Blodgett Model CTB-1
Electric Half-Size Convection Oven

Appliance Performance in Production
Report 5011.95.17

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Fianl Report, June 1996

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CONTENTS

FIGURES

TABLES

POLICY ON THE USE OF FOOD SERVICE TECHNOLOGY CENTER TEST RESULTS AND OTHER RELATED INFORMATION

- The FSTC is *strongly* committed to testing food service equipment using the best available scientific techniques and instrumentation.

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PREFACE

Decisions involving the purchase of modern food service equipment are influenced by many factors. Cost is certainly a main priority. Are extra features worth the additional cost? Performance considerations are crucial. Will advanced technology, fuel-efficient appliances show a good return on the investment? Should appliances be gas or electric? How much will they cost to operate? Can an appliance meet peak production demands? The food service industry has historically relied on manufacturer specifications and limited test data when selecting new equipment. PG&E is providing a source of reliable information through its Food Service Technology Center (FSTC) in San Ramon, California.

The appliance testing program at the FSTC was originally undertaken to respond to the many requests for information about the performance of cooking appliances PG&E receives from the 25,000 food service customers in its service territory. Since its beginning in 1986, the project has grown into a full-scale research program, combining the sophisticated instrumentation and controlled environment of a laboratory with the real-life conditions of a production kitchen. The FSTC comprises two distinct, but complementary, research components.

The first, integrated with PG&E's corporate Learning Center, is the production-test kitchen. This facility is a unique combination of a test environment within a real food service operation. As a production kitchen, it provides cafeteria-style breakfast and lunch, and sit-down dinner for 500 customers a day. As a test kitchen, it is equipped to monitor the energy consumed by both gas and electric cooking appliances as they are used for routine menu production by the kitchen staff. Appliance usage and associated energy consumption patterns in the production-test kitchen are used to support the development of laboratory test methods.

The second component is an appliance laboratory equipped with energy monitoring and data acquisition equipment, 60 feet of canopy exhaust hoods integrated with utility distribution systems, appliance setup and storage areas, and a state-of-the-art demonstration and training facility. Within the Center, the research team develops uniform testing procedures to evaluate the overall performance of gas and electric cooking equipment. These test methods focus on measuring the energy consumption and production capacity of an appliance as it is used to cook standardized loads of typical food products.

ACKNOWLEDGMENTS

The establishment of a state-of-the art Food Service Technology Center reflects PG&E's commitment to the hospitality industry. The goal of the research project is to provide PG&E's food service customers with information to help them evaluate technically innovative cooking appliances and make informed equipment purchases regarding advanced technologies and energy sources. The project was the result of many people and departments working together within PG&E and the overwhelming support of the commercial equipment manufacturers who loan the cooking appliances for testing. Specific appreciation is extended to The Blodgett Oven Company for supplying the FSTC with the Model CTB-1 electric convection oven for controlled testing in the appliance laboratory and subsequent installation and monitoring in the production-test kitchen.

PG&E's Food Service Technology Center acknowledges the support of the project's National Advisory Group. Participating organizations from the research community include the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), the American Gas Association Laboratories (AGAL), and Underwriters Laboratories (UL). Representing end users are the National Restaurant Association, the California Restaurant Association, McDonald's Corporation, Darden Restaurants, Inc., Marriott International, and the International Facility Management Association (IFMA).

EXECUTIVE SUMMARY

This study documents the performance and energy use of the 5.6 kW Blodgett half-size convection oven, Model CTB-1, as it was used for routine menu production in PG&E's production-test kitchen over a six-month test period and during tests under controlled conditions. Investigated performance indices included the measured peak energy input rate, preheat energy requirement and time, production energy consumption rate, idle energy consumption rate, and duty cycle. A summary of the results is presented in Table ES-1.

Table ES-1

Summary of Blodgett Model CTB-1 Half-Size Electric Oven In-Kitchen Energy Performance

Rated Energy Input (kW)	5.6
Measured Peak Energy Input Rate (kW)	5.4
Preheat:	
Time to 350°F (min)	10.9
Energy (kWh)	1.0
Rate to 350°F (°F/min)	25.7
Idle Energy Rate with Thermostat Set at 350°F (kW)	1.4
Idle Duty Cycle (%)	25.9
Production Energy Use (kWh/d)	22.2
Appliance On-Time (h/d)	10.8
Average Production Energy Consumption Rate (kW)	2.1
Duty Cycle (%)	38.9

Energy-use data for the test period were reduced to include only days that reflected typical oven usage in the production-test kitchen (i.e., days when the oven was used for all three-meal periods—breakfast, lunch, and dinner). The oven typically used 22.2 kWh of energy over 10.8 hours of operation. The average rate of production energy use (based on the aggregate preheat, idle, and cooking energy for the entire day of appliance operation) was 2.1 kW, resulting in a duty cycle of 39%.

The oven would consume an estimated 5,772 kWh per year and increase monthly billing demands for the facility by 2.1 kW per month. At a cost of $0.0897/kWh and a demand charge of $4.30/kW per month,

the total cost to operate the oven would be $626, production energy accounting for $518 and demand for $108. This represents an average monthly energy cost of approximately $52. The energy cost calculation was based on PG&E's A-10 rate schedule, dated January 1, 1995, and a five-day-per-week, 52-week-per-year food service operation.

Controlled energy tests were conducted to supplement monitoring information acquired during actual production. The measured peak energy input rate for the Blodgett electric convection oven was measured at 5.4 kW, confirming its 5.6 kW nameplate input. The oven preheated to 350°F in 10.9 minutes and the idle energy rate at 350°F was 1.4 kW, reflecting an idle duty cycle of 26%.

In-kitchen observations provided information about actual use of the half-size oven over a typical day of operation in the kitchen. The oven was used for all three meal periods. For breakfast, the chefs used the oven to cook sausages and biscuits; at lunch, they baked food such as potatoes, chicken, fish, and lasagna; and at dinner, the chefs used the oven primarily to finish or hold fish, steaks, ribs, or other food first cooked on the broiler. Typically, about 40 pounds of food was prepared in the oven each day. Additionally, the oven functioned as a plate warmer during the dinner period.

Interviews with the cooks also furnished non-energy performance information about the Blodgett half-size convection oven. The cooks found the oven easy to operate and clean. It cooked fast and evenly and was given an excellent overall rating by the users.

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Donald R. Fisher

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Section 1

INTRODUCTION

The Blodgett Model CTB-1 electric half-size convection oven was monitored for energy consumption and performance evaluation in PG&E's production-test kitchen over a six-month test period. To supplement production energy monitoring data, controlled energy test data were also documented. Two half-size gas convection ovens were similarly monitored at the PG&E facility.[1,2] Prior to installation in the kitchen, this oven along, with its gas counterpart, was used in the appliance laboratory to develop the American Society for Testing and Materials (ASTM) Standard Test Method for the Performance of Convection Ovens (ASTM Designation F 1496-93).[3,4]

The glossary in Appendix A is provided so that the reader has a quick reference guide for the terms used in this report.

OBJECTIVES

The objective of this appliance performance report is to present the energy consumption characteristics and consumption patterns of the Blodgett electric half-size oven while it was in operation at the production-test kitchen. The report documents oven usage and the relationship of its energy consumption to its operating characteristics while in production. The reader should therefore bear in mind that this information is specific to the production-test kitchen, a corporate, cafeteria-style operation.

THE PRODUCTION–TEST KITCHEN

The 1,500-square-foot kitchen is an integral component of the campus-style dining facility at PG&E's Learning Center in San Ramon, California (Figure 1-1). Nine cooking appliances are centrally located on two sides of a utility distribution system, which functions as a central "spine" that contains all plumbing, wiring, and natural gas distribution lines. A 16-foot, double-sided canopy exhaust hood ventilates the equipment island at a design air flow of 9,600 cfm. Grilles along the front face of the hood direct makeup air into the kitchen. Figure 1-1 shows the floor plan of the production-test kitchen, UDS and appliance lineup.

The production center was designed to accommodate quick connection and disconnection of the appliances as they are rolled in or out of the "line," with the flexibility to accommodate either a gas or an electric model in each appliance slot. Gas and electric meters interface with a remote data acquisition and processing system. Appliance monitoring and performance evaluations are conducted by an interdisciplinary research team, independent of the food service operation.

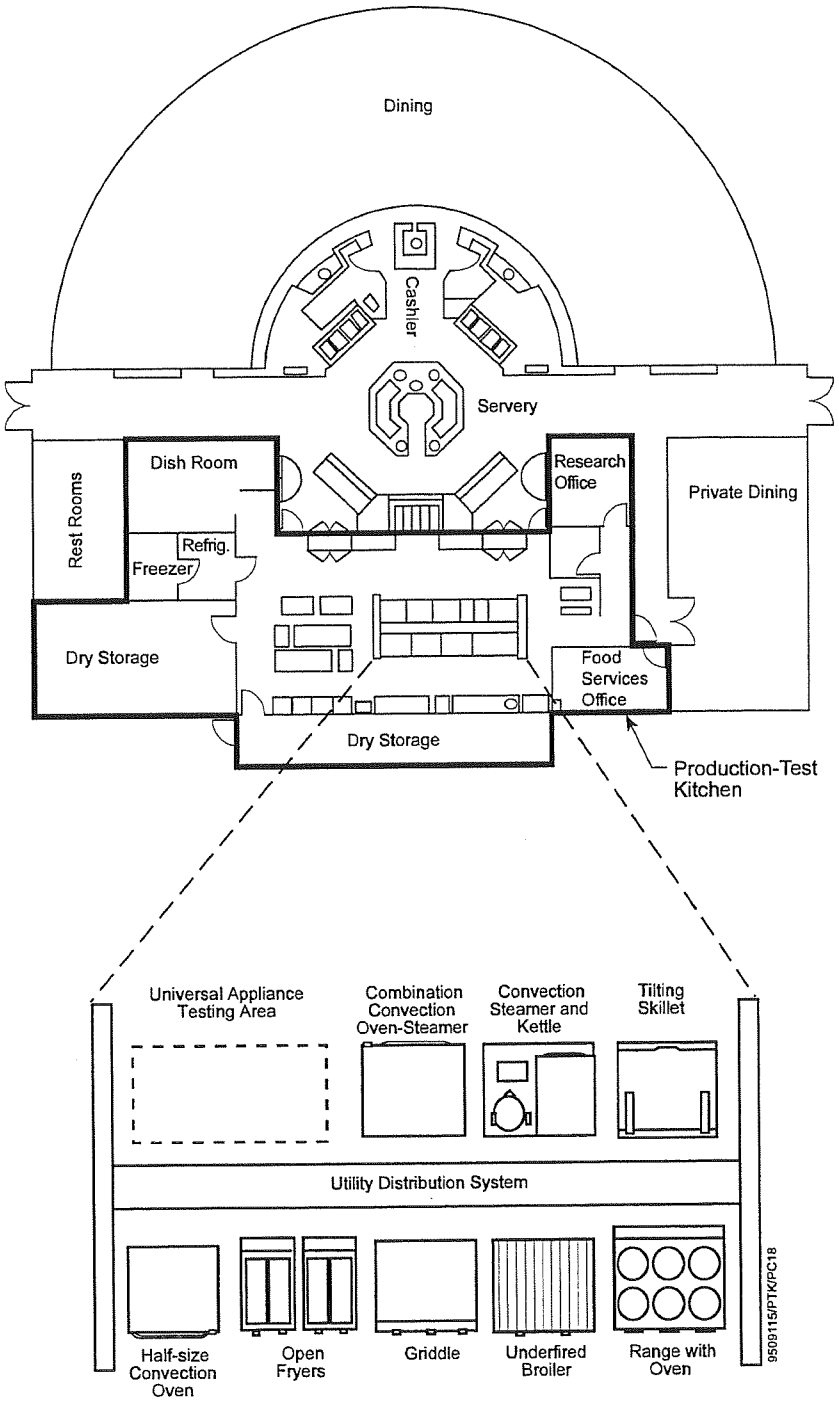


Figure 1-1. Dining facility, PG&E Learning Center.

APPLIANCE DESCRIPTION AND INSTALLATION

The Blodgett CTB-1 electric convection oven was installed in accordance with the manufacturer's instruction manual. Appliance specifications are summarized in Table 1-1. The manufacturer's specification sheet is in Appendix B.

Table 1-1
Appliance Specifications

Generic Appliance Type:	Thermostatically controlled convection oven
Manufacturer:	The Blodgett Oven Company
Model:	CTB-1 electric convection oven
Rated Energy Input:	5.6 kW
Heat Transfer:	Heat transfer is direct. Air is circulated over the heating elements and into the oven cavity by a ¼ hp fan.
Controls:	Solid-state thermostat with temperature control
Configuration:	Half-Size
Dimensions:	15¼″ wide by 21″ deep by 20″ high (cavity)
	30¼″ wide by 26⅝″ deep by 25 1/16″ high (oven)

Section 2

CONTROLLED ENERGY TESTS

PURPOSE

The purpose of conducting energy tests under controlled, or lab-style, conditions is to:

1. Verify that the appliance operates at the manufacturer's rated energy input.
2. Characterize preheat and idle energy use under selected operating conditions.

METHODS AND RESULTS

FSTC researchers operated the oven under controlled laboratory conditions without a food load. The controlled energy tests were conducted with the thermostat at the calibrated 350°F set point. Preheat was considered complete when the temperature reached 350°F (i.e., when the elements first cycled off). For the idle test, the oven was allowed to stabilize at 350°F for 1 hour. After the oven had stabilized, the energy was monitored over a 2-hour idle period.

During preheat, the measured peak input rate for this oven was 5.4 kW, 3.6% lower than the rated input of 5.6 kW. The results of the controlled energy tests are summarized in Table 2-1. Figure 2-1 shows the energy consumption rate during the preheat and idle tests.

Table 2-1

Summary of Convection Oven Controlled Energy Test

Rated Energy Input Rate (kW)	5.6
Measured Energy Input Rate (kW)	5.4
Preheat:	
Time to 350°F (min)	10.9
Energy (kW)	1.0
Rate to 350°F (°F/min)	25.7
Idle Energy Rate with Thermostat Set to 350°F (kW)	1.4
Idle Duty Cycle (%)	25.9

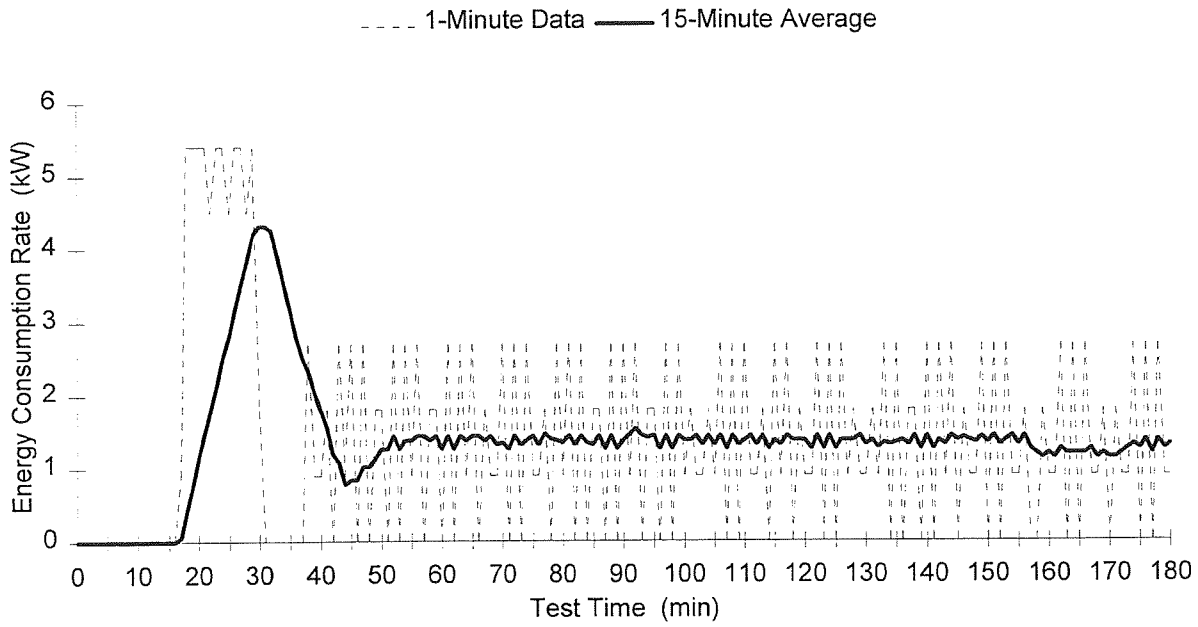


Figure 2-1. Preheat and idle energy test at 350°F.

Note: The energy consumption profile for the controlled energy test is plotted on a 1-minute basis and a 15-minute average. The 1-minute plot reflects the instantaneous input of energy into the appliance, while the 15-mintue plot better characterizes the average rate of energy input into the appliance over 15-minute windows of operation (see Appendix C).

Section 3

PRODUCTION MONITORING

ENERGY

FSTC researchers used data gathered over a 6-month test period to quantify typical day energy-use characteristics. Fridays, Saturday, Sundays, and holidays were eliminated because the oven was not used for the three-meal periods (breakfast, lunch, and dinner) typical of oven usage in this food service operation. The oven dataset was reduced to 91 days. Average daily energy performance of the convection oven is summarized in Table 3-1. The energy monitoring system used to collect this data is described in Appendix C.

Table 3-1

Average Daily Energy Performance

Measured Peak Energy Input Rate (kW)	5.4
Daily Production Energy Use[a] (kWh/d)	22.2
Appliance On-Time (h/d)	10.8
Production Energy Consumption Rate (kW)	2.1
Duty Cycle (%)	38.9

[a] Includes preheat and idle energy over the hours of operation when the oven was in use.

The energy consumption profile plotted in Figure 3-1 illustrates the typical day production energy use for the oven. This day was selected because the daily energy consumption, operating hours, and average production rate closely matched the average values shown in Table 3-1. The oven was used for a total of approximately 10 hours and used about 20 kWh of energy.

The energy consumption peaked around 4:30 A.M. and again at about 3:30 P.M. on the 15-minute average profile, representing the energy required to preheat the oven to a given operating temperature. Following each preheat period, the intermittent spikes above the idle or base rate of energy use (about 1.4 kW) reflect the incremental energy required to cook the food product loaded into the oven. On the typical day (Figure 3-1), the oven was used from about 5:00 A.M. until 10:00 A.M. and then again from 3:30 P.M. until 9:00 P.M., when the oven was turned off. The profile, along with in-kitchen observations, indicated that during this particular morning, the oven was in an idle condition from around 7:30 A.M. until 10:00 A.M., at which time it was shut off. The oven was most heavily used in the morning and again for several hours during the dinner period.

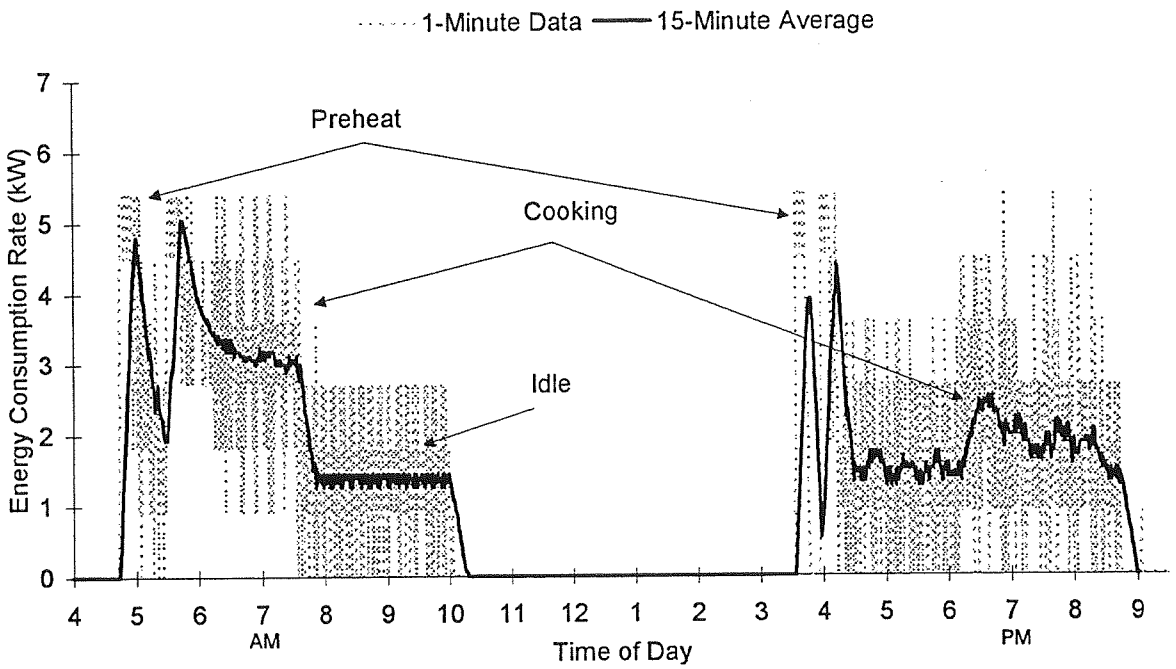


Figure 3-1. Typical day energy consumption profile.

Note: The energy consumption profile for the typical day is plotted on a 1-minute basis and a 15-minute average. The 1-minute plot reflects the instantaneous input of energy into the appliance, while the 15-minute plot better characterizes the average rate of energy used by the appliance over 15-minute windows of demand (see Appendix C).

The frequency distributions for daily production energy use and hours of operation for the oven are presented in Appendix D. Energy consumption varied from 15 to 30 kWh per day; appliance on-time varied between 8 and 14 hours per day.

ESTIMATED ANNUAL ENERGY COST

Based on a year-round, 52-week, five-day-per-week food service operation, the oven would consume approximately 5,772 kWh per year and increase monthly billing demands for the facility by 2.1 kW. This estimated average contribution to demand assumes that the appliance is operating when the maximum building demand occurs. At a cost of $0.0897/kWh and a demand charge of $4.30 kW per month, the total cost to operate the oven would be $626, production accounting for $518 and demand for $108. These costs of operation, as shown in Table 3-2, were calculated using PG&E's non-time-of-use rate (Schedule A-10), which would be applicable if the production kitchen were separately metered and billed by PG&E (Appendix E).

Table 3-2
Estimated Annual Energy Cost

Annual Production Energy Consumption and Cost:[a]		
5,772 kWh/year x $0.0897/kWh	=	$ 518
Probable Contribution to Billing Demand:[b]		
2.1 kW x $4.30/kW/month x 12 months	=	$ 108
Annual Energy Cost[c]	=	$ 626

[a]Estimates are based on PG&E's A-10 rate schedule in effect on January 1, 1995 (see Appendix E).
[b]The demand charge was based on the assumption that the oven was used during the peak period of time that the billing demand was likely to be set. The actual contribution to billing demand may vary significantly at other food service operations, depending on oven usage pattern (operating schedule, appliance on-time, etc.) in relation to other electric equipment at the facility.
[c]Does not include customer charges.

FOOD

Researchers observed oven use during several periods of normal operation, interviewed the cooks, and reviewed the cooks' daily worksheets to get an idea of the variety of food items prepared in the oven. The oven was used for all three meal periods. For breakfast, the chefs used the oven to cook sausages and biscuits; at lunch, they baked food such as potatoes, chicken, fish, and lasagna; and at dinner, the chefs

used the oven primarily to finish fish, steaks, ribs, or other food cooked on the broiler. Typically, about 40 pounds of food was prepared in the oven each day.

Oven temperature settings ranged from 325°F to 400°F, but most of the cooking and idling was done at 350°F. The oven was lightly used for preparing breakfast, more heavily used for preparing lunch and dinner menu items. After the food items for breakfast and lunch were prepared, the oven was left to idle, in case additional food needed to be prepared. Typically, the oven idled, with nothing in it, for at least 2.5 hours during the day, consuming about 3.5 kWh. Additionally, the oven also functioned as a plate warmer during the dinner period.

Section 4

CONCLUSIONS AND RECOMMENDATIONS

PRODUCTION

The cooks found the oven easy to operate and clean, and they liked its reliability and sturdy construction. Also, the chefs thought this oven cooked faster than a comparable oven without any loss of quality. It cooked fast and evenly and was given an excellent rating by the chefs.

ENERGY CONSUMPTION AND CONSERVATION POTENTIAL

The chefs generally left the oven on after preparing food for breakfast and lunch so that it would be ready to begin cooking food, when needed. While it may be reasonable to assume that the idle time could be reduced by 1 hour in this operation, this would only reduce the energy use by about 6% per day, or save $33 per year if the oven is used 5 days per week, 52 weeks per year. Turning the oven off is less imperative than for a boiler, for example, given their low idle energy use rate (e.g., 1.4 kW when set at 350°F); however, as with any appliance, if it is unlikely that the oven will be used, turning it off will reduce the energy use, hence the cost. Because oven use at PG&E's Learning Center dining facility is typical of food service operations catering to a mixed customer base, the opportunities for reducing energy costs pertain to other operations as well.

Section 5

REFERENCES

1. Food Service Technology Center. 1992. *Appliance Performance Report: Blodgett Model DFG-50 Gas Half-Size Convection Oven.* Report 008.1-91.11. Research and Development. San Ramon, California: Pacific Gas and Electric Company.

2. Pacific Gas and Electric Company. 1990. *PG&E Production-Test Kitchen: Cooking Appliance Performance Report.* Report 008.1-90.8, Research and Development. San Ramon, California: Pacific Gas and Electric Company.

3. American Society for Testing and Materials. *Standard Test Methods for the Performance of Convection Ovens.* ASTM Designation F 1496-93. In *Annual Book of ASTM Standards.* Philadelphia: American Society for Testing and Materials.

4. Pacific Gas and Electric Company. 1994. *Development and Application of a Uniform Testing Procedure For Convection Ovens.* Report 008.1-94.12. Research and Development. San Ramon, California: Pacific Gas and Electric Company.

Appendix A

GLOSSARY

GLOSSARY

Appliance On-Time (minute, hour)
Hours of Operation
Operating Period
Operating Time

The total period of time that an appliance is operated (from the perspective of food service staff) from the time it is turned "on" to the time it is turned "off." Appliance on-time excludes any "off" periods between the first and last appliance operation.

Average Daily Production Energy Consumption Rate (kW or kBtu/h)

The average rate of production energy consumption based on the daily production energy consumption and the appliance operating or "on" time.

$$\text{Average Daily Production Energy Rate} = \frac{\text{Daily Production Energy Consumption}}{\text{Appliance On - Time}}$$

Note: By basing the total daily production energy consumption on a 24-hour period, the total quantity of pilot energy (if applicable) is considered within the average production energy consumption rate and is based on the actual period of appliance usage.

Average Production Energy Consumption Rate (kW or kBtu/h)
Average Production Energy Rate
Average Production Energy Use Rate

The average rate of production energy consumption based on the production energy consumption and the appliance operating or "on" time for a specified period of appliance operation.

$$\text{Average Production Energy Consumption Rate} = \frac{\text{Production Energy Consumption}}{\text{Operating Time}}$$

Baseload Energy Consumption (Btu or kBtu)
Baseload Energy

The total amount of energy that would be consumed over the operating period of an appliance if it had never been used to cook food.

Baseload Energy Consumption Rate (kW or kBtu/h)

Base Rate
Baseload Energy Rate
Baseload Rate

The lowest rate of energy consumption reflected by the energy consumption profile (based on a 15-minute sliding window average) recorded during appliance operation. Generally, this definition is not extended to include the rate of pilot energy consumption. It is typically equal to the lowest value of idle energy consumption rate.

Cold Zone

The volume in the oven below the heating element(s) or heat exchanger surface designed to remain cooler than the fry zone and hot zone.

Cook Zone

Cooking Zone

The volume of oil in the oven where the fries are cooked. Typically, the entire volume from the heating element(s) of a heat exchanger surface to the surface of the frying medium.

Cooking Energy Consumption (kWh or kBtu)

The total energy consumed by an appliance during the cooking period.

Cooking Energy Consumption Rate (kW or kBtu/h)

The average rate of energy consumption during the cooking period.

Cooking Energy Efficiency

The quantity of energy input to the food products; expressed as a percentage of the quantity of energy input to the appliance during the heavy-, medium-, and light-load test.

Cooking Period (minute, hour)

The period of time (derived from in-kitchen monitoring or by interpreting the energy consumption profile) that an appliance is actually used for cooking.

Daily Energy Consumption (kWh or kBtu)
Daily Energy Use
Daily Production Energy Consumption
Daily Production Energy Use

The total amount of energy consumed by an appliance as it is used within the production kitchen over a 24-hour period.

Note: By basing the total daily production energy consumption on a 24-hour period, the total quantity of pilot energy (if applicable) is considered within the average production energy consumption rate.

Duty Cycle (%)
Load Factor
Production Energy Factor
Production Factor

The average production energy consumption rate (based on a specified operating period for the appliance) expressed as a percentage of the measured energy input rate.

$$\text{Duty Cycle} = \frac{\text{Average Production Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

Energy Consumption Profile
Energy Use Profile

A plot of appliance energy consumption showing energy consumption rate on the Y-axis and time on the X-axis.

Note: The area under the curve (plot) represents the total energy consumption for the period of integration. For uniformity in production reports, use the following terms and units for the coordinate labels:

y-axis: Energy Rate (kW or kBtu/h)

x-axis: Time (AM & PM): (Hour) (Min)

Energy Consumption Rate (kW or kBtu/h)
Energy Input Rate
Energy Rate

The rate of appliance energy consumption over a specified period of operation (see Energy Consumption Profile).

Energy Use Data Set

A set of daily energy consumption data compiled in accordance with typical day criteria.

Hot Zone

The area surrounding the heating element(s) or heat exchanger surface.

Idle Energy Consumption (kWh or kBtu)
Idle Energy Use

The amount of energy consumed by an appliance operating under an idle condition over the duration of an idle period.

Idle Energy Consumption Rate (kW or kBtu/h)
Idle Energy Input Rate
Idle Energy Rate
Idle Rate

The rate of appliance energy consumption while it is "idling" or "holding" at a stabilized operating condition or temperature.

Idle Duty Cycle (%)
Idle Energy Factor
Idle Load Factor

The idle energy consumption rate expressed as a percentage of the measured energy input rate.

$$\text{Idle Energy Factor} = \frac{\text{Idle Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

Idle Temperature (°F, Setting)

The temperature of the cooking cavity/surface (selected by the appliance operator or specified for a controlled test) that is maintained by the appliance under an idle condition.

Idle Time (minutes, hour)
Idle Period

A period of time that an appliance is consuming energy at its idle energy consumption rate while maintaining a specified stable operating condition or temperature.

Note: Idle time may include both necessary or unnecessary appliance "idling." This is simply differentiated by applying the appropriate adjective to the idle energy period term (e.g., needless idle time, necessary idle period.)

Measured Energy Input Rate (kW, W or kBtu/h, Btu/h)
Measured Input
Measured Peak Energy Input Rate
Peak Rate of Energy Input

The maximum or peak rate at which an appliance consumes energy, measured during appliance preheat or while conducting a water-boil test (i.e., the period of operation when all burners or elements are "on").

Pilot Energy Consumption (kBtu)
Pilot Energy Use
Standing or Constant Pilot Energy Consumption
Standing or Constant Pilot Energy Use

The amount of energy consumed by the standing pilot of an appliance over a specified period of time.

Pilot Energy Rate (kBtu/h)
Average Pilot Energy Rate
Average Pilot Energy Use Rate
Pilot Energy Consumption Rate

The rate of energy consumption by the standing or constant pilot while the appliance is not being operated (i.e., when the thermostats or control knobs have been turned off by the food service operator).

Preheat Energy Consumption (kWh or kBtu)
Preheat Energy

The total amount of energy consumed by an appliance during the preheat period.

Note: The reporting of preheat energy must be supported by the specified temperature/operating condition.

Preheat Energy Rate

The rate of appliance energy consumption while it is "preheating" to a predetermined temperature.

Preheat Time (minute, hour)
Preheat Period

The time required for an appliance to "preheat" from the ambient room temperature (75 ± 5°F) to a specified (and calibrated) operating temperature or thermostat set point.

Production Day
Production Period

The time period when an appliance is used by the kitchen staff, typically between the hours of 5 A.M. and 8 P.M.

Production Energy Consumption (kWh or kBtu)
Production Energy Use

The total amount of energy consumed by an appliance as it is used within the production kitchen over a specified time period (e.g., 10 A.M. to 1 P.M., dinner period). Production energy consumption is numerically equal to daily energy consumption if the production period is not specified.

Note: This integrated energy use includes preheat energy, idle energy, and pilot energy associated with the specified time period.

Rated Energy Input Rate (kW, W or kBtu/h, Btu/h)
Input Rating (ANSI definition)
Nameplate Energy Input Rate
Rated Input

The maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the nameplate.

Typical Day

A selected day of energy usage based on predetermined criteria that will generate a production energy consumption profile reflecting typical production usage for a specific appliance. The typical day criteria may comprise:

- Typical day energy consumption should approximate average daily energy consumption for energy use data set.

- A specified number of appliance operations and/or cooking periods (e.g., lunch and dinner only).

- A specified range in operating hours.

- A specified mode of operation (or combination of modes) may be associated with a typical day's operation.

Appendix B

MANUFACTURER'S PRODUCT SPECIFICATIONS

General Specifications for

BLODGETT Ovens
Since 1848

MODELS CTB-SINGLE, CTB-DOUBLE AND CTBR-SINGLE, CTBR-DOUBLE ELECTRIC BAKING AND ROASTING CONVECTION OVENS

GENERAL: The CTBR ovens shall have the same specifications as the CTB ovens with the exception they are a mirror image with the door opening to the right and the control panel on the left.

DOUBLE OVEN: CTB-Double (CTBR-Double) oven shall consist of two CTB-Single (CTBR-Single) sections mounted on 19″ (482mm) stand.

STANDARD EXTERIOR FINISH: Shall consist of #430 STAINLESS STEEL front, #3 finish, and a dull heat resistant black enamel finish on the top, sides and back of oven.

CONTROL PANEL: Shall be of a modular type with individual control markings on durable red LEXAN. Tilt forward panel is hinged at the bottom for easy access.

STANDARD BAKING COMPARTMENT INTERIOR: Including baffle to be of PORCELAIN-ENAMELED STEEL. Dimensions 15¼″ (387mm) wide, 20″ (508mm) high and 21″ (533mm) deep.

INSULATION: Top, back, bottom and sides to be insulated with 1″ (25.4mm), high temperature mineral fiber sheet.

DOOR AND HANDLE: A single handle mounted on the right hand side (CTB) or left hand side (CTBR) of the door shall open to a horizontal plane up to 180°. Doors shall have a dual pane thermal window of tempered glass.

RACKS AND RACK SUPPORTS: Standard racks and rack supports shall be of a bright chrome plated steel wire, capable of holding 9 racks with a minimum of 1⅛″ (41mm) spacing. Standard sections shall have 5 wire racks, 14⅞″ x 20⅞″ (371mm x 530mm).

VENTING: Venting is automatic through the vent opening in the rear of the oven.

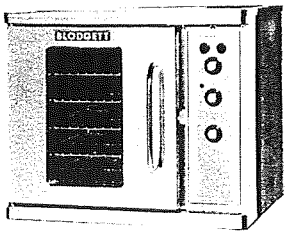
THERMOSTAT: Shall be an infinite setting solid state thermostat with temperature control. Range shall be 200°F (93°C) to 500°F (260°C).

TIMERS: 60-minute electric timer with buzzer is standard.

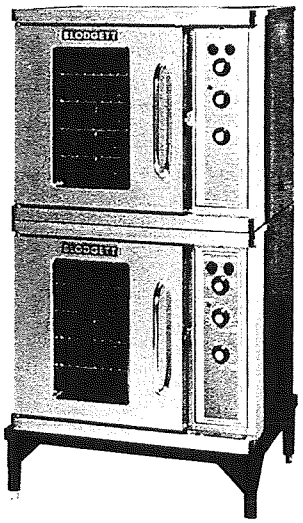
ELECTRICAL COMPONENTS: The standard oven shall have 2 tubular type heaters (208 or 220-240 VAC), 1 or 3 phase with a combined heater rating of 5.0 K.W.H. Each section shall be equipped with ¼ HP blower motor with automatic thermal overload protection and a control area cooling fan. Blower and heating elements shall be interconnected for simultaneous operation. With two panelmount fuseholders; Selector switch to choose COOL DOWN (to operate blower with doors open), OVEN OFF and COOK positions. Interlock switch to automatically shut off blower upon door opening.

INCREASED INPUT (OPTIONAL): In addition to electrical components specified, each section shall have 3 tubular heaters (208 or 220–240 VAC) 1 or 3 phase with a combined heater rating of 7.5 K.W.H.

LISTINGS: Ovens shall be U.L. and NSF listed and CSA certified.



CTB-SINGLE



CTB-DOUBLE

OPTIONAL EXTRAS AT ADDITIONAL COST:

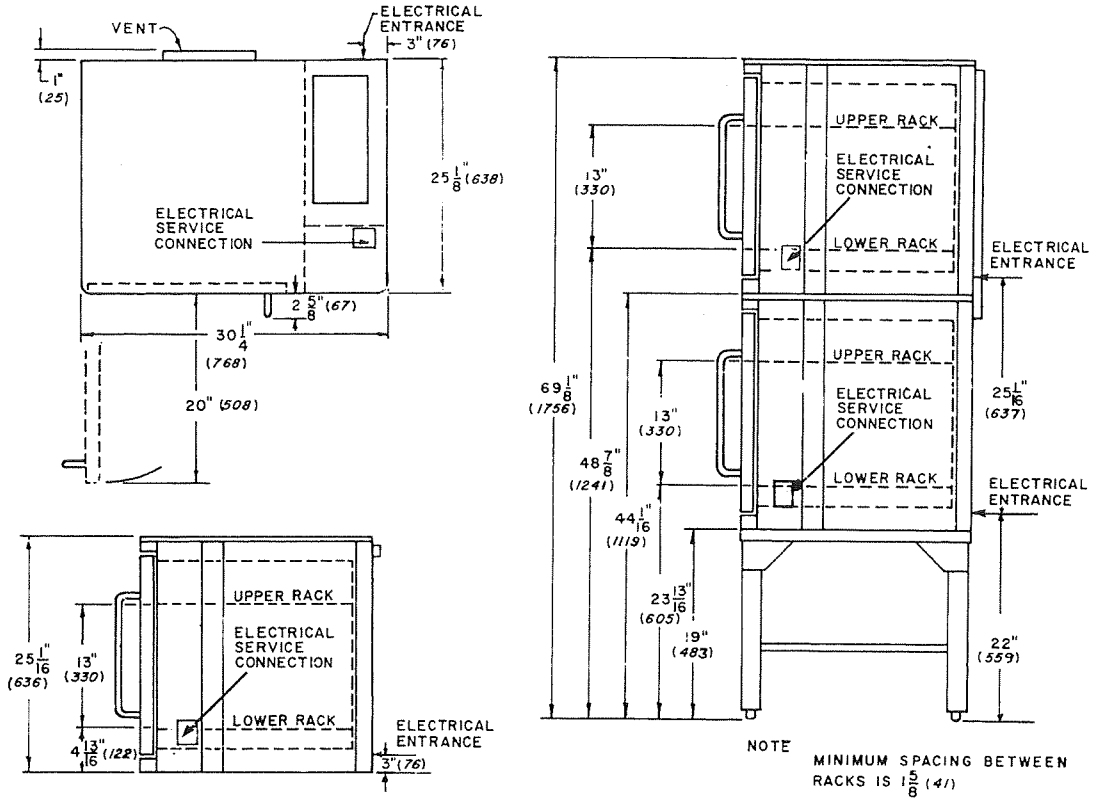
____ Stainless steel top and/or sides — 430, #3 finish.
____ Decorator color on top, sides and back. Available in Mandarin Red, Coppertone and Platinum Gray.
____ Stainless steel baking compartment lining.
____ Stainless steel bottom.
____ Stainless steel right or left side ONLY.
____ Stainless steel top ONLY.
____ Extra racks.
____ 7″ (178mm) Stand, painted finish.
____ 7″ (178mm) Stand, SS with chrome plated legs.
____ 19″ (482mm) Stand, w/shelf, painted finish.
____ 19″ (482mm) Stand, w/SS shelf, chrome plated legs.
____ 24″ (610mm) Stand, w/shelf, painted finish.
____ 24″ (610mm) Stand, w/SS shelf, chrome plated legs.
____ 33″ (838mm) Stand, w/shelf, painted finish.
____ 33″ (838mm) Stand, w/SS shelf, chrome plated legs.
____ 6″ (152mm) Casters, swivel w/locks.
____ Fan delay w/Pulse Plus.
____ 8 set point solid state thermostat.
____ 2 speed motor.

OPTIONAL EXTRAS AT NO ADDITIONAL COST:

____ Solid doors (recommended for roasting)

NOTE: The company reserves the right to make substitutions of components without prior notice.

MODELS CTB-SINGLE, CTB-DOUBLE AND CTBR-SINGLE, CTBR-DOUBLE ELECTRIC CONVECTION OVENS



ALL DIMENSIONS ARE BOTH INCHES AND MILLIMETERS

	CTB-SINGLE ☐ CTBR-SINGLE ☐	**CTB-DOUBLE ☐ CTBR-DOUBLE ☐**
Floor or counter space	30¼" (768mm) wide × 26⅝" (676mm) deep	30¼" (768mm) wide × 26¼" (664mm) deep
K.W.H.	5.6	11.2 (5.6 each section)
Motor	¼ H.P., 60 hz., 1725 RPM	¼ H.P., 60 hz., 1725 RPM
Minimum entry clearance	30½" (775mm) (crated), 25 1/16" (636mm) (uncrated)	30½" (775mm) (crated), 25 1/16" (637 mm) (uncrated)
Approx. Shipping weight (crated)	280 lbs. (127kg)	630 lbs. (286kg)
Crate size	30½" × 35" × 33" (775mm × 889mm × 838mm)	(2) 30½" × 35" × 33" (775mm × 889mm × 838mm) (1) 33" × 28" × 9" (838mm × 711mm × 229mm)

ELECTRICAL RATINGS PER SECTION

STANDARD					INCREASED INPUT				
VAC	Hz	Phase	K.W.H.	Amperes L1 L2 L3	VAC	Hz	Phase	K.W.H.	Amperes L1 L2 L3
208	60	1	5.6	26- 0-26	208	60	1	8.0	37- 0-37
208	60	3	5.6	23-12-14	208	60	3	8.0	22-21-22
220-240	60	1	5.6	22- 0-22	220-240	60	1	8.0	32- 0-32
220-240	60	3	5.6	20-12-14	220-240	60	3	8.0	20-18-19

BLODGETT OVEN COMPANY 50 Lakeside Avenue, Box 586, Burlington, Vermont 05402 USA
Telephone (802) 860-3700 1-800-331-5842 FAX: (802) 864-0183
A Division of G. S. Blodgett Corporation

GL 5368 10/95

Note: For Commercial use only

Appendix C

ENERGY MONITORING SYSTEM

ENERGY MONITORING SYSTEM

Energy data are collected once each minute, which means that the highest resolution measurement of energy rate is a 1-minute average. This 1-minute average, shown as the dotted line on the graph of the typical day profile, differs from actual instantaneous power explained in the following paragraphs.

Short periods of full input are not reflected as full input. Heating elements and burners are usually either full on or off. A plot of 1-minute data may show some less-than-full-on 1-minute values because the elements or burners operate on full for only part of the minute.

Long periods of constant input rate are usually reflected as a sawtooth pattern. Electronic pulses are generated by the meter, which measures the flow of electricity or gas to the appliance. Each pulse corresponds to a specific quantity of electric or gas energy consumed. The system stores the number of pulses for each minute, but it only stores an integer value for the number of pulses even though the actual energy consumed during the period corresponds to a noninteger value. For example, if the actual consumption during a 1-minute period corresponds to 6.6 pulses, only the integer "6" will be stored for that minute. The "0.6" will be carried forward and added to pulses generated during the next minute. If the energy consumed during the next minute is also 6.6 pulses, then the pulse value stored will be the integer portion of 7.2 (6.6 + 0.6), and the 0.2 will be carried to the next time interval.

Appendix D

FREQUENCY DISTRIBUTION OF DATASET

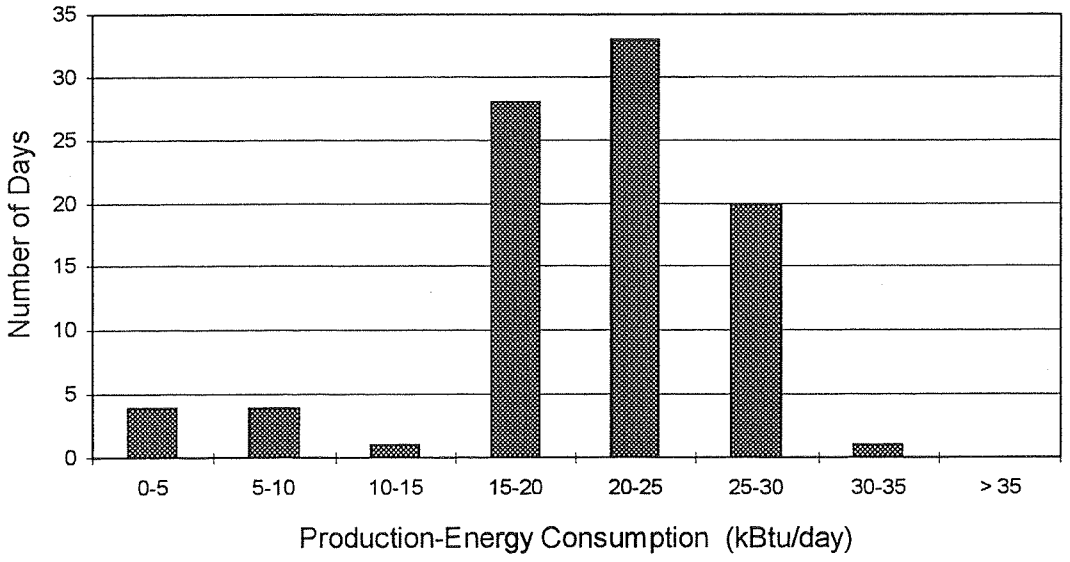


Figure D-1. Frequency of convection oven daily production energy use.

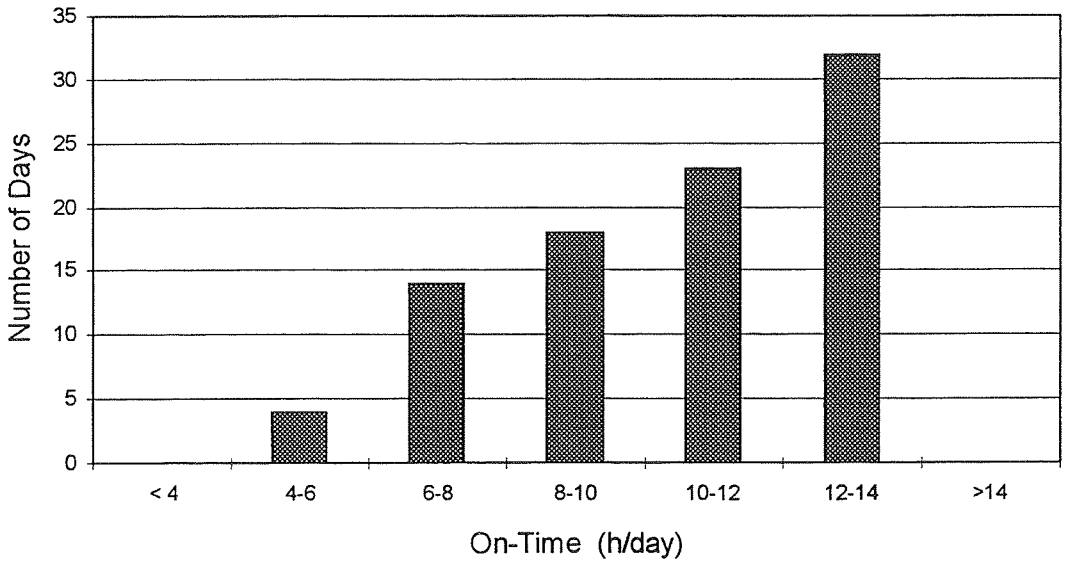


Figure D-2. Frequency of convection oven daily hours on-time.

Appendix E

PG&E ENERGY RATES

Commercial Electric Rates
(for customers with less than 500 kw demand)

Small General Service: A-1

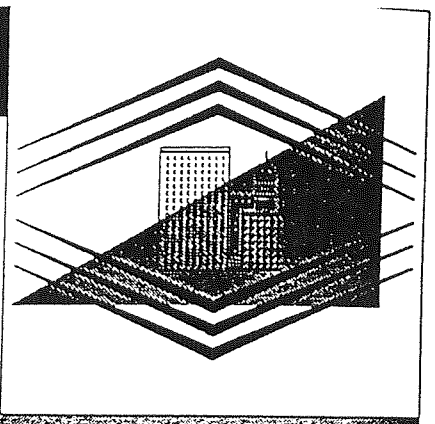
	$ Per Month	$ Per kwh Summer	$ Per kwh Winter
Customer Charges			
Single-Phase Service	8.10		
Polyphase Service	12.00		
Energy Charge		.15999	.10967

Small General Time-of-Use Service: A-6

	$ Per Month	$ Per kwh Summer	$ Per kwh Winter
Customer Charge			
Single-Phase Service	8.10		
Polyphase Service	12.00		
Meter Charge (per meter)	6.80		
Energy Charges			
Peak		.24935	-
Partial-Peak		.11030	.12396
Off-Peak		.06023	.07686

Medium General Demand-Metered: A-10

	$ Per Month	$ Per kwh Summer	$ Per kwh Winter
Customer Charge (per meter)	75.00		
Demand Charge			
(per kw of maximum demand)			
Summer	6.70		
Winter	1.65		
Energy Charge		.09816	.08015
Transmission Voltage Discount			
(per kw of maximum demand)			
Summer	4.75		
Winter	1.20		
Primary Voltage Discount			
(per kw of maximum demand)			
Summer	1.20		
Winter	0.00		



Commercial and Industrial A-6, E-19, and E-20 Time-of-Use Periods

Summer:
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. Monday through Friday
All day Saturday, Sunday, and holidays

Winter:
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.
Monday through Friday, except holidays
All day Saturday, Sunday, and holidays