192	190	187	192

HR X 10000

HR X 10000

GEOGRAPHIC/SOLAR DATA

	18.44	INWARD FLOW FRACTIONS
LATITUDE	18.44	NI NIW NIS
GROUND REFLECTIVITY	0.26	0.33 0.66 0.00
CLEARNESS FACTOR	1.00	
MAX. SOLAR GAIN, RTU/H/SF	PC.00	DAYLIGHT SVG. J F M A M J J A S O N D
DEGS. FROM STD. MERIDIAN	-5.00	IN EFFECT 0 0 0 0 0 0 0 0 0 0 0 0

DESIGN CONDITIONS

	WINTER	SUMMER	MASTER BUILDING DATA
INSIDE			BLDG. ORIENT. 65.0 DEG. CUPR. FACT.
TEMPERATURE	76.0	76.0	WALL HEIGHT 26.80 FEET
RELATIVE HUM	50.0	55.0	HOUR-AVERAGE 5
HUMIDITY RAT	0.0096	0.0106	COOLING D.T. 20.0 DEG.
OUTSIDE			HEATING D.T. 50.0 DEG.
TEMPERATURE,DR	0.0	86.0	HEATING LOAD NO
TEMPERATURE,WR	0.0	78.5	COOLING LOAD YES
MONTH	1	10	OMIT WINTP SUN NO
			CIREN. RATE 0.09 AC/HF, MIN
			COIL R.P.FAC. 0.10
			R.A. PLENUMS NO
			CALC. ADP NO

OCCUPANCY

	LIGHTING	
RTU/PERSON, SENS.	255.	WATTS/SF 9.80
RTU/PERSON, LAT.	255.	LOAD PROFILE NO. 2
LOAD PROFILE NO.	1	PERCENT TO R.A. 0.
SE/PERSON	0.00	
MAX. NO. OF PEOPLE	40	

LOAD FACTOR MULTIPLIERS

	AIR QUANTITY FACTORS	
LIGHTS	0.90	JOB SITE ALTITUDE 0 FT
APPLIANCES	0.50	BAROMETRIC PRESSURE 29.921
PEOPLE	0.90	AIR DENSITY FACTOR 1.000
PUMP HEAT	1.00	

VENTILATION

	INFILTRATION	
CFM/SF	0.50	AIR CHANGE/Hr 0.00
CFM/PERSON	10.00	DIVERSITY FACTOR 0.90
AIR CHANGE/Hr	2.60	
PCT. FAN CFM	0.00	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-II (CPI) - CAPACETE-MARTIN AND ASS., SAN JUAN, PR.
 PROJECT - #468 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 12

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING		HEAT LOSS	
	SENSIBLE	LATENT	HEATING	WINTER GAIN
WINDOW TRANS.	10221.		0.	0.
WINDOW SOLAR	20472.		0.	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.

PLNW HT 0.
VENT. 375803.

TOTAL 375803. 37.6 BTUH/SF
HUMID 410696.

LIGHT HEAT TO R.A.

0. 786499. HEATING+HUMID

VENTILATION CFV

13000. 13304. LOSS-LESS INT. GAIN

EXHAUST CFV

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	BTUH/CF	SF PER	CFV/SF
			COOL HEAT	COOL HEAT	TON	MBH COOL
COOLING	9990.	267732.	126.5	4.7	95.1	2.8
HEATING	0.	0.	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-HII(02) - CAPACITTE-MARTIN AND ASS. SAN JUAN, PR.

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

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

HOURLY	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	18381.	18381.	7352.	12866.	16542.	16381.
WIN SOLAR	46022.	53133.	53245.	48993.	41738.	31608.
WALL	30720.	29345.	29340.	27965.	27965.	41397.
ROOF/CEILING	3851.	3742.	3632.	3522.	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.	457201.

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	449670.	458922.	464494.	464172.	405055.	465714.
PLDG REFG. *	819417.	967955.	1021923.	10998050.	1102474.	1257603.

TONS	77	80	85	92	92	105
HOURLY	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.	450018.	34483.	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	465940.	467220.	460445.	469341.	84483.	85071.
PLDG REFG. *	1263399.	1215163.	1227107.	1209505.	548136.	539846.
TONS	105	101	102			

$\sum = 33.7 \cdot 11.1$

C.E.E.R. N.W.-11

35

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - 8406 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE

WEATHER PROFILES

HOURS	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
MONTH	1	71.	73.	76.	80.	82.	83.	83.	83.	82.	81.	80.	88.	67.8	68.7	71.1	73.0	74.5	74.6	74.2	73.6	73.4	72.9	73.2	72.8	WR	130	140	150	160	167	166	162	157	156	154	153	152	151	150	149	148	147	146	145	144	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	128	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	1000	
MONTH	11	74.	76.	79.	82.	84.	85.	85.	85.	85.	84.	83.	82.	88.	70.6	71.5	72.4	74.3	75.6	76.3	76.3	75.6	75.3	75.3	75.1	75.2	WR	154	156	157	166	172	176	176	170	167	170	170	173	173	173	170	167	166	166	165	164	163	162	161	160	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145	144	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	128	127	126	125	124	123	122	121	120	1200

GEOGRAPHIC/SOLAR DATA

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

INWARD FLOW FRACTIONS

MI	NIU	NIR
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0.33	0.00	0.00
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DAYLIGHT SVG.	J	F	M	A	M	J	J	A	S	O	N	D
---------------	---	---	---	---	---	---	---	---	---	---	---	---

DESIGN CONDITIONS

INSIDE	WINTER	SUMMER
TEMPERATURE	74.0	76.0
RELATIVE HUM	50.0	55.0
HUMIDITY RAT	0.0006	0.0106
OUTSIDE		
TEMPERATURE,DR	0.0	85.0
TEMPERATURE,WR	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 R.P.FAC.	0.10
R.A. PLENUMS	NO
CAFC. ADP	NO

OCCUPANCY

BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SEAPERSON	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	0.60
PEOPLE	0.40
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-II (102) CAPACETE-MARTIN AND ASS. SAN JUAN, PR.

PROJECT - 8498 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 1

BUILDING LOADS SUMMARY

	HEAT GAIN = COOLING	HEAT LOSS
	SENSIBLE LATENT	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.
LIGHTS	267076.	267076.
PEOPLE (31)	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	457477. 8423.	9. 362499.

PLNM HT 0.
VENT. 273416.TOTAL 273416. 27.4 BTUH/SF
HUMID 314600.LIGHT HEAT TO R.A. 0.
SKYLIGHT HEAT TO R.A. 0.
VENTILATION CFM 12000. 588016. HEATING+HUMID
EXHAUST CFM 0. -99093. LOSS LESS INT. GAIN
PUMP HEAT FACTOR 1.00 -89093. LOSS LESS INT.+SOLAR
BUILDING REFRIGERATION LOAD. 1144506.

TONS OF REFRIGERATION

95.

REFERENCE VALUES

	BTUH/SF	BTUH/CF	SF/PFP	CFM/SE
COOLING	ARFA	VOLUME	COOL HEAT	COOL HEAT
HEATING	9990.	267732.	114.6	4.3
TOTAL PLNG	9990.	267732.	114.6	27.4 1.0 105.2 36.5 2.8

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

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

PROJECT - #495 CENTER FOR ENERGY & EQUIPMENT RESEARCH 10/12/78 PAGE 1

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

HR	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-2476.	0.	-6514.	-11028.	-14704.	16542.
WIN SOLAR	40143.	59880.	60239.	57142.	50811.	41218.
HALL	25210.	24835.	24830.	23455.	23455.	31543.
DOOR/CEILING	-2602.	-2492.	-2383.	-2274.	-2274.	2155.
FLOOR	0.	0.	0.	0.	0.	0.
DOOR	0.	0.	0.	0.	0.	0.
INFILT	0.	0.	0.	0.	0.	0.
LIGHT TO RV	267076.	267076.	267076.	267076.	227015.	267076.
PEOPLE	8423.	8423.	8423.	8423.	7159.	8423.
APPLIANCE	87000.	87000.	87000.	87000.	73049.	87000.
TOTAL (INCL. PARTITIONS)	436770.	448708.	455467.	456400.	399371.	453470.

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 PLDG REFG. *	445202.	457132.	463890.	464923.	406530.	462203.
PLDG REFG. *	P25514.	P75712.	P940516.	P1039458.	P1024796.	P1130425.

TONS	69	73	78	87	85	95
------	----	----	----	----	----	----

SENSIBLE

HR	14	15	16	17	18	19
WIN TRANS	16542.	16542.	16542.	14704.	12866.	11028.
WIN SOLAR	29352.	17365.	8204.	2662.	0.	0.
HALL	46906.	52196.	54730.	55364.	59255.	60772.
DOOR/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 RV	267076.	267076.	267076.	267076.	0.	0.
PEOPLE	8423.	8423.	8423.	8423.	0.	0.
APPLIANCE	87000.	87000.	87000.	87000.	0.	0.
TOTAL (INCL. PARTITIONS)	457477.	460007.	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 PLDG REFG. *	465000.	450420.	454187.	449936.	74555.	79159.
PLDG REFG. *	1144526.	1102742.	1070109.	1071060.	462767.	450291.

TONS

95

92

90

8

$\Sigma = 764 \text{ T.R.H.}$
14

C.E.E.R. N.W.-12

38

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATION, 4CC-III(02) CAPACITE-MARTIN AND ASS. SAN JUAN, PR.

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

WEATHER PROFILES

GEOGRAPHIC/SOLAR DATA

TOWARD EQUATOR FRACTIONS

LATITUDE	18.44	NI	NIU	NIR
GROUND REFLECTIVITY	0.20	-0.33	-0.00	0.00
CLEARNESS FACTOR	1.00			
MAX. SOLAR GAIN, PTUH/SF	80.00	DAYLIGHT SVG.	J F M A N J J A S O N D	
DEGS. FROM STD. MERIDIAN	5.00	IN EFFECT	0 0 0 0 0 0 0 0 0 0 0 0	

DESIGN CONDITIONS

	WINTER	SUMMER	FACTOR BUILDING DATA	
INSIDE			BLDG. ORIENT.	65.0 DEG. CORR. FACT.
TEMPERATURE	74.0	76.0	WALL HEIGHT	26.80 FEET
RELATIVE HUM	50.0	55.0	HOUR AVERAGE	5
HUMIDITY RAT	0.0096	0.0106	COOLING D.T.	20.0 DEG.
OUTSIDE			HEATING D.T.	50.0 DEG.
TEMPERATURE, DB	68.0	81.0	HEATING LOAD	NO
TEMPERATURE, WB	68.0	72.3	COOLING LOAD	YES
MONTH	1	12	OMIT WINTR SUN	NO
			CIRCL. RATE	0.00 AC/HP, MIN
			COIL R.P.FAC.	0.10
			R.A. PLENUMS	NO
			CAECA APP	NO

OCCUPANCY

LIGHTING	
BTU/PERSON, SENS.	255.
BTU/PERSON, LAT.	255.
LOAD PROFILE NO.	1
SF/PERSON	0.00
MAX. NO. OF PEOPLE	40
WATTS/SF	9.80
LOAD PROFILE NO.	2
PERCENT TO R.A.	0.

LOAD FACTOR MULTIPLIERS

AER QUANTITY FACTORS			
LIGHTS	0.90	JOB SITE ALTITUDE	0 FT
APPLIANCES	0.50	BAROMETRIC PRESSURE	29.921
PEOPLE	0.80	AIR DENSITY FACTOR	1.000
PUMP HEAT	1.00		

VENTILATION

CFM/SF	0.50	AIR CHANGE/HR	0.00
CFM/PERSON	10.00	DIVERSITY FACTOR	0.80
<u>AIR-CHANGE/HR</u>	<u>2.60</u>		
PCT. FAN CFM	0.00	1 2 3 4 5 6 7 8	
		BUD. OPTIONS USED	0 0 1 0 0 1 0 1

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS, HCC-IIIEC2) -- CAPARTE-MARTIN AND ASS. SAN JUAN, PR.

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

BUILDING LOADS SUMMARY

	HEAT GAIN - COOLING	HEAT LOSS
	SENSIBLE LATENT	HEATING WINTER GAIN
WINDOW TRANS.	9190.	0.
WINDOW SOLAR	35360.	0.
WALL	36032.	0.
DOOR/Ceilings	376.	0.
DARTITION	0.	0.
FLOOR	0.	0.
DOOR	0.	0.
INFILTRATION	0.	0.
LIGHTS	267076.	267076.
PEOPLE	8423.	8423.
APPLIANCES	87000.	87000.
TOTALS	443459.	362499.
TOTAL HEAT	451982.	PLMN HT 0.
AT PEAK HOUR	14	VENT. 281424.
SENS. HEAT RATIO	0.98	TOTAL 281424. 28.2 BTUH/SF
LIGHT HEAT TO P.A.	0.	HUMID 335191.
SKYLIGHT HEAT TO P.A.	0.	616615. HEATING+HUMID
VENTILATION CFV	13000.	-81075. LOSS-LESS INT. GAIN
EXHAUST CFV	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	BTUH/CF	SF PEP	CFV/SF	
			COOL HEAT	COOL HEAT	TON	MBH	COOL
COOLING	9990.	267732.	92.2	3.4	129.7	2.7	
HEATING	0.	0.	0.0	0.0	0.0	0.0	
TOTAL PLDG	9990.	267732.	92.2	28.2	3.4	1.1	129.7 35.5 2.7

AUTOMATED PROCEDURES FOR ENGINEERING CONSULTANTS, INC.

HVAC CALCULATIONS, HCC-III(02) CAPACETS-MARTIN AND ASS. SAN JUAN, PR.
 PROJECT - 9423 CENTER FOR ENERGY & ENVIRONMENT RESEARCH 10/12/78 PAGE 13

BUILDING HOURLY COOLING LOADS (#=BLDG. PFFG. INCLUDES VENTILATION)

	8	9	10	11	12	13
SENSIBLE						
WIN TRANS	-1830.	-1838.	-3676.	-5514.	-9190.	-9190.
WIN SOLAR	45478.	59377.	62605.	69651.	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.	439927.	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.	441014.	448250.	449019.	392222.	442203.
BLDG PFFG. *	805219.	877201.	999140.	903436.	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.	43125.	43744.	41754.	45740.	46099.
ROOF/CEILING	376.	599.	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)	443469.	439926.	429926.	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	461992.	446692.	437240.	426765.	55540.	54829.
BLDG PFFG. *	821072.	825676.	805706.	810075.	264487.	241567.

TONS

77

75

74

8
 = SUITE H.
 11

ATTACHMENT #2

C.E.E.R. NEW WING
COOLING LOAD PROFILES

C.E.E.R. - New Wing
Cooling Load Profiles
Summary

Sheet

C.E.E.R. New Wing

Building hourly Cooling Load

Profile for January (1)

(Typical Day)

1 of 4

Same for May (5)

2 of 4

Same for September (9)

3 of 4

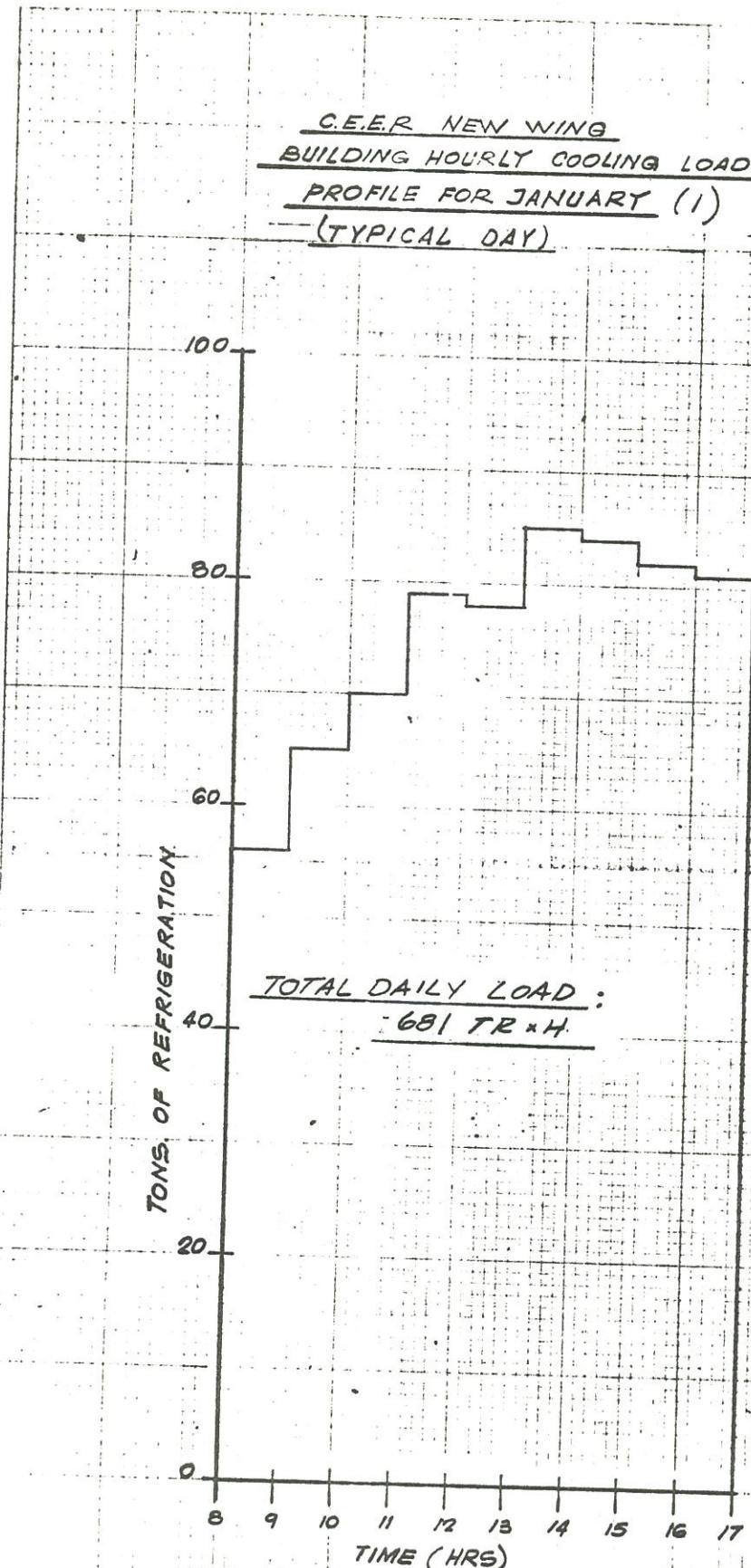
C.E.E.R. New Wing Year Cooling

Load Profile at 4:00 p.m. (hour 16)

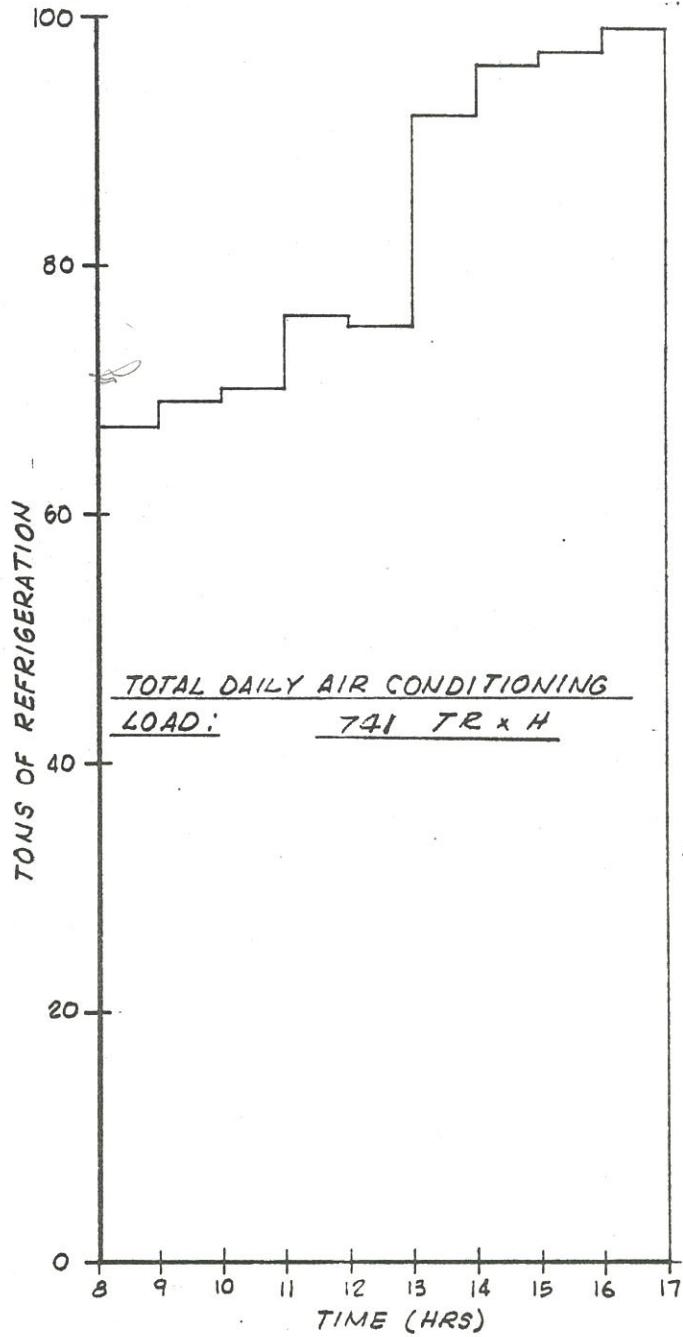
4 of 4

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

Mr. R. M. DATE 1/10/70 SUBJECT:
CHD. BY P.M. DATE 1/10/70
SHEET NO. 1 OF 4
JOB NO. 8295



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



SHEET NO. 2 OF 4
JOB NO. 8975

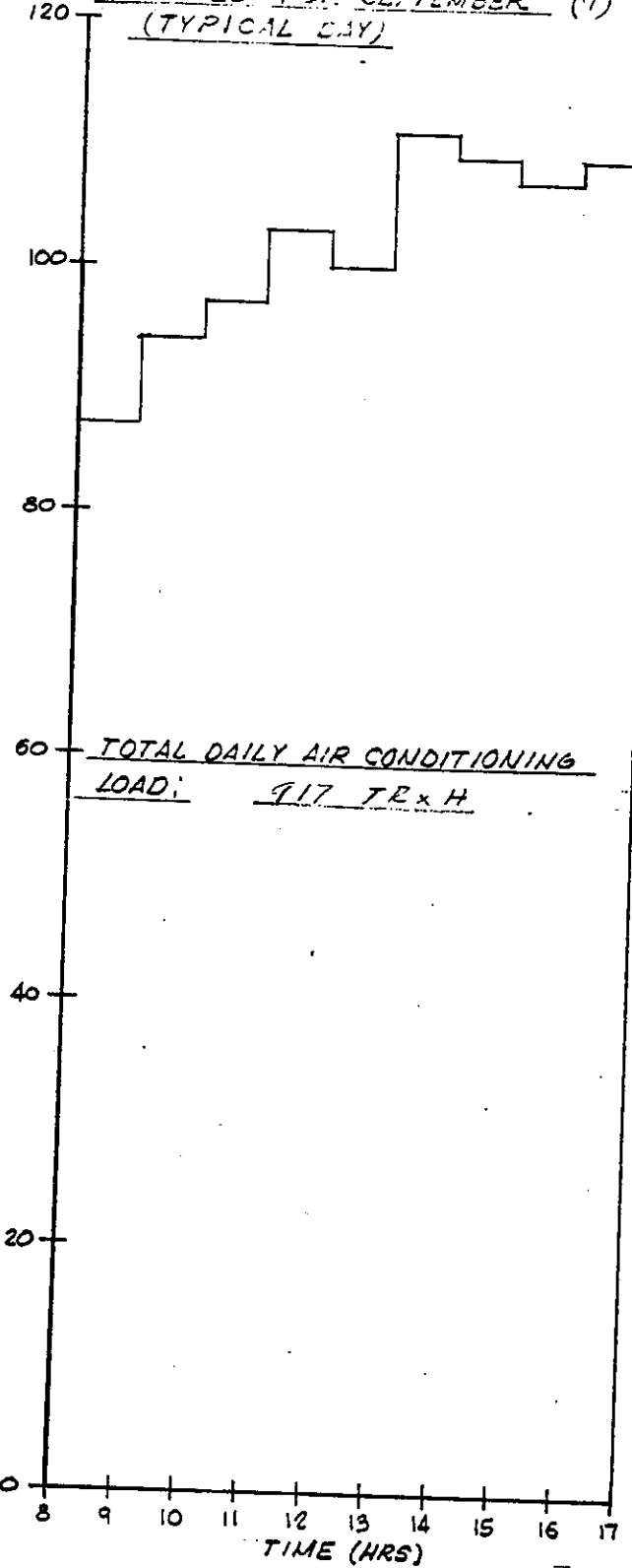
SUBJECT: V
DATE: 11/24/78

BY R. M. DATE 11/24/78
CHKD. BY F.M.L. DATE 11/24/78

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

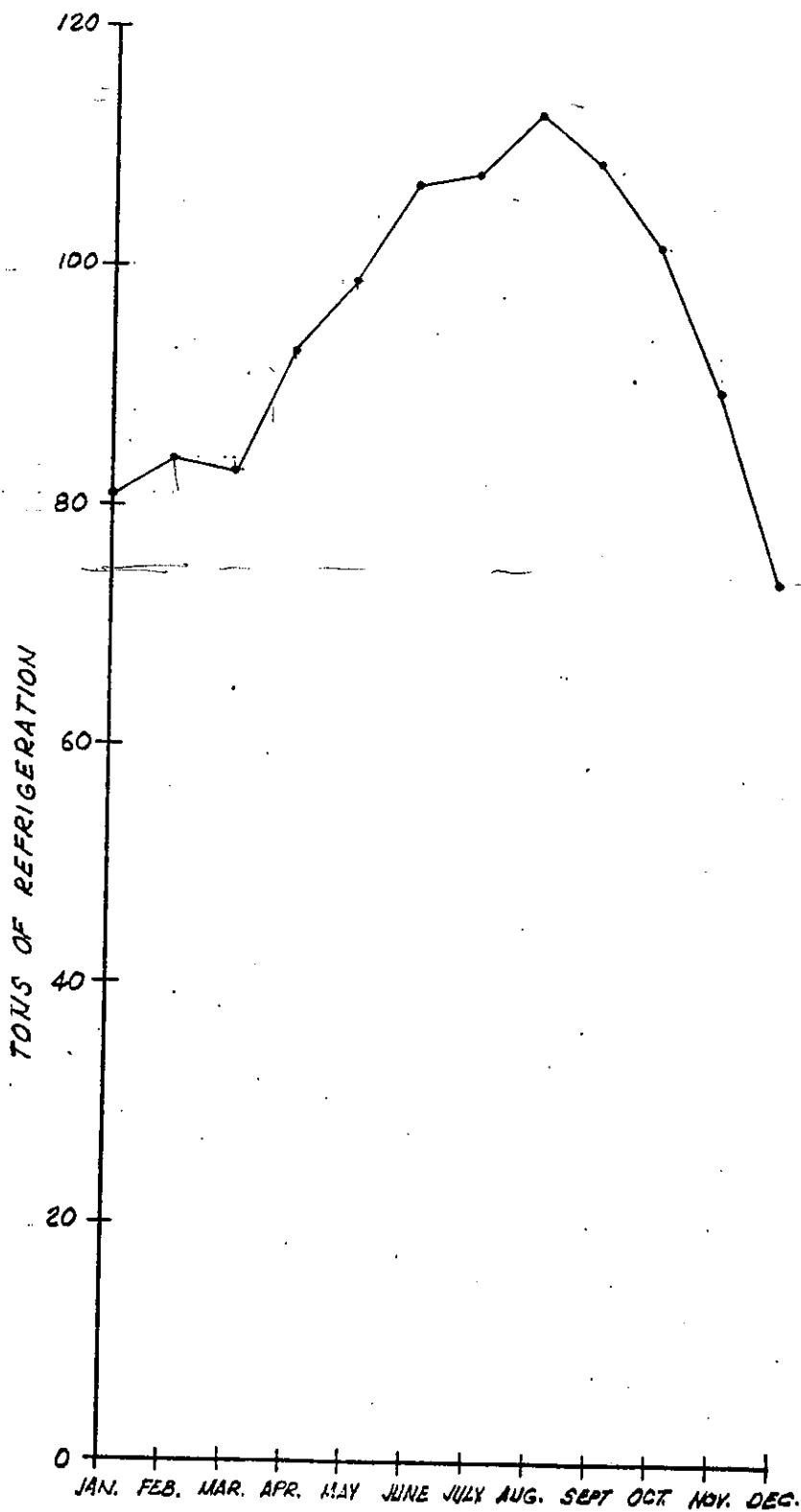
BY: P.M. DATE: 11/20/93
SUBJECT: SHEET NO. 3 OF 4
JOB NO. 8493
CHKD. BY F.M. DATE: 11/20/93

TONS OF REFRIGERATION



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

BY: R. M. DATE: 1/21/78
SUBJECT: YEAR COOLING LOAD PROFILE
SHEET NO. 4 OF 4
JOB NO. 6425
CHKD. BY F.M. DATE: 1/21/78

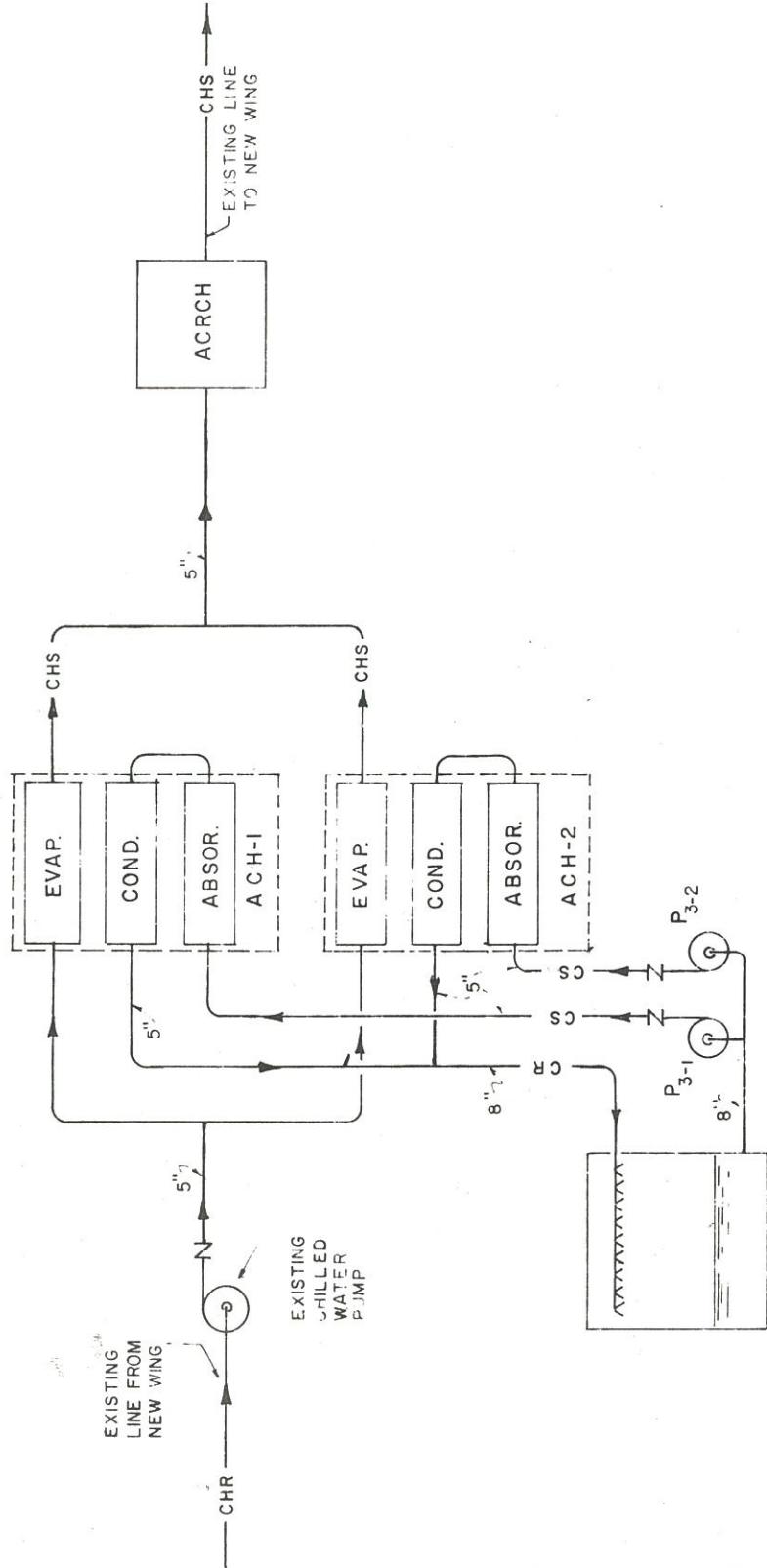


ATTACHMENT #3

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
*C.R. F.D. ROOSEVELT AVE., SAN JUAN, P.R.

2-5-79	---	---	---	---	---	---	---
F.M.L.	---	---	---	---	---	---	---
REVISION:	---	---	---	---	---	---	---

DATE 10/13/78
CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS
CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

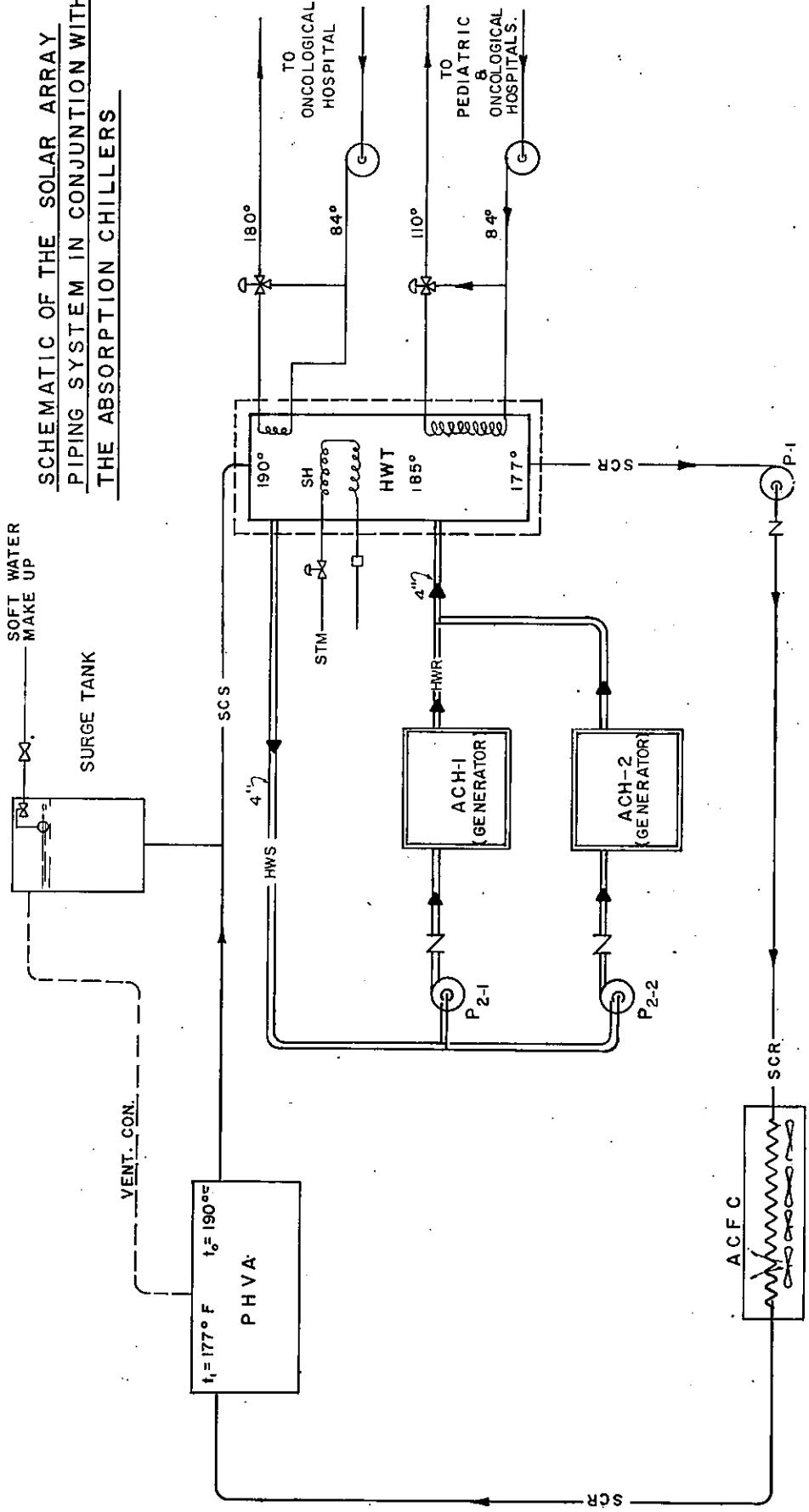
ATTACHMENT #4

SCHEMATIC OF THE CHILLED WATER
AND CONDENSING WATER PIPING
SYSTEM

JOB NO. 8495

SHEET NO.

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

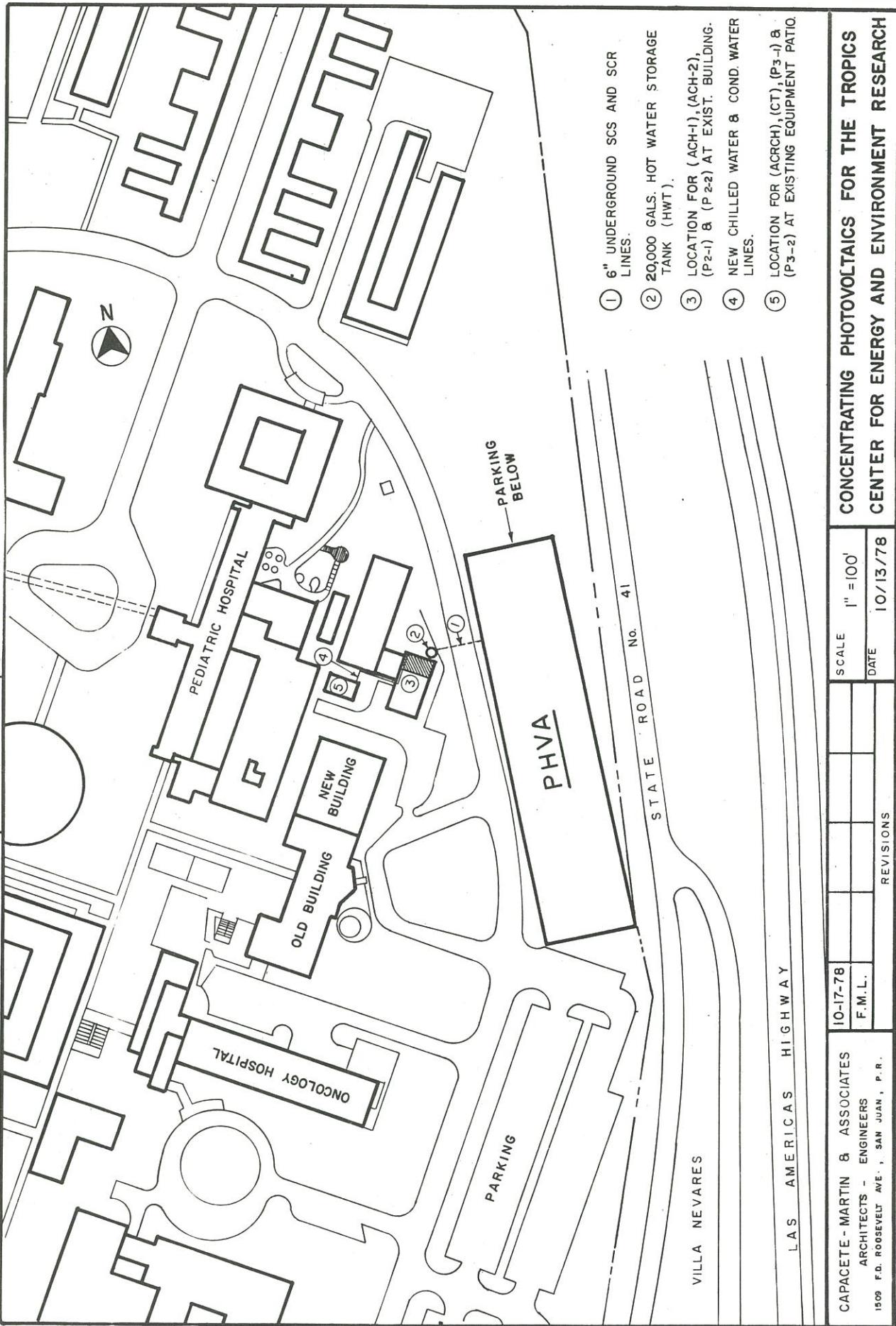


CARACOTE - MARTIN & ASSOCIATES		10-17-78	2-5-79			SCALE	None	CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
ARCHITECTS - ENGINEERS	F.M.L.	F.M.L.				DATE	10/13/78	
1509 F.D. ROOSEVELT AVE., SAN JUAN, P.R.				REVISIONS				

ATTACHMENT #5

GENERAL PLAN

JOB NO. 8495
SHEET NO.



LAS AMERICAS HIGHWAY

SCALE 1" = 100'
DATE 10/13/78

REVISIONS

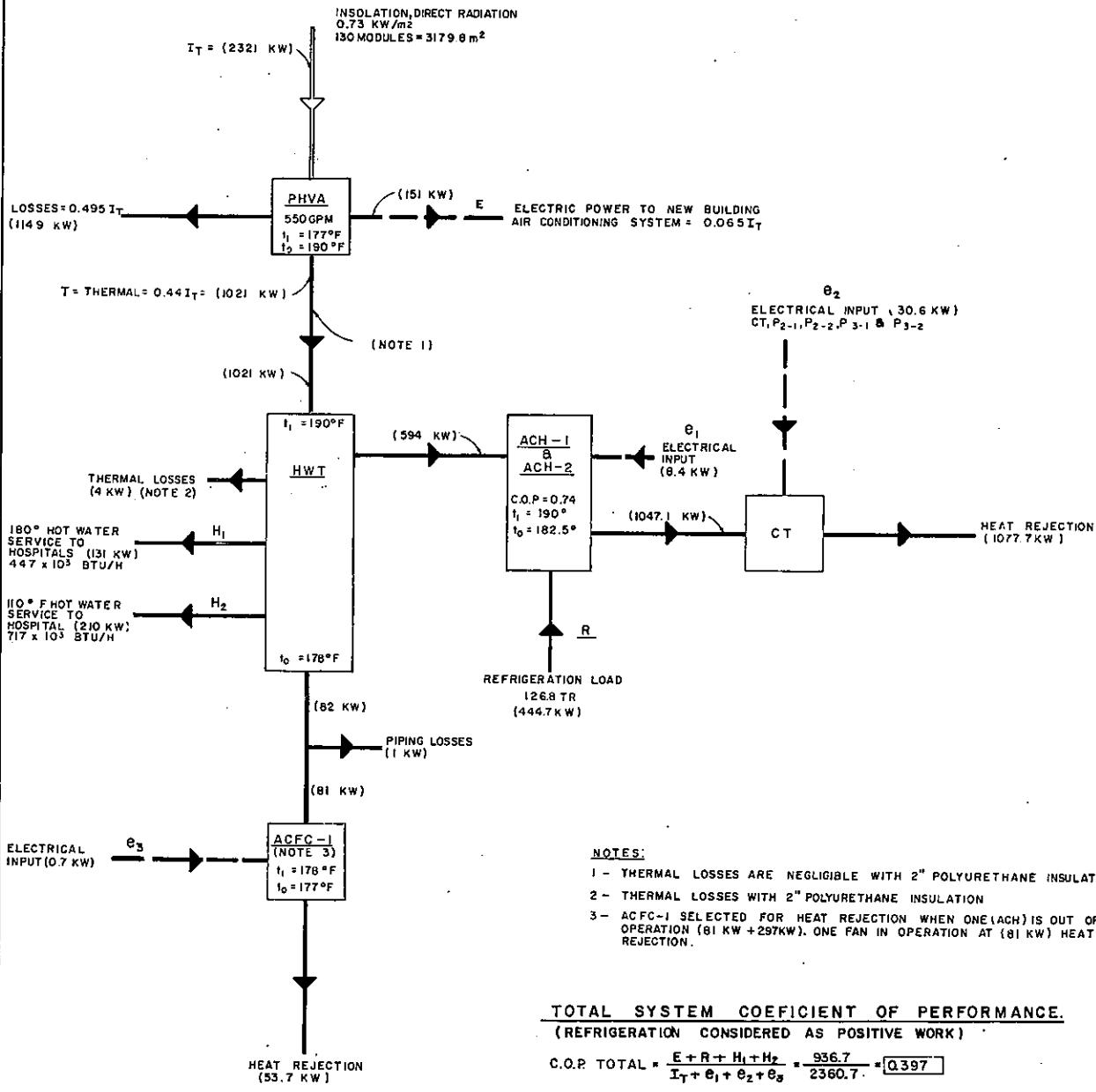
CAPACETE - MARTIN & ASSOCIATES
ARCHITECTS - ENGINEERS
1509 F.D. ROOSEVELT AVE., SAN JUAN, P.R.

CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS
CENTER FOR ENERGY AND ENVIRONMENT RESEARCH

ATTACHMENT #6

POWER FLOW DIAGRAM DURING
THE PEAK HOUR INSOLATION

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



CAPACETE-MARTIN & ASSOCIATES ARCHITECTS - ENGINEERS 1509 F.D. ROOSEVELT AVE., SAN JUAN, P.R.	10-17-78 F.M.L.		DRAWN BY HERNAN RAMOS DATE OCT. 13, 1978	CONCENTRATING PHOTOVOLTAICS FOR THE TROPICS CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
		REVISIONS		

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.