June 27, 2002

Initial Technical and Price Proposal For Energy Savings Performance Contract

Submitted To:

Frank Hagel Federal Building

GSA

SOCIAL SECURITY ADMINISTRATION USA

Submitted By:

Sempra Energy Services

Sempra Energy Services is not the same company as the utility, SDG&E or SoCalGas, and the California Public Utilities Commission does not regulate the terms of Sempra Energy Services' products and services.

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EXECUTIVE SUMMARY

Sempra Energy Solutions (SES) is proud to present to the Social Security Administration and the General Services Administration a comprehensive energy services Initial Proposal for the Frank Hagel Federal Building that accomplishes the following objectives:

- Reduces on-going energy consumption and costs
- Provides facility infrastructure improvements
- Provides the above results at no capital cost to the GSA or SSA

The timing for this proposal is very advantageous to the SSA/GSA for the following reasons:

- High electricity rates and relatively low gas rates create good payback periods for capital intensive energy conservation projects such as distributed generation
- Interest rates are low compared to the last 10-year average, lowering the overall cost of the program
- Utility, state and federal rebates and grants are now available

Next Step

The next step in the process, should you decide to proceed, is the "Request For Detailed Study" and "Notice of Intent to Award" to be issued to Sempra Energy Solutions.

Building Description

The Frank Hagel Federal Building serves as the Western Program Service Center (WNPSC) for the Social Security Administration (SSA). The building is owned by the General Services Administration (GSA) and is occupied and operated by the SSA. The building is located in Richmond, California on the San Francisco Bay. This document presents the Initial Proposal prepared by Sempra Energy Solutions for an energy conservation project to be performed under the U.S. Department of Energy's Super Energy Savings Performance Contract (ESPC) program.

The point of contact at the building for this proposed energy project is:

Mr. David Rouggly
Construction Projects Manager
Telephone: (510) 970-4111
Fax: (510) 970-1116
E-mail: david.a.rouggly@ssa.gov

The address of the building is:

Frank Hagel Federal Building
1221 Nevin Avenue
Richmond, CA 94801

Energy Use

Electricity and natural gas are supplied to the building by Pacific Gas & Electric Company. Current electricity consumption is as follows:

Electric Rate:	E-20 S (secondary),
Peak Demand:	2,500 kW,
Annual Electricity Use:	11,000,000 kWh,
Energy Use Index:	24.6 kWh/ft^2-yr,
Current Electricity Cost:	$1,500,000 per year.

The electric rate schedule is included in Appendix A. Also, included in Appendix B is a summary of electric bills for the past several years.

Natural gas is supplied through two meters, one serving the building heating needs and the other serving the cafeteria. Natural gas use is as follows:

Building Heat:	
Natural Gas Rate:	GNR1,
Natural Gas Use:	90,000 Therms/yr,
Natural Gas Cost:	$50,000/yr.
Cafeteria:	
Natural Gas Rate:	GNR1,
Natural Gas Use:	2,300 Therms/yr,
Natural Gas Cost:	$1,265/yr.

(Based on a nominal natural gas cost of $0.55/Therm.)

The building consists of a basement and six floors, comprising a total of 526,050 ft^2 of enclosed area with 446,600 ft^2 of conditioned area. Table 1 shows a summary of the major areas of the building, and floor plans are included in Appendix C. The building is near the San Francisco Bay and experiences moderate weather. Design conditions for the building are 85°F dry bulb and 64°F wet bulb (42% relative humidity) in summer, and 35°F dry bulb in winter.

Table 1

Frank Hagel Building
Summary of Building Areas

Floor	Building Area, ft2
Basement:	
Warehouse	16,600
Office Space	20,250
Aux. Service Areas	12,350
Circulation & Toilets	9,250
Unconditioned	40,950
1st Floor:	
Dining Area	6,400
Kitchen	6,750
Auditorium	7,900
Health Unit	3,000
Office Space	11,600
Lobbies & Toilets	19,200
Unaccounted	5,800
Unconditioned	4,600
2nd Floor:	
Computer Room	9,600
Office Space	47,100
Circulation & Toilets	8,800
Unconditioned	4,700
3rd, 4th, 5th, and 6th Floors (Area for Each):	
Office Space	56,700
Circulation and Toilets	8,800
Unconditioned	4,700
Penthouse (Mechanical Equipment)	10,400
Total Enclosed Area, ft2:	526,050
Total Air-Conditioned Area, ft2:	446,600

Energy Conservation Measures Previously Implemented

The HVAC system at the Hagel Building is a relatively complicated system. The system is equipped with a modern digital energy management system and, overall, is well controlled by knowledgeable operating personnel. A number of energy conservation measures (ECMs) that are typically applied to older buildings have already been implemented at this facility. These ECMs include:

- High efficiency lighting,
- Automatic on/off control of lighting and major equipment,
- High efficiency motors,
- High efficiency chillers,
- Variable frequency drives on large supply and return fans,
- Automatic controls of HVAC system operation including control of the enthalpy wheel, run-around coils, supply air temperatures, chilled water reset, and condenser water reset.

Previous Energy Studies

Recent energy studies that have been performed on the Hagel Building include:

- Energy Efficiency Study by Bonneville Power Administration, 05/31/00
- Distributed Generation Feasibility Study by Bonneville Power Administration, 02/27/02
- Recommissioning Assessment by Facility Dynamics Engineering, 04/09/02

Energy measures recommended in these studies were considered in the development of the energy conservation measures proposed by SES to be performed under the Energy Savings Performance Contract.

Energy Conservation Measures (ECMs) Under Consideration

It is our understanding that a separate building recommissioning project is being implemented at the Hagel Building by others. This recommissioning includes the reduction of minimum outside air setpoints, air-side and water-side balancing. Further modifications to the air and water-side systems depend on the specific scope and outcome of the recommissioning.

Measures that can be considered for inclusion in the energy project by SES include:

Optimization of the air-side systems:

- Reducing minimum outside air setpoints, and
- Implementing supply air reset with humidity override.

Optimization of the water-side systems:

- Optimization of chiller staging to maximize chiller efficiency,
- Modification of chilled water piping to allow water chillers (CH 1 & 2) to serve air handlers AHU 1-4,
- Installation of variable speed drives on one or more chillers.

ECMs Included in Sempra Energy Solutions Initial Proposal

1. Convert the electrical service received from PG&E from secondary (E-20S) to primary (E-20P). We have included provisions for the installation of new

transformers and electrical metering as part of this conversion. This ECM has a savings of $112,479 per year.

2. Installation of a natural gas engine distributed generation system. This system consists of a nominal 500 kW engine generator with waste heat recovery. The engine will be operated during building operating hours (12 hours per day, 6 days per week). The waste heat from the engine will be used to heat hot water for space heating and domestic water. Estimated savings are $171,712 per year.

3. Replacement of Griswold automatic flow control valves. The Griswold valves will be removed and replaced with circuit-setter valves to improve the control of chilled water supplied to the VAV terminal boxes. Savings are estimated to be $2,070 per year.

Table 2 shows a summary of the proposed ECMs.

Table 2. Summary of ECMs Proposed for Initial Proposal

ECM No.	Description	Energy Savings			
		kW	kWh/yr	Therms/yr	$/yr
1.	Convert from Secondary to Primary Electrical Service	38	164,370	0	$112,479
2.	Engine Distributed Generation with Hot Water Heat Recovery	500	1,732,800	-141,385	$171,712
3.	Replace Griswold Automatic Flow Control Valves	0	20,700	0	$2,070
Total		538	1,917,870	-141,385	$286,261

Additional energy conservation measures recommended for evaluation as part of a Detailed Energy Study by SES include the following:

- Air-side optimization including supply air reset and other modifications to minimize electric reheat,
- Water-side optimization including repiping of the chilled water system to allow the water chillers to serve AHU 1-4 and application of variable speed drives to the chillers,
- Renovation of the elevators, and
- Photovoltaic distributed generation system

More detailed information on the proposed ECMs, the associated energy savings, Measurement and Verification Overview, Management Approach, and Price Proposal are included in the following sections.

Project Schedule

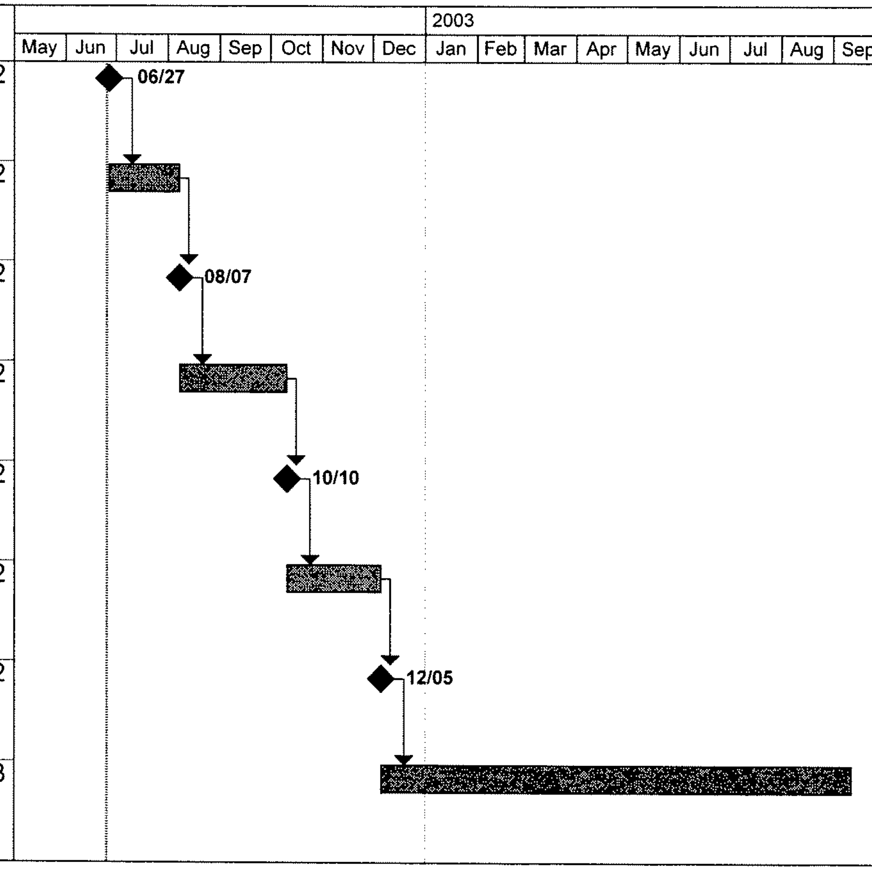
See proposed project schedule on following page

Sempra Energy Solutions

Hagel Building

Tue 06/25/02

ID	Task Name	Duration in Work Days	Start	Finish
1	Initial Proposal	0 days	Thu 06/27/02	Thu 06/27/02
2	Client Evaluation	30 days	Thu 06/27/02	Wed 08/07/02
3	Request for Detailed Study	0 days	Wed 08/07/02	Wed 08/07/02
4	Detailed Study	46 days	Thu 08/08/02	Thu 10/10/02
5	Final Proposal Presentation	0 days	Thu 10/10/02	Thu 10/10/02
6	Client Evaluation	40 days	Fri 10/11/02	Thu 12/05/02
7	Award Contract	0 days	Thu 12/05/02	Thu 12/05/02
8	Execution of the Work	200 days	Fri 12/06/02	Thu 09/11/03



BACKGROUND INFORMATION

The building was constructed beginning in 1972 and was first occupied in 1974. The building's heating, ventilating, and air conditioning (HVAC) system was subjected to a major renovation in 1995 and 1996. This renovation included the installation of new chillers and modification of the large air handlers. Objectives of the renovation included addressing air quality concerns regarding the outside air ventilation rates and air dehumidification. The design and operation of the renovated system are described in detail in the *User Manual* prepared by Gershon Meckler Associates, P.C.

Figure 1 shows monthly profiles of electricity demand (kW). The profiles show that the peak demand is about 2,500 kW with little variation from season to season. There is also only slight variation in demand for the time-of-use periods (peak, partial-peak, and off-peak). This is because the building operating hours (6:00 a.m. to 6:00 p.m.) occur during portions of each of the time-of-use periods.

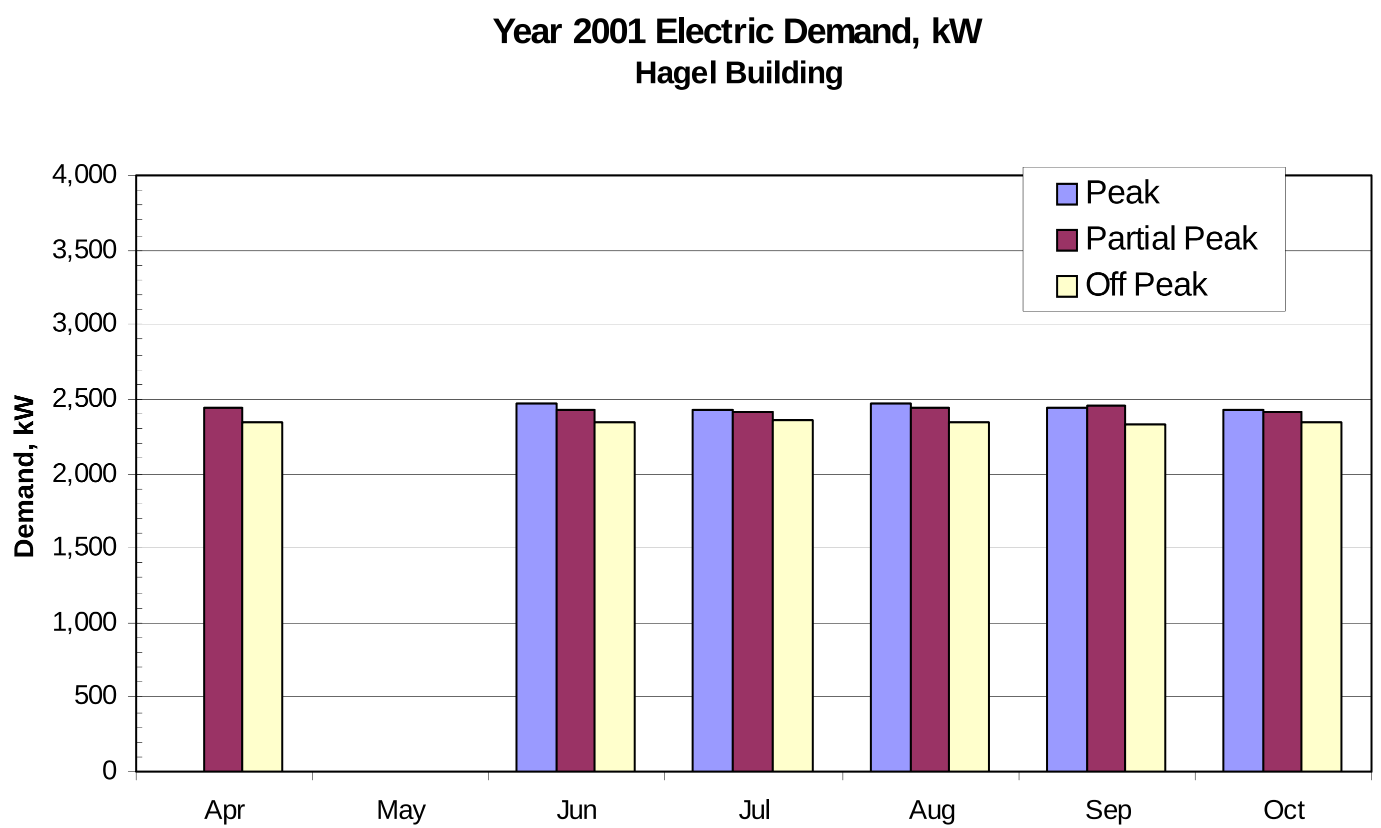
Figure 2 shows monthly use of electric energy (kWh). These profiles show only slight seasonal variations. There is a significant difference between the usage shown for most of the months for Year 2000 compared to Year 2001. This difference is due to problems with the billing meter during Year 2000. Therefore, Year 2001 was used for the baseline energy use.

Figure 3 shows hourly profiles of total electricity use for weekdays with varying peak daily outside air temperatures. Figure 4 shows electricity profiles on Sunday, when the building normally is not in use. These profiles show that scheduling controls are in place in the building to turn off most equipment at night and on Sundays. Hourly electricity use is consistent and shows slightly higher use on days with higher peak outside air temperatures.

Figure 5 shows a profile of electricity use by the chillers. The chillers are turned off at night and on Sundays. The profiles show significantly increased electricity use with increasing outside air temperature. A review of selected days showed that normally one chiller is operated during the day with two chillers operated on warm days (temperatures in the 70's or above).

Figure 6 shows the monthly use of natural gas for the Building Heat meter. This gas is primarily used in the steam boilers to produce hot water for space heating and domestic hot water. Natural gas is higher in the winter than in the summer. It is interesting to note that there is significant natural gas use even in the summer months with a minimum monthly use of about 6,000 therms. Our evaluation indicates that summer gas usage is primarily due to rehearing of ventilation air that has been de-humidified.

Figure 1



Note: Data unavailable for the month of May.

Figure 2

Electric Energy Use, kWh

Hagel Building

Billing Days Normalized to 30-Day Month

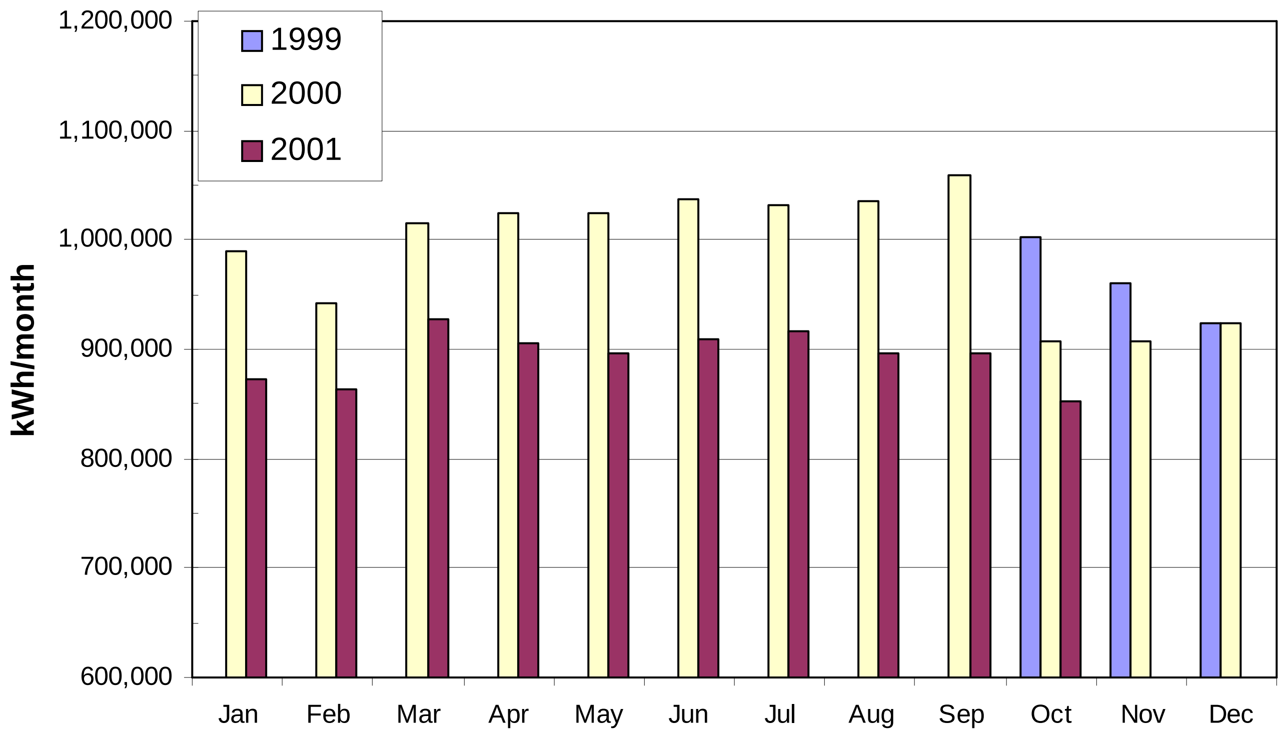


Figure 3

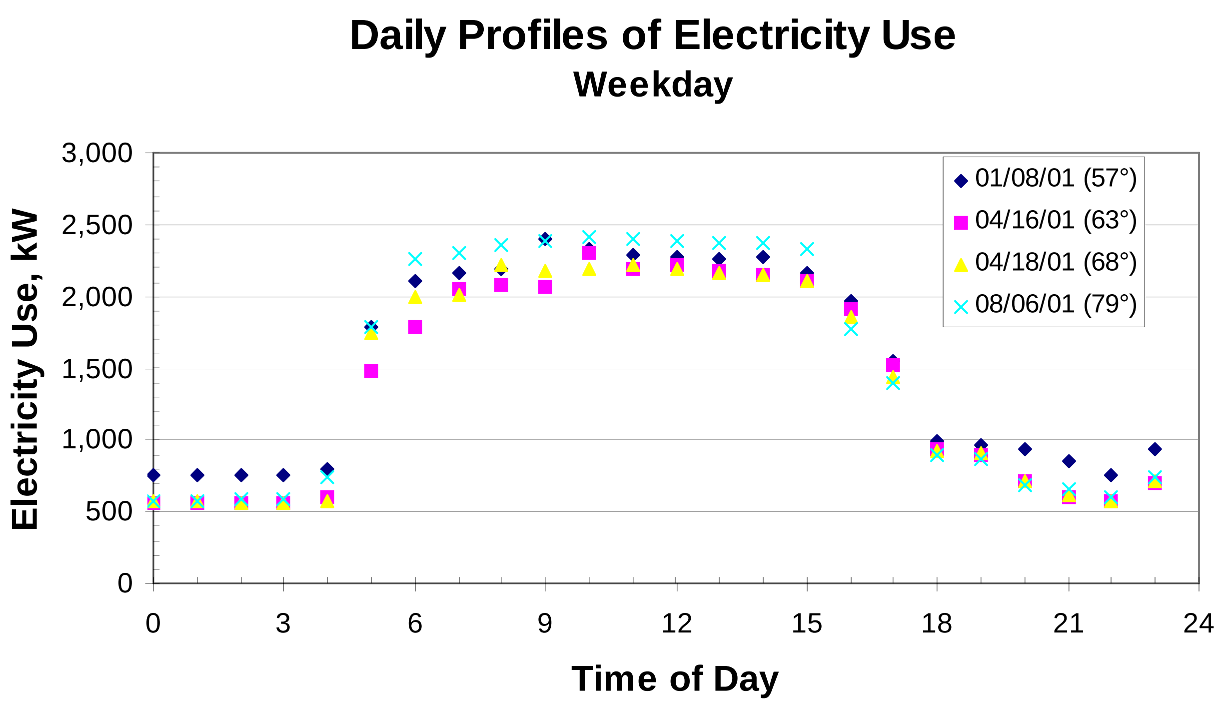

Daily Profiles of Electricity Use
Weekday
Electricity Use, kW
Time of Day
3,000
2,500
2,000
1,500
1,000
500
0
0
3
6
9
12
15
18
21
24
01/08/01 (57°)
04/16/01 (63°)
04/18/01 (68°)
08/06/01 (79°)

Figure 4

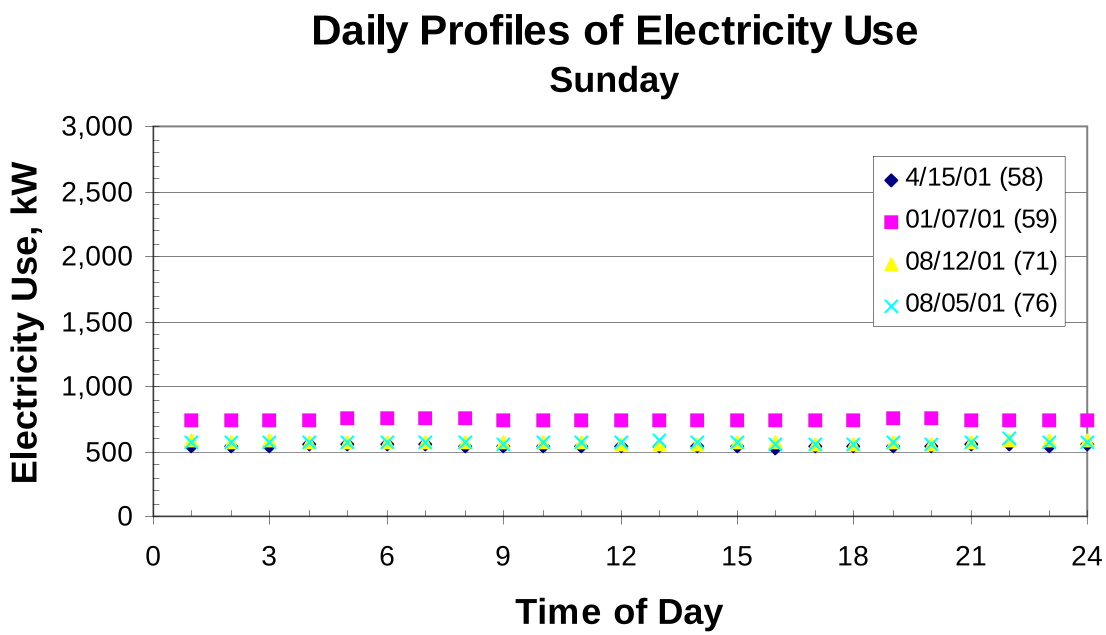

Daily Profiles of Electricity Use
Sunday
Electricity Use, kW
3,000
2,500
2,000
1,500
1,000
500
0
0
3
6
9
12
15
18
21
24
Time of Day
4/15/01 (58)
01/07/01 (59)
08/12/01 (71)
08/05/01 (76)

Figure 5

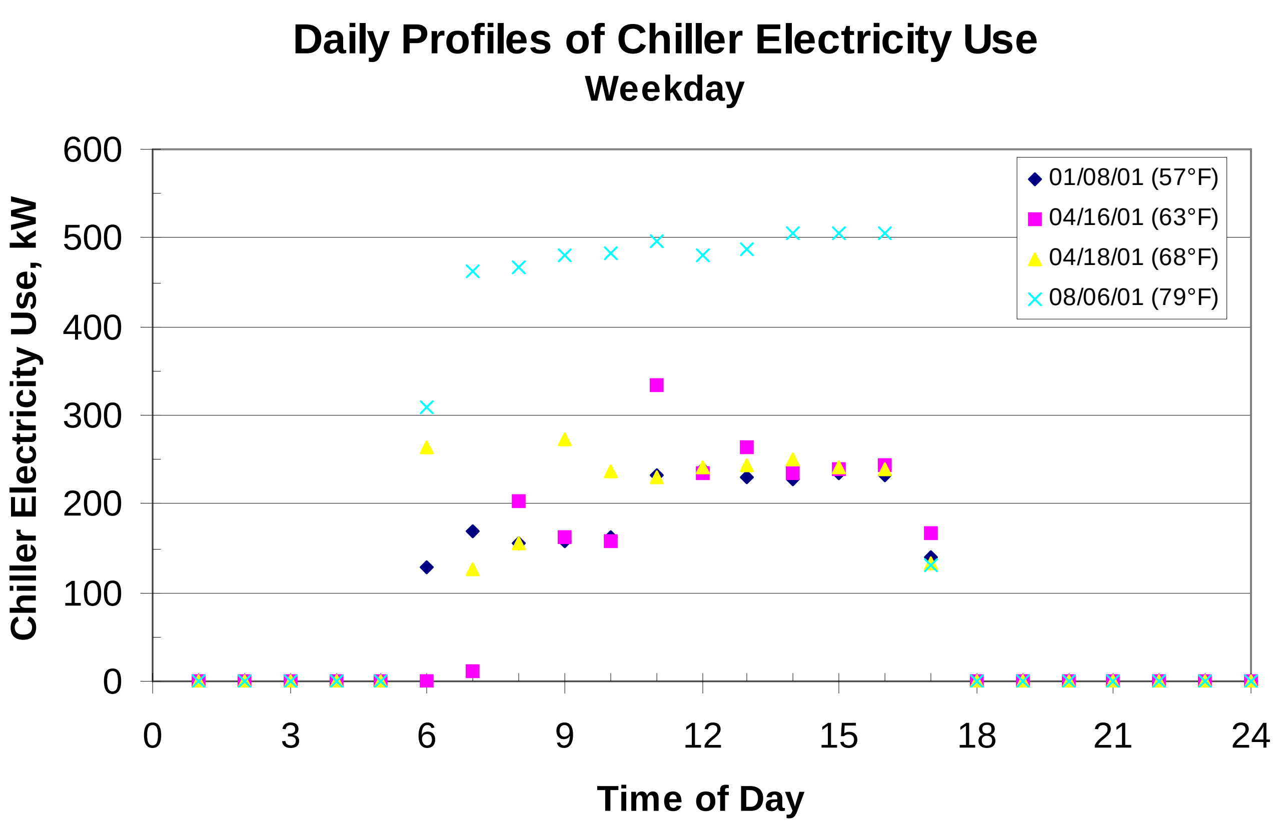
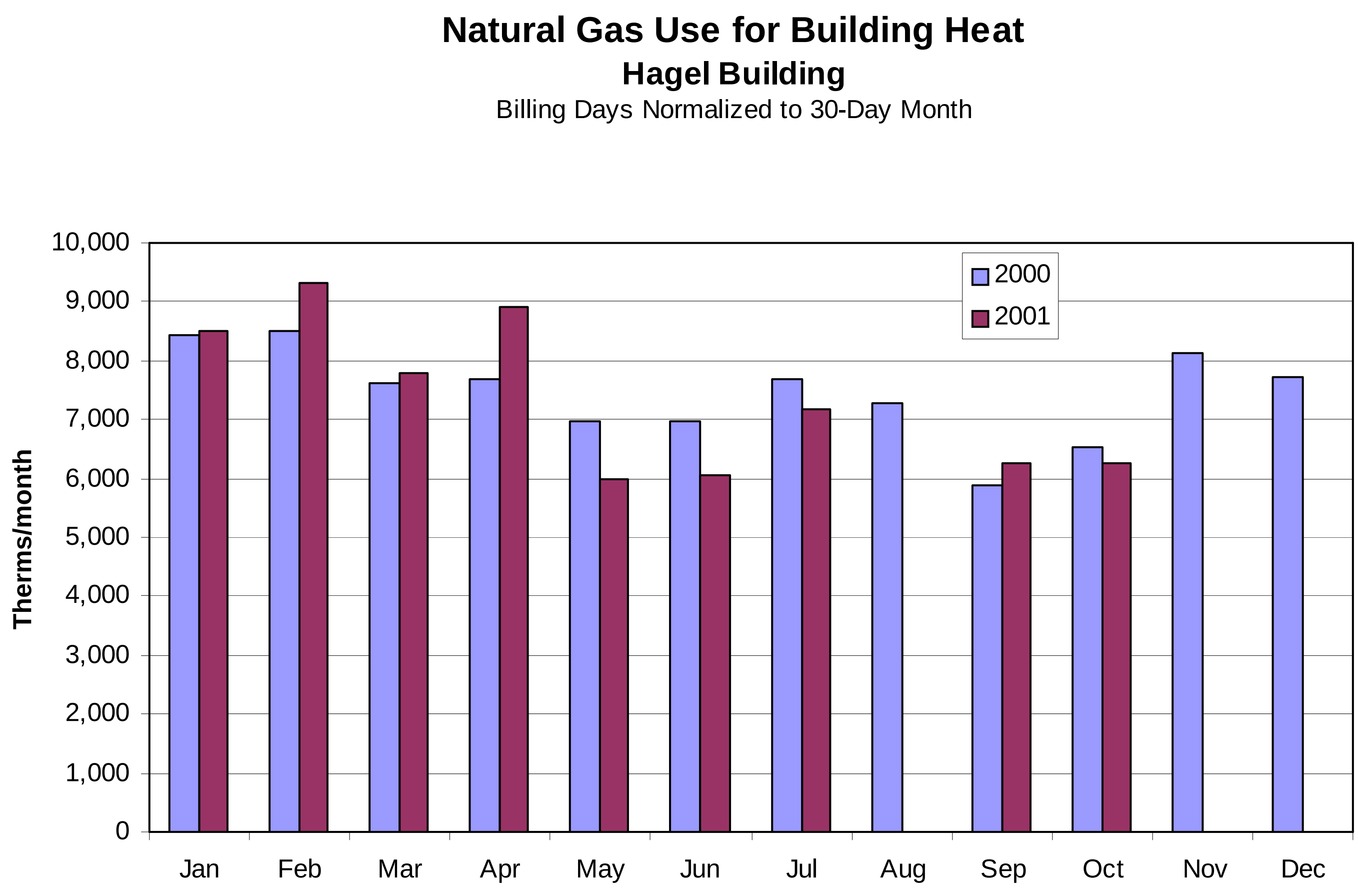

Daily Profiles of Chiller Electricity Use
Weekday
Chiller Electricity Use, kW
Time of Day
0
100
200
300
400
500
600
0
3
6
9
12
15
18
21
24
01/08/01 (57°F)
04/16/01 (63°F)
04/18/01 (68°F)
08/06/01 (79°F)

Figure 6


Natural Gas Use for Building Heat
Hagel Building
Billing Days Normalized to 30-Day Month
Therms/month
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2001
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Heating, Ventilating, and Air Conditioning (HVAC) Equipment

The building has a sophisticated HVAC system. This system includes glycol chillers to produce very cold water for dehumidification of ventilation air introduced into the building. Some of the air handlers are equipped with enthalpy wheels and run-around coils to recover energy from the building exhaust air. The building has a sophisticated digital energy management control system to monitor space temperature and humidity and to control the temperature, humidity, and flow rate of conditioned air supplied to the spaces.

Cooling and heating of most areas of the building is provided by a central plant using chilled water produced by water-cooled electric chillers, and hot water for space heating and domestic hot water provided by two steam boilers. Cooled or heated air is supplied to building areas by air handling units (AHUs). Four major air handlers (AHU 1 – 4) serve the core (inside) areas of Floors 1 – 6, two air handlers (AHU 7 and AHU 8) serve the perimeter areas of Floors 1 – 6, and a single air handler serves the basement (AHU 9). Separate air handlers serve corridor and lobby areas on the first floor, auditorium, cafeteria, 2nd floor computer room, and fitness center. A list of the major equipment is included in Appendix D.

There are four electric centrifugal chillers in the central plant. Two are conventional chillers that produce chilled water at a nominal temperature of 42°F. The other two chillers use glycol and produce a nominal chilled water temperature of 32 °F. Design characteristics of the chillers are included in Appendix E.

The glycol chillers are used to supply very cold water ("ice water") to air handlers AHU 1 – 4 for dehumidification of the building ventilation air. The conventional water chillers are used for cooling of the other air handlers and air conditioning equipment.

AHU 1 through 4 serve the core areas of floors 1 through 6. Figure 7 shows a diagram of one of these air handlers. The air handlers supply 100% outside air to fan-powered terminal boxes located throughout the conditioned spaces. Each of the air handlers are equipped with filters, an enthalpy energy recovery wheel, heating coil, cooling coil, and a run-around coil. The operation of the enthalpy wheel is controlled by the energy management system based on the relative temperature and humidity of the outside air, supply air, and building exhaust air.

The heating coils in the air core handlers are normally used only for building warm-up when the building is not occupied. During normal building-occupied operation, the incoming outside air is cooled by the cooling coils. The nominal set point is 55°F leaving the coil for non-dehumidification operating mode or 45°F for humidification mode. The cooled, dehumidified supply air can then be reheated by the run-around coil, which transfers heat from the return air to the supply air.

Figure 7

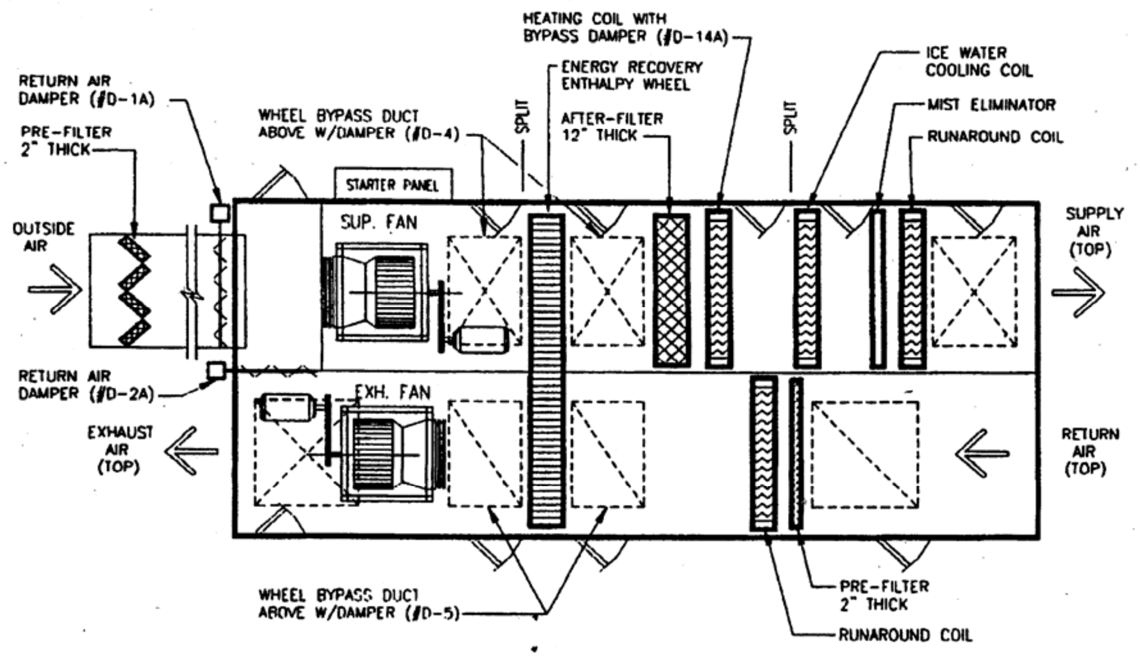


FIGURE 1.2-5 INTERIOR SYSTEM PRIMARY AIR HANDLING UNIT CONFIGURATION

Air from the air handlers is distributed to the building through fan-powered terminal boxes located in the building zones. Figure 8 shows diagram of a terminal box. They mix the supply air from the air handlers, referred to as "primary air" with recirculated air that is drawn into the terminal box from the ceiling plenum above the space. Some of the terminal boxes are equipped with cooling coils to cool the return air for supplemental cooling and are designated as "air-water" boxes. Chilled water is supplied to the terminal coils at a relatively high temperature (50 to 55°F) to avoid condensation of moisture on the coils. Terminal boxes without cooling coils are designated as "all-air" boxes. Some of the boxes also are equipped with electric strip heaters to reheat the air supplied to the spaces if needed to maintain the space temperature. All of the boxes on the 6th floor have electric heaters.

Figure 8

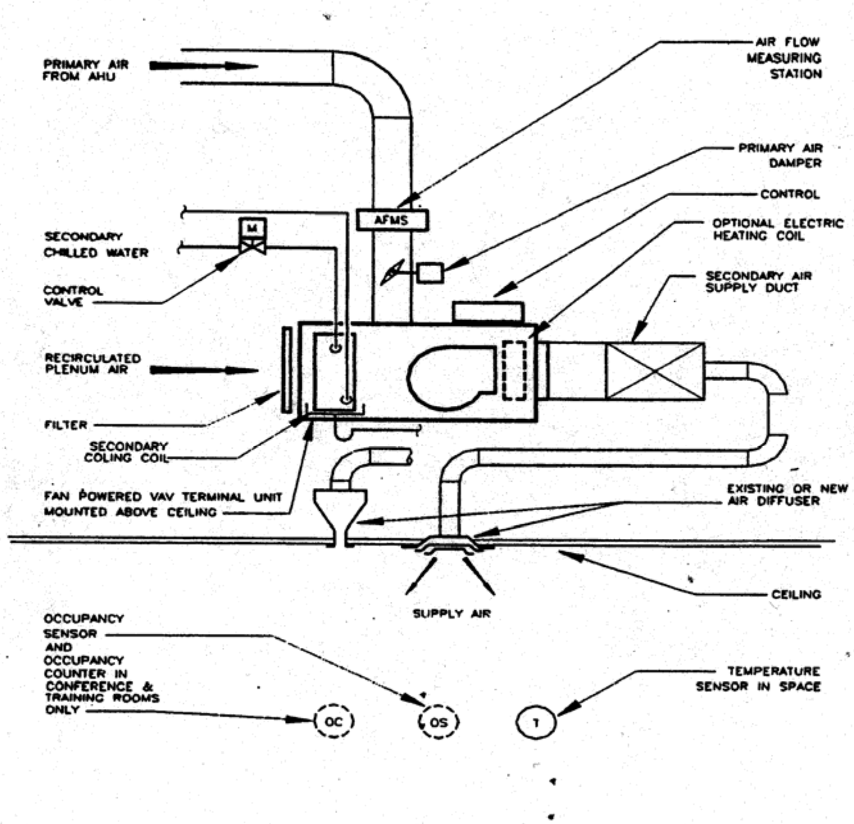


FIGURE 1.2-4 AIR/WATER TERMINAL UNIT CONFIGURATION FOR CONFERENCE OR TRAINING ROOMS

The basement is served by a single air handler, AHU 9. This air handler provides primary air that is 100% outside air. However, AHU 9 is not equipped with an enthalpy wheel or run-around coil. The basement is equipped with fan-powered terminal boxes, all of which are "all-air" type (no supplemental cooling coil). As with AHU 1 – 4, these terminal boxes mix primary air from the air handler with recirculated air at the terminal box. All of the basement terminal boxes are equipped with electric heaters to reheat the supply air as needed.

Air handlers AHU 7 and AHU 8 serve the perimeter areas of Floors 1 through 6. These air handlers are equipped with constant speed fans and supply a mixture of outside air and return air or 100% outside air depending on outside air conditions. The air handlers provide primary air to two-pipe fan coil units located around the perimeter of the building. The primary air is mixed with return air drawn into the fan coil unit. The mixed air is then passed over a single coil for heating or cooling. Space temperatures are controlled by the water control valve on the coil.

HVAC Operation
The HVAC system is controlled by a computer-based direct digital control (DDC) energy management system (EMS). The EMS allows detailed monitoring and control of the operation of the equipment including on/off scheduling, staging of chillers and pumps, control of chilled and hot water supply temperatures, supply air temperatures, etc.

Because the Hagel Building is located in an area with relatively high humidity, a key function of the HVAC system is to control humidity as well as air temperature. The air handlers provide ventilation air that is 100% outside air. This "primary air" can be cooled to as low as 40°F for dehumidification. Primary air is then supplied to terminal boxes for distribution throughout the building. The terminal boxes mix the primary air from the air handlers with recirculated room air. Temperature control in the space is achieved by varying the amount of primary air that is supplied to the terminal box. The energy management system maintains a minimum flow of primary air to each space from the air handler for (outside air) ventilation. Boxes in locations subject to over-cooling at the minimum primary set point are supplied with electric heaters to reheat the supply air from the boxes.

On/Off Scheduling
The building is normally open from 5:30 a.m. to 6:00 p.m., Monday through Saturday. Major equipment including chillers, pumps, air handlers, and non-emergency lighting is turned off by the EMS when the building is not occupied.

Humidity Control
Control of the humidity in the building is achieved by cooling the air passing through the air handlers to a very low temperature. Sensors are used to measure the temperature and humidity, and to calculate the enthalpy of the outside air, the supply air, and return air from the building areas. If the enthalpy of the outside air is less than 21.6 Btu/lb (enthalpy of 40°F dew point), chilled water is supplied to the air handlers by the chilled water chillers at a temperature of 42°F to produce a supply air temperature leaving the cooling coil of 55°F. If the enthalpy of the outside air is greater than 21.6 Btu/lb, the chiller system operates in "dehumidification" mode to achieve additional dehumidification. Chilled water is supplied by the glycol chillers at a temperature of 32°F

to produce a supply air temperature leaving the cooling coil of 45°F. This supply air temperature is then reheated to about 52°F by the run-around coil, strip heaters, or hot water coils.

Outside Air Ventilation

The outside air supplied to the building spaces specified in the *User Manual* is based on a minimum ventilation rate of 20 cfm per person and 0.2 cfm/ft^2 for office areas and 0.1 cfm/ft^2 for other areas. The design minimum outside airflow rate for the entire building was estimated based on the building areas described in the *User Manual*. Results are shown in Appendix F. The estimated outside airflow rate is 75,000 cfm for the entire building. Based on a ventilation rate of 20 cfm/person, this would correspond to a maximum building occupancy of 3,750 people.

More detailed analysis using available design data was performed on air handlers AHU 1–4 (serving the building core) and air handler AHU 9 (serving the basement). The results of this analysis are included in Appendix F. AHU 1–4 serve a total area of 262,175 ft2. The design minimum outside air for these air handlers is 53,107 cfm, which corresponds to a building occupancy of 2,655 for the building core areas. The minimum outside air ventilation rate can be reduced based on occupancy of 200 ft2 per person (50% of occupant load factor specified for emergency exit requirements). The allowable number of occupants would be 1,311 with a minimum outside airflow of 26,218 cfm. This represents a reduction in the design outside airflow rate of a factor of 2.

Similarly, AHU 9 serves an area of 56,590 ft2 with a design minimum outside air flow rate of 11,320 cfm. The revised occupancy based on 200 ft2/person is 283 people with a minimum outside airflow of 5,659 cfm. This also represents a reduction in the design minimum outside air by a factor of 2.

Based on the above analysis, the minimum outside airflow for the building can be reduced by a factor of 2. For the entire building, this would correspond to an outside airflow of about 37,000 cfm and a maximum building occupancy of 1,850 based on 20 cfm/person.

Reducing the minimum outside air can provide energy savings due to both decreased fan power and reduced cooling or heating. The most significant energy savings are available in building areas that are subject to over-cooling. For example, many areas of the basement are over-cooled even with primary air from the air handler reduced to the minimum set point. Some terminal boxes are equipped with electric heaters to reheat the supply air to the areas to alleviate this over-cooling. Reducing the minimum primary (outside) air supplied to these areas will reduce primary air cooling and subsequent supply air reheating. Because the air handler supply and return fans are equipped with variable frequency drives (VFDs), fan energy savings can be realized as well.

Control of Space Temperatures

Unlike many HVAC systems that condition building return air through the air handlers, the air handlers serving the basement and building core areas of the building only condition outside ventilation air. Recirculated air is processed through the terminal boxes located in the building spaces. The intent of this system is for the air handlers to process a smaller volume of air compared to a typical system, and to meet the cooling demand by cooling this smaller volume of air to a lower temperature than in a typical system (e.g. 49° vs. 55°F in a typical system). Cooling of each space in the building is controlled by a damper in the primary air supply duct to each terminal box. If the box is equipped with a cooling coil, additional cooling can be provided at the box. If the box is equipped with an electric heater, the supply air from the box can be reheated if needed to control the space temperature.

A brief review of the HVAC operation during SES' site visit on April 23 and April 24, 2002 indicated the following:

1. Most of the electric heaters in the basement terminal boxes show significant operating time indicating that the spaces are receiving too much cooling from the primary air supplied by the air handler. Primary air to these boxes is typically being controlled to the minimum air set point. Outside air ventilation supplied to the basement is higher than needed based on the current building occupancy. Reducing the minimum airflow set point of the primary air to each box can reduce the over-cooling. This will provide significant energy savings due to reduced air handler supply and return fan power, cooling of outside air, and electric reheating. Over-cooling can also be reduced by resetting the primary air temperature to a higher temperature, but this would reduce dehumidification of the outside air.

2. Terminal boxes served by AHU 1 – 4 show less electric reheating. Most of these boxes have primary air flow rates that are above the minimum set point indicating that the cooling demand is being maintained by the primary air. Lowering the minimum primary air set point for these boxes will not be effective because the primary air is needed for cooling. The air handlers serving these boxes use the run-around coil to reheat the primary air from about 46°F to 52°F. Rather than reheating the primary air, it would be preferable to supply the colder primary air to the terminal boxes. This will allow the amount of primary air to be reduced, resulting in lower fan power and lower cooling of outside air. Alternately, the temperature of the chilled water provided to the terminal cooling coils could be lowered to increase cooling capacity. This would introduce the potential for condensation of moisture on the coils in the terminal boxes.

A summary of findings of the terminal box primary airflow rates and electric heater operation is included in Appendix G.

SECTION 1.0: ECM DESCRIPTIONS & PROJECTED ENERGY SAVINGS

ECM No. 1: Convert from Secondary to Primary Electrical Service

The Hagel Building currently obtains electrical service from PG&E under the E-20 S rate schedule. This is a time of use rate for secondary (480V) service. The proposed ECM involves converting the electrical service to primary service under the E-20 rate (E-20 P). The facility will receive electrical service at the primary voltage of 12,000V. There are two PG&E-owned transformers located in the basement of the building that reduce the voltage from 12,000 V to 480 V. The electric billing meters are located on the secondary side (downstream) of the transformers.

With primary service, the facility will be responsible for the transformers and the billing meters will be located on the primary side (upstream) of the transformers. SES proposes to install new transformers as part of this ECM. This will alleviate concerns regarding the remaining lifetime of the existing transformers and will reduce energy losses from the transformers due to the higher efficiency of the new transformers. Under primary service, the meters are located prior to the transformers and the transformer losses are included in the electric bill. This provides additional incentive to install new high efficiency transformers.

The estimated savings associated with this ECM are as follows:

Electricity cost: $112,479.

Calculations of the energy cost savings are included following this ECM description. The calculations include the addition of the transformer losses that are not included in the electric bill with the current secondary service but that will be included with primary service. With the installation of new high efficiency transformers, there will be an overall reduction in energy consumption due to reduced transformer losses, although the savings will be realized by PG&E. These savings are estimated to be:

Electricity demand savings: 38 kW,
Electricity energy savings: 164,370 kWh/yr.

Electric Utility Bills
Convert from Secondary to Primary Electric Service

Assumptions:

Existing Transformer Efficiency:	97.00%
New Transformer Efficiency	98.50%

Service Dates		Billing Days	Data from Monthly Electric Bills, Meter After Transformer: Demand, kW Peak	Partial Peak	Off Peak	Energy, kWh Peak	Partial Peak	Off Peak	Total	Electricity Use with New Transformer, Meter Before Transformer: Demand, kW Peak	Partial Peak	Off Peak	Energy, kWh Peak	Partial Peak	Off Peak	Total
06/04/01	07/04/01	30	2,473	2,425	2,340	259,064	225,431	424,501	908,996	2,511	2,462	2,376	263,009	228,864	430,965	922,839
07/04/01	08/02/01	29	2,426	2,409	2,355	257,003	220,668	408,546	886,217	2,463	2,446	2,391	260,917	224,028	414,768	899,713
08/02/01	09/03/01	32	2,472	2,438	2,350	259,019	221,743	475,026	955,788	2,510	2,475	2,386	262,963	225,120	482,260	970,343
09/03/01	10/02/01	29	2,442	2,452	2,334	253,660	220,762	391,312	865,734	2,479	2,489	2,370	257,523	224,124	397,271	878,918
10/02/01	10/31/01	29	2,422	2,415	2,348	250,637	216,009	357,817	824,463	2,459	2,452	2,384	254,454	219,298	363,266	837,018
02/03/02	03/05/02	30		2,406	2,261		460,248	392,063	852,311		2,443	2,295		467,257	398,034	865,290
03/05/02	04/03/02	29		2,415	2,301		468,460	392,680	861,140		2,452	2,336		475,594	398,660	874,254
Average Summer Month, kWh/yr:									888,240							901,766
Average Winter Month, kWh/yr:									856,726							869,772
Typical Annual, kWh/yr:									10,469,791							10,629,229

Service Dates		Electricity Cost, E-20S Rate: Demand, kW Peak	Partial Peak	Maximum Demand	Energy, kWh Peak	Partial Peak	Off Peak	Total	Electricity Cost, E-20P Rate: Demand, kW Peak	Partial Peak	Maximum Demand	Energy, kWh Peak	Partial Peak	Off Peak	Total	Savings E-20 P vs. E-20 S $/month
06/04/01	07/04/01	$33,015	$8,973	$6,306	$47,686	$22,124	$38,498	$156,601	$29,626	$6,524	$6,402	$41,842	$20,451	$37,718	$142,564	$14,037
07/04/01	08/02/01	$32,387	$8,913	$6,186	$47,307	$21,656	$37,051	$153,501	$29,063	$6,481	$6,281	$41,509	$20,019	$36,300	$139,653	$13,847
08/02/01	09/03/01	$33,001	$9,021	$6,304	$47,678	$21,762	$43,080	$160,845	$29,614	$6,559	$6,400	$41,835	$20,117	$42,207	$146,731	$14,114
09/03/01	10/02/01	$32,601	$9,072	$6,227	$46,691	$21,666	$35,488	$151,745	$29,254	$6,597	$6,322	$40,969	$20,028	$34,769	$137,939	$13,806
10/02/01	10/31/01	$32,334	$8,936	$6,176	$46,135	$21,199	$32,450	$147,230	$29,015	$6,497	$6,270	$40,481	$19,597	$31,793	$133,653	$13,577
02/03/02	03/05/02		$8,782	$6,135		$47,824	$35,474	$98,215		$6,473	$6,229		$45,506	$35,162	$93,370	$4,845
03/05/02	04/03/02		$8,815	$6,158		$48,678	$35,530	$99,180		$6,497	$6,252		$46,318	$35,218	$94,285	$4,895
Average Summer, $/month:								$153,984							$140,108	$13,876
Average Winter, $/month:								$98,698							$93,828	$4,870
Estimated Annual, $/yr:								$1,516,093							$1,403,614	$112,479

Overall Energy Savings with New Transformer

	Monthly Peak Demand kW	Annual Electricity Use kWh/yr
Current Bill (Meter Before Transformer):	2,400	10,469,791
Current Electricity Use Including Transformer Losses:	2,474	10,793,599
Electricity Use with New Transformer Including Transformer Losses:	2,437	10,629,229
Overall Energy Savings with New Transformer:	38	164,370

Utility: Pacific Gas & Electric (PG&E)
Electric Rate: E-20 S, Demands of 1,000 kW or >(Secondary)

Energy Cost

	On-Peak	Partial-Peak	Off-Peak
Summer			
Energy Rate, $/kWh:	$0.18407	$0.09814	$0.09069
Winter			
Energy Rate, $/kWh:	$0	$0.10391	$0.09048

Demand Cost

	Demand Charge $/kW	Applicable Time mos/yr
Summer Peak-Period	$13.35	6
Summer Part-Peak Period	$3.70	6
Winter Part-Peak Period	$3.65	6
Summer Maximum Demand	$2.55	6
Winter Maximum Demand	$2.55	6

Utility: Pacific Gas & Electric (PG&E)
Electric Rate: E-20 P, Demands of 1,000 kW or >(PRIMARY)

Energy Cost

	On-Peak	Partial-Peak	Off-Peak
Summer			
Energy Rate, $/kWh:	$0.15909	$0.08936	$0.08752
Winter			
Energy Rate, $/kWh:	$0	$0.09739	$0.08834

Demand Cost

	Demand Charge $/kW	Applicable Time mos/yr
Summer Peak-Period	$11.80	6
Summer Part-Peak Period	$2.65	6
Winter Part-Peak Period	$2.65	6
Summer Maximum Demand	$2.55	6
Winter Maximum Demand	$2.55	6

ECM No. 2: Distributed Generation Using Natural Gas Engine with Waste Heat Recovery

The Hagel Building has an electrical demand in the range of 2,000 to 2,500 kW during building operating hours. At night and on Sundays, this demand decreases to about 500 kW. A limiting factor for a natural gas-fired distributed generation system (gas turbine or natural gas engine) is the utilization of the waste heat. Effective use of the waste heat is necessary for the system to be cost-effective. In addition, the California Public Utilities Commission is offering a 30% incentive for distributed generation systems through PG&E. The system must achieve a minimum overall efficiency of 42.5% to qualify for the incentive. Meeting the required efficiency requires effective utilization of the waste heat from turbine or engine generators. Potential uses for the waste heat include hot water heating for space heating and domestic hot water, or using the waste heat in an absorber to generate chilled water.

A number of configurations of distributed generation systems were evaluated for the Hagel Building. These configurations included combinations of the following technologies:

- Natural Gas Engine Distributed Generation,
- Gas Turbine Distributed Generation,
- Thermal Energy Storage (TES),
- Hot Water Generation Using Waste Heat,
- Absorber to Produce Chilled Water from Waste Heat.

SES performed an energy and economic evaluation of these combinations. The most cost-effective configuration was selected. The proposed distributed generation system involves the installation of a nominal 500 kW natural gas-fired reciprocating engine with waste heat recovery to produce hot water for building space heating and domestic hot water.

A distributed generation system larger than the minimum load of about 500 kW will generate more waste heat than can be utilized in the building. The proposed system is based on operating the 500 kW engine during building operating hours (12 hours per day, 300 days per year) and using the engine jacket water to produce hot water for space heating and domestic hot water. Operating the engine at night and on Sundays would only provide a slight savings compared to PG&E off-peak electric rates and would produce more waste heat than could be utilized to produce hot water.

An engine is proposed rather than a gas turbine due to the following:

- Engines are less costly than gas turbines in the 500 kW size range, and
- Engines in the 500 kW size range have a higher electrical generating efficiency and produce less waste heat compared to gas turbines.

The size of the engine has been limited to about 500 kW because larger engines will produce more waste heat than can be utilized by the building. Excess waste heat from a larger engine could be used in an absorber to produce chilled water. However, the building has excess chilled water capacity and the cost of installing an absorber does not provide enough additional savings to be attractive. Also, because the building electrical demand is only 500 kW during off-hours, it would necessary to start-up and shut-down an absorber on a daily basis, complicating the operation and maintenance of the system.

Thermal energy storage (TES) also was considered in combination with the distributed generation system or alone. To avoid peak electric demand charges during the summer, a nominal ice storage capacity of 5,000 ton-hours would be required. The largest standard ice storage modules have a capacity of about 570 ton-hours with dimensions of 22.6 ft. long x 7.4 ft. wide x 8.5 ft. high. Space for nine of these modules is not available in the central plant area without filling nearly all available open space. A possible alternative would be to install the storage tanks at ground level in the vicinity of the cooling tower silos. Based on the estimated cost to install the ice storage tanks and associated piping, pumps, and controls, TES was determined to not be cost effective.

Energy cost savings associated with the proposed engine distributed generation system are as follows:

Purchased Electric Demand Savings:	500 kW,
Purchased Electric Energy Savings:	1,732,800 kWh/yr,
Increased Natural Gas Consumption:	141,385 Therms/yr,
Energy Cost Savings:	$171,712/year
Maintenance Cost Savings:	$10,000/year.

Calculations of the energy cost savings are included following this ECM description.

The savings in maintenance cost is an estimate of reduced boiler maintenance with the distributed operation system. The heat recovery from the distributed generation system will offset most of the steam required from the boilers. One boiler can be permanently shut down and the operation of the other boiler will be reduced, significantly reducing the maintenance cost.

Estimation of Energy Cost Savings with Distributed Generation

Utility:	**Pacific Gas & Electric (PG&E)**
Electric Rate:	**E-20P, (Primary)**

Energy Cost

	On-Peak	Partial-Peak	Off-Peak	Total hrs/yr
Summer				
Energy Rate, $/kWh:	$0.15909	$0.08936	$0.08752	
Operating Time, hrs/yr (6 days/wk, 50 wks/yr)	774	451.5	622.5	1,848
Winter				
Energy Rate, $/kWh:	$0	$0.09739	$0.08834	
Operating Time, hrs/yr (6 days/wk, 50 wks/yr)	0	1,187.5	612.5	1,800
Total Operating Time, hrs/yr:				3,648

Demand Cost

	Demand Charge $/kW	Applicable Time mos/yr
Summer Peak-Period	$11.80	6
Summer Part-Peak Period	$2.65	6
Winter Part-Peak Period	$2.65	6
Summer Maximum Demand	$2.55	6
Winter Maximum Demand	$2.55	6

Savings with Distributed Generation (Excluding Credit for Heat Recovery)
Cost of Electricity with Cogeneration, $/kWh: 0.0525

	Electric Energy, $/kWh		
	On-Peak	Partial-Peak	Off-Peak
Summer	$0.10659	$0.03686	$0.03502
Winter	N/A	$0.04489	$0.03584

Annual Savings with Distributed Generation (Excluding Credit for Heat Recovery)

Generation Capacity, kW:	500
Engine Availability, %	95%
Reduction in Purchased Electricity, kWh/yr:	1,732,800
Increased Consumption of Natural Gas, Therms/yr:	192,549

Energy Cost Savings

	On-Peak	Partial-Peak	Off-Peak	Total
Summer Electric Energy, $/yr:	$39,186	$7,904	$10,354	$57,444
Winter Electric Energy, $/yr:	N/A	$25,318	$10,426	$35,744
Summer Demand (5 Months Savings), $/yr:	$35,875	$6,625		$42,500
Winter Demand (5 Months Savings), $/yr:		$13,000		$13,000
Total Energy Cost Savings, $/yr:				$148,689

Assumes engine is down once per month during summer and during winter for maintenance.

Hagel Building
Engine Jacket Water Heat Recovery
Heat Recovery Used for Building Hot Water

Natural Gas Bill for "Building Heat"		
Minimum Monthly Gas Use, Therms/month:	5,828	(October, 2001)
Minimum Monthly Gas Use, Therms/day:	233	based on building operation of 6 days/week, 50 weeks/yr
Minimum Monthly Gas Use, MMBtu/day:	23.3	
Engine Jacket Water Heat Recovery, MMBtu/hr:	1.255	
Engine Jacket Water Heat Recovery, MMBtu/day (Based on 12 hrs/day):	15.1	
Engine Jacket Water Heat Recovery, Therms/day (Based on 12 hrs/day):	151	
Efficiency of Existing Boilers, %:	85%	
Cost of Natural Gas, $/Therm:	$0.45	
Natural Gas Savings with Engine Jacket Water Heat Recovery, Therms/hr:	14.76	
Annual Natural Gas Savings with Engine Heat Recovery (3648 hrs/yr x 95% availability), Therms/yr:	51,163	
Value of Fuel Savings with Engine Jacket Water Heat Recovery, $/yr:	$23,024	

Assumptions:
Natural gas use is primarily for hot water heating for space heat and domestic hot water.
Engine heat recovery will be used for space heating and domestic hot water.
Building can use all of heat recovered by engine.

Hagel Building
Engine Distributed Generation

Assumptions:

Nominal Capacity, kW:	500	
Nominal Electrical Efficiency, %:	34%	(Typical Engine Performance)
Jacket Heat Recovery, %:	25%	(Typical Engine Performance)
Stack Heat Recovery, %:	15%	(Typical Engine Performance)

Calculated Values:

Heat Rate, Btu/kWh LHV :	10,039
Heat Rate, Btu/kWh HHV:	11,112

CPUC Efficiency Based on Electric Efficiency (LHV) + 50% of Jacket Heat Recovery:
34% + 25%/2 = 46.5%

Engine Operating Cost

Engine Heat Rate, Btu/kWh HHV:	11,112
Engine Degradation Factor:	0.05
Cost of Natural Gas, $/Therm:	$0.45
Fuel Cost, $/kWh:	$0.0525

Energy Cost Savings

Electricity Generated by Engine, $/yr:	$148,689	(See calculations that follow)
Engine Jacket Hot Water Recovery, $/yr:	$23,024	(See calculations that follow)
Total Energy Cost Savings, $/yr:	$171,712	

Impact on Purchased Energy

Reduction in Purchased Electricity, kWh/yr:	1,732,800
Increased Consumption of Natural Gas, Therms/yr:	192,549
Annual Natural Gas Savings with Engine Heat Recovery, Therms/yr:	51,163
Net Increase in Natural Gas Consumption, Therms/yr:	141,385

ECM No. 3: Replace Griswold Flow Control Valves

The Recommissioning Assessment recently performed by Facility Dynamics Engineering noted that the terminal VAV boxes serving interior zones in the building have a Griswold automatic flow control valves installed upstream of each box as well as a modulating control valve installed downstream of the cooling coil in the box. The Griswold valve acts to maintain a constant flow of chilled water to the coil with the result that the two valves "fight" each other. As the control valve opens or closes to try to achieve the desired flow of chilled water, the Griswold valve does the opposite in an attempt to maintain the flow of chilled water at a constant value. The overall result is poor control of the chilled water flow to the terminal box coils. This poor control contributes to poor temperature control of the spaces and wastes energy through over-cooling and reheating, and excessive pumping energy.

The proposed ECM involves replacing the Griswold valves with circuit-setter valves. These valves will only act to control the maximum flow to each coil. Rebalancing of the chilled water loop serving the terminal boxes will also be performed.

Energy savings due to the improved control of the box cooling coils will be obtained by a reduction in pumping energy, chilled water cooling, and terminal box reheating. Estimating energy savings is difficult based on the limited operating data obtained during the site visit by SES. For the purposes of this Initial Proposal, energy savings have been estimated to be equal to the savings estimated for variable flow chilled water pumping for the ice water pumps. These are the pumps that serve air handlers AHU 1 – 4 that are equipped with the VAV terminal boxes. The estimated energy savings are as follows:

Electric Demand Savings:	0 kW,
Electric Energy Savings:	20,700 kWh/yr,
Energy cost savings:	$2,070/year.

Calculations of the energy savings are included following this ECM description.

Hagel Building
Convert Secondary Chilled Water Pumps to Variable Speed Drive
Calculated Savings Assumed to be Equal to Savings for Replacement of Griswold Valves

Annual System Operating Hours: 3,600

Pumps IWP-1 and IWP-2
Pump Load Profile **Pump Energy Use**

Pump Load	Annual Operating Time		Constant Speed			Variable Speed				Energy Savings kWh/yr
	IWP-1	IWP-2	kW	IWP-1 kWh	IWP-2 kWh	Power Input	kW	IWP-1 kWh	IWP-2 kWh	
30%	8.3%	0.0%	10.4	3,120	0	10.0%	1.0	312	0	
40%	14.8%	0.0%	10.4	5,522	0	13.0%	1.4	718	0	
50%	4.9%	0.0%	10.4	1,841	0	18.0%	1.9	331	0	
60%	0.0%	0.0%	10.4	0	0	26.0%	2.7	0	0	
70%	42.8%	0.0%	10.4	16,006	0	39.0%	4.1	6,242	0	
80%	10.7%	0.0%	10.4	3,994	0	56.0%	5.8	2,236	0	
90%	0.7%	0.0%	10.4	250	0	77.0%	8.0	192	0	
100%	0.0%	0.0%	10.4	0	0	105.0%	10.9	0	0	
Total	82.1%	0.0%	Total of Two Pumps		30,732				10,032	20,700

Assumed pump load profiles.

Average Cost of Electricity, $/kWh: $0.10
Energy Cost Savings, $/yr: $2,070

ECMs To Be Considered Further in Detailed Energy Study

Renovation of Elevators

The building is equipped with ten elevators manufactured by Haughton that are original equipment, for the most part. There are eight gearless traction passenger elevators and two geared traction freight elevators. These elevators use obsolete DC drive motor generators that are less efficient than current elevator equipment. The age of the elevators results in increased maintenance costs and availability of replacement parts is a problem.

This proposed ECM involves the renovation of the elevators. The energy savings based on the approach proposed by Schindler Elevator Company (the successor to Haughton) involves the following: Freight elevators will be converted to AC-Variable Frequency controls, which is the most efficient type of elevator control. The passenger elevators will be converted to SCR (silicon controlled rectifier) controls because AC-VF controls are not available for gearless traction elevators. The use of AC-VF controls on the passenger elevators would require the entire drive mechanism to be replaced.

Estimate energy savings are:

Electric Energy Savings:	118,750 kWh/yr
Energy Cost Savings:	$16,025/year

Calculations of energy savings follow this ECM description.

Preliminary Elevator Savings

<u>Conversion of Passenger Elevators from Motor-Generator Drive to SCR Drive</u>

Typical Elevator Savings, kWh/day (8 hr day):	31
Typical Elevator Savings, kWh/day (10 hr day):	39
Annual Savings Based on 250 days/year, kWh/yr:	9,688
Annual Savings for 8 Elevators, kWh/yr:	77,500
Cost Savings Based on $0.14/kWh (includes demand):	$10,850

<u>Conversion of Freight Elevators from Motor-Generator Drive to AC Variable Frequency Drive</u>

Typical Elevator Savings, kWh/day (8 hr day):	66
Typical Elevator Savings, kWh/day (10 hr day):	83
Annual Savings Based on 250 days/year, kWh/yr:	20,625
Annual Savings for 2 Elevators, kWh/yr:	41,250
Cost Savings Based on $0.14/kWh (includes demand):	$5,775

Total Estimated Savings:	48 kW
	118,750 kWh/yr
	$16,625 per year

nergy Solutions Resources

*pic: **"elevator"***

uestion:
ome elevators use "regenerative" motors. When the carriage goes down, the motor acts as a generator and pumps current ack into the electrical nework. This produces energy savings. What is the relative energy efficiency of alternative elevator rive mechanisms such as this?

nswer:
he following describes various types of elevators.

ow-rise buildings may use an elevator driven and supported by a telescoping jack powered by a hydraulic motor. These units perate at a low, fixed-speed, do not feature regenerative braking, and have a limited travel or lift of approximately 25-feet.

or a building with seven or fewer floors, a variation of the hydraulic elevator may be specified that features a constant speed ydraulic pump which imparts pressurized hydraulic fluid onto a hydraulic elevator drive motor. Varying the control valve etting provides the ability to vary the elevator speed. These hydraulic elevators are equipped with counterbalances, but do ot have regenerative braking. These units are often found in mid-rise facilities with "residential" usage characteristics, such s apartments, condominiums, or nursing homes.

igh-rise buildings are served by geared or gearless traction elevators. These elevators are driven by DC MG sets, silicon ontrolled rectified (SCR) DC motors, or variable voltage variable frequency (VVVF) drives coupled to AC motors. All of these onfigurations provide variable and high-speed operation and provide regeneration, but do exhibit different operating fficiencies.

over Elevators has calculated the average kWh required per day for a single elevator equipped with MG, SCR, and VVVF rives (see table below). Elevators with hydraulic drives would be expected to use about 25% more energy than the SCR rive. The average energy use values are given for elevators of various capacities, serving from 3 to 32 floors, and are based pon an 8-hour operating day and an elevator with a maximum full-load mass of 19,000 pounds.

Average Energy Consumption (kWh) Per Day

Number of Floors	2500 # Capacity			4000# Capacity		
	VVF	*SCR*	*MG*	*VVF*	*SCR*	*MG*
5	31	53	72	49	84	115
10	39	54	76	62	86	121
20	48	57	94	76	92	151
30	58	67	102	92	108	164

Vote: Average energy consumption values are based on 8 hours of elevator operation per day. If energy consumption for 10-ıour operation is desired, multiply the numbers in the table by 1.25

:n general, traction elevators, or elevators with regeneration capability, initially cost twice as much as hydraulic units, and are ypically found in office buildings with heights of 5 stories or greater.

1709 56732

Related Resources

Article(s) and Fact Sheet(s):

- ***An Overall Review of Advanced Elevator Technologies***
  An article from the June 1996 issue of Elevator World.
- ***Designing for Reduced Elevator Energy Cost***
  An article from the March 1996 issue of Elevator World.
- ***Lift Power Consumption***
  An article from the May 1996 issue of Elevator World.

NW Venture(s):

- ***Energy Ideas Clearinghouse (EIC) and EnergyIdeas.org***
  Information services for utilities, businesses, industries and governments. Web, hotline, listserv, technical assistance.

Organization(s):

- ***Conveyor Equipment Manufacturers Association (CEMA)***
  Professional Association for Conveyor Equipment Manufacturers (CEMA) - homepage

5 Resources

nergy Glossary - Terms and Definitions

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: updated Monday June 17 2002

ASHINGTON STATE UNIVERSITY ENERGY PROGRAM

NORTHWEST ENERGY EFFICIENCY ALLIANCE

Photovoltaic Distributed Generation

This ECM involves the installation of a photovoltaic generation system to be installed on the building. The size of the system has been selected to be 30 kW, which is the minimum size necessary to qualify for the Self-Generation Incentive Program offered by PG&E. This program provides an incentive of $4.50/watt.

The type of system will be the Powerlight Powerguard or a comparable system that can be installed on the roof of the building. This type of system is installed flat on the roof and thus avoids the need for structural members to support the photovoltaic panels. The panels will provide a degree of roof protection and increased insulation over the roof areas where the panels are installed. The system will be interconnected to the building electrical system (with appropriate metering and disconnects) and the electricity produced by the photovoltaic system will reduce electricity purchased from the utility. The power generated by the photovoltaic system is much less than the minimum consumed by the building, so no power will be back-fed to the utility system.

Energy savings are conservatively based on savings of electric energy only, excluding any demand savings. Estimated savings are as follows:

Electric Demand Savings:	0 kW,
Electric Energy Savings:	47,586 kWh/yr,
Energy cost savings:	$4,759/year.

Calculations of the energy savings are included following this ECM description.

Chilled Water System Optimization

Due to the complexity of the chilled water system, it is expected that additional savings opportunities can be identified with more detailed assessment of the system. For example, it appears from the limited operating data obtained by SES that the chiller cooling capacity available from the four chillers is considerably more that the building cooling demand. During much of the year, the cooling load can be met by a single chiller. Chilled water to the interior air handlers, AHU 1, 2, 3, and 4, can only be supplied by the glycol chillers. If only one glycol chiller is operating, the cooling demand for the other building loads is also satisfied by the glycol chiller through heat exchangers PHE 3, 4, and 5. Modifications to improve the efficiency or minimize the use of the glycol chillers can provide significant energy savings.

Additional measures that can be considered in a Detailed Study to optimize system operation and reduce energy use include modification of the chilled water piping to allow the chilled water chillers to supply air handlers AHU 1-4, the application of a variable frequency drive to one of the glycol chillers, the use of a small ice storage system to minimize glycol chiller operation during days with low cooling loads, and improved control of the chilled water pumping to maintain chilled water temperature differentials near design conditions. Optimization and balancing of the various chilled water loops is expected to provide a significant reduction in power used by the chilled water pumps beyond that achieved only by implementation of variable flow.

A Performance Calculator for Grid-Connected PV Systems

PVWATTS calculates electrical energy produced by a grid-connected photovoltaic (PV) system. Currently, PVWATTS can be used for locations within the United States and its territories. Researchers at the National Renewable Energy Laboratory developed PVWATTS to permit non-experts to quickly obtain performance estimates for grid-connected PV systems.

In a grid-connected PV system, PV modules, wired together to form a PV array, pass DC electricity through an inverter to convert it into AC power. If the PV system AC power is greater than the owner's needs, the inverter sends the surplus to the utility grid for use by others. The utility provides AC power to the owner at night and during times when the owner's requirements exceed the capability of the PV system.

- **More About PVWATTS**
- **System Parameters**
- **Interpreting the Results**
- **How Photovoltaics Work**
- **PV Manufacturers**
- **Consumer's Guides**
- **Financial Incentives and Programs**
- **Net Metering Information**

Two Calculators:

Choose a calculator by clicking on "Version 1" or Version 2".

AC Energy and Cost Savings

Station Identification	
City	San Francisco
State:	CA
Latitude:	37.62 ° N
Longitude:	122.38 ° W
Elevation:	5 m
PV System Specifications	
AC Rating:	30.0 kW
Array Type:	Fixed Tilt
Array Tilt :	0.0 °
Array Azimuth:	180.0 °
Energy Specifications	
Cost of Electricity:	10.0 ¢/kWh

Energy Production		
Month	Energy (kWh)	Energy Value ($)
1	1783	178.30
2	2428	242.80
3	3609	360.90
4	4785	478.50
5	5822	582.20
6	5963	596.30
7	6449	644.90
8	5549	554.90
9	4509	450.90
10	3213	321.30
11	1935	193.50
12	1542	154.20
Year	47586	4758.60

Interpreting the Results

- **Run PVWATTS v.1 for another location**
- **Run PVWATTS v.2**

Pl send questions and comments regarding PVWATTS to rredc@nrel.gov

Recommended ECMs To Be Performed by Others

It is our understanding that the following measures will be incorporated as part of the Recommissioning Project being performed separately from this ESPC:

Reduce Primary (Outside) Air Flow
Air handlers 1, 2, 3, 4, and 9 supply 100% outside air as primary air to the areas of the buildings served by these air handlers. Based on current building occupancy, the outside air ventilation rate is at least 2 times the amount necessary. SES' recommendation is to reset the building controls to reduce the minimum outside airflow rate by an overall factor of 2. As part of this ECM, the occupancy of building zones served by each air handler terminal should be reviewed to determine the proper outside air rate. Minimum airflow settings can then be established for each zone.

Reducing the primary air set point will only affect the operation of the system when a zone is calling for minimum airflow, typically when there is minimal demand for cooling. If additional primary air is called for to meet the zone cooling load, the system will operate as it does now.

Energy savings will be achieved when outside air is reduced to zones that are being over-cooled. This will provide savings due to reduced air handler supply and return fan power, reduced cooling energy necessary to cool and dehumidify the outside air, and reduced electric reheating at the terminal units. Ability to meet cooling demand, heating demand, and supplying adequate outside ventilation air will not be affected.

Estimated energy savings are based only on savings from reduced electric reheating at the terminal units, which is conservative. The estimated savings are as follows:

Electric demand savings:	0 kW,
Electric energy savings:	180,018 kW/yr,
Energy cost savings:	$18,002/year.

Calculations of the energy savings follow.

Variable Speed Chilled Water Pumping
The chilled water pumping system at the Hagel Building is configured as a primary/secondary system. Primary pumps provide a constant flow of chilled water through the evaporator section of the chillers. Secondary chilled water pumps circulate chilled water through the cooling loops to the air handlers and fan coil units. Pumps CHP-1, 2, and 3 are the primary pumps for the chilled water chillers. Pumps GWP-1, 2, and 3 are the primary pumps for the glycol chillers.

Secondary chilled water pumps CHP 4, 5, and 6 supply chilled water from the chilled water chillers to air handlers AHU 5, 6, 7, 8, 9, 11, and 12. They also supply chilled water to the interior terminal boxes through heat exchanger PHE-2 and secondary chilled water pumps SCWP 1, 2, and 3.

Secondary pumps P-9A and P-9B supply chilled water to the fan coil units serving the north and south perimeter zones, respectively.

Hagel Building
Estimated Energy Savings
Reduce Electric Reheat at Terminals by Reducing Minimum Primary Air Setpoint

Floor	Terminal Electric Heater Capacity, kW AHU-1	AHU-2	AHU-3	AHU-4	AHU-9	Total
1		9		25		
2	6	2	2	10		
3	18	20	2	18		
4	6	8	2	30		
5	6	8	14	8		
6	58	43	32	54		
Basement					147	
Total, kW:	94	90	52	145	147	
Total Excluding Floor 6, kW:	36	47		91		
Avg. Heater On Time (All Floors), %:			0.25		0.36	
Avg. Heater On Time (Excluding Floor 6), %:	0.19	0.27		0.16		
Estimated Air Handler Operating Time, hrs/yr:	3,600	3,600	3,600	3,600	3,600	
Annual Electric Heater Energy Use, kWh/yr:	24,624	45,684	46,800	52,416	190,512	
Est. Energy Savings at 50% of Current Use, kWh/yr:	12,312	22,842	23,400	26,208	95,256	180,018
Estimated Cost Savings at $0.10/kWh:	$1,231	$2,284	$2,340	$2,621	$9,526	$18,002

$0.10/kWh cost of electricity based on energy savings only, no demand savings.

Secondary pumps IWP 1, 2, and 3 supply chilled water from the glycol chillers to air handlers AHU 1, 2, 3, and 4.

The system is equipped with additional heat exchangers that provide additional flexibility so that chilled water for much of the building can be supplied by either the chilled water chillers or the glycol chillers.

The preliminary scope for this ECM is based on converting the chilled water loops serving the air handlers to variable flow. These two systems are the “chilled water system” that serves AHU 5, 6, 7, 8, 9, 11, and 12, and the “ice water system” that serves AHU 1, 2, 3, and 4. The implementation of variable flow will require the conversion of the three-way valves at the air handlers to two-way valves and the installation of a variable speed drive on the chilled water pump. Each of these systems has three pumps. One or two pumps are used in normal operation with the third pump as a back up. A variable frequency drive (VFD) will be installed on one of the pumps serving each of the systems.

Estimated energy savings are based on the savings in pump energy. The savings are:

Electric Demand Savings:	0 kW,
Electric Energy Savings:	41,373kWh/yr,
Energy Cost Savings:	$4,137/yr.

Calculations of the estimated savings are included following this ECM description.

Hagel Building
Convert Secondary Chilled Water Pumps to Variable Speed Drive

Annual System Operating Hours: 3,600

Pumps CHP-4 and CHP-5

Pump Load Profile / **Pump Energy Use**

Pump Load	Annual Operating Time		Constant Speed			Variable Speed				Energy Savings kWh/yr
	CHP-4	CHP-5	kW	CHP-4 kWh	CHP-5 kWh	Power Input	kW	CHP-4 kWh	CHP-5 kWh	
30%	8.3%	0.0%	16.3	4,890	0	10.0%	1.6	489	0	
40%	7.9%	0.0%	16.3	4,646	0	13.0%	2.1	604	0	
50%	3.3%	0.0%	16.3	1,956	0	18.0%	2.9	352	0	
60%	17.4%	0.0%	16.3	10,220	0	26.0%	4.2	2,657	0	
70%	5.6%	0.0%	16.3	3,293	0	39.0%	6.4	1,284	0	
80%	3.1%	0.0%	16.3	1,809	0	56.0%	9.1	1,013	0	
90%	1.9%	0.0%	16.3	1,125	0	77.0%	12.6	866	0	
100%	0.0%	0.0%	16.3	0	0	105.0%	17.1	0	0	
Total	47.6%	0.0%	Total of Two Pumps		27,938				7,266	20,673

Assumed pump load profiles.

Average Cost of Electricity, $/kWh: $0.10
Energy Cost Savings, $/yr: $2,067

Pumps IWP-1 and IWP-2

Pump Load Profile / **Pump Energy Use**

Pump Load	Annual Operating Time		Constant Speed			Variable Speed				Energy Savings kWh/yr
	IWP-1	IWP-2	kW	IWP-1 kWh	IWP-2 kWh	Power Input	kW	IWP-1 kWh	IWP-2 kWh	
30%	8.3%	0.0%	10.4	3,120	0	10.0%	1.0	312	0	
40%	14.8%	0.0%	10.4	5,522	0	13.0%	1.4	718	0	
50%	4.9%	0.0%	10.4	1,841	0	18.0%	1.9	331	0	
60%	0.0%	0.0%	10.4	0	0	26.0%	2.7	0	0	
70%	42.8%	0.0%	10.4	16,006	0	39.0%	4.1	6,242	0	
80%	10.7%	0.0%	10.4	3,994	0	56.0%	5.8	2,236	0	
90%	0.7%	0.0%	10.4	250	0	77.0%	8.0	192	0	
100%	0.0%	0.0%	10.4	0	0	105.0%	10.9	0	0	
Total	82.1%	0.0%	Total of Two Pumps		30,732				10,032	20,700

Assumed pump load profiles.

Average Cost of Electricity, $/kWh: $0.10
Energy Cost Savings, $/yr: $2,070

Total Savings: 41,373 kWh
$4,137 per year

SECTION 2.0 – ENERGY BASELINE & ECM PERFORMANCE MEASUREMENT

Measurement and Verification Overview

The proposed plan for monitoring and verifying savings from the installed ECMs is based on the methods described in the Federal Energy Management Program's (FEMP) Measurement and Verification (M&V) Guideline. SES' approach to M&V is directly consistent with, and in compliance with, the FEMP M&V Guideline. The intent of the M&V plan is to verify that the ECMs installed by SES are performing at the expected energy-efficiency levels. In order to achieve this goal, accurate and cost effective measurement procedures must be identified and implemented.

A key consideration in the establishment of an M&V plan for a specific project is balancing the value of information received with the cost of obtaining that information. In many cases, obtaining the "80% solution" in terms of objective data with regards to system performance may be cost-effectively achieved whereas to go beyond that "comfort level" may consume a disproportionate share of the savings thereby rendering the ECM non-economical. In those cases, it is preferable to extrapolate based upon that 80% solution to derive a cost effective M&V plan.

Construction Period Energy Savings

All conservation measures which are mutually agreed upon by SES and GSA/SSA to have been completed during the construction period will generate energy savings. These verified savings will be added to the first year energy savings results.

Utility Incentives or Agency Grants

The value of all money or equipment received resulting from energy-efficiency incentives from the local utilities, AQMD, the California Energy Commission (CEC), or other agencies as a result of work performed by SES in this proposal will be applied to augment the energy savings for the year in which it was received, unless it has been used to offset installation costs.

General Approach to M&V

Energy (or water or O&M) savings are determined by comparing the energy (or water) use associated with a facility or certain systems within a facility before and after the installation of an ECM or other measure. The "before" case is called the baseline. The "after" case is called the post-installation, or performance, period. Baseline and post-installation energy use measurements or estimates can be constructed using the methods associated with M&V options A, B, C, and D, as described in FEMP guidelines. The challenge of M&V is to balance M&V costs, accuracy, and repeatability with the value of the ECM(s) or systems being evaluated, and to increase the potential for greater savings by careful monitoring and reporting.

M&V Options

The FEMP M&V Guidelines classify the M&V procedures into four categories, Options A, B, C and D. As shown in the table below, these options differ in their approach to the level of complexity of the M&V procedures.

M&V Options Summary

M&V Option	Performance Verification Techniques
Option A Verifying that the measure has the potential to perform and to generate savings.	Engineering calculations (possibly including spot measurements) with stipulated values.
Option B Verifying that the measure has the potential to perform and verifying actual performance by end use.	Engineering calculations with metering and monitoring throughout term of contract.
Option C Verifying that the measure has the potential to perform and verifying actual performance (whole building analysis.)	Utility meter billing analysis using techniques from simple comparison to multivariable regression analysis.
Option D Verifying actual performance and savings through simulation of facility components and/or the whole facility	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.

Option A is appropriate for ECMs that have energy use that can be readily quantified, such as the use of high efficiency lighting fixtures or high efficiency constant speed motors. Option B is appropriate for ECMs that require periodic or on-going measurements to quantify energy use; such as the use of variable speed drives on pump or fan motors. Option C is used for ECMs for which the energy use or energy savings cannot be measured directly. Option C is based on the use of utility meters to quantify building energy use. Option D is used for ECMs for which the energy use or energy savings cannot be measured directly, or savings for individual ECMs are heavily interdependent. Calibrated building simulation is used to separate the energy savings attributable to each ECM.

Specific Measurement and Verification Plan

The site-specific ECMs are given in the Table 2-1. The table also designates under which FEMP M&V option/options the proposed M&V approach falls.

Table 2-1
Hagel Building-Specific M&V Plan by ECM

ECMs Description & Location	Energy Cost Savings ($)	% Energy Savings	FEMP M&V Option
ECM #1: Convert from Primary to Secondary Electrical Service	$112,479	39%	A
ECM #2: Distributed Generation-Hot Water Recovery	$171,712	60%	B
ECM #3: Replace Griswold Flow Control Valves	$2,070	1%	A

1. % energy savings for each ECM expressed as a percentage of overall program energy savings

Site-Specific M&V Plan:

ECM #1 Secondary to Primary Electrical Service
ECM #3 Replace Griswold Valves

Objective
The objective of this plan is to verify that (1) baseline conditions determined during the Initial Proposal were properly assessed, (2) the measures are properly installed, operated, and maintained and to ensure the highest possible level of energy cost savings.

Approach
SES recommends agreed-to savings based on annual verification of operation. The effect of the each measure has been calculated and will be agreed-to based on the calculations described in the audit report. As long as the ECM is installed and operating, the savings will be achieved as calculated.

Post Retrofit Monitored Parameters
Since the savings for this ECM will be agreed-to based on the calculations, there are no monitored parameters.

Post Retrofit Sampling Plan
There are no population, usage groups or sampling plans integral to this M&V plan.

Post Retrofit Data Collection Plan
No future data collection is planned for these ECMs.

Post Retrofit Savings Analysis Method

Since the savings for this ECM will be agreed-to based on engineering calculations, the energy and cost savings will be identical to the numbers reported in the audit report.

Post-Retrofit M&V Activities

Annual inspection will be performed to verify that the circuit-setters are being properly maintained. SES will also analyze monthly electric utility billing and cost data to check for savings persistence from the conversion of service.

ECM #2: Distributed Generation System

Objective

The objective of this plan is to verify that (1) baseline conditions are properly assessed in the savings analysis, (2) the measures are properly installed, operated, and maintained to ensure the highest possible energy saving impacts, and (3) to verify the performance of the installed equipment by measuring key parameters.

Approach

The key to achieving the calculated energy savings is maintaining engine fuel efficiency, or heat rate, and ensuring engine reliability. A poor heat rate can lead to excess fuel consumption and resulting cost while excessive downtime has a major impact on electricity savings and a smaller impact on thermal related savings (heating hot water production).

Due to the potential for variations in the Hagel Building's electricity or heating demand due to operating requirements outside the control of SES, the M&V approach for this ECM is based on verifying the performance of the distributed generation system rather than measuring savings directly. Distributed energy system performance is defined as engine heat rate (efficiency) and engine availability. If the distributed generation system meets the specified goals for these performance parameters, then the system will be presumed to have met the energy savings goal. Therefore, if heat rate is maintained within 5% of the manufacturer's specifications, then fuel consumption and its resulting cost will be controlled to the point predicted by the distributed generator energy model. Accordingly, if the distributed generator's availability is maintained, the resulting electricity production and associated thermal savings are also expected to occur.

Post Retrofit Monitored Parameters

The commissioning of the distributed generator system will verify its functionality and potential to save energy. The M&V plan will use monitored data to verify that the system is installed and operating correctly to provide the potential for energy savings. These points will be included as part of the EMCS controls and provide trends that will be periodically downloaded into the database:

- Natural gas consumption by the engine
- Electricity (kWh) generated by the engine

Post Retrofit Sampling Plan

All the monitored parameters will be trended on a continuous basis for life of the project in order to verify the performance of the ECM. Sampling plan coverage is 100%.

Post Retrofit Data Collection Plan

The following points will be included as part of the EMCS controls and put into trends, which will be periodically downloaded into the database.

Table*: Post-Installation M&V Monitored Parameters ECM # 2*

Point	Engineering Units	Sampling Interval
Generated Electricity	kWh	15 min.
Natural Gas Consumption by the Engine	Btu	15 min.

The above parameters will be collected on a continuous basis for the life of the contract (15 years). This data will be used for performance verification only.

Performance Guarantee

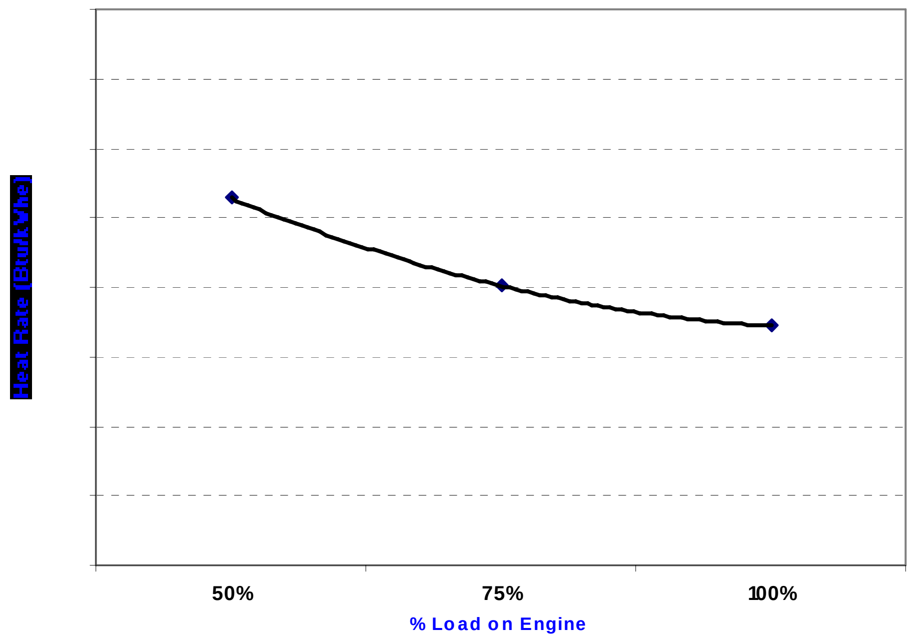
The potential to save energy will be verified by the commissioning process and by annual review of the installation. Performance testing will be consistent with the methodology used in the commissioning process. Permanently installed instrumentation will be used to determine engine heat rate[1].

The data points listed under "Post Retrofit Monitored Parameters" will be collected and analyzed to check the performance of the engine (using 15 minute interval data) installed by SES. The analysis will include calculating the Heat Rate (Btu/kWh) of the engine at different operating conditions. However, it will not be used to calculate the savings. If the ECMs installed by SES are not performing within ±5% of the manufacturers' specifications, then SES will make all necessary adjustments and repairs to meet the specified performance level. This is in accordance with the performance assurance provided to SES by the engine manufacturer. If the goals cannot be achieved, then the agreed to savings will be adjusted/recalculated accordingly to reflect the measured performance by replacing the design/recommended values by the measured values while keeping all the other assumptions and parameters constant.

An annual report will be generated to show the results of the measured heat rate of the engines. A graph between the % load and the calculated heat rate will be created using the measured data and the values will be compared at different loading conditions with the manufacturers' specifications.

[1] Heat rate (Btu/kWh) is an indication of the performance of the engines. It is the ratio of the heat added to the cycle in Btu/h (LHV), to generation, in kW.
Heat Rate = Gas Consumption (Btu/h)/[(kW Output at the shaft)

ENGINE HEAT RATE (BTU/KWhe) Vs. % LOAD



Availability Guarantee

SES will be responsible for unavailability of the distributed generator engine. It is the responsibility of the Hagel Building operating personnel to promptly notify SES of any engine malfunctions that impact system availability. The Hagel Building is responsible for the balance of the central plant equipment and for the impact of this equipment on distributed generator system availability.

When the engine-generator is not available, the facility may have to purchase electricity from the utility. Estimated savings are based on a 95% availability. An average annual availability of 95% on the engine represents a potential purchase of 91,200 kWh per year. Electricity purchased because an engine-generator was not available will be compared to the potential purchased kWh. If the purchased kWh is less than the potential purchased kWh (91,200 kWh), the ECM will be considered to have met the availability performance standard. If the purchased kWh is greater, then SES will be subject to penalty if the overall energy savings fall below the guaranteed savings. Certain major maintenance activities do not occur every year but are included in the annual average. Therefore, the potential purchase of kWh will not be reset every year but will be cumulative over the term of the project.

In the event the engine does not meet the specified performance for availability, the loss in energy savings will be calculated at the rate of $0.05/kWh for electricity that must be purchased to compensate for engine availability below 95%. The $0.05/kWh represents the nominal difference between purchased electric energy at $0.15/kWh (energy and demand) less the cost to produce electricity with the engines at $0.10/kWh.

Payments by SES for any distributed generation energy savings shortfall will be capped at $50,000 per year.

Pre-Installation Energy and Facility Performance Baseline

Pre-Installation energy and facility performance baseline issues will be addressed in the detailed audit report.

Post-Installation Facility Conditions

Post-Installation facility conditions will be addressed for each ECM in the detailed audit report and the M&V plan.

Determination of Energy Savings

Determination of energy savings based on the selected approach and the Pre and Post installation conditions are addressed for each ECM in the detailed audit report and the M&V plan.

Future Periodic (Annual) Measurement Plan

The SES M&V Group will inspect and verify all the completed ECMs in the building on an annual basis. Typically this will include visual inspection of key parameters for each ECM as outlined in the M&V plan. Wherever feasible, trended data from the Hagel Building's existing EMCS system will be utilized to verify the effectiveness of the ECMs. The inspection will be focused, but not limited to:

1. Transformer Upgrades
2. Performance checks on Distributed Generator System.
3. Performance checks on new Griswold Valves

The M&V Group may also collect the monthly energy reports from SES Maintenance staff, which will be used to assist the M&V process.

Energy Savings Guarantee Reconciliation

If savings shortfalls require next year contractor payments to be reduced downward, then these shortfalls and associated reduced payments may be recovered in successive years within the program term by SES. This recovery would be calculated as the amount of verified savings exceeding the guaranteed amount.

Dispute Resolutions

A well-defined M&V approach along with regular project meetings and reviews minimize the potential for a dispute. SES will work to accommodate any concerns about the above M&V plan. A major consideration in the establishment of an M&V plan, however, is to balance the value of information received with the cost of obtaining that information. Disputes shall be resolved by engineering analysis of the calculations and adjustment to maintain equitable resolution to both parties.

In the event of an actual dispute, it is recommended that an independent third-party review team be established to review and mediate issues. This third-party review team will be composed of individuals with the necessary technical knowledge and background to resolve the dispute. The members of this independent resolution team will be agreed upon by all parties involved, and will be provided all background material and data related to the disputed ECM(s). Based upon this information, a letter report will be prepared by the third-party reviewer, describing the disputed issue(s) and any actions necessary to resolve the dispute.

SECTION 3.0 – MANAGEMENT APPROACH

Organization

Sempra Energy Services (SES) will ensure a highly effective site management approach, providing competitive pricing, subcontractor expertise, and teamwork. SES will draw upon the unique skills and extensive experience of direct employees and subcontractor personnel and, in addition, will emphasize the use of local labor to the maximum extent possible. SES delivers a strong commitment to understand the short- and long-term goals of the GSA and SSA and to ensure that our approach is innovative, on target, and causes no adverse impacts on day-to-day operations.

The advantages offered by SES are highlighted by strong capabilities for accomplishing all phases of energy savings performance contracting, and proven by nationally recognized results in conducting complex projects for large governmental entities.

Project Management Approach

SES' management approach and implementation plan for the Hagel Building are based on:

- A proven record of managing complex projects;
- Experience in managing and verifying large-scale energy savings programs;
- A proven set of procedures and tools for controlling and managing costs, schedule, and overall performance;
- A quality assurance program to guarantee that the work performed in the design, development, implementation and operation of each ECM is of the highest quality; and
- A system of interfaces that ensures the GSA and SSA involvement in all appropriate decision making aspects of this program.

To effectively manage a project, the overall approach must consist of a plan that includes:

- Clearly defined lines of communication;
- Single points of responsibility for each functional area of the contract;
- Defined procedures for contract; and
- A system for integrating project personnel (including subcontractors if applicable) into a responsive, cohesive team.

SES' management approach offers experience and innovation as follows:

- A team integration approach that minimizes management burden, provides single points of contact, and simplifies program interfaces and subcontract management.

- A quality assurance program that is based on strong customer focus, effective and efficient work processes, and is dedicated to examining products/services and processes to prevent problems and improve quality continuously.
- An environmental safety and health program that will focus on customer requirements, as well as any appropriate state, local, or federal requirements, policies and procedures governing work performed.
- A project specific team that will be with the project from start to finish under the direction of the Project Manager, assisted by the Project Engineers to provide technical direction and quality assurance. The Project Engineer reports to SES' Director of Engineering and manages both in-house engineering and our design sub-contractor(s).
- A team approach that follows a comprehensive process during all phases of the project. This includes peer review of SES and our design sub-contractor's work.

The steps SES uses for energy efficiency improvement projects are generally:

- ***Project Development*** - SES, either through our staff or through our audit, engineering, and construction sub-contractor(s), conducts on-site analysis of sufficient detail to establish the guaranteed energy savings, the scope of work, and a fixed project cost.
- ***Project Engineering*** - SES, either through our staff or our engineering consultant(s), will perform on-site verification, gather operating data, and perform detailed design and calculations which culminate in construction documents that are based on the definitive energy savings and project scope. SES provides over-sight of equipment specifications on all projects where we use outside design services. Our project team will have the full support of our mechanical engineering staff to review the equipment specifications before they are issued for bid. Additionally, our on-site team will inspect the equipment for compliance with the specifications to ensure that all requirements are met. For complex systems, our on-site team will be supported by our staff experts. This approach provides excellent over-sight and keeps the project cost down. Additionally, since we purchase a wide variety of equipment from many vendors, we are constantly tracking the delivery dates. In cases where a piece of equipment is schedule sensitive, it is very important to be able to track production and have the buying power to expedite equipment delivery schedules if necessary.
- ***Regulatory Compliance*** - During the audit and energy analysis phase of the project, compliance with the required regulatory bodies, codes, and standards will be developed. This information will be formalized in the project design criteria and, when appropriate, will be scheduled as a task or milestone, e.g., for plan check review and approval. SES has worked with many federal, state, local, and other agencies as part of our execution of performance contracts and has always maintained a positive working relationship with these oversight or compliance agencies.
- ***Construction Management*** - Complete authority to develop and authorize work

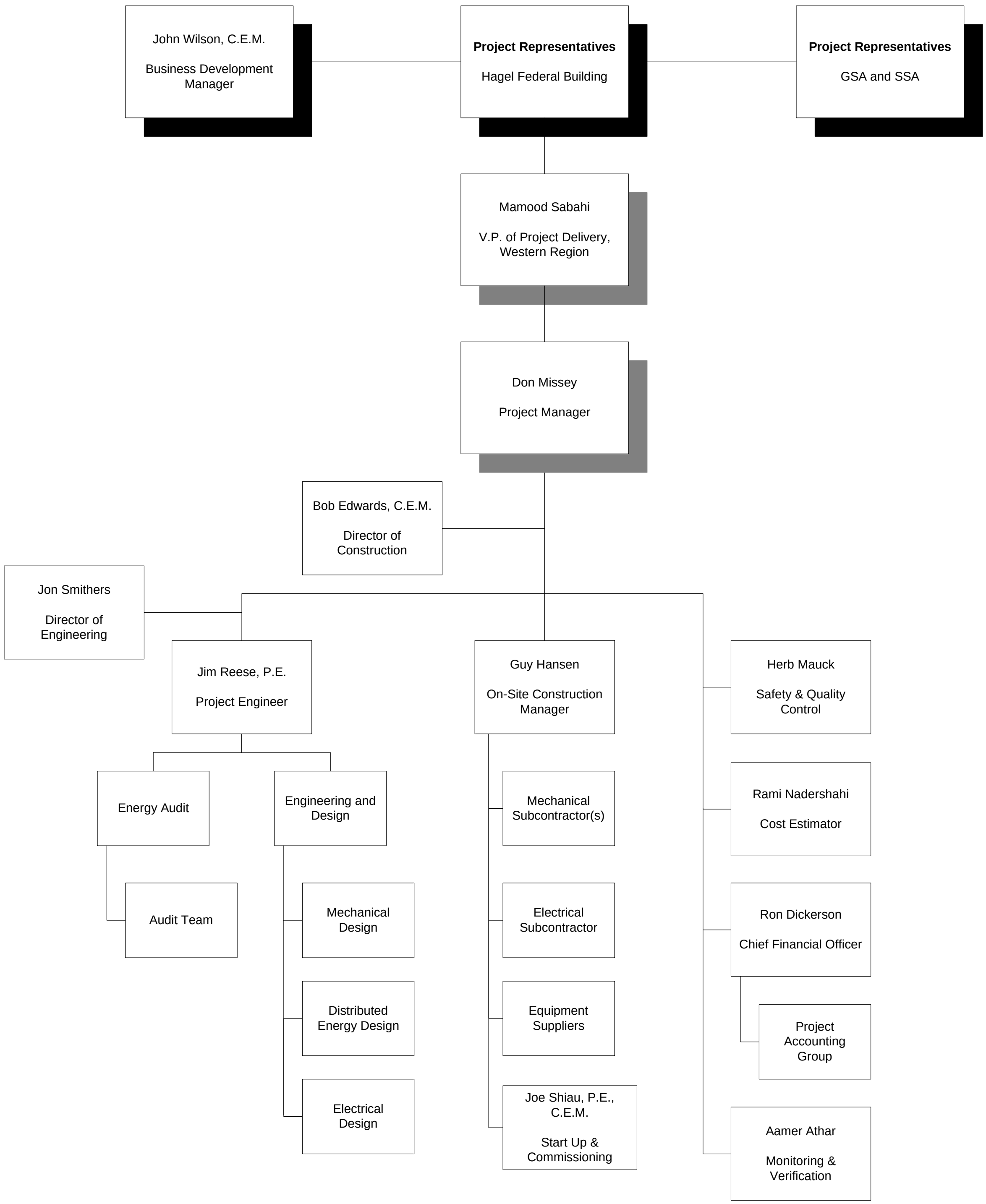
plans within the approved contract scope and budget is provided at the site level. The commitment of project resources is delegated to the On-Site Construction Manager by the Project Manager. SES will provide on-site construction management during all critical points in the construction process. This Construction Manager will also manage the project from off site locations. It is estimated that this will be approximately a 50% - 50% mix.

- ***Problem Resolution*** - The Construction Manager has complete on-site project authority to resolve construction problems. This authority includes, but is not limited to, the ability to allocate resources, settle conflicts and initiate corrective actions, as needed, in order to resolve a problem.
- ***Resources*** - Complete control of project resources is maintained at the Project Manager level. Additionally, the On-Site Construction Manager has authority over all on-site resources, including the commitment and allocation of funding, and personnel within the framework of the contract requirements.
- ***Decision-Making*** - The On-Site Construction Manager has operational decision-making authority within the limitations of the contract. Examples of site level decisions include personnel hire and dismissal, purchase of services and materials, and establishment of project policies and procedures.
- ***Commitment*** - Full commitment authority is provided to the On-Site Construction Manager, up to the limit of the contract. Each successive management level has commensurate authority for commitments up to the level of their budget and area of responsibility within the framework of contract requirements and project policy.
- ***Project Maintenance, Measurement and Verification*** - Superior design and implementation, maintenance programs, continuous peer review, and accurate energy consumption measurement reduce exposure to savings shortfalls and equipment failure.
- ***Project Close-Out*** - At the completion of every project, SES submits to the client a set of “as-built” drawings, operation manuals, maintenance manuals, and a list of recommended spare parts. We also provide training on the equipment installed.

Project Team

SES’ Project Team is backed by a strong corporate commitment from all companies that comprise the Sempra Energy Services’ Team. This project will fall under the direction of Mr. Don Missey, Project Manager. The On-Site Construction Manager will be Mr. Guy Hansen.

ORGANIZATIONAL STRUCTURE FOR MANAGING THE PROJECT



Proposed Personnel and Responsibility

Vice President of Project Delivery, Western Region

Mamood Sabahi, Vice President of Project Delivery, Western Region: Mr. Sabahi will have overall responsibility and accountability for the project. As the V.P. of Project Delivery, Mr. Sabahi will have complete authority to use appropriate internal and external resources to control, monitor, and execute project activities.

Business Development Manager

John Wilson, Business Development Manager: Mr. Wilson will serve as the secondary interface with GSA/SSA, and will have overall responsibility for client satisfaction. Mr. Wilson will closely monitor the project activities to ensure that client expectations are met.

Project Manager

Don Missey, Project Manager: Mr. Missey will be the team leader for this project, and will direct all activities necessary to ensure that all resources are focused on maximizing the potential for energy conservation projects. Mr. Missey will manage this project from SES' Los Angeles office and will serve as the primary interface with GSA/SSA for energy management services.

Director of Construction

Bob Edwards, Director of Construction: Mr. Edwards is responsible for all construction activities for SES' Western Region. Mr. Edwards will perform various reviews of the work in progress and the construction work. He will provide technical assistance as needed to the on-site Construction Manager.

On-Site Construction Manager

Guy Hansen, Site Construction Manager: Mr. Hansen has complete on-site project authority, including but not limited to, the ability to allocate resources, settle conflicts, make operating decisions, and initiate corrective actions within the limitations of the contract. The on-site Construction Manager has complete authority at the site level to develop and authorize work plans within the approved contract scope and budget. The on-site Construction Manager will develop and administer all sub-contracts.

Estimating

Rami Nadershahi, Project Estimator: Mr. Nadershahi will provide support for the Project Manager and the Construction Manager in estimating the project cost, evaluating the costs of alternatives, evaluating the cost of changes that might occur during construction and developing the site specific implementation strategy.

Safety and Quality Control

Herb Mauck, Safety and Quality Manager: Mr. Mauck will provide inspection services for all measures and commissioning for all equipment and controls modifications. These inspections will certify compliance with plans and specifications under the direction of the on-site Project Manager. Mr. Mauck, the team leader, will have the authority and responsibility to ensure that the equipment services and/or suppliers conform to the GSA/SSA requirements.

Project Engineer

Jim Reese, Project Engineer: Mr. Reese will provide direct supervision for the energy audit and the engineering and detailed design of the ECMs to be implemented. Mr. Reese will be responsible for the technical correctness of the engineering and design for the Hagel Building project. The energy audit and the detailed design engineering will be accomplished through both in-house personnel and through the use of design consultants. Additionally, Mr. Reese will coordinate and conduct training and support through local vendor representatives and equipment manufacturers. This training entails conducting required management workshop(s) for the operations and maintenance personnel, as well as the administrative staff. The workshop(s) will help personnel to understand the energy implications of their actions by conducting training sessions on preventive maintenance and other energy-saving practices as applicable to each ECM.

Start up and Commissioning

Joe Shiau, Commissioning Supervisor: Mr. Shiau will be responsible for start-up and commissioning of the new equipment and systems to be installed during the project. This will include verifying that the installed equipment meets specifications, is installed and started-up in accordance with manufacturer's recommendations, and operates as intended. A commissioning plan will be prepared that describes the functional tests to be performed on the equipment and the acceptance criteria. Of particular concern will be to verify that the modifications to the EMS will provide a fully functional system. A commissioning report will be prepared to document the results of the commissioning for future reference.

Monitoring and Verification

Aamer Athar, M & V Manager: Mr. Athar will be responsible for monitoring and verification of the new equipment and systems to be installed during the energy retrofit. This will include verifying that the installed equipment meets the energy saving specifications and is installed and started-up in accordance with the project energy savings plan.

Project Financial Accounting

Ronny Dickerson, Controller: Mr. Dickerson is responsible for tracking all project expenditures. All project costs will be tracked using a construction industry accounting program called COINS. Mr. Dickerson will assist the Project Manager and the on-site Construction Manager to ensure that standard accounting procedures are met and that a complete audit trail is documented.

Sub-Contractors

SES' approach to construction subcontracting is to utilize the local contractors when possible. SES solicits our clients for their input regarding contractors. SES will develop a list of proposed sub-contractors based on prior experience and client input, and issue bid packages to this group. SES will select the best-qualified contractor to perform the work. In some cases, where specific expertise is required, SES may chose to add a specific contractor to the initial team.

Risk/Responsibility Matrix

SES' proposed approach for the ESPC Contract Risk/Responsibility Matrix is shown in the table below:

ESPC Contract Risk/Responsibility Matrix

RESPONSIBILITY/DESCRIPTION	ESCO PROPOSED APPROACH	AGENCY ASSESSMENT
Financial:		
Interest rates: Neither the ESCO nor the agency has significant control over prevailing interest rates. During all phases of the project, interest rates will change with market conditions. Higher interest rates will increase project cost, financing/project term, or both. The timing of the Delivery Order signing may impact the available interest rate and project cost. Clarify when the interest rate is locked in, and if it is a fixed or variable rate.	SES utilizes an estimated interest rate for the development of the IP, DES & Proposal. The estimate is intended to be higher than what is expected to be in place at signing. SES proposes to complete negotiations on the proposal including the basis point differential on the estimated rate. At time of signing, the fixed rate will be locked in using the negotiated differential and final financial schedules will be published for inclusion in the Delivery Order.	
Energy prices: Neither the ESCO nor the agency has significant control over actual energy prices. For calculating savings, the value of the saved energy may either be constant, change at a fixed inflation rate, or float with market conditions. If the value changes with the market, falling energy prices place the ESCO at risk of failing to meet cost savings guarantees. If energy prices rise, there is a small risk to the agency that energy saving goals might not be met while the financial goals are. If the value of saved energy is fixed (either constant or escalated), the agency risks making payments in excess of actual energy cost savings.	SES proposes to utilize the current utility rates and rate structures in the proposal, escalated in the out years at an agreed-to rate. The resulting rate figures will be fixed for the term of the Delivery Order.	
Construction costs: The ESCO is responsible for determining construction costs and defining a budget. In a fixed-price design/build contract, the agency assumes little responsibility for cost overruns. However, if construction estimates are significantly greater than originally assumed, the ESCO may find that the project or measure is no longer viable and drop it. In any design/build contract, the agency loses some design control. Clarify design standards and the design approval process (including changes) and how costs will be reviewed.	SES will provide firm fixed construction costs based on specified equipment (or equivalent) in the negotiated proposal. SES designs to standards established by the Uniform Building Code and will submit all drawings, specifications, and submittals for government approval. If unusual design standards are required, the government should designate in the Delivery Order RFP. If design changes result in increased costs, SES would expect to negotiate an equitable cost adjustment with the government if necessary. The basis of all costs will be detailed in the DES.	

RESPONSIBILITY/DESCRIPTION	ESCO PROPOSED APPROACH	AGENCY ASSESSMENT
M & V costs: The agency assumes the financial responsibility for M & V costs directly or through the ESCO. If the agency wishes to reduce M & V cost, it may do so by accepting less rigorous M & V activities with more uncertainty in the savings estimates. Clarify what performance is being guaranteed (equipment performance, operational factors, energy cost savings) and that the M & V plan is detailed enough to satisfactorily verify it.	SES' approach to M&V is to verify the guaranteed performance of the equipment installed where cost effective to do so in relation to the value of the savings achieved with a given measure. SES cannot guarantee factors beyond its control, i.e. operating hours, personnel population changes etc. SES will utilize appropriate practices to validate the base case in all instances, and an acceptable value will be negotiated with the customer.	
Delays: Both the ESCO and the agency can cause delays. Failure to implement a viable project in a timely manner costs the agency in the form of lost savings, and can add cost to the project. Clarify schedule and how delays will be handled.	SES will develop (with customer consultation) and provide a schedule in the proposal for customer review and acceptance. Circumstances that may lead to delays in the schedule should be communicated as quickly as identified. Discussion will seek mitigating alternatives. Resolution to delays that result in meaningful cost impacts will be negotiated.	
Major changes in facility: The agency (or Congress) controls major changes in facility use, including closure. Clarify responsibilities in the event of a premature facility closure, loss of funding, or other major change.	Facility use profiles will be identified and discussed and agreed upon in the proposal phase. SES cannot accept responsibility for, or guarantee, facility use profiles.	
Operational:		
Operating hours: The Agency generally has control over the operating hours. Increases and decreases in operating hours can show up as increases or decreases in "savings" depending on the M & V method (e.g. operating hours times, improved efficiency of equipment vs. whole building, utility analysis). Clarify if operating hours are to be measured or stipulated and what the impact will be if they change. If the equipment loads are stipulated, the baseline should be carefully documented and agreed to by both parties.	SES will work with the agency to identify acceptable values for operating hours. The M&V protocol will focus on equipment performance rather than total energy use, minimizing the impact of changing operating hours. If a substantial change in operating hours (i.e. from 9 hours for 5 days to 24 hours for 7 days a week) occurs, and the change impacts the life of equipment that SES is responsible for repair and replacement, SES would expect to negotiate an equitable price adjustment.	
Load: Equipment loads can change over time. The agency generally has control over hours of operation, conditioned floor area, intensity of use (e.g. changes in occupancy or level of automation). Changes in load can show up as increases or decreases in "savings" depending on the M & V method. Clarify if equipment loads are to be measured or stipulated and what the impact will be if they change. If the equipment loads are stipulated, the baseline should be carefully documented and agreed to by both parties.	The M&V protocol will focus on equipment performance where technically and economically feasible. SES will work with the customer to measure existing loads or identify expected equipment loads; and those loads will be utilized for calculating savings. The methodology for determining these loads will be carefully documented. The loads will be stipulated.	

RESPONSIBILITY/DESCRIPTION	ESCO PROPOSED APPROACH	AGENCY ASSESSMENT
Weather: A number of energy efficiency measures are affected by weather. Neither the ESCO nor the agency has control over the weather. Changes in weather can increase or decrease "savings" depending on the M & V method (e.g. equipment run hours times efficiency improvement vs. whole building utility analysis). If weather is "normalized" actual savings could be less than payments for a given year, but will "average out" over the long run. Weather corrections to the baseline or ongoing performance should be clearly specified and understood.	For ECMs impacted by weather, energy savings will be calculated using typical weather profiles agreed to by SES and the Agency (such as published Typical Meteorological Year (TMY) data). This weather profile will be stipulated for the determination of baseline and post-retrofit energy savings. Energy savings will then be verified based on measurements to verify proper equipment performance.	
User participation: Many energy conservation measures require user participation to generate savings (e.g. control settings). The savings can be variable and the ESCO may be unwilling to invest in these measures. Clarify what degree of user participation is needed and utilize monitoring and training to mitigate risk. If performance is stipulated, document and review assumptions carefully and consider M & V to confirm the capacity to save (e.g. confirm that the controls are functional).	It will be the responsibility of the Agency to maintain proper setpoints and programming of controls. The savings will be calculated based on anticipated compliance with established control settings that are agreed to by both the Agency and SES. SES will provide training regarding the operation and maintenance of the controls and guidelines for proper control settings. SES will review operating procedures and control setpoints as part of the M&V Procedures.	
Performance:		
Equipment performance: Generally the ESCO has control over the selection of equipment and is responsible for its proper installation and performance. Generally the ESCO has responsibility to demonstrate that the new improvements meet expected performance levels including standards of service and efficiency. Clarify who is responsible for initial and long-term performance, how it will be verified, and what will be done if performance does not meet expectations.	SES will select the equipment that will best meet the needs of the facility. SES will verify proper operation of the equipment upon completion of the installation. SES will be responsible for the performance of the equipment and will verify the performance at intervals agreed to with the Agency as specified in the M&V Plan.	
Operations: Responsibility for operations is negotiable, and it can impact performance. Clarify how proper operation will be assured. Clarify responsibility for operations and implication of equipment control.	The Agency will operate the equipment installed. SES will provide training in proper equipment operation. SES will specify operating logs to be maintained by the Agency. SES will periodically review the equipment operation and operating logs to verify proper operations.	

RESPONSIBILITY/DESCRIPTION	ESCO PROPOSED APPROACH	AGENCY ASSESSMENT
Maintenance & Repair: Responsibility for maintenance and repair is negotiable, however it is often tied to performance. Clarify how long-term maintenance and repair will be assured, especially if the party responsible for long-term performance is not responsible for maintenance. Clarify who is responsible for ECM overhaul, component or equipment repair required to maintain operational performance throughout the contract term.	The agency will be responsible for maintenance and repair of all ECM equipment with the exception of the distributed energy plant. For this system, regularly scheduled major maintenance events and repairs will be the responsibility of SES. SES will also be responsible for the distributed energy SCR system to include urea and catalyst replacements. SES will be responsible for emissions testing as required. The agency will provide minor maintenance for the distributed generation system. SES will provide the Agency with training in proper maintenance and repair procedures and will specify maintenance records to be kept by the Agency. SES will periodically review these records as specified in the M&V Plan to ensure proper maintenance and repair.	
Equipment Replacement: Responsibility for replacement of contractor-installed equipment is negotiable, however it is often tied to ECM performance. Clarify who is responsible for replacement of failed components or equipment throughout the term of the contract. Specifically address potential impacts on performance due to equipment failure. Life of equipment is critical to ECM performance during the contract term. Specify equipment life expected for all installed equipment and specify warranties proposed for the installed ECMs.	Replacement of distributed energy equipment will be the responsibility of SES. Replacement of all other ECMs will be the responsibility of the agency. SES will periodically review these records as specified in the M&V Plan to ensure proper maintenance.	

Operations, Maintenance, Repair and Replacement

Operations and Maintenance

To achieve the projected savings, all ECMs must be operated, maintained, and repaired according to the manufacturer, design, and installation specifications. Upon completion of the installation, SES will provide the GSA/SSA with appropriate technical manuals that describe the equipment and its operation, as well as the manufacturer's recommended maintenance. SES will provide training in the operation and maintenance of the new equipment.

Many of the ECMs involve modifications to the existing HVAC or electrical equipment such as the new valves and transformers. The operation and maintenance of this equipment is comparable to the work required for the existing facility equipment. Thus, to minimize overall program costs, SES proposes that the current Hagel Building facilities staff be responsible for the operations and maintenance of these ECMs. SES will conduct annual inspections of the equipment to observe that the necessary operating and maintenance procedures are being followed. Hagel Building staff will make operating logs and maintenance records available to SES for review. SES will notify the GSA/SSA in writing if there are any maintenance discrepancies noted.

The ECM with the largest impact on facilities operation and maintenance is the addition of the distributed energy plant. The Hagel Building will utilize the existing staff at the central plant to operate and perform minor maintenance of the distributed energy plant. SES will also provide major maintenance of the distributed energy system including catalytic converter replacements, emissions testing, and overhaul of the distributed energy engine.

Repairs and Replacements

SES proposes that the GSA/SSA be responsible for the routine repair and replacement of new equipment that is generally comparable to existing facility equipment such as valves. Manufacturer's warranties will be passed along to the GSA/SSA.

SES will be responsible for repair and replacement of equipment that is significantly beyond the scope of existing equipment, including the distributed energy plant.

Training

SES will provide training for each ECM to Hagel Building personnel or their designees prior to project acceptance. The training will be structured to include classroom and hands-on training. The Operations and Maintenance manuals will be utilized in this training. The training will include education on the concept of each measure and the importance of proper operating, maintenance, and troubleshooting procedures. The training will also include procedures on proper reporting of operations and maintenance activities. Specialized systems such as the distributed energy plant will require additional training and will include training support by the original equipment manufacturer (OEM). The training sessions will be videotaped for the GSA/SSA to use in training new personnel in the future or as a refresher for existing staff.

The table below shows the proposed assignments of the responsibilities for operations, maintenance, and repair and replacement of each ECM.

Summary of Operations, Maintenance, Repair & Replacement Responsibility
Hagel Federal Building

ECM No.	Energy Conservation Measure	Location	Responsible Party		
			Operations	Maintenance	Repair & Replacement
1.	Primary to Secondary Transformers	Basement	SSA	SSA	SSA
2.	Distributed Energy System	Basement	SSA	SES	SES
3.	Replace Griswold Valves	Throughout Building	SSA	SSA	SSA

PRICE PROPOSAL

Schedule DO-1 (Initial)

SCHEDULE DO-1 (Initial)

Proposed Guaranteed Annual Cost Savings and Annual Contractor Payments

If selected the Contractor shall complete the installation of all proposed ECMs not later than 12 months after delivery order awar

	Delivery Order No.:	Contractor Name:	Project Site:
		Sempra Energy Services	Hagel Building
Performance Period Year	(a) Initial Estimated Annual Cost Savings $	(b) Proposed Guaranteed Annual Cost Savings $	(c) Annual Contractor Payments $
ZERO			
ONE	$296,261	$275,709	$275,708
TWO	$306,630	$286,078	$286,077
THREE	$317,363	$296,810	$296,809
FOUR	$328,470	$307,918	$307,917
FIVE	$339,967	$319,415	$319,414
SIX	$351,866	$331,313	$331,312
SEVEN	$364,181	$343,629	$343,628
EIGHT	$376,927	$356,375	$356,374
NINE	$390,120	$369,568	$369,567
TEN	$403,774	$383,222	$383,221
ELEVEN	$417,906	$397,354	$397,353
TWELVE	$432,533	$411,980	$411,979
THIRTEEN	$447,671	$427,119	$427,118
TOTALS	$4,773,668	$4,506,491	$4,506,478

(1) The first year Initial Estimated Annual Cost Savings reflects technical proposal & engineering estimates as presented in DO-4.
(2) The "Proposed Guaranteed Annual Cost Savings" is based on the site specific M&V plan.
(3) The Total of Annual Contractor Payments represents the delivery order price and should be supported by information submitted in and provided with Schedules DO-2 and DO-3.
(4) If applicable, pre-performance period expenses will be submitted for year Zero.
(5) The Proposed Guaranteed Annual Cost Savings must exceed the Annual Contractor Payments (except year zero) for each year of the delivery order performance period.
(6) If applicable, submit escalation rates applied to Initial Estimated Annual Cost Savings in column (a) as follows:
Energy Rates 3.50%.
Energy Related O & M Savings 3.50%.

Schedule DO-2

SCHEDULE DO-2

IMPLEMENTATION PRICE BY ECM

Project Site: Hagel Building			Delivery Order No.:		Contractor Name: Sempra Energy Services	
Tech Category	**ECM No.**	**Equipment Description - Title**	**ECM Size**	**(a) Total Implementation Expense**	**(b) Mark-up (%)**	**(c) = (a) x (1+(b)) Implementation Price ($)**
C.2.17		Proposal Development Energy Surveys		$50,000	27.00%	$63,500
C.2.15	1	Convert to Primary Electrical Service	6,000 kVA	$393,780	27.00%	$500,100
C.2.10	2	Distributed Generation with Hot Water Heat Recovery	500 kW	$943,993	27.00%	$1,198,871
C.2.7	3	Replace Griswold Flow Control Valves		$113,279	27.00%	$143,864
Total				$1,501,052		$1,906,336
Bonded Amount ($)						$1,906,336

Notes:

1) Total Implementation Expenses shall include only direct costs, and no performance period expenses.
2) Contractor shall identify direct costs for DES and proposal development costs as a separate line item, as applicable.
3) Contractor shall attach adequate supporting information detailing total implementation expenses (direct costs), in accordance with Section H.24.2 of the contract.
4) Contractor shall propose bonded amount representing the basis of establishing performance and payment bonds per Section H.17 of the contract, as required.
5) Attached supporting information shall be presented to identify portions of ECM or project expenses included in proposed bonded amount.
6) Proposed Bonded Amount is assumed to include markup applied to implementation expenses above, unless otherwise specified by Contractor.
7) For the following ECMs, enter the total installed capacity of new equipment in the units specified (e.g. chillers-150); chillers and packaged units in tons, VFDs in hp, boilers and furnaces in input Btu/hr, BAS/EMCS in number of points, transformers in kVA, generators in kW. For lighting ECMs, specify baseline kW treated.

Schedule DO-3

SCHEDULE DO-3

Performance Period Cash Flow

Applicable Financial Index			
Term (Years)	13	Issue Date	
Index Rate		Source	
Added Premium			
Project Interest Rate	8.00%	Effective Through	

Project Site: Hagel Building	**Delivery Order No.:** 1		**Contractor Name:** Sempra Energy Services							
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Project Capitalization										
Total Implementation Price (DO-2 Total)	$1,906,336									
Financing Procurement Price ($) (Note 5.)	$77,214									
Less Pre-Performance Period Payments (Note 4.)	-$333,020									
Total Amount Financed ($)	$1,650,531									
ANNUAL CASH FLOW (PERFORMANCE PERIOD)										
Debt Service:										
Interest ($)	$131,037	$128,293	$124,500	$119,731	$113,877	$106,824	$98,443	$88,597	$77,133	$63,886
Principal Repayment ($)	$27,832	$42,151	$53,785	$66,699	$81,012	$96,851	$114,356	$133,678	$154,982	$178,447
Total Debt Service ($) (a)	$158,868	$170,444	$178,285	$186,430	$194,889	$203,675	$212,799	$222,275	$232,115	$242,333
Penalty if debt is retired at year end ($)	$162,270	$158,055	$152,676	$146,006	$137,905	$128,220	$116,785	$103,417	$87,919	$70,074
Performance Period Expenses:										
Management/Administration ($)	$7,500	$7,688	$7,880	$8,077	$8,279	$8,486	$8,698	$8,915	$9,138	$9,366
Operation ($)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Maintenance ($)	$32,000	$32,800	$33,620	$34,461	$35,322	$36,205	$37,110	$38,038	$38,989	$39,964
Repair and Replacement ($)	$39,500	$40,488	$41,500	$42,537	$43,601	$44,691	$45,808	$46,953	$48,127	$49,330
Measurement and Verification ($)	$10,000	$7,000	$7,175	$7,354	$7,538	$7,727	$7,920	$8,118	$8,321	$8,529
Permits and Licenses ($)	$3,000	$3,075	$3,152	$3,231	$3,311	$3,394	$3,479	$3,566	$3,655	$3,747
Insurance ($) (Note 6)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Property Taxes ($) (Note 6)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other (describe & itemize on attachment) ($)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal Performance Period Expenses ($)	$92,000	$91,050	$93,326	$95,659	$98,051	$100,502	$103,015	$105,590	$108,230	$110,936
Performance Period Mark-up (%)	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Performance Period Mark-up ($)	$24,840	$24,584	$25,198	$25,828	$26,474	$27,136	$27,814	$28,509	$29,222	$29,953
Total Performance Period Expenses (b)	$116,840	$115,634	$118,524	$121,487	$124,525	$127,638	$130,829	$134,099	$137,452	$140,888
Total Annual Contractor Payment (a)+(b)	$275,708	$286,077	$296,809	$307,917	$319,414	$331,312	$343,628	$356,374	$369,567	$383,221

Notes: 1) Performance Period Expenses shall include only direct costs, and no implementaion period expenses.

3) Contractor shall attach adequate supporting information detailing total performance period expenses (direct costs), in accordance with Section H.24.2 of the contract.

3) If applicable, contractor shall specify escalation rate applied to Performance Period Expenses: 2.50%.

4) If applicable, pre-performance period payments will be applied in year Zero to reduce principal repayment. Pre-Performance Payment represents 30% NPV of utility incentive for distributed generation system.

5) Financing Procurement Price includes performance bond, finance fees, construction interest, and financing procurement.

6) No costs are shown for Insurance or Property Taxes on the basis that the Government will take ownership of equipment at the end of the construction period.

SCHEDULE DO-3

Performance Period Cash Flow

Project Site: **Hagel Building**

	Year 11	Year 12	Year 13	Total
Project Capitalization				
Total Implementation Price (DO-2 Total)				
Financing Procurement Price ($) (Note 5.)				
Less Pre-Performance Period Payments (Note 4.)				
Total Amount Financed ($)				
ANNUAL CASH FLOW (PERFORMANCE PERIOD)				
Debt Service:				
Interest ($)	$48,677	$31,310	$11,572	$1,143,879
Principal Repayment ($)	$204,265	$232,649	$263,825	$1,650,531
Total Debt Service ($) (a)	$252,942	$263,959	$275,397	$2,794,410
Penalty if debt is retired at year end ($)	$49,647	$26,383	($0)	$1,339,356
Performance Period Expenses:				
Management/Administration ($)	$9,601	$9,841	$10,087	$113,553
Operation ($)	$0	$0	$0	$0
Maintenance ($)	$40,963	$41,987	$43,036	$484,494
Repair and Replacement ($)	$50,563	$51,827	$53,123	$598,047
Measurement and Verification ($)	$8,742	$8,961	$9,185	$106,569
Permits and Licenses ($)	$3,840	$3,936	$4,035	$45,421
Insurance ($) (Note 6)	$0	$0	$0	$0
Property Taxes ($) (Note 6)	$0	$0	$0	$0
Other (describe & itemize on attachment) ($)	$0	$0	$0	$0
Subtotal Performance Period Expenses ($)	$113,709	$116,552	$119,465	$1,348,085
Performance Period Mark-up (%)	27%	27%	27%	
Performance Period Mark-up ($)	$30,701	$31,469	$32,256	
Total Performance Period Expenses (b)	$144,410	$148,021	$151,721	$1,712,068
Total Annual Contractor Payment (a)+(b)	$397,353	$411,979	$427,118	$4,506,478

Notes: 1) Performance Period Expenses shall include o
3) Contractor shall attach adequate supporting i
3) If applicable, contractor shall specify escalatic
4) If applicable, pre-performance period paymer
5) Financing Procurement Price includes perforr
6) No costs are shown for Insurance or Property

Schedule DO-4

SCHEDULE DO-4

First Year Energy And Cost Savings By ECM,Technology Category, and Delivery Order

Project site: Hagel Building	Delivery Order No.	Contractor Name: Sempra Energy Services	Project Square Footage (KSF) 446.6

	(a1) Electricity Energy ($/kWh)	(b1) Electricity Demand ($/kW)	(c1) Natural Gas ($/therm)	(d1) Other Savings ($/MMBTU)	
Baseline Energy Prices (provide supporting attachment)	$ -	$ -	$ -	$ -	$ -

Tech No.	ECM No.	(a) ECM Energy Baseline (MBTU/yr)	(b1) Electricity Energy Savings (kWh/yr)	(b2) Electricity Savings ($/yr)	(c1) Demand Savings (kW)	(c2) Demand Savings ($/yr)	(d1) Natural Gas Savings (MBTU/yr)	(d2) Natural Gas Savings ($/yr)	(e1) Other Savings (MBTU/yr)	(e2) Other Savings ($/yr)	(f) =0.003413*(b1)+(d1)+(e1) Total Energy Savings (MBTU/yr)	(g)=(b2)+(c2)+(d2)+(e2) Total Energy Cost Savings ($/yr)	(h) Other Energy Related & O&M Cost Savings ($/yr)	(i)=(g)+(h) Estimated Annual Cost Savings ($/yr)	(j) Implement-ation Price ($)	(k) = (j)/(I) Simple Payback (yrs.)
C.2.15	Convert to Primary Elect Serv		164,370	$ -	38	$ -	0	$ -	0	$ -	561	$112,479	$0	$112,479	$500,100	4.4
C.2.10	Distrib. Gen. HW Recovery		1,732,800	$ -	500	$ -	-14,139	$ -	0	$ -	-8,224	$171,712	$10,000	$181,712	$1,198,871	6.6
C.2.7	Replace FC Valves		20,700	$ -	0	$ -	0	$ -	0	$ -	71	$2,070	$0	$2,070	$143,864	69.5
Total			1,917,869		538		-14,139		0		-7,593	$286,261	$10,000	$296,261	$1,842,836	6.2

Notes:
1) Project Square Footage (in 1000 SF) - Include only building square footage affected by installed ECMS in project.
2) For collumn (a) insert estimated energy baseline by ECM and total project in MBTU based on DES and Final Proposal data.
3) Energy conversion factors for MBTU: MBTU = 10^6 BTU; Electricity - 0.003413 MBTU/kWh; Natural Gas - 0.1 MBTU/therm; #2 Oil - 0.128 MBTU/gal.
4) Specify "Other" energy savings in (e)(1) & (e)(2) as applicable. Include energy type ________; energy units ________; and BTU conversion factor _____ BTU/_____ (unit).

APPENDICES

APPENDIX A

ELECTRIC RATE SCHEDULES

Utility: Pacific Gas & Electric (PG&E)
Electric Rate: E-20 S, Demands of 1,000 kW or >(Secondary)

Energy Cost

	On-Peak	Partial-Peak	Off-Peak
Summer			
Energy Rate, $/kWh:	$0.18407	$0.09814	$0.09069
Winter			
Energy Rate, $/kWh:	$0	$0.10391	$0.09048

Demand Cost

	Demand Charge $/kW	Applicable Time mos/yr
Summer Peak-Period	$13.35	6
Summer Part-Peak Period	$3.70	6
Winter Part-Peak Period	$3.65	6
Summer Maximum Demand	$2.55	6
Winter Maximum Demand	$2.55	6

Utility: **Pacific Gas & Electric (PG&E)**
Electric Rate: **E-20, Demands of 1,000 kW or >(Secondary)**

Rate Components[1]	Trans	Distr	PPP	Gen	NDC	Reliability Services	Subtotal	Energy Surcharge	Total
Energy Charge, $/kWh:									
<u>Summer</u>									
On-Peak		0.01154	0.00336	0.07185	0.00033		0.08708	0.10131	0.18839
Mid-Peak		0.00764	0.00336	0.04634	0.00033		0.05767	0.04479	0.10246
Off-Peak		0.00665	0.00336	0.03988	0.00033		0.05022	0.04479	0.09501
<u>Winter</u>									
On-Peak		N/A	N/A	N/A	N/A		N/A	N/A	N/A
Mid-Peak		0.00840	0.00336	0.05135	0.00033		0.06344	0.04479	0.10823
Off-Peak		0.00663	0.00336	0.03969	0.00033		0.05001	0.04479	0.09480
Economic Stimulus Rate Credit				-0.00432			-0.00432		-0.00432
Trans. Rev. Bal. Accnt. Adj. Rate	-0.00157			0.00157			0		0
Customer Charge, $/month:		385					385		385
Time Related Demand, $/kW:									
Maximum Peak-Period									
Summer		4.95		8.40			13.35		13.35
Winter		N/A		N/A			N/A		
Maximum Part-Peak Period									
Summer		1.37		2.33			3.70		3.70
Winter		1.36		2.29			3.65		3.65
Maximum Demand									
Summer	1.85	1.78		-2.72		1.64	2.55		2.55
Winter	1.85	1.78		-2.72		1.64	2.55		2.55

1. Abbreviations:
Transmission
Distribution
Public Purpose Programs
Generation
Nuclear Decommissioning
Reliability Services
Energy Procurement Surcharge

Utility:	**Pacific Gas & Electric (PG&E)**
Electric Rate:	**E-20 P, Demands of 1,000 kW or >(PRIMARY)**

Energy Cost

	On-Peak	Partial-Peak	Off-Peak
<u>Summer</u>			
Energy Rate, $/kWh:	$0.15909	$0.08936	$0.08752
<u>Winter</u>			
Energy Rate, $/kWh:	$0	$0.09739	$0.08834

Demand Cost

	Demand Charge $/kW	Applicable Time mos/yr
Summer Peak-Period	$11.80	6
Summer Part-Peak Period	$2.65	6
Winter Part-Peak Period	$2.65	6
Summer Maximum Demand	$2.55	6
Winter Maximum Demand	$2.55	6

Utility: **Pacific Gas & Electric (PG&E)**
Electric Rate: **E-20, Demands of 1,000 kW or >(PRIMARY)**

Rate Components[1]	Trans	Distr	PPP	Gen	NDC	Reliability Services	Subtotal	EPS	Total
Energy Charge, $/kWh:									
Summer									
On-Peak		0.00477	0.00298	0.05407	0.00028		0.06210	0.10131	0.16341
Mid-Peak		0.00370	0.00298	0.04125	0.00028		0.04821	0.04547	0.09368
Off-Peak		0.00357	0.00298	0.03954	0.00028		0.04637	0.04547	0.09184
Winter									
On-Peak		N/A	N/A	N/A	N/A		N/A	N/A	
Mid-Peak		0.00433	0.00298	0.04865	0.00028		0.05624	0.04547	0.10171
Off-Peak		0.00363	0.00298	0.04030	0.00028		0.04719	0.04547	0.09266
Economic Stimulus Rate Credit				-0.00432			-0.00432		-0.00432
Trans. Rev. Bal. Accnt. Adj. Rate	-0.00157			0.00157			0		0
Customer Charge, $/month:		310					310		310
Time Related Demand, $/kW:									
Maximum Peak-Period									
Summer		2.84		8.96			11.80		11.80
Winter		N/A		N/A			N/A		N/A
Maximum Part-Peak Period									
Summer		0.64		2.01			2.65		2.65
Winter		0.64		2.01			2.65		2.65
Maximum Demand									
Summer	2.71	1.07		-2.24		1.01	2.55		2.55
Winter	0.56	1.07		-0.09		1.01	2.55		2.55

1. Abbreviations:
Transmission
Distribution
Public Purpose Programs
Generation
Nuclear Decommissioning
Reliability Services
Energy Procurement Surcharge

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE

CONTENTS: This rate schedule is divided into the following sections:

1. APPLICABILITY: **Initial Assignment:** A customer is eligible for service under Schedule E-20 if the customer's maximum demand (as defined below) has exceeded 999 kilowatts for at least three consecutive months during the most recent 12-month period. If 70 percent or more of the customer's energy use is for agricultural end-uses, the customer will be served under an agricultural schedule.

Customer accounts which fail to qualify under these requirements will be evaluated for transfer to service under a different applicable rate schedule.

The provisions of Schedule S—Standby Service Special Conditions 1 through 6 shall also apply to customers whose premises are regularly supplied in part (but not in whole) by electric energy from a nonutility source of supply. These customers will pay monthly reservation charges as specified under Section 1 of Schedule S, in addition to all applicable Schedule E-20 charges. Customers who utilize solar generating (N)
facilities which are less than or equal to one megawatt to serve load and who do not sell power or make more than incidental export of power into PG&E's power grid and who have not elected service under Schedule E-NET, will be exempt from paying standby charges under this provision. (N)

Transfers Off of Schedule E-20: PG&E will review its Schedule E-20 accounts annually. A customer will be eligible for continued service on Schedule E-20 if its maximum demand has either: (1) Exceeded 999 kilowatts for at least 5 of the previous 12 billing months, or (2) Exceeded 999 kilowatts for any 3 consecutive billing months of the previous 14 billing months. If a customer's demand history fails both of these tests, PG&E will transfer that customer's account to service under a different applicable rate schedule, except as specified in the Energy Efficiency Adjustment provision below.

Assignment of New Customers: If a customer is new and PG&E believes that the customer's maximum demand will exceed 999 kilowatts and that the customer should not be served under a time-of-use agricultural schedule, PG&E will serve the customer's account under Schedule E-20.

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

1. APPLICABILITY: (Cont'd.)

Definition of Maximum Demand: Demand will be averaged over 30-minute intervals. "Maximum demand" will be the highest of all the 30-minute averages for the billing month. If the customer's use of electricity is intermittent or subject to violent fluctuations, a 5-minute or 15-minute interval may be used instead of the 30-minute interval. If the customer has any welding machines, the diversified resistance welder load, calculated in accordance with Section J of Rule 2, will be considered the maximum demand if it exceeds the maximum demand that results from averaging the demand over 30-minute intervals. The customer's maximum-peak-period demand will be the highest of all the 30-minute averages for the peak period during the billing month. (See Section 5 for a definition of "Peak-Period.")

Standby Demand: For customers for whom Shedule S—Standby Service Special Conditions 1 through 7 apply, standby demand is the portion of a customer's maximum demand in any month caused by nonoperation of the customer's alternate source of power, and for which a demand charge is paid under the regular service schedule.

If the customer imposes standby demand in any month, then the regular service maximum demand charge will be reduced by the applicable reservation capacity charge (see Schedule S Special Condition 1).

To qualify for the above reduction in the maximum demand charge, the customer must, within 30 days of the regular meter read date, demonstrate to the satisfaction of PG&E the amount of standby demand in any month. This may be done by submitting to PG&E a completed Electric Standby Service Long Sheet (Form 79-726).

Energy Efficiency Adjustment: A customer who implements measures to improve electrical energy efficiency on or after January 1, 1990, may be eligible to receive an enery efficiency adjustment. A customer will qualify for an energy efficiency adjustment if both following conditions are met: (1) the customer's service was established prior to January 1, 1990, and (2) the energy efficiency measures reduce the customer's maximum demand to the point that the customer would no longer be eligible for service under Schedule E-20.

To receive the energy efficiency adjustment, the customer must qualify for and sign an Agreement for Maximum Demand Adjustment for Energy Efficiency Measures (Form No. 79-758). The energy efficiency adjustment shall be the fixed reduction in demand specified in Form 79-758, and shall be added to the customer's maximum demand for the sole purpose of determining the customer's eligibility for Schedule E-20.

The energy efficiency adjustment specifically does not guarantee the customer's continued eligibility for service under Schedule E-20. The energy efficiency adjustment will not be applied to the customer's maximum demand for the purposes of calculating the monthly maximum demand charge.

Economic Stimulus Rate Credit: The Economic Stimulus Rate Credit applies to customers that take service under Schedule E-20, and will terminate on the effective date of the end of PG&E's rate freeze. (N)
|
(N)

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

2. TERRITORY: Schedule E-20 applies everywhere PG&E provides electricity service.

3. FIRM SERVICE RATES:

SECONDARY (E-20S)	Transmission	Distribution	Public Purpose Programs	Generation	Nuclear Decom-missioning	Reliability Services	Total Rate
Maximum Peak-Period Demand							
Summer	–	$4.95 (I)	–	$8.40 (R)	–	–	$13.35
Winter	–	–	–	–	–	–	–
Maximum Part-Peak-Period Demand							
Summer	–	$1.37 (I)	–	$2.33 (R)	–	–	$3.70
Winter	–	$1.36 (I)	–	$2.29 (R)	–	–	$3.65
Maximum Demand							
Summer	$1.85	$1.78 (I)	–	($2.72) (R)	–	$1.64	$2.55
Winter	$1.85	$1.78 (I)	–	($2.72) (R)	–	$1.64	$2.55
Energy Charges (per kWh)							
Peak-Period							
Summer	–	$0.01154 (I)	$0.00336	$0.07185 (R)	$0.00033	–	$0.08708
Winter	–	–	–	–	–	–	–
Part-Peak-Period							
Summer	–	$0.00764 (I)	$0.00336	$0.04634 (R)	$0.00033	–	$0.05767
Winter	–	$0.00840 (I)	$0.00336	$0.05135 (R)	$0.00033	–	$0.06344
Off-Peak-Period							
Summer	–	$0.00665 (I)	$0.00336	$0.03988 (R)	$0.00033	–	$0.05022
Winter	–	$0.00663 (I)	$0.00336	$0.03969 (R)	$0.00033	–	$0.05001
Economic Stimulus Rate Credit (per kWh)	–	–	–	$0.00432	–	–	$0.00432
Average Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	$0.13995
Peak Period Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	$0.97708
Customer Charge (per meter per month)	–	$385.00	–	–	–	–	$385.00
Transmission Revenue Balancing Account Adjustment Rate per kWh per month	($0.00145)	–	–	$0.00145	–	–	$0.00000

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

3. FIRM SERVICE RATES: (Cont'd.)

PRIMARY (E-20P)	Transmission	Distribution	Public Purpose Programs	Generation	Nuclear Decom-missioning	Reliability Services	Total Rate
Demand Charges (per kW)							
Maximum Peak-Period Demand							
Summer	–	$3.33 (I)	–	$8.47 (R)	–	–	$11.80
Winter	–	–	–	–	–	–	–
Maximum Part-Peak-Period Demand							
Summer	–	$0.75 (I)	–	$1.90 (R)	–	–	$2.65
Winter	–	$0.75 (I)	–	$1.90 (R)	–	–	$2.65
Maximum Demand							
Summer	$1.85	$1.25 (I)	–	($2.19) (R)	–	$1.64	$2.55
Winter	$1.85	$1.25 (I)	–	($2.19) (R)	–	$1.64	$2.55
Energy Charges (per kWh)							
Peak-Period							
Summer	–	$0.00477 (I)	$0.00298	$0.05407 (R)	$0.00028 (I)	–	$0.06210
Winter	–	–	–	–	–	–	–
Part-Peak-Period							
Summer	–	$0.00370 (I)	$0.00298	$0.04125 (R)	$0.00028 (I)	–	$0.04821
Winter	–	$0.00433 (I)	$0.00298	$0.04865 (R)	$0.00028 (I)	–	$0.05624
Off-Peak-Period							
Summer	–	$0.00357 (I)	$0.00298	$0.03954 (R)	$0.00028 (I)	–	$0.04637
Winter	–	$0.00363 (I)	$0.00298	$0.04030 (R)	$0.00028 (I)	–	$0.04719
Economic Stimulus Rate Credit (per kWh)	–	–	–	$0.00432	–	–	$0.00432
Average Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	$0.13995
Peak Period Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	$0.84876
Customer Charge (per meter per month)	–	$310.00	–	–	–	–	$310.00
Transmission Revenue Balancing Account Adjustment Rate per kWh per month	($0.00145)	–	–	$0.00145	–	–	$0.00000

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

3. FIRM SERVICE RATES: (Cont'd.)

TRANSMISSION (E-20T)	Transmission	Distribution	Public Purpose Programs	Generation	Nuclear Decom-missioning	Reliability Services	Total Rate
Demand Charges (per kW)							
Maximum Peak-Period Demand							
Summer	–	$0.26 (I)	–	$7.24 (R)	–	–	$7.50
Winter	–	–	–	–	–	–	–
Maximum Part-Peak-Period Demand							
Summer	–	$0.02 (I)	–	$0.58 (R)	–	–	$0.60
Winter	–	$0.02 (I)	–	$0.73 (R)	–	–	$0.75
Maximum Demand							
Summer	$1.85	$0.11 (I)	–	($3.25) (R)	–	$1.64	$0.35
Winter	$1.85	$0.11 (I)	–	($3.25) (R)	–	$1.64	$0.35
Energy Charges (per kWh)							
Peak-Period							
Summer	–	$0.00284 (I)	$0.00247	$0.05199 (R)	$0.00020 (I)	–	$0.05750
Winter	–	–	–	–	–	–	–
Part-Peak-Period							
Summer	–	$0.00216 (I)	$0.00247	$0.03878 (R)	$0.00020 (I)	–	$0.04361
Winter	–	$0.00264 (I)	$0.00247	$0.04838 (R)	$0.00020 (I)	–	$0.05369
Off-Peak-Period							
Summer	–	$0.00202 (I)	$0.00247	$0.03628 (R)	$0.00020 (I)	–	$0.04097
Winter	–	$0.00218 (I)	$0.00247	$0.03935 (R)	$0.00020 (I)	–	$0.04420
Economic Stimulus Rate Credit (per kWh)	–	–	–	$0.00432	–	–	$0.00432
Average Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	–
Peak Period Rate Limiter (per kWh in summer months)	–	–	–	–	–	–	$0.55750
Customer Charge (per meter per month)	–	$715.00	–	–	–	–	$715.00
Transmission Revenue Balancing Account Adjustment Rate per kWh per month	($0.00145)	–	–	$0.00145	–	–	$0.00000

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

3. FIRM SERVICE RATES: (Cont'd.)

Generation charge is calculated based on the total rate less the sum of: Distribution, Transmission, Public Purpose Program, Nuclear Decommissioning, and FTA (where applicable) charges. CTC is calculated residually by subtracting the PX charge as calculated in Schedule PX from the generation charge. (N)

a. TYPES OF CHARGES: The customer's monthly charge for service under Schedule E-20 is the sum of a customer charge, demand charges, and energy charges: (L)

– The **energy charge** is the sum of the energy charges from the peak, partial-peak, and off-peak periods less the product of the Economic Stimulus Rate Credit and the total energy used during the billing month. The customer pays for energy by the kilowatt-hour (kWh), and rates are differentiated according to time of day and time of year.

– The monthly charges may be increased or decreased based upon the power factor. (See Section 6.)

– The **customer charge** is a flat monthly fee. (L)

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

3. FIRM SERVICE RATES: (Cont'd.)

a. TYPES OF CHARGES: (Cont'd.)

– Schedule E-20 has three **demand charges**, a maximum-peak-period-demand charge, a maximum-part-peak-period demand charge, and a maximum-demand charge. The maximum-peak-period-demand charge per kilowatt applies to the maximum demand during the month's peak hours, the maximum-part-peak-demand charge applies to the maximum demand during the month's part-peak hours, and the maximum-demand charge per kilowatt applies to the maximum demand at any time during the month. The bill will include all of these demand charges. (Time periods are defined in Section 5.)

– As shown on the rate chart, which set of customer, demand, and energy charges is paid depends on the voltage at which service is taken. Service voltages are defined in Section 4 below.

– Please note that the rates in the chart on the preceding page apply only to firm service. Rates for non-firm service can be found in Section 12 of this rate schedule. Customers participating in the Nonfirm Bidding Pilot Program will be billed according to Section 17. Customers participating in the Local Nonfirm Bidding Pilot Program will be billed according to Section 18

b. AVERAGE RATE LIMITER (applies to firm service only): If the customer takes service on Schedule E-20, in either the secondary or primary voltage class, bills will be controlled by a "rate limiter" during the summer months. The bill will be reduced if necessary so that the average rate paid for all demand and energy (T)
charges as determined prior to application of the Energy Procurement Surcharge (T)
(EPS) as provided in Schedule E-EPS during a summer month does not exceed the rate limiter shown on this schedule. This provision will not apply if the customer has elected to receive separate billing for back-up and maintenance service pursuant to Special Condition 8 of Schedule S.

Reductions in revenue resulting from application of the average rate limiter will be reflected as reduced generation amounts for billing purposes.

c. PEAK-PERIOD RATE LIMITER (applies to firm service only): If the customer takes service on Schedule E-20 at any service voltage level, bills will be controlled by a "peak-period rate limiter" during the summer months. The bill will be reduced if necessary so that the average rate paid for all on-peak demand (T)
and energy charges as determined prior to application of the EPS as provided in (T)
Schedule E-EPS during the peak period in a summer month does not exceed the peak-period rate limiter shown on this schedule. This provision will not apply if the customer has elected to receive separate billing for back-up and maintenance service pursuant to Special Condition 8 of Schedule S.

Reductions in revenue resulting from application of the peak-period rate limiter will be reflected as reduced generation amounts for billing purposes.

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

4. DEFINITION OF SERVICE VOLTAGE: The following defines the three voltage classes of Schedule E-20 rates. Standard Service Voltages are listed in Rule 2. (L)

a. Secondary: This is the voltage class if the service voltage is less than 2,400 volts or if the definitions of "primary" and "transmission" do not apply to the service.

b. Primary: This is the voltage class if the customer is served from a "single customer substation" or without transformation from PG&E's serving distribution system at one of the standard primary voltages specified in PG&E's Electric Rule 2, Section B.1.

c. Transmission: This is the voltage class if the customer is served without transformation at one of the standard transmission voltages specified in PG&E's Electric Rule 2, Section B.1.

5. DEFINITION OF TIME PERIODS: Times of the year and times of the day are defined as follows:

SUMMER Period A (Service from May 1 through October 31):

Peak:	12:00 noon. to 6:00 p.m.	Monday through Friday (except holidays)
Partial-peak:	8:30 a.m. to 12:00 noon AND 6:00 p.m. to 9:30 p.m. Monday through Friday (except holidays).	
Off-peak:	9:30 p.m. to 8:30 a.m. All day	Monday through Friday Saturday, Sunday, and holidays (L)

WINTER Period B (service from November 1 through April 30):

Partial-Peak:	8:30 a.m. to 9:30 p.m.	Monday through Friday (except holidays).
Off-Peak:	9:30 p.m. to 8:30 a.m. All day	Monday through Friday (except holidays). Saturday, Sunday, and holidays

HOLIDAYS: "Holidays" for the purposes of this rate schedule are New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, and Christmas Day. The dates will be those on which the holidays are legally observed.

CHANGE FROM SUMMER TO WINTER OR WINTER TO SUMMER: When a billing month includes both summer and winter days, PG&E will calculate demand charges as follows. It will consider the applicable maximum demands for the summer and winter portions of the billing month separately, calculate a demand charge for each, and then apply the two according to the number of billing days each represents. NOTE: If the meter is read within one workday o the season changeover date (May 1 or November 1), PG&E will use only the rates and charges from the season having the greater number of days in the billing month. Workdays are Monday through Friday, inclusive.

(L)

(Continued)

COMMERCIAL/INDUSTRIAL/GENERAL
SCHEDULE E-20—SERVICE TO CUSTOMERS WITH MAXIMUM DEMANDS OF 1,000 KILOWATTS OR MORE
(Continued)

6. POWER FACTOR ADJUSTMENTS: The bill will be adjusted based upon the power factor. The power factor is computed from the ratio of lagging reactive kilovolt-ampere-hours to the kilowatt-hours consumed in the month. Power factors are rounded to the nearest whole percent.

The rates in this rate schedule are based on a power factor of 85 percent. If the average power factor is greater than 85 percent, the total monthly bill (excluding any taxes and the Energy Procurement Surcharge (EPS) as provided in (T) Schedule E-EPS) will be reduced by 0.06 percent for each percentage point (T) above 85 percent. If the average power factor is below 85 percent, the total monthly bill (excluding any taxes and the EPS provided in Schedule E-EPS) will (T) be increased by 0.06 percent for each percentage point below 85 percent.

Power factor adjustments will be assigned to generation for billing purposes.

7. CHARGES FOR TRANSFORMER AND LINE LOSSES: The demand and energy meter readings used in determining the charges will be adjusted to correct for transformation and line losses in accordance with Section B.4 of Rule 2.

8. STANDARD SERVICE FACILITIES: If PG&E must install any new or additional facilities to provide the customer with service under Schedule E-20, the customer may have to pay some of the cost. Any advance necessary and any monthly charge for the facilities will be specified in a line extension agreement. See Rules 2, 15, and 16 for details.

Facilities installed to serve the customer may be removed when service is discontinued. The customer will then have to repay PG&E for all or some of its investment in the facilities. Terms and conditions for repayment will be set forth in the line extension agreement.

9. SPECIAL FACILITIES: PG&E will normally install only those standard facilities it deems necessary to provide service under Schedule E-20. If the customer requests any additional facilities, those facilities will be treated as "special facilities" in accordance with Section I of Rule 2.

10. ARRANGEMENTS FOR VISUAL-DISPLAY METERING: If the customer wishes to have visual-display metering equipment in addition to the regular metering equipment, and the customer would like PG&E to install that equipment, the customer must submit a written request to PG&E. PG&E will provide and install the equipment within 180 days of receiving the request. The visual-display metering equipment will be installed near the present metering equipment. The customer will be responsible for providing the required space and associated wiring.

PG&E will continue to use the regular metering equipment for billing purposes.

(Continued)

SCHEDULE E-EPS—ENERGY PROCUREMENT SURCHARGES

APPLICABILITY: This schedule applies to electric customers as described below. The surcharges under this schedule provide an increase in revenues, subject to refund or adjustment, for the purpose of improving utility recovery of the costs of procuring future energy costs in the wholesale market.

TERRITORY: Schedule E-EPS applies everywhere PG&E provides electric service.

RATES: The following surcharges are applied after all other calculations are made pursuant to the terms set forth in each rate schedule:

1. An Energy Procurement Surcharge shall be charged to all electric service customers, except customers taking service on the California Alternative Rates for Energy (CARE) program, and customers taking service on Schedule E-DEPART.

   Per kWh

   $0.01000

2. An additional Energy Procurement Surcharge shall be charged to all bundled service customers, except customers taking service on the California Alternative Rates for Energy (CARE) program or who receive a medical baseline allowance.

   For Residential Tier 1 and Tier 2 rates, see the customer's otherwise-applicable rate schedule. Tier 3 rates apply to 130 percent to 200 percent of the customer's Tier 1 baseline quantity; Tier 4 rates apply to 201 percent to 300 percent of the Tier 1 baseline quantity; Tier 5 rates apply to use over 300 percent of the Tier 1 baseline quantity.

Rate Schedule		Surcharge ($/kWh)
Residential:		
E-1, EM, ET, ES, ESR, E-7, E-A7, E-8, E-9		
Tier 3		$0.05124
Tier 4		$0.09517
Tier 5		$0.11505
Commercial/Industrial:		
A-1	Summer	$0.06140
	Winter	$0.02838
A-6	Summer On-Peak	$0.10064
	Summer Partial Peak	$0.04551
	Summer Off-Peak	$0.03551
	Winter Partial Peak	$0.04551
	Winter Off-Peak	$0.03551

(L)

(Continued)

SCHEDULE E-EPS—ENERGY PROCUREMENT SURCHARGES
(Continued)

(N)

RATES:
(Cont'd.)

Rate Schedule		Surcharge ($/kWh)
Commercial/Industrial (Cont'd.):		
A-15	Summer	$0.06371
	Winter	$0.02731
TC-1	Summer	$0.04551
	Winter	$0.04551
E-19	Transmission	
	Summer On-Peak	$0.08875
	Summer Partial Peak	$0.04131
	Summer Off-Peak	$0.03131
	Winter Partial Peak	$0.04131
	Winter Off-Peak	$0.03131
E-19	Primary	
	Summer On-Peak	$0.09202
	Summer Partial Peak	$0.04131
	Summer Off-Peak	$0.03131
	Winter Partial Peak	$0.04131
	Winter Off-Peak	$0.03131
E-19	Secondary	
	Summer On-Peak	$0.09070
	Summer Partial Peak	$0.04131
	Summer Off-Peak	$0.03131
	Winter Partial Peak	$0.04131
	Winter Off-Peak	$0.03131
E-20	Transmission	
	Summer On-Peak	$0.09131
	Summer Partial Peak	$0.03596
	Summer Off-Peak	$0.03596
	Winter Partial Peak	$0.03596
	Winter Off-Peak	$0.03596

(N)

(Continued)

SCHEDULE E-EPS—ENERGY PROCUREMENT SURCHARGES (N)

RATES: (Cont'd.)

Rate Schedule	Surcharge ($/kWh)
Commercial/Industrial (Cont'd.):	
E-20 - Primary	
Summer On-Peak	$0.09131
Summer Partial Peak	$0.03547
Summer Off-Peak	$0.03547
Winter Partial Peak	$0.03547
Winter Off-Peak	$0.03547
E-20 - Secondary	
Summer On-Peak	$0.09131
Summer Partial Peak	$0.03479
Summer Off-Peak	$0.03479
Winter Partial Peak	$0.03479
Winter Off-Peak	$0.03479
E-25 - Transmission	
Summer On-Peak	$0.11247
Summer Partial Peak	$0.04131
Summer Off-Peak	$0.03131
Winter Partial Peak	$0.04131
Winter Off-Peak	$0.03131
E-25 - Primary	
Summer On-Peak	$0.11738
Summer Partial Peak	$0.04131
Summer Off-Peak	$0.03131
Winter Partial Peak	$0.04131
Winter Off-Peak	$0.03131
E-25 - Secondary	
Summer On-Peak	$0.11540
Summer Partial Peak	$0.04131
Summer Off-Peak	$0.03131
Winter Partial Peak	$0.04131
Winter Off-Peak	$0.03131

(N)

(Continued)

APPENDIX B

SUMMARY OF ELECTRIC BILLS

Hagel Building
Summary of Electric Bills

Account No. DJT T3 25002-6

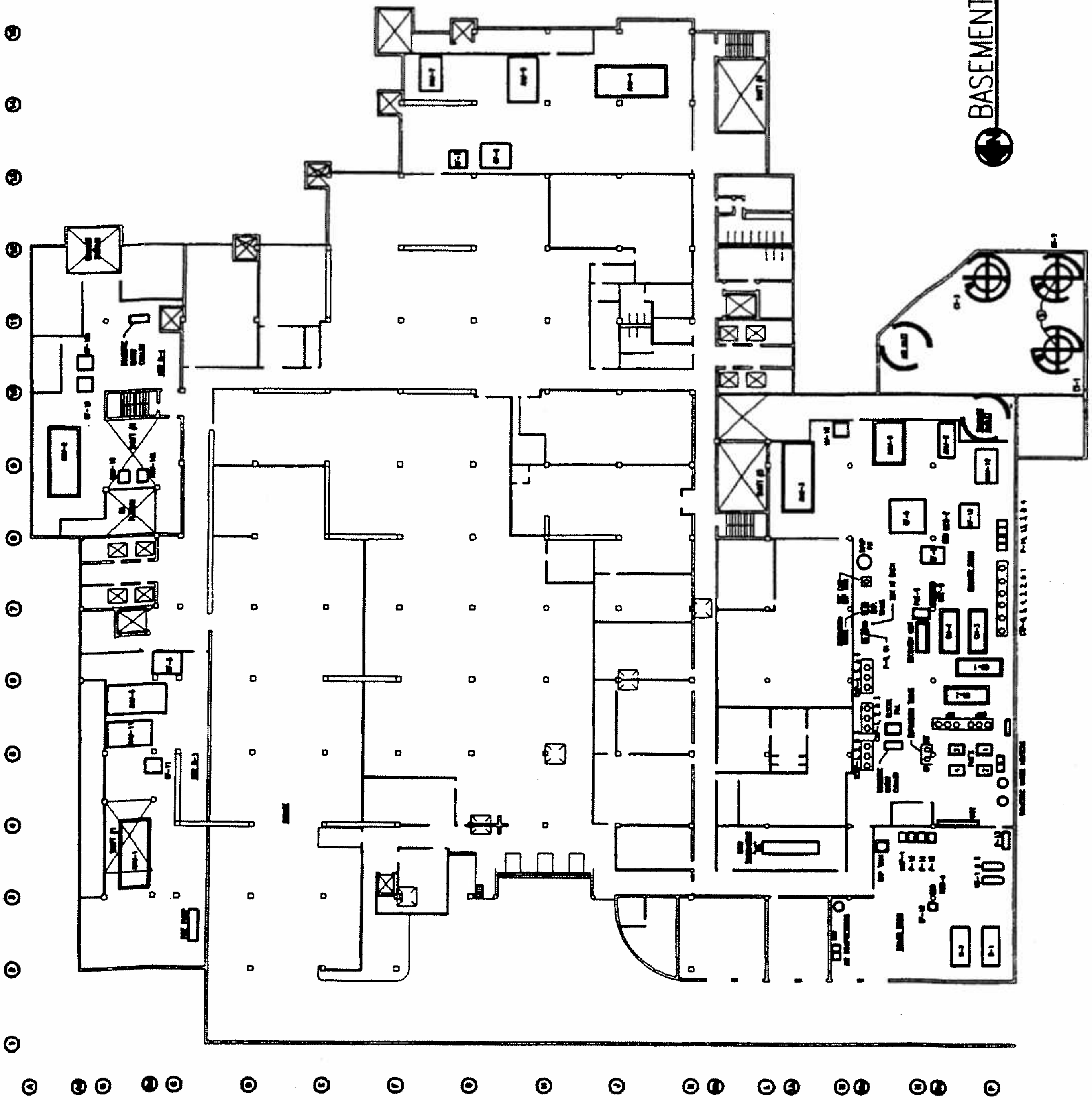
			Data from Monthly Electric Bills							SSA Summary Sheet		
			Demand, kW			Energy, kWh						
		Billing Days	Peak	Partial Peak	Off Peak	Peak	Partial Peak	Off Peak	Total	kWh	$/month	$/kWh
10/04/99	11/03/99	30								1,002,024	$107,484	$0.107
11/03/99	12/06/99	33								1,057,097	$71,784	$0.068
12/06/99	01/05/00	30		2,560	2,477		493,036	430,252	923,288	923,288	$64,841	$0.070
01/05/00	02/04/00	30		2,706	2,528		535,414	454,260	989,674	989,674	$69,368	$0.070
02/04/00	03/07/00	32		2,578	2,430		505,295	499,267	1,004,562	1,004,562	$68,856	$0.069
03/07/00	04/05/00	29		2,693	2,488		514,126	467,030	981,156	981,156	$68,616	$0.070
04/05/00	04/30/00	25		2,619	2,546		454,314	423,631	877,945			
05/01/00	05/04/00	4	2,550	2,613	2,384	40,581	33,653	37,612	111,846	989,791	$74,221	$0.075
05/04/00	06/06/00	33	2,691	2,699	2,595	303,165	259,212	564,632	1,127,009	1,127,009	$117,672	$0.104
06/06/00	**07/06/00**	**30**	**2,475**	**2,504**	**2,424**	**172,684**	**145,974**	**302,509**	**621,167**	1,036,345	$110,805	$0.107
07/06/00	08/04/00	29								997,188	$109,112	$0.109
08/04/00	**09/05/00**	**32**	**1,368**	**1,306**	**1,328**	**146,900**	**117,843**	**273,352**	**538,095**	1,104,695	$116,829	$0.106
09/05/00	**10/04/00**	**29**	**1,358**	**1,362**	**1,317**	**150,422**	**121,357**	**238,125**	**509,904**	1,023,795	$111,243	$0.109
10/04/00	**10/31/00**	**27**	**1,296**	**1,251**	**2,137**	**128,338**	**102,757**	**183,836**	**414,931**			
11/01/00	**11/02/00**	**2**		**1,278**	**1,110**		**11,706**	**6,937**	**18,643**	877,695	$101,339	$0.115
11/02/00	12/04/00	32							0	967,153	$67,284	$0.070
12/04/00	01/04/01	31								955,334	$67,010	$0.070
01/04/01	02/02/01	29								844,195	$69,624	$0.082
02/02/01	03/06/01	32								921,669	$73,410	$0.080
03/06/01	04/04/01	29							0	896,105	$72,431	$0.081
04/04/01	04/30/01	26		2,445	2,344		431,689	370,148	801,837			
05/01/01	05/04/01	4	2,403	2,349	2,296	37,105	32,580	33,486	103,171	905,008	$77,469	$0.086
05/04/01	06/04/01	31							0	927,117	$124,590	$0.134
06/04/01	07/04/01	30	2,473	2,425	2,340	259,064	225,431	424,501	908,996	908,996	$156,884	$0.173
07/04/01	08/02/01	29	2,426	2,409	2,355	257,003	220,668	408,546	886,217	886,217	$153,748	$0.173
08/02/01	09/03/01	32	2,472	2,438	2,350	259,019	221,743	475,026	955,788	955,788	$161,078	$0.169
09/03/01	10/02/01	29	2,442	2,452	2,334	253,660	220,762	391,312	865,734	865,734	$152,044	$0.176
10/02/01	10/31/01	29	2,422	2,415	2,348	250,637	216,009	357,817	824,463		$147,394	$0.179
10/31/01	12/03/01										$103,839	

Note: Data shown in bold appears to incorrect due to suspected problems with PG&E meter.

APPENDIX C

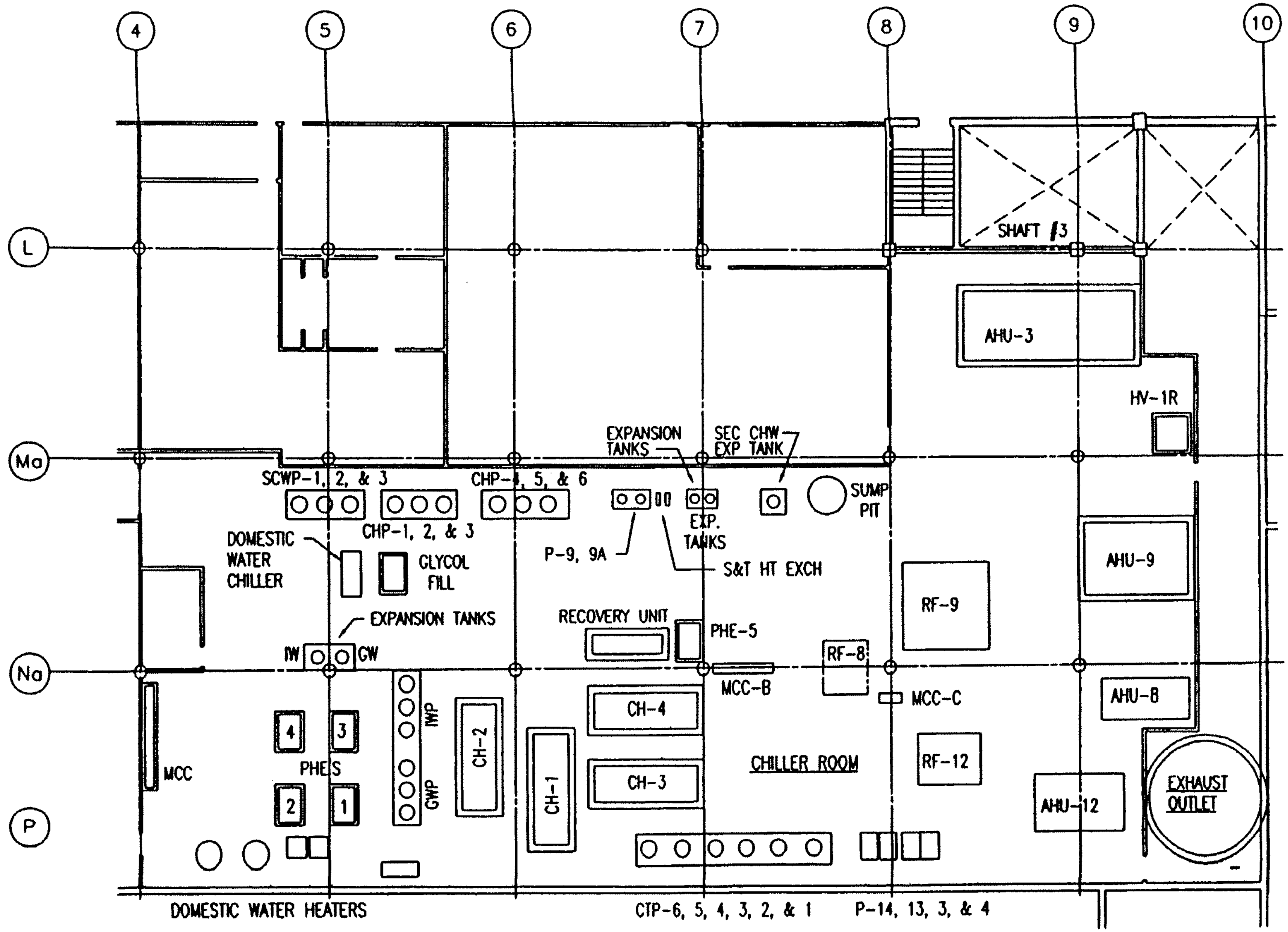
FLOOR PLANS

BASEMENT FLOOR PLAN

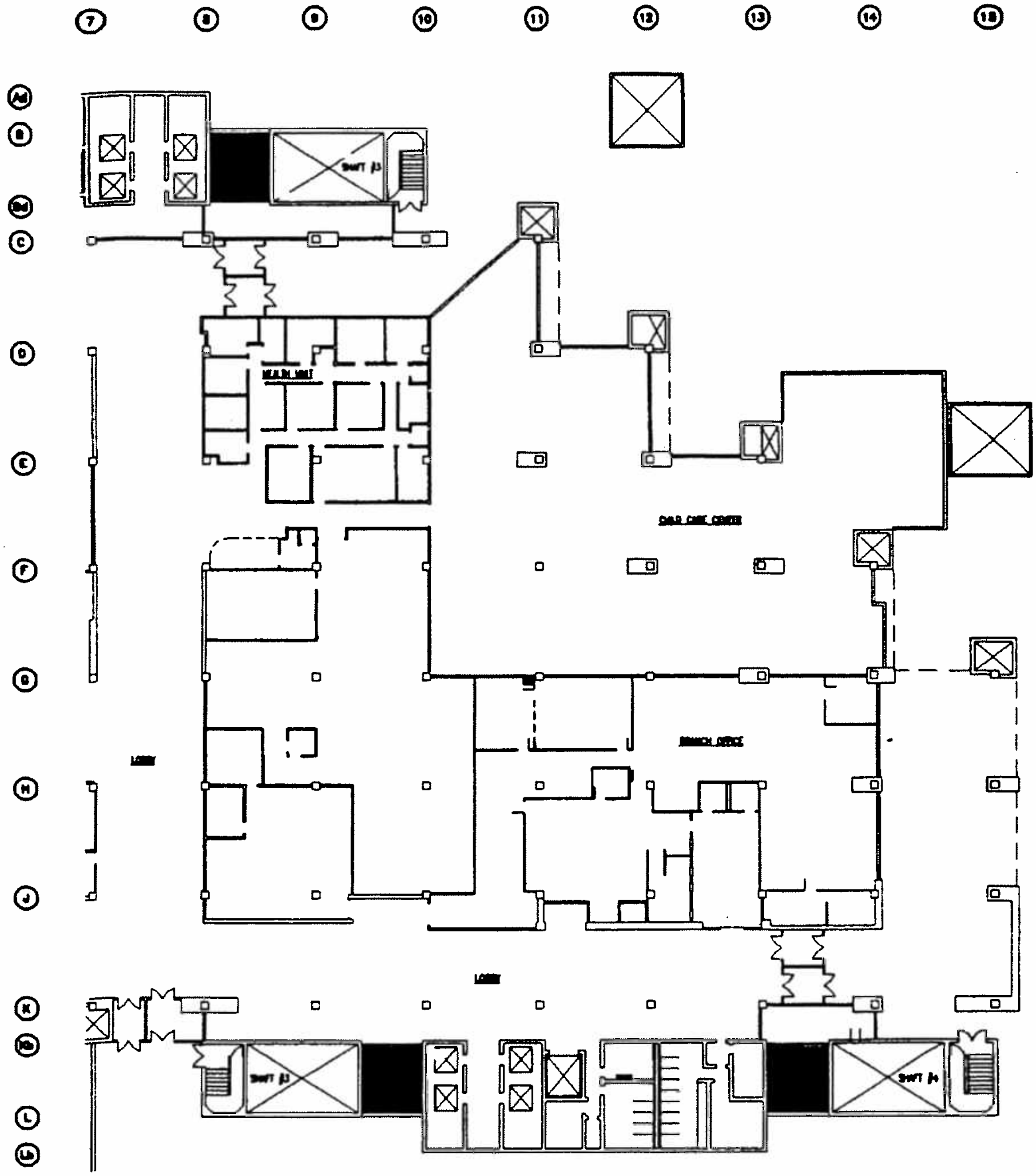


REV: 10/12/96

BASEMENT.DWG



CHILLER ROOM FLOOR PLAN

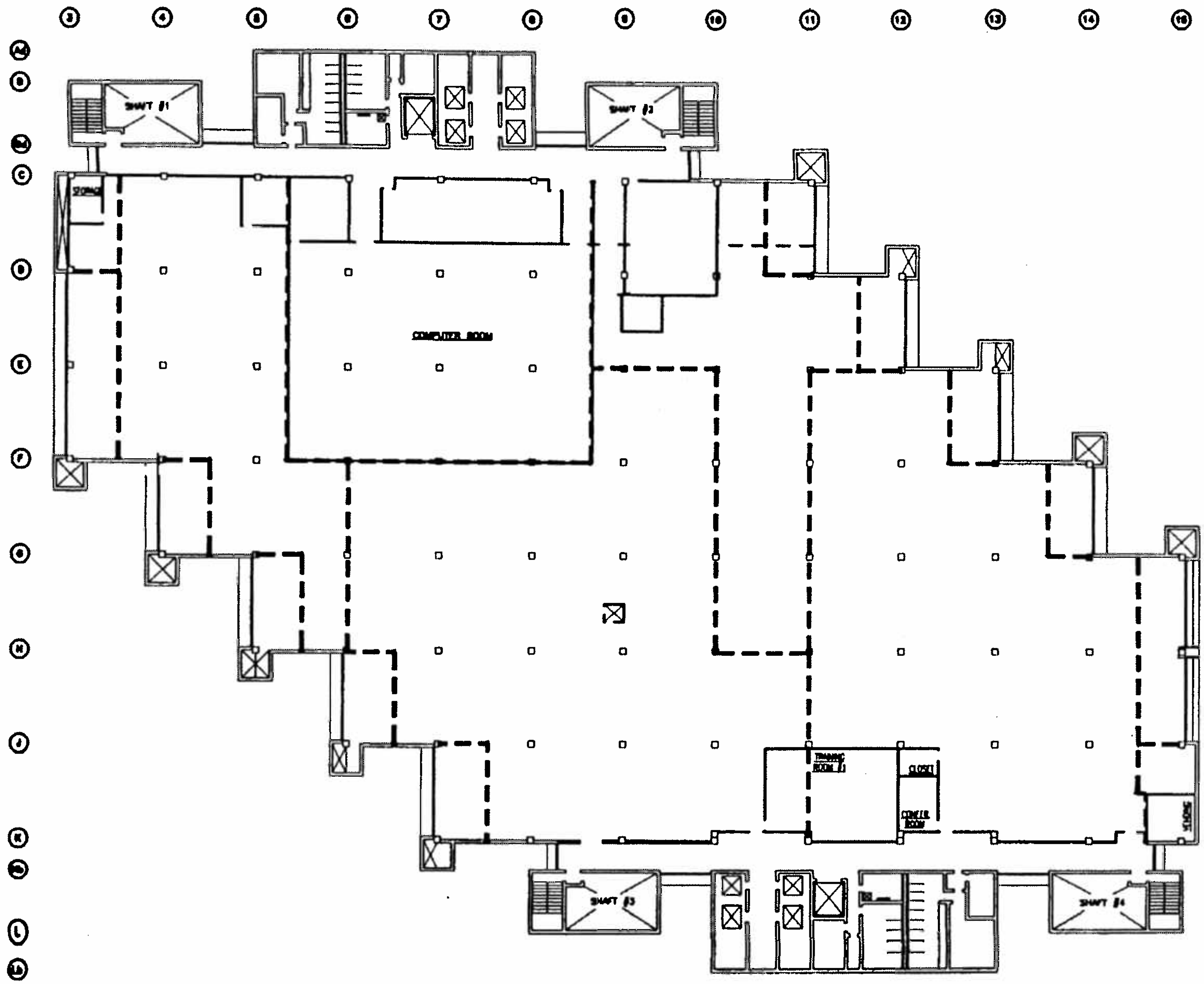


FIRST FLOOR PLAN

NONE

REV: 10/12/96

1ST-FL.DWG

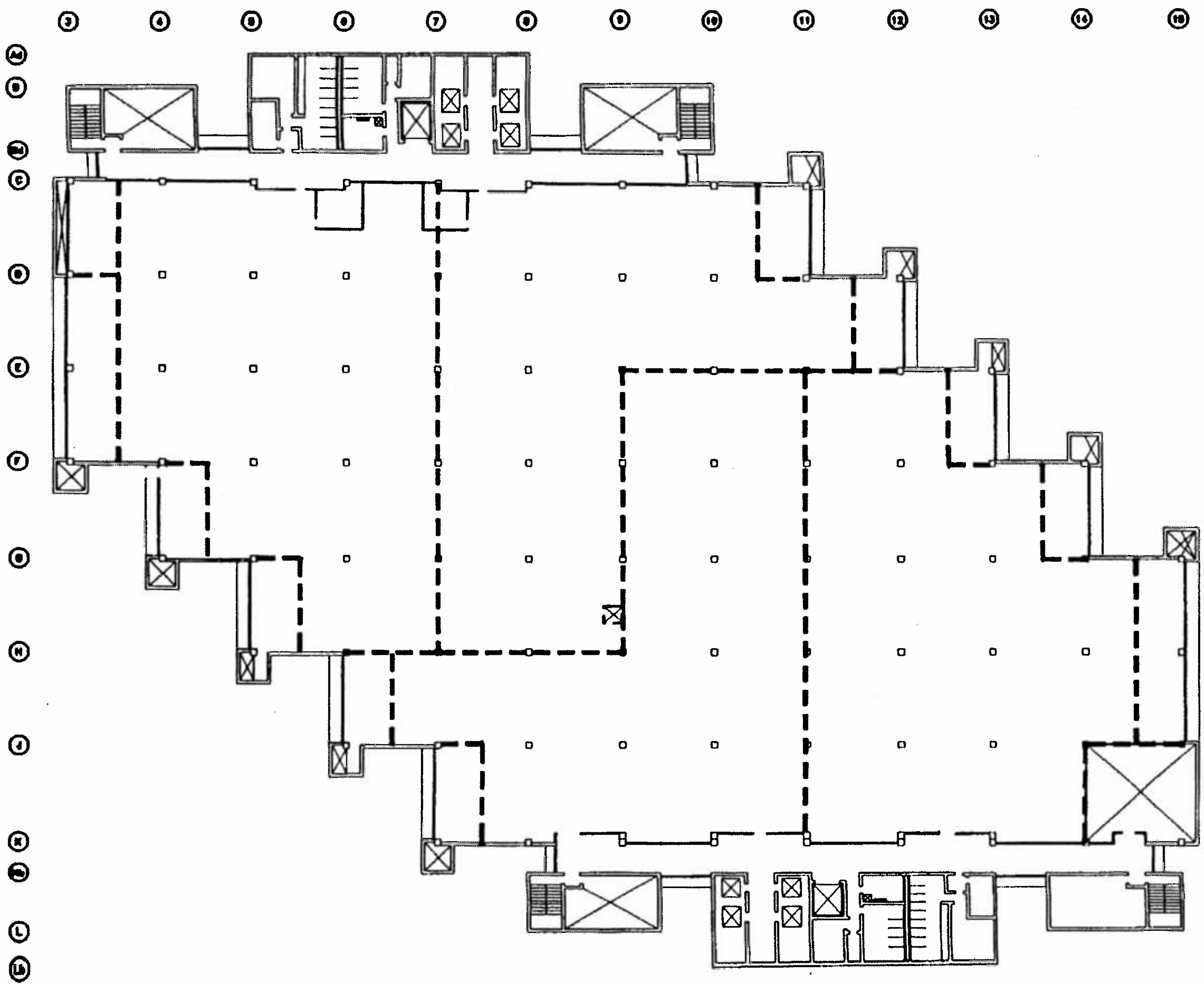


SECOND FLOOR PLAN

NONE

REV: 10/12/96

2ND-FL.DWG



TYPICAL FLOOR PLAN – (3RD–6TH)

REV: 10/12/96

TYP-FL.DWG

APPENDIX D

LIST OF MAJOR EQUIPMENT

Air Handling Units

	Floor Area	Zones Served	Econo. Cycle?	Air Flow cfm	Min. OSA cfm	Supply Fan hp	VFD?	Return Fan hp	VFD?	CHW Supply Temp	HW Supply Temp	100% OSA	Primary Air Temp.	Primary Air Humidity lb H2O/ lb dry air	Terminal Units	Terminal Electric Heat?	CHW Supply Temp	HW Supply Temp
AHU-1	S/E Side of Flrs. 2 - 6 + South Side of Flr. 1	Interior								34		Yes	49	0.005	Induced Fan, Air/Water & All/Air	Some	55 - 60	
AHU-2	S/W Side of Flrs. 2 - 6 + South Side of Flr. 1	Interior				50	Y	25	Y	34		Yes	49		Induced Fan, Air/Water & All/Air	Some	55 - 60	
AHU-3	N/E Side of Flrs. 2 - 6 + South Side of Flr. 1	Interior				50	Y	25	Y	34		Yes	49		Induced Fan, Air/Water & All/Air	Some	55 - 60	
AHU-4	N/W Side of Flrs. 2 - 6 + South Side of Flr. 1	Interior				60	Y	30	Y	34		Yes	49		Induced Fan, Air/Water & All/Air	Some	55 - 60	
AHU-5	East Corridor & Toilet Areas, Main Lobby					15	N	60?	N								42?	
AHU-6	West Corridor & Toilet Areas, Main Lobby					75	N	15	N								42?	
AHU-7	South Side of Flrs. 2 - 6	Perimeter	Yes	6750	2700	20	N	5	N			No	55 - 120		Induced Fan with 2-Pipe Fan Coil for Cooling or Heating	No	50	140
AHU-8	North Side of Flrs. 2 - 6	Perimeter	Yes	5400	2700	20	N	5	N			No	55 - 120		Induced Fan with 2-Pipe Fan Coil for Cooling or Heating	No	50	140
AHU-9	Basement	Interior		38760 max		50	Yes	25	Y			Yes	49		Induced Fan, All/Air	Some	42?	
AHU-10	Floor 2 Computer Room					2	N	1.5	N									
AHU-10A						2	N	1.5	N									
AHU-11	Cafeteria					25	Y	5	Y								42?	
AHU-11A						10	Y	3	Y									
AHU-12	Auditorium					20	Y	15	Y								42?	

Miscellaneous HVAC Equipment

Designation	Description	Capacity	Size HP	Size kW	VFD?	Equipt. Served	Comments
	AHU-1 Enthalpy Wheel						
	AHU-1 Runaround Pump?						
	AHU-1 Runaround Pump?						
	AHU-2 Enthalpy Wheel		0.75				
AHU-2 RAP-3	AHU-2 Runaround Pump?		0.5				
AHU-2 RAP-3A	AHU-2 Runaround Pump?		0.5				
	AHU-3 Enthalpy Wheel		0.75				
AHU-3 RAP-3	AHU-3 Runaround Pump?		0.5				
AHU-3 RAP-3A	AHU-3 Runaround Pump?		0.5				
	AHU-4 Enthalpy Wheel						
AHU-4 RAP-3	AHU-4 Runaround Pump?		0.5				
AHU-4 RAP-3A	AHU-4 Runaround Pump?		0.5				
	AHU-5 Enthalpy Wheel						
	AHU-5 Runaround Pump?						
	AHU-5 Runaround Pump?						
BDA-1	32 Terminal Electric Reheaters			32			
BDA-2	9 Teminal Electric Reheaters			9			
2F1	20? Terminal Fans		20				
2F4	20? Terminal Fans		20				
1F1	20? Terminal Fans		20				
EF-1	Exhaust Fan		7.5		No		
EF-3	Exhaust Fan		10		No		
EF-5	Exhaust Fan		5		No		
EF-6	Exhaust Fan		25		No		
AC-10	AC Unit		27		N		
AC-11	AC Unit		27		N		
CRAC	5 Computer Room Units		10		N		

Heating and Cooling Equipment

Designation	Description	Capacity	Size HP	Size kW	VFD?	Equipt. Served	Comments
CH-1	Water Chiller	500 T		275?			Carrier 19XL575457CQ, HCFC 22
CH-2	Water Chiller	500 T		275?			Carrier 19XL575457CQ, HCFC 22
CH-3	Glycol Chiller	470 T		334?			Carrier 19XL5858462CN, HCFC 22
CH-4	Glycol Chiller	470T		334?			Carrier 19XL5858462CN, HCFC 22
CHP-1	Primary CHW Pump		25		N	CH-1 & CH-2	1 pump spare
CHP-2	Primary CHW Pump		25		N	CH-1 & CH-2	
CHP-3	Primary CHW Pump		25		N	CH-1 & CH-2	
CHP-4	Secondary CHW Pump		25		N	AHU-5, 6, 7, 8, 9, 11, 12	1 pump spare
CHP-5	Secondary CHW Pump		25		N		
CHP-6	Secondary CHW Pump		25		N		
GWP-1	Glycol Chiller Pump		20		N	CH-3 & CH-4	
GWP-2	Glycol Chiller Pump		20		No	CH-3 & CH-4	
GWP-3	Glycol Chiller Pump		20		N	CH-3 & CH-4	
IWP-1	Ice Water Pump		15		N	AHU 1 - 4 via PHE-1	1 pump spare
IWP-2	Ice Water Pump		15		N	AHU 1 - 4 via PHE-1	
IWP-3	Ice Water Pump		15		N	AHU 1 - 4 via PHE-1	
SCWP-1	Interior Secondary CHW Pump		30		N		1 pump spare
SCWP-2	Interior Secondary CHW Pump		30		No		
SCWP-3	Interior Secondary CHW Pump		30		No		
P-9A, P-4A?	Dual Temp. Pump		7.5		N	CHW or HW to North Perimeter Terminal Fan Coils	
P-9B, P-7B?	Dual Temp. Pump		10		N	CHW or HW to South Perimeter Terminal Fan Coils	
PHE-1	Plate & Frame Heat Exch.					Glycol / Ice Water for AHU 1 - 4	
PHE-2	Plate & Frame Heat Exch.					Primary CHW / Interior Secondary CHW	
PHE-3	Plate & Frame Heat Exch.					Glycol / Interior Secondary CHW	
PHE-4	Plate & Frame Heat Exch.					Glycol / Interior "Tertiary" CHW (6th Flr. Terminal Coils)	
PHE-5	Plate & Frame Heat Exch.					Glycol / Primary CHW System	

Heating and Cooling Equipment

Designation	Description	Capacity	Size HP	Size kW	VFD?	Equipt. Served	Comments
CT-1	Cooling Tower Fan		40		N		2-speed prop. fan
CT-2	Cooling Tower Fan		40		N		2-speed prop. fan
CT-3	Cooling Tower Fan		40		N		2-speed prop. fan
CTP-1	Cond. Water Pump		40		N	CH-1 & CH-2	1 pump spare
CTP-2	Cond. Water Pump		40		N	CH-1 & CH-2	
CTP-3	Cond. Water Pump		40		N	CH-1 & CH-2	
CTP-4	Cond. Water Pump		40		N	CH-3 & CH-4	1 pump spare
CTP-5	Cond. Water Pump		40		N	CH-3 & CH-4	
CTP-6	Cond. Water Pump		40		N	CH-3 & CH-4	
P-3	Cond. Water Pump		15		N	Computer Room A/C	1 pump spare
P-4	Cond. Water Pump		15		N	Computer Room A/C	
P-13, P-15?	Cond. Water Pump		15		N	Misc. Equipt.	1 pump spare
P-14	Cond. Water Pump		15		N	Misc. Equipt.	
CWP-1			5		N	?	
CWP-2			5		N	?	
B-1	Steam Boiler	8.37 MMBtu/yr					Kewanee, 15 psig, FGR?
B-2	Steam Boiler	8.37 MMBtu/yr					Kewanee, 15 psig, FGR?
Boiler 1	Combustion Air Fan?		5		N		
Boiler 2	Combustion Air Fan?		5		N		
HWP-1	Heating Hot Water Pump		15		N	Heating Hot Water Supply Loop	
HWP-10	Heating Hot Water Pump		15		N		
HWP-11	Heating Hot Water Pump		15		N		
HWP-12	Heating Hot Water Pump		15		N		
	2 HHW Heat Exchangers						140 - 190°F (OSA reset)
	2 DHW Heat Exchangers						
	DHW Electric Heaters						

APPENDIX E

CHILLER DESIGN PERFORMANCE

Nominal Chiller Design Performance

Chiller Designation	CH-1 and CH-2	CH-3 and CH-4
Make and Model No.	Carrier 19XL575457CQ	Carrier 19XL5858462CN
Refrigerant	HCFC 22	HCFC 22
Capacity, Tons	500	470
Power Input, kW	277	347
Power Input, kW/Ton	0.55	0.74
Evaporator Liquid	Water	20% Ethlyene Glycol
Evaporator Supply Temperature, °F	42	32
Evaporator Return Temperature, °F	52	42
Evaporator Flowrate, gpm	1200	1170
Condenser Water Inlet Temperature, °F	89	90
Condenser Water Outlet Temperature, °F	80	80
Condenser Water Flowrate, gpm	1500	1400

APPENDIX F

USER MANUAL RESULTS

Summary of Building Areas and Estimated Design Minimum Outside Air Flow Rates

	Building Area, ft2	Design Min. OSA at 0.1 cfm/ft2	Design Min. OSA at 0.2 cfm/ft2
Basement:			
Warehouse	16,600	1,660	
Office Space	20,250		4,050
Aux. Service Areas	12,350	1,235	
Circulation & Toilets	9,250	925	
Unconditioned	40,950		
1st Floor:			
Dining Area	6,400		
Kitchen	6,750		
Auditorium	7,900		
Health Unit	3,000		600
Office Space	11,600		2,320
Lobbies & Toilets	19,200	1,920	
Unaccounted	5,800		1,160
Unconditioned	4,600		
2nd Floor:			
Computer Room	9,600		1,920
Office Space	47,100		9,420
Circulation & Toilets	8,800	880	
Unconditioned	4,700		
3rd, 4th, 5th, and 6th Floors (Area for Each):			
Office Space	56,700		45,360
Circulation and Toilets	8,800	3,520	
Unconditioned	4,700		
Penthouse (Mechanical Equipment)	10,400		
Total Enclosed Area, ft2:	526,050		
Total Air-Conditioned Area, ft2:	446,600		
Estimated Building Minimum Outside Air, cfm:		10,140	64,830
Total Minimum Outside Air, cfm:			74,970
Allowable Bldg. Occupancy at 20 cfm/person:			3,749

Hagel Building
Minimum Outside Air Requirements

Design Data, AHU 1 - 4 & 9

Floor	Area Served, ft2					Maximum Primary Air, cfm					Minimum Primary Air, cfm				
	AHU-1	AHU-2	AHU-3	AHU-4	AHU-9	AHU-1	AHU-2	AHU-3	AHU-4	AHU-9	AHU-1	AHU-2	AHU-3	AHU-4	AHU-9
Basement					56,590					37,260					11,320
1		7,840		6,645			3,200		2,815			1,697		1,310	
2	6,750	6,450	15,300	13,275		2,295	2,115	4,748	4,663		1,825	1,260	3,060	2,665	
3	12,975	12,445	12,250	13,500		4,671	4,309	4,312	4,658		2,415	2,470	2,370	2,880	
4	12,975	12,650	12,600	13,790		4,150	3,992	3,893	4,858		2,560	2,530	2,465	2,515	
5	12,975	12,760	12,600	13,050		4,095	4,048	4,253	4,157		2,595	2,505	2,670	2,890	
6	12,895	13,000	11,700	13,750		5,331	4,253	3,578	5,205		2,770	2,580	2,290	2,785	
Total Each AHU	58,570	65,145	64,450	74,010	56,590	20,542	21,917	20,784	26,356	37,260	12,165	13,042	12,855	15,045	11,320
Total AHU 1 - 4:				262,175						126,859				53,107	
Allowable No. of People at 20 cfm/person:														2,655	566

	AHU 1 - 4	AHU 9
Occupant Load Factor Based on 50% of Egress Requirements, ft2/person:	200	200
Building Area Served by AHU 1 - 4 & 9, ft2:	262,175	56,590
No. of People Based on 200 ft2/person:	1,311	283
Minimum OSA Based on 20 cfm/person:	26,218	5,659
Ratio of Design Minimum OSA Compared to Revised Minimum OSA:	2.0	2.0

Total Building:

Total Building Conditioned Area, ft2:	446,600
Maximum Building Occupancy	1,850
Minimum Outside Air Flow Rate at 20 cfm/person:	37,000
Minimum Outside Air Flow Rate at 15 cfm/person (Title 24):	27,750

APPENDIX G

TERMINAL BOX AIR FLOW RATES AND ELECTRIC HEATER OPERATION

Hagel Building
Air Handler Unit 1 Primary Air Flow Rates

AHU-1

Terminal Box No.	Design Primary Air Flow, cfm Min	Max	Min/Max	Current Primary Air Setting, cfm Min	Max	Min/Max	Current Min/ Design Min	Current Air Flow cfm	Current Air Flow / Min Setting	Electric Reheat Capacity, kW	Heater On Time %	Type of Box
2-1-5	45	160	0	45	135	0.33	1.00	109	2.4	2	23%	All-Air
2-1-8	45	160	0	45	135	0.33	1.00	125	2.8	2	24%	All-Air
2-1-10	80	230	0	34	315	0.11	0.43	**42**	1.2	0	41%	All-Air
2-1-12	50	200	0	31	307	0.10	0.62	78	2.5	0	24%	All-Air
3-1-2a				54	158	0.34		0		6	2%	Air-Water
3-1-3a				54	415	0.13		**50**	0.9	6	2%	Air-Water
3-1-8	45	160	0	45	318	0.14	1.00	**50**	1.1	2	35%	All-Air
3-1-11	45	160	0	45	135	0.33	1.00	0		2	28%	All-Air
3-1-12	110	220	1	109	220	0.50	0.99	**111**	1.0	0	20%	Air-Water
4-1-5	270	540	1	295	715	0.41	1.09	715	2.4	0	6%	Air-Water
4-1-8	45	135	0							2		All-Air
4-1-9	45	90	1	45	90	0.50	1.00	0		2	22%	All-Air
5-1-8	45	160	0	45	135	0.33	1.00	61	1.4	2	13%	All-Air
5-1-11	45	160	0	45	135	0.33	1.00	135	3.0	2	4%	All-Air
												Avg. Flrs 1 - 5 19%
6-1-1a	180	360	1	54	279	0.19	0.30	71	1.3	6	6%	Air-Water
6-1-1b	200	400	1	54	415	0.13	0.27	177	3.3	6	2%	Air-Water
6-1-3	50	200	0	50	151	0.33	1.00	156	3.1	2	0%	All-Air
6-1-6	90	315	0	55	315	0.17	0.61	311	5.7	3	7%	All-Air
6-1-7	200	400	1	210	621	0.34	1.05	558	2.7	3	1%	Air-Water
6-1-10	270	540	1	269	537	0.50	1.00	525	2.0	3	8%	Air-Water
6-1-15	270	540	1	269	537	0.50	1.00	332	1.2	3	5%	Air-Water
6-1-18	40	140	0	66	179	0.37	1.65	0		2	1%	All-Air
Total	2,125			1,811	6,247	0.290						Avg. Flr 6 4%

Bold air flow indicates candidate for reduced minimum air flow setting.

AHU-2

Terminal Box No.	Design Min	Design Max	Design Min/Max	Current Setting Min	Current Setting Max	Current Setting Min/Max	Current Min/ Design Min	Current Air Flow cfm	Current Air Flow / Min Setting	Electric Reheat Capacity, kW	Heater On Time %	Type of Box
1-2-1				113	403	0.28		**109**	1.0		49%	All-Air
1-2-2				197	695	0.28		**197**	1.0		52%	All-Air
1-2-3				88	248	0.35		**80**	0.9		49%	All-Air
2-2-1												All-Air
2-2-5				45	135	0.33		111	2.5		47%	All-Air
3-2-2				40	191	0.21		0	0.0		37%	Air-Water
3-2-3a				126	600	0.21		151	1.2		20%	Air-Water
3-2-7				45	135	0.33		0	0.0		43%	All-Air
4-2-1				105	184	0.57		170	1.6		4%	Air-Water
4-2-5				164	413	0.40		282	1.7		11%	Air-Water
4-2-6				45	135	0.33		59	1.3		7%	All-Air
5-2-2								0			2%	Air-Water
5-2-5				73	149	0.49		0	0.0		16%	Air-Water
5-2-7				45	135	0.33		101	2.2		9%	All-Air
												Avg. Flrs 1 - 5 27%
6-2-1				210	623	0.34		623	3.0		4%	Air-Water
6-2-3				80	238	0.34		139	1.7			Air-Water
6-2-6				269	537	0.50		512	1.9		2%	Air-Water
6-2-7				328	656	0.50		649	2.0		3%	Air-Water
6-2-10				179	361	0.50		304	1.7		11%	Air-Water
6-2-11				170	335	0.51		**172**	1.0		3%	Air-Water
6-2-15				28	300	0.09		182	6.5		1%	All-Air
6-2-15n				33	210	0.16		0			2%	
Total	0			2383	6683	0.36						Avg. Flr 6 3%

Bold air flow indicates candidate for reduced minimum air flow setting.

AHU-3

Terminal Box No.	Design Min	Design Max	Design Min/Max	Current Setting Min	Current Setting Max	Current Setting Min/Max	Current Min/ Design Min	Current Air Flow cfm	Current Air Flow / Min Setting	Electric Reheat Capacity, kW	Heater On Time %	Type of Box
2-3-1				73	153	0.48		**73**	1.0	0	0.57	Air-Water
2-3-5								0		2		All-Air
3-3-6				5761	17,585	0.33		13,037	2.3	2	0.3	All-Air
4-3-1				45	135	0.33		57	1.3	2	0.29	All-Air
4-3-3				42	168	0.25		125	3.0	0	0.04	Air-Water
4-3-12				33	300	0.11		201	6.1	0	0.01	All-Air
5-3-1				45	135	0.33		116	2.6	2	0.1	All-Air
5-3-7a				94	415	0.23		**94**	1.0	6	0.26	Air-Water
5-3-7b				99	161	0.61		**99**	1.0	6	0.26	Air-Water
6-3-1				45	135	0.33		0	0.0	2	0.16	All-Air
6-3-3				33	312	0.11		71	2.2	3	0.54	Air-Water
6-3-6				54	415	0.13		399	7.4	3	0.37	Air-Water
6-3-7				179	361	0.50		338	1.9	3	0.08	Air-Water
6-3-10										3		Air-Water
Total				6503	20,275					34	2.98	
Avg.				542	1,690	0.32					0.25	

AHU-4

Terminal Box No.	Design			Current Setting			Current Min/ Design Min	Current Air Flow cfm	Current Air Flow / Min Setting	Electric Reheat Capacity, kW	Heater On Time %	Type of Box
	Min	Max	Min/Max	Min	Max	Min/Max						
1-4-1				68	144	0.47		83	1.2	0	0.06	Air-Water
1-4-3				109	499	0.22		495	4.5	3	0.11	All-Air
1-4-11				38	130	0.29		127	3.3	2	0.29	All-Air
1-4-5				90	179	0.50		106	1.2	3	0.15	Air-Water
2-4-8				45	135	0.33		111	2.5	0	0.25	All-Air
2-4-10				45	135	0.33		**40**	0.9	2	0.32	All-Air
2-4-11				45	135	0.33		57	1.3	2	0.21	All-Air
2-4-13				38	198	0.19		64	1.7	6	0.19	Air-Water
3-4-4b				229	839	0.27		223	1.0	6	0.38	Air-Water
3-4-9				45	99	0.45		66	1.5	2	0.3	All-Air
3-4-10				78	130	0.60		125	1.6	2	0.07	All-Air
3-4-12				78	130	0.60		106	1.4	2	0.02	All-Air
4-4-7										2		All-Air
4-4-9				45	137	0.33		0	0.0	2	0.45	All-Air
4-4-10				42	159	0.26		189	4.5	2	0.09	All-Air
5-4-8				45	137	0.33		0	0.0	2	0.03	All-Air
5-4-10				45	135	0.33		61	1.4	2	0.02	All-Air
6-4-3				147	499	0.29		306	2.1	3	0.06	Air-Water
6-4-6				179	359	0.50		264	1.5	3	0.03	Air-Water
6-4-7				59	125	0.47		151	2.6	3	0.12	Air-Water
6-4-12				45	399	0.11		142	3.2	3	0.14	Air-Water
6-4-14				19	248	0.08		172	9.1	2	0.01	All-Air
6-4-18				0	1070	0.00		424			0.12	
Total	0			1534	6021						3.42	
Avg.	0.0			69.7	273.7	0.25					0.16	

AHU-9 (Basement)

Terminal Box No.	Design Min	Design Max	Design Min/Max	Current Setting Min	Current Setting Max	Current Setting Min/Max	Current Min/ Design Min	Current Air Flow cfm	Current Air Flow / Min Setting	Reset Min Air Flow	Flow Reduction cfm	Electric Reheat Capacity, kW	Heater On Time %
B-9-1	165	985	0.17	164	984	0.17	0.99	872	5.3			3	53%
B-9-3	235	1,005	0.23	236	1,003	0.24	1.00	229	1.0	118	111	3	0%
B-9-6	260	1,195	0.22	262	1,193	0.22	1.01	249	1.0	131	118	3	0%
B-9-7	240	1,120	0.21	236	1,115	0.21	0.98	1,108	4.7			6	21%
B-9-9	230	1,390	0.17	229	1,390	0.16	1.00	229	1.0	115	115	3	52%
B-9-10	230	1,390	0.17	229	1,390	0.16	1.00	243	1.1	115	129	6	0%
B-9-11	300	1,385	0.22	295	1,383	0.21	0.98	295	1.0	148	148	3	18%
B-9-13	225	1,040	0.22	466	1,036	0.45	2.07	564	1.2			3	56%
B-9-14	270	1,250	0.22	269	1,246	0.22	1.00	256	1.0	135	122	3	18%
B-9-17	230	1,065	0.22	227	1,057	0.21	0.99	312	1.4			3	25%
B-9-18	270	1,245	0.22	466	1,239	0.38	1.73	636	1.4			3	38%
B-9-19	270	1,245	0.22	295	1,239	0.24	1.09	288	1.0	148	141	3	79%
B-9-21	270	1,245	0.22	269	1,239	0.22	1.00	400	1.5			3	14%
B-9-22	270	1,245	0.22	269	1,239	0.22	1.00	531	2.0			3	52%
B-9-25	230	1,370	0.17	229	1,364	0.17	1.00	256	1.1			6	69%
B-9-28	**210**	**745**	0.28	**19,171**	**32,767**	**0.59**	91.29	18,840	1.0			9	46%
B-9-29	60	350	0.17	193	399	0.48	3.22	164	0.8	97	68	6	50%
B-9-31	230	1,390	0.17	229	1,390	0.16	1.00	223	1.0	115	109	3	75%
B-9-33	210	845	0.25	334	839	0.40	1.59	426	1.3			3	26%
B-9-34	230	1,370	0.17	229	1,364	0.17	1.00	223	1.0	115	109	6	45%
B-9-36	85	400	0.21	298	399	0.75	3.51	294	1.0	149	145	6	13%
Total	4,720	23,275	0.20	24,595	55,275	0.44		26,638	1.1		1,311		36%
Total Excl. B-9-28	4,510			5,424	22,508	0.24	1.2	7,798	1.4				