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GEOHERMAL FEASIBILITY STUDY
FOR
CITY OF SONOMA, CALIFORNIA
FOUR MUNICIPAL BUILDINGS

PREPARED BY

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I INTRODUCTION:

The City of Sonoma, located in the Northern California Wine Country, consists of several buildings which are old and historic in nature. Four of these buildings, (which shall be designated 1 through 4), totaling approximately 31,150 square feet, shall be evaluated to determine the economic feasibility of converting the existing Environmental Control Systems to water source heat pumps utilizing a natural Geothermal heat sink. Presently, on the State Park's site, there exists a warm water well which produces 250 gallons per minute of water at 73°F.

The four buildings are connected to the warm water well with assumed 2-4" Ø schedule 40 PVC pipe in a 30" deep trench over an estimated 250 foot course. (See Plan A on Sheet Number 31).

Each of the four buildings in question presently houses an Environmental Control System. These systems will be described later in this report and referenced to their applicable buildings. Due to the rising cost of fuel, the Sonoma County City Officials have asked if the buildings can utilize Geothermal Energy for Environmental Space Control.

The underground piping is tentatively routed through the State of California's property on the north side of Spain Street and across County property at the Depot Park and Veteran's Memorial Building. (See Plan A, Page 31). No investigation was made to procure right of way across State or County property. Mr. G. Eliason, of Carl's Trenching of Sonoma, mentioned a possible sensitive archaeological area crossing the State property. Mr. L. Ettinger, City of Sonoma Corporation Yard, tentatively assured this report staff that the City hot well at the Veteran's Building could be used as a "down well" for "spent" water.

There was an initial consideration by the City to include State of California Historic Building in the study. There was a brief review of four (4) State buildings in the preliminary study. This staff decided not to include them in this report at this time.

II CONCLUSIONS

Based on utility rates forecast by Pacific Gas and Electric, installation of heat pumps in the City buildings at Sonoma does not appear to be attractive. The economic evaluation was continued until the year 2000, as presented in the enclosed table. Pacific Gas and Electric is re-evaluating its rate forecasts and will issue a new forecast in April, 1982.

The high capital cost is due to retrofitting the heating, ventilating, and air conditioning equipment for the existing buildings. For a new installation, the concept of using heat pumps should be re-evaluated.

The total equipment cost is estimated to be \$152,000. Maintenance costs have been assumed at three percent of capital and to inflate at an annual rate of 8-1/2 percent. Insurance expenses have been assumed at 0.5 percent of capital and to inflate at one percent per year.

As shown in the Table #1, the discounted cash flow rate of return is 6.4 percent. In our estimation, a value of 15 percent or more would be necessary to indicate an attractive project.

The four State historical buildings, although not included in this report, would have an estimated rate of return similar to the City buildings or 6.4 percent. It should be emphasized again that the rate of return was based on a Pacific Gas and Electric forecast given to the California Energy Commission in August, 1980. See letter from Pacific Gas and Electric which follows. A new forecast is forthcoming.

III AVAILABILITY OF GEOTHERMAL WATER:

There is evidence of a Geothermal Resource in the Central Sonoma City Area. The warm water well currently produces 200-250 GPM of water tested at 73°F with a draw depth of 100 feet. The well is located at the Depot Park, which is part of the Sonoma City State Park Area. It should be pointed out that heat pump performance and energy use improve as resource temperature increases. If a temperature higher than 73°F is encountered at the various buildings, energy savings greater than those set forth in this report may be expected.

IV HEATING LOAD CALCULATIONS:

Design Conditions:

Outdoors - 27°F
Indoors - 70°F
Temp. Diff. (AT) - 43°F
Annual Heating Degree Days: 2,690

Data based on recommended Outdoor Design Temperatures for Northern California as published by the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

(a) Building No. 1 - Police Facility

The total building heat loss calculations were performed by examining the Building Envelope Data contained in the Construction Documents and extrapolating this data to the total building based on gross floor area. This resulted in an overall heating load at the previously mentioned Design Conditions of 25 BTUH/FT². The load imposed by ventilation air was calculated based on present design air flows as indicated on the Construction Documents.

(b) Building No. 2 - Courts/Council Building

The Outdoor and Indoor Design Conditions are the same as indicated for Building No. 1. The Exterior Envelope Construction is also the same as Building No. 1, with the exception of fenestration areas. The total heating load requirement is 33.8 BTUH/FT² based on information contained in the Construction Documents.

(c) Building No. 3 - Veteran's War Memorial Building

The Outdoor and Indoor Design conditions are the same as indicated for Building No. 1. The Building Envelope consists of exterior stucco on concrete with 2" furring strips and interior plaster finish at the walls. Roofing/ceiling system consists of build-up composite gravel roofing on plywood sheathing with 2 x 10 wood joists at 24 inch centers and interior plaster ceiling. At present, the building is uninsulated.

The calculated heating load based on Design Conditions as previously mentioned, and data contained in the contract drawings is 40.8 BTUH/FT². This load is largely due to the poor Thermal Characteristics of the Building Envelope. It should be pointed out

that the addition of Thermal Insulation at the exposed walls and roof areas will reduce the overall heating load considerably.

(d) Building No. 4 - City Hall

No available documents were available for evaluation at the time of this report. However, a limited field survey was made of the existing building construction and existing HVAC Systems employed. With the help of Mr. Brock T. Arner, City Manager for the City of Sonoma, the energy use data from July, 1980 to June, 1981 was obtained. The City Hall Building consumed 1575 therms or 157,500,000 BTU/Year during the above-mentioned period. Using this yearly consumption of 157,500,000 BTU/Year (which is equivalent to 157,500 cubic feet of gas) and the Design Conditions as stated for Building 1, the estimated heating load is 84,000 BTU/Hour, or 14.0 BTUH/FT². A safety factor of 20 percent shall be added to this load to yield the total load for calculation purposes of 17.5 BTU/FT².

V COOLING LOAD CALCULATIONS:

Design Conditions:

Outdoors	- 96°FDB, 69°FWB
Indoors	- 78°FDB, 65°FWB (50% R.H.)
Temp. Diff. (AT)	- 18°F
Daily Range:	- 40°F

(a) Building No. 1 - Police Facility

The total building instantaneous heat gain was calculated using the approved Ashrae Method, at the Design Conditions as previously stated. The total heat gain, with respect to building zoning, was found to be 257,000 BTU/HR, with the total sensible cooling load at 156,600 BTU/HR. In checking these figures with data incorporated in the Construction Documents, it was found to coincide with the existing system load.

(b) Building No. 2 - Courts/Council Building

The total building instantaneous heat gain was calculated using the approved Ashrae Method as indicated for Building No. 1. The total heat gain was calculated to be 231,500 BTU/HR with the sensible cooling load at 173,625 BTU/HR. The building block load was calculated to be 156,000 BTU/HR. In checking these figures with data incorporated in the Construction Documents, it was found to coincide with existing system load.

(c) Building No. 3 - Veteran's War Memorial Building

The building, as presently designed, has only heating and ventilation. The instantaneous heat gain was calculated using the approved Ashrae Method and the Design Conditions as previously stated. The total heat gain was calculated to be 780,000 BTU/HR, with a sensible cooling load of 479,520 BTU/HR. The building block cooling load was calculated at 665,000 BTU/HR.

(d) Building No. 4 - City Hall

Due to the fact that no available documents were available for evaluation at the time of this report, the total heat gain was obtained through a limited field survey of the existing building envelope, exterior glazing and building orientation. The total heat gain was calculated at 296,000 BTU/HR. The internal heat gains were calculated at 3.0 watts per FT² for lighting and receptacles

and one person per 100 square feet of gross floor area, for occupants. The sensible heat gain was found to be 180,360 BTU/HR. The building block load was calculated at 260,480 BTU/HR.

VI EXISTING ENVIRONMENTAL SYSTEMS DESCRIPTION:

(a) Building No. 1 - Police Facility

The existing environmental space temperature control is accomplished by multizone air handling system with a gas fired duct furnace, direct expansion cooling coil with remote air cooled condensing unit. Refrigerant R-22 is piped to the cooling coil via insulated type "L" copper tubing. The system is designed to maintain 70°F during winter and 78°F @ 50% relative humidity during summer conditions. Air handling equipment is located in the attic mechanical equipment room.

(b) Building No. 2 - Courts/Council Building

This building is served by four independent systems:

1. System No. 1 serving the Court Council Chamber consists of a constant volume air handling unit with gas fired duct furnace, direct expansion cooling coil and remote air cooled condensing unit.

2. System No. 2 serving the Clerk Office, is of the same type as System No. 1.

3. System No. 3 serving the Jury Room and Adjacent Office, is of the same type as System No. 1.

4. System No. 4 serving the Judge's Chambers consists of a horizontal draw through air handler with a heat pump coil and remote outdoor air to air heat pump compressor unit.

(c) Building No. 3 - Veteran's War Building

The existing environmental system consists of two horizontal draw through air handlers with steam coils to handle the heating load in the auditorium and banquet room. All other adjacent areas and trophy room areas are heated by a hot water radiant slab. Hot water for the radiant slab system is generated from the central boiler room. The boiler room houses two gas fired steam boilers with a steam to water heat exchanger and circulation pump for the radiant slab system. Steam is supplied to the steam coils located in the air handling apparatus with condensate flowing to the boiler feed pump receiver by gravity.

(d) Building No. 4 - City Hall

The existing environmental system consists of three gas fired heating furnaces with heat pump coils at the discharge. Refrigerant R-22 is piped to the heat pump coils from two outdoor air to air heat pump compressor units.

VII PROPOSED GEOTHERMAL HEAT PUMP SYSTEMS:

(a) General:

Due to the relatively low well water temperature of 73°F, the application of water source heat pump systems at each of the four buildings in question may prove to be economical. The principal reason is its ability to meet four important needs.

1. Energy conserving, heat recovery capabilities.
2. Competitive installed cost.
3. Simple design.
4. Compatibility with energy management systems, if required.

(b) Principal Advantages of Water Source Heat Pumps:

1. The water source heat pump system provides an excellent energy saving opportunity, simply because it is a heat recovery system.
2. Accommodates the requirements of speculative jobs. Only the units required for the initial installation need be purchased. Additional units can be purchased, installed, and connected to the loop as needed. Thys not only contributes to increased cash flow, but it provides the flexibility needed to accommodate future expansion.
3. The individual units can handle a call for heating or cooling at any time.
4. Failure of one individual unit has no effect on the remainder of the system.
5. Cost competitiveness with other HVAC Systems serving the same number of zones.
6. Ideal for retrofit projects.
7. Applies well with energy management systems (if applicable) which can help minimize the KW demand charge.

(c) System Description:

The water source heat pump is essentially a heat recovery system. The heat recovery function is made possible by piping all of the condenser/evaporator heat exchangers to a common water loop. It should be pointed out that a water source heat pump will have a better energy usage efficiency compared to the existing systems

presently installed in the respective buildings. This is due to the heat pumps (EER) when operating in the heating mode.

When operating in the cooling mode, the condenser/evaporator water side heat exchanger functions as a condenser, rejecting heat extracted from the space to the water loop. Conversely, when operating in the heating mode, the condenser/evaporator, water side heat exchanger functions as an evaporator, extracting heat from the same water loop to be rejected to the space. Therefore, during times of the year when heating is required at the exterior building perimeter, an energy saving potential exists when the interior zone units are in the cooling mode, rejecting heat to the loop, and the exterior zone units are in the heating mode extracting heat from the loop. In other words, unneeded heat, which is normally rejected into the atmosphere, is transferred from the interior zones to heat the exterior zones of the building.

(d) Heat Pump Systems Components:

The basic components required for a proper water source heat pump system are as follows:

1. Heat pump fan/coil compressor unit (horizontal or vertical).
2. Heat Rejector (natural heat sink well).
3. Heat Adder (if required) usually a boiler, either gas fired or electric.
4. Air Separator.
5. Expansion Tank.
6. Primary and Stand-by Pumps.
7. Loop Water Piping (copper or black steel).

Due to the relatively warm summer, design outdoor temperature PVC piping for the water loop within the respective buildings is not advisable, due to the problems with expansion, contraction, and supports.

Building No. 1 - Police Facility

The horizontal heat pumps designated 1 through 4 represent the respective zones they will condition. These zones are as follows:

1. Offices - north exposure.
2. Offices and holding cells - south exposure.
3. Sergeant's area, briefing room, and radio console.
4. Lobby and records area.

The new heat pump units, circulation pumps, heat exchanger, and expansion tank can be installed in the existing attic mechanical equipment room. Refer to Diagram #1 - Page 35.

Building No. 2 - Courts/Council Building

The horizontal heat pumps designated 1 through 4 represent the respective zones they will condition. These zones are as follows:

1. Court council chamber.
2. Clerk/s office.
3. Jury room.
4. Judge's chambers.

The new heat pump units, circulation pump, heat exchanger, and expansion tank can be installed in the existing attic mechanical equipment room. Refer to Diagram #2 - Page 36.

Building No. 3 - Veteran's War Memorial Building

The horizontal heat pumps designated as 1 through 6 represent the respective zones they will condition. These zones are as follows:

1. Auditorium.
2. Auditorium.
3. Committee rooms, lobby, offices (west exposure).
4. Trophy room, check room, corridor.
5. Banquest room.
6. Kitchen.

The two existing steam boilers presently providing heating for the building shall remain. However, some modifications to the system are required, and shall be described later in this report. Refer to Diagram #3 for proposed system. It should be pointed out that the system, as indicated in Diagram #3, will be more efficient than systems indicated on Diagrams #1 and #2. This is due to the possibility of increasing the loop water temperature by utilizing the existing steam boilers. Refer to Diagram #3 - Page 37.

The existing radiant slab system for the toilets, lockers, and shower rooms shall remain. This is due to the ventilation requirements for these areas. Since supply air to these spaces cannot be recirculated, the installation of a heat pump system in these areas, supplying 100% outside air at the design outdoor heating and cooling conditions, would result in discharge air temperatures of insufficient heat content to maintain indoor design comfort conditions.

Building #4 - City Hall Building

The horizontal heat pumps designated 1 through 3 represent preliminary building zoning. The intent of the diagram is to present concept only. The heat pump capacities shall be as indicated in Table 1 of the Appendix.

The heat pump system Diagrams #1 through #4 are diagrammatic only and do not reflect the actual number of heat pump units to be installed in each building. The primary intent of the diagrams is to present the concept only.

The amount of heat pump units to be installed in each building will be indicated in Table 1 of the Appendix.

VIII COST ESTIMATE ANALYSIS

The cost estimates for Buildings 1 through 4 were made based on 1981 equipment and labor costs. A 12% contingency cost has been added to the costs estimated to cover equipment and labor cost escalations.

Based on previous studies, the operation and maintenance costs are expected to be 3% of capital investment, and insurance costs to be 0.5% of capital investment.

Energy consumption estimates were based on the Degree Day Method, as established in the 1980 Ashrae Fundamentals, Section 28.1 for heating and the equivalent full load method for cooling.

IX ECONOMIC ANALYSIS

The cost for natural gas was estimated at \$0.5102 per therm of gas consumed. The costs shall be evaluated over a 20 year life with annual utility cost increases as indicated in Pacific Gas and Electric's cost schedule.

The cost for electricity was estimated at \$0.790 kilowatt hour of electricity consumed. The costs shall be evaluated over a 20 year life with annual utility cost increases as indicated in the Pacific Gas and Electric cost schedule.

SUMMARY OF COSTS USED IN ECONOMIC EVALUATION

<u>BLDG. NO.</u>	<u>BUILDING IDENTIFICATION</u>	<u>COSTS</u>
1	Police Facility	\$ 28,000.00
2	Courts/Council Building	\$ 18,144.00
3	Veteran's War Memorial Building	\$ 47,208.00
4	City Hall	\$ 28,224.00
	Sub-Total	\$121,576.00
	New Underground Piping to/from Pump and Buildings	\$ 30,000.00
	Total Estimated Capital Costs	\$151,576.00
	Say	\$152,000.00
	First Year Mainatenance (3%) (1)	\$ 4,560.00
	First Year Insurance (0.5%) (2)	\$ 760.00

(1) Assume to escalate at 8-1/2% per year.

(2) Assume to escalate at 1% per year.

X CAPITAL COST ESTIMATE

Building No. 1 - Police Facility - 6,000 Ft.

<u>EQUIPMENT</u>	<u>COSTS</u>
1. Heat Pump Units -----	\$ 9,000.00
2. Circulating Pumps -----	\$ 1,500.00
3. Loop Piping (Approx. 500 Linear Ft.) -----	\$ 3,250.00
4. Heat Exchanger -----	\$ 2,500.00
5. Pipe Insulation -----	\$ 2,750.00
6. Valves, Cocks, and Gages -----	\$ 1,500.00
7. Controls -----	\$ 3,000.00
8. Testing and Balancing -----	\$ 1,500.00
 Sub-Total -----	 \$25,000.00
12% Contingency -----	\$ 3,000.00
Demolition Costs -----	\$15,000.00
Grand Total -----	\$43,000.00
Cost per Square Foot = \$4.67	

The capital costs, as indicated, are based on manufacturer's 1981 unit prices and do not include costs for labor, shipping, or contractor's overhead and profit.

Building No. 2 - Courts/Council Building - 3,000 FT

<u>EQUIPMENT</u>	<u>COSTS</u>
1. Heat Pump Units -----	\$ 6,000.00
2. Circulating Pumps -----	\$ 1,000.00
3. Heat Exchanger -----	\$ 2,000.00
4. Loop Piping ----- (Air Separator and Expansion Tank)	\$ 2,000.00
5. Pipe Insulation -----	\$ 1,200.00
6. Valves, Cocks, and Gages -----	\$ 1,000.00
7. Controls -----	\$ 2,000.00
8. Testing and Balancing -----	\$ 1,000.00
 Sub-Total -----	 \$16,200.00
12% Contingency -----	\$ 1,944.00
Demolition Costs -----	\$ 4,000.00
Grand Total -----	\$22,144.00
 Cost Per Square Foot = \$6.05	

The capital costs, as indicated, are based on manufacturers' 1981 unit prices, and do not include costs for labor, shipping, or contractors' overhead and profit.

Building No. 3 - Veteran's War Memorial Building - 16,150 FT

EQUIPMENT

COSTS

1. Heat Pump Units -----	\$16,800.00
2. Circulating Pumps -----	\$ 2,550.00
3. Heat Exchangers -----	\$ 3,800.00
4. Steam to Water Heat Exchanger -----	\$ 2,000.00
5. Hot Water Pump -----	\$ 500.00
6. Loop Piping -----	\$ 4,500.00
7. Loop Insulation -----	\$ 3,000.00
8. Valves and Gages -----	\$ 2,000.00
9. Controls -----	\$ 5,000.00
10. Testing and Balancing -----	\$ 2,000.00

Sub-Total ----- \$42,150.00

12% Contingency ----- \$ 5,058.00

Demolition Costs ----- \$15,000.00

Grand Total ----- \$62,208.00

Cost Per Square Foot = \$2.93

The capital costs, as indicated, are based on manufacturers' 1981 unit prices, and do not include costs for labor, shipping, or contractors' overhead and profit.

Building No. 4 - City Hall - 6,000 FT

<u>EQUIPMENT</u>	<u>COSTS</u>
1. Heat Pump Units -----	\$12,000.00
2. Circulating Pumps -----	\$ 1,500.00
3. Heat Exchanger -----	\$ 2,500.00
4. Loop Piping -----	\$ 2,000.00
5. Pipe Insulation -----	\$ 1,200.00
6. Valves, Cocks, and Gages -----	\$ 1,500.00
7. Controls -----	\$ 3,000.00
8. Testing and Balancing -----	\$ 1,500.00
 Sub-Total -----	 \$25,200.00
12% Contingency -----	\$ 3,024.00
Demolition -----	\$10,000.00
Grand Total -----	\$38,224.00
 Cost Per Square Foot = \$4.70	

The capital costs, as indicated, are based on manufacturers' 1981 unit prices, and do not include costs for labor, shipping, or contractors' overhead and profit.

XI EXISTING ENVIRONMENTAL SYSTEM MODIFICATION:

General:

The modifications required to incorporate the proposed Geothermal System shall be as described herein. Each building shall be described separately, with the initial modifications indicated. The demolition costs have been included in the Capital Cost Estimates. It should be stated that "the exact costs of demolition will depend on the amount of strip-out work required and the time period (or date) when the demolition contract is awarded, if the Sonoma County officials proceed with design and construction."

The initial modifications are as follows:

Building No. 1 - Police Facility

Referring to the section describing the existing Environmental Control System, the following demolition work is required:

1. Removal of the existing multi-zone air handling unit with all its associated appurtenances, including fans, filters, dampers, air mixing plenums, gas fired furnaces and control systems.
2. Removal of the existing outdoor air cooled condensing unit, including refrigerant piping, valving, direct expansion cooling coil, and all associated controls.
3. All main and branch supply and return ductwork should remain in place, if possible, to avoid shutdown of unnecessary areas. The existing air distribution equipment, (ductwork, diffusers, etc.), should remain in place. The new proposed water source heat pump units should be designed and installed in such a manner that the existing building zoning and duct distribution can be re-used.

Building No. 2 - Courts/Council Building

1. Removal of four existing Environmental Control Systems, including air handling units, filter section, dampers, air mixing plenums, gas fired duct furnaces, and associated control systems, including air to air heat pump systems.

2. Removal of three outdoor air cooled condensing units and one outdoor air to air heat pump, compressor unit, all associated refrigerant piping, valving, direct expansion cooling coils, DX heat pump coil, and all associated controls.

3. All main and branch supply and return ductwork should remain in place, if possible, to avoid shutdown of unnecessary areas. The existing air distribution equipment (ductwork, diffusers, etc.), should remain in place.

The new proposed water source heat pump units should be designed and installed in such a manner that the existing building zoning and duct distribution can be re-used.

Building No. 3 - Veteran's War Memorial Building

Referring to the section describing the existing Environmental Control System for this building, the following demolition work is required:

1. Removal of the existing air handling units serving the auditorium and banquet facilities, including all fans, steam heating coils, filters, air mixing plenums, dampers, and all associated controls.

2. Disconnect and cap all existing radiant slab piping from existing hot water main piping, with the exception to the piping system serving the locker room, shower, and toilet areas radiant slab systems.

3. All main and branch supply and return ductwork should remain in place if possible. The existing air distribution equipment, (ductwork, diffusers, etc.), should remain in place. The new proposed water source heat pump units should be designed and installed in such a manner that the existing ductwork can be re-used.

Building No. 4 - City Hall

Referring to the section describing the existing Environmental Control System for this building, the following demolition work is required:

1. Removal of the existing gas fired heating furnaces, including DX heat pump coil, outdoor air to air heat pump compressor

units, intake and discharge ductwork, dampers, and all associated control systems.

2. Removal of all refrigerant piping between heat pump compressor unit and DX heat pump coil, including all valves and fittings.

3. Where possible, the existing branch ductwork and air outlets should be re-used to reduce first costs.

CITY OF SONOMA, CALIFORNIA

BUILDING IDENTIFICATION

<u>BLDG NO.</u>	<u>NAME</u>	<u>AREA (SQ. FT.)</u>
1	Police Facility	6,000
2	Courts/Council Building	3,000
3	Veteran's War Memorial Building	16,150
4	City Hall	6,000

ESTIMATED GAS CONSUMPTION WITH EXISTING FACILITIES

<u>BLDG NO.</u>	<u>GAS CONSUMPTION (THERMS)</u>		<u>TOTAL</u>	<u>1982</u>
	<u>HEATING</u>	<u>HOT WATER</u>	<u>CONS.</u>	<u>COSTS</u>
1	2,224	225	2,449	\$1,249
2	1,353	150	1,503	\$ 767
3	5,520	551	6,071	\$3,097
4	2,411	270	2,681	\$1,368
TOTAL GAS CONSUMPTION			12,704	\$6,481

ESTIMATED GAS CONSUMPTION WITH PROPOSED HEAT PUMPS

<u>BLDG NO.</u>	<u>GAS CONSUMPTION (THERMS)</u>		<u>TOTAL</u>	<u>1982</u>
	<u>HEATING</u>	<u>HOT WATER</u>	<u>CONS.</u>	<u>COSTS</u>
1	0	225	225	\$ 115
2	0	150	150	\$ 77
3	89	551	640	\$ 327
4	0	270	270	\$ 138
TOTAL GAS CONSUMPTION			1,285	\$ 657
ENERGY SAVINGS			11,419	\$5,824

GAS AT \$0.5102/THERM in 1982

CITY OF SONOMA, CALIFORNIA

BUILDING IDENTIFICATION

<u>BLDG NO.</u>	<u>NAME</u>	<u>AREA (SQ. FT.)</u>
1	Police Facility	6,000
2	Courts/Council Building	3,000
3	Veteran's War Memorial Building	16,150
4	City Hall	6,000

ESTIMATED ELECTRICAL CONSUMPTION WITH EXISTING FACILITIES

<u>BLDG NO.</u>	<u>ELECTRICAL CONSUMPTION</u> <u>LIGHTING</u>	<u>COOLING</u>	<u>(KWH)</u> <u>OTHER</u>	<u>TOTAL</u> <u>CONS.</u>	<u>1982</u> <u>COSTS</u>
1	20,363	35,420	15,060	70,843	\$ 5,597
2	15,272	25,200	9,020	49,492	\$ 3,910
3	66,088	49,765	19,405	135,258	\$10,685
4	24,553	37,076	21,553	83,182	\$ 6,571
TOTAL ELECTRICAL CONSUMPTION				338,775	\$26,763

ESTIMATED ELECTRICAL CONSUMPTION WITH PROPOSED HEAT PUMPS

<u>BLDG NO.</u>	<u>ELECTRICAL CONSUMPTION</u> <u>LIGHTING</u>	<u>COOLING</u>	<u>(KWH)</u> <u>OTHER</u>	<u>TOTAL</u> <u>CONS.</u>	<u>1982</u> <u>COSTS</u>
1	20,363	16,875	11,650	48,888	\$ 3,862
2	15,272	10,357	5,765	31,374	\$ 2,478
3	66,088	48,390	25,980	140,458	\$11,096
4	24,553	17,820	10,670	53,043	\$ 4,190
TOTAL ELECTRICAL CONSUMPTION				273,763	\$21,626

ELECTRICAL SAVINGS	65,012	\$ 5,137
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ELECTRICITY AT \$0.079/KWH in 1982

APPENDIX

Table #1 - Geothermal Economic Study - Energy Savings

Table #2 - Heat Pump Capacity Schedule

Table #3 - Estimated Utility Costs

Plan #A

Rate Chart

Pacific Gas and Electric Company Correspondence

Pacific Gas and Electric Company Rate Chart Table

Diagram #1 - Police Facility

Diagram #2 - Courts/Council Building

Diagram #3 - Veteran's War Memorial Building

Diagram #4 - City Hall Building

TABLE 1

GEO-THERMAL ECONOMIC STUDY
CITY OF SONOMA

<u>YEAR</u>	<u>ENERGY SAVINGS \$/YEAR</u>	<u>MAINTENANCE GEOTHERMAL</u>	<u>INSURANCE GEOTHERMAL</u>	<u>NET SAVINGS \$/YEAR</u>
1982	10,962	4,560	760	5,642
1983	12,561	4,948	768	6,846
1984	14,297	5,368	775	8,153
1985	15,582	5,824	783	8,975
1986	17,304	6,320	791	10,194
1987	18,922	6,857	799	11,266
1988	21,117	7,439	807	12,871
1989	23,144	8,072	815	14,257
1990	24,207	8,758	823	14,626
1991	25,843	9,502	831	15,510
1992	27,777	10,310	840	16,628
1993	29,800	11,186	848	17,765
1994	31,869	12,137	856	18,875
1995	32,915	13,169	865	18,881
1996	37,264	14,288	874	22,103
1997	39,029	15,503	882	22,644
1998	43,837	16,821	891	26,125
1999	47,518	18,250	900	28,368
2000	51,323	19,802	909	30,612

DCF RATE OF RETURN = 6.4%
 CAPITAL COST = \$152,000
 DISCOUNTED CASH FLOW = \$152,000

TABLE #2

HEAT PUMP CAPACITY SCHEDULE

BLDG. NO.	AREA	TOTAL HTG. MBH	TOTAL COOL'G. MBH	CAPACITY PER UNIT						GPM PER UNIT	NO. OF UNITS	MFGR.
				CFM	HTG. MBH	COOL. MBH	GPM	EER COP	COMP. HP			
1	6000	150	257	1200	43,000	40,000	8	9.2 2.8	3	9.2	6	WPHA-40
2	3000	101.4	231.5	1620	58,000	47,000	9.4	8.5 3.0	5	8.5	4	WPHA-52
3	16,150	658.9	780	1575	56,400	45,700	9.1	8.5 3.0	5	8.3	14	WPHA-52
4	6000	105	296	840	35,500	33,000	6.6	9.4 2.9	2½	9.4	10	WPHA-33

UNIT SELECTIONS ARE BASED ON TRANE WATER SOURCE HEAT PUMP UNITS

TABLE 2

TABLE 3

ESTIMATED UTILITY COSTS - OBTAINED FROM P.G.&E.

CITY OF SONOMA

YEAR	GAS COST		ELECTRICITY	
	\$/YEAR	% INCREASE	\$/KWH	% INCREASE
1982	0.5102	0.000	0.0790	0.000
1983	0.5905	15.379	0.0895	13.291
1984	0.6821	15.512	0.1001	11.844
1985	0.7668	12.418	0.1050	4.895
1986	0.8658	12.911	0.1141	8.667
1987	0.9613	11.030	0.1222	7.099
1988	1.1006	14.491	0.1315	7.610
1989	1.2343	12.148	0.1392	5.856
1990	1.2539	1.588	0.1521	9.267
1991	1.3312	6.165	0.1637	7.627
1992	1.4015	5.281	0.1811	10.629
1993	1.4932	6.543	0.1961	8.283
1994	1.5543	4.092	0.2172	10.760
1995	1.6795	8.055	0.2113	- 2.716
1996	1.8167	8.169	0.2541	20.256
1997	1.9849	9.259	0.2517	- 0.945
1998	2.1594	8.791	0.2950	17.203
1999	2.3537	8.998	0.3175	7.627
2000	2.5656	9.003	0.3388	6.709

AID ASSOCIATED INDUSTRIAL DESIGNERS
P. O. BOX 327 MARTINEZ, CALIFORNIA 94553
415/372-7300

GEO-THERMAL ECONOMIC STUDY CITY of SONOMA

1-20-82
BB

	YR.	\$/KWH			\$/THERM	
		SMALL	MEDIUM	LARGE	COMMER	INDUSTR.
1	1982	8.03	7.90	7.43	51.02	66.42
2	3	8.95	8.95	8.53	59.05	79.41
3	4	10.11	10.01	9.57	68.21	91.03
4	5	10.61	10.50	10.11	76.68	100.83
5	6	11.54	11.41	11.11	86.58	111.88
6	7	12.35	12.22	11.99	96.13	123.35
7	8	13.30	13.15	13.02	110.06	137.71
8	9	14.07	13.92	13.86	123.43	152.50
9	1990	15.38	15.21	15.28	125.39	162.21
10	1	16.54	16.37	16.45	133.12	175.08
11	2	18.31	18.11	18.25	140.15	188.39
12	3	19.82	19.61	19.77	149.32	203.67
13	4	21.95	21.72	21.93	155.43	218.21
14	5	21.36	21.13	21.41	167.95	237.18
15	6	25.68	25.41	25.91	181.67	257.90
16	7	25.44	25.17	26.52	198.49	281.51
17	8	29.82	29.50	30.04	215.94	306.78
18	9	32.09	31.75	32.29	235.37	334.39
19	2000	34.24	33.88	34.45	256.56	364.49

GIVEN BY PHONE FR PAM DIMARTINI
PG #E IN S.F. 781-4211 EXT 1310

PACIFIC GAS AND ELECTRIC COMPANY

77 BEALE STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211 • TWX 910-372-6587

S. P. REYNOLDS
MANAGER
RATE DEPARTMENT

January 27, 1982

Mr. Blaine Bonacci
A.I.D.
P. O. Box 327
Martinez, California 94553

Dear Mr. Bonacci:

As you requested in your telephone conversation with Ms. P. M. DeMartini, we are attaching a copy of forecasted gas and electric rates for years 1980-2000. The rates are based on our Common Forecasting Methodology provided to the California Energy Commission in August 1980. We are in the process of updating this information. However, we have nothing available for release at this time.

These forecasts are based upon a specific set of assumptions on the timing and level of rate relief, economic conditions and energy conditions. Any changes to these factors, will of course, affect the forecasts. We therefore, urge you to use these numbers only as a general guide to the trend in future electric and gas rates.

If you need further assistance, please contact Ms. P. M. DeMartini at 781-4211, extension 1310.

Sincerely,

Steph P. Reynolds

Table VI-2 (Cont'd)

PACIFIC GAS AND ELECTRIC COMPANY
 FORECAST OF ENERGY PRICES
 ELECTRIC PRICES - \$ PER KWH/GAS PRICES - \$ PER THERM
 (INITIAL DOLLARS)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ELECTRIC PRICES:											
RESIDENTIAL	0.0595	0.0630	0.0765	0.0868	0.0965	0.0992	0.1113	0.1160	0.1297	0.1343	0.1515
SMALL LIGHT & POWER	0.0658	0.0680	0.0813	0.0895	0.1011	0.1061	0.1154	0.1235	0.1330	0.1407	0.1538
MEDIUM LIGHT & POWER	0.0630	0.0655	0.0790	0.0895	0.1001	0.1050	0.1141	0.1222	0.1315	0.1392	0.1521
LARGE LIGHT & POWER	0.0540	0.0600	0.0743	0.0853	0.0957	0.1011	0.1111	0.1199	0.1302	0.1386	0.1528
GAS PRICES:											
RESIDENTIAL	0.5011	0.4676	0.5357	0.6236	0.7270	0.8246	0.9387	1.0490	1.2106	1.3657	1.3883
COMMERCIAL	0.3877	0.4473	0.5102	0.5905	0.6821	0.7668	0.8658	0.9613	1.1006	1.2343	1.2539
INDUSTRIAL	0.4519	0.5556	0.6642	0.7941	0.9103	1.0803	1.1189	1.2335	1.3771	1.5250	1.6221
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
ELECTRIC PRICES:											
RESIDENTIAL	0.1601	0.1608	0.1919	0.2171	0.2172	0.2567	0.2583	0.2909	0.3163	0.3375	
SMALL LIGHT & POWER	0.1654	0.1831	0.1982	0.2195	0.2136	0.2568	0.2544	0.2902	0.3209	0.3474	
MEDIUM LIGHT & POWER	0.1637	0.1811	0.1961	0.2172	0.2113	0.2541	0.2517	0.2950	0.3175	0.3402	
LARGE LIGHT & POWER	0.1645	0.1625	0.1977	0.2193	0.2141	0.2551	0.2552	0.3004	0.3279	0.3445	
GAS PRICES:											
RESIDENTIAL	1.4776	1.5593	1.6662	1.7372	1.8430	2.0425	2.2379	2.4404	2.6680	2.8994	
COMMERCIAL	1.3312	1.4015	1.4997	1.5543	1.6795	1.8167	1.9849	2.1594	2.3537	2.5656	
INDUSTRIAL	1.7505	1.8839	2.0367	2.1821	2.3718	2.5790	2.8151	3.0678	3.3439	3.6449	

AUGUST 1980

DIAGRAM 1

SCHEMATIC PIPING DIAGRAM

NOT TO SCALE

SCHEMATIC PIPING DIAGRAM
NOT TO SCALE

SCHEMATIC PIPING DIAGRAM

NOT TO SCALE

SCHEMATIC PIPING DIAGRAM

NOT TO SCALE

ACKNOWLEDGEMENTS

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Alex Brown, PE	AID
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Pat Wagner	City of Sonoma Engineer
Loyd Ettinger	City of Sonoma Corporation Yard

State of California - Historical Building Contracts

Ken Armstrong	Park Maintenance Supervisor (707) 938-1519
Buck Nelson	Drawing Procurement (916) 322-7557