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EXPERIMENTAL OPTIMIZATION OF COOLING TOWER FAN CONTROL BASED ON FIELD DATA

A THESIS
Presented to
The Academic Faculty

by

David Laurence Herman

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Mechanical Engineering

Georgia Institute of Technology
April 1991

EXPERIMENTAL OPTIMIZATION OF COOLING TOWER FAN CONTROL BASED ON FIELD DATA

APPROVED:

Samuel V. Shelton, Chairman

William J. Wepfer

James S. Patton

Date Approved by Chairman 3 April 91

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LIST OF ABBREVIATIONS

A	- current
c_{pw}	- constant specific heat of liquid water
CHW	- chilled water
CHWR	- chilled water supply
CHWS	- chilled water return
CW	- condenser water
CWR	- condenser water return
CWS	- condenser water supply
ENT	- entering
$f_d a$	- cooling tower coefficient
GPM_C	- flow rate of the condenser water
GPM_E	- flow rate of the evaporator water
k	- cooling tower constant
KW_C	- chiller energy demand
KW_F	- cooling tower fan energy demand
KW_T	- total system energy demand
KWH_C	- chiller energy consumption

KWH_F - cooling tower fan energy consumption

KWH_T - total system energy consumption

$LMTD_C$ - log mean temperature difference of the condenser

$LMTD_E$ - log mean temperature difference of the evaporator

LVG - leaving

$\dot{m}_a$ - mass flow rate of dry air per unit area of tower face exposed to the air flow

$\dot{m}_{CHW}$ - mass flow rate of the chilled water through the evaporator

$\dot{m}_{CW}$ - mass flow rate of the condenser water through the condenser

$\dot{m}_w$ - mass flow rate of the liquid water per surface area exposed to water flow

n - tower exponent

OSA - outside air

PF - power factor

PL - part load fraction

Q_C - condenser heat flow rate

Q_E - evaporator heat flow rate

UA_C - overall conductance of the condenser

UA_E - overall conductance of the evaporator

V - voltage

ΔT_{CHW} - temperature drop of the chilled water flowing through the evaporator

ΔT_{CW} - temperature rise of the condenser water flowing through the condenser

η_{isent} - compressor isentropic efficiency at full load including electric motor efficiency

η_{ton} - compressor part load efficiency

Additional subscripts used:

actual - relating to the experimental data

model - relating to the analytical model

Units:

BTUH - British thermal unit per hour

F - Fahrenheit

GPM - gallon per minute

KW - kilowatt

KWH - kilowatt-hour

RT - refrigeration ton (1 RT = 12,000 Btu/h)

SUMMARY

Energy costs continue to play an important role in the decision-making process for building design and operation. Since the chiller, cooling tower fans, and associated pumps consume the largest fraction of energy in a heating, ventilating, and air-conditioning (HVAC) system, the control of these components is of major importance in determining building energy use. A significant control parameter for the chilled water system is the minimum entering condenser water set point temperature at which the cooling tower fans are cycled on and off. Several studies have attempted to determine the optimum value for this minimum set point temperature, but direct measurements are not available to validate these studies.

The purpose of this study was to experimentally determine the optimum minimum entering condenser water set point temperature from field data based on minimum energy consumption and to validate a chilled water system analytical model previously developed in earlier work. The total chiller system electrical consumption (chiller and cooling tower fan energy) was measured for four entering condenser water set point temperatures (70, 75, 80, and 85 °F). The field results were compared to results obtained using an analytical model previously developed in a thesis entitled "Optimized Design of a Commercial Building Chiller/Cooling Tower System," written by Joyce.

Based on total system energy for chiller part loads less than 50%, the field results showed that the optimum for the system studied in this work corresponded to an entering condenser water set point temperature of 85 °F. For part loads greater than 50%, the optimum entering condenser water set point temperature was found to be 80 °F. Although decreasing the entering condenser water set point temperature further resulted in an increase in chiller efficiency, the chiller energy savings were offset by the increase in tower fan energy consumption at lower set points.

The trends predicted by the chilled water system analytical model are in close agreement with the data obtained from the field results. Based on the total system energy use for an entire year, the analytical model predicted an annual optimum constant entering condenser water set point temperature of 85 °F, which is in agreement with the field data. According to the results from the analytical model simulation, the additional cost of lowering the entering condenser water set point temperature from 85 °F to 70 °F would be approximately $25,000/year for the 1000 RT chiller studied in this work.

CHAPTER I

INTRODUCTION

1.1 Background

Energy costs continue to play an important role in the decision-making process for building design and operation. Since the chiller, cooling tower fans, and associated pumps consume the largest portion of energy in a heating, ventilating, and air-conditioning (HVAC) system, the proper control of these components is imperative in determining building energy costs. Numerous studies [Sud, 1984; Hackner et al., 1984, 1985; Johnson, 1985; Lau et al., 1985; Braun, 1988] have been performed to identify computer strategies to reduce the cost of operating the chilled water plants of large commercial facilities.

To produce strategies to reduce energy costs, Lau et al. [1985] concentrated on one subsystem of the entire chilled water system to simplify the problem. The subsystem included the chiller, pumps, cooling tower, and condenser pumps (Figure 1.1). Their objective was to find the proper control strategy that would result in minimum power consumption for each combination of the wet-bulb temperature and total chiller load. They developed computer models of the chilled water system to study the energy conservation potential of various control strategies. They produced empirical curve fits from actual field data for a specific chilled water system to develop component models.

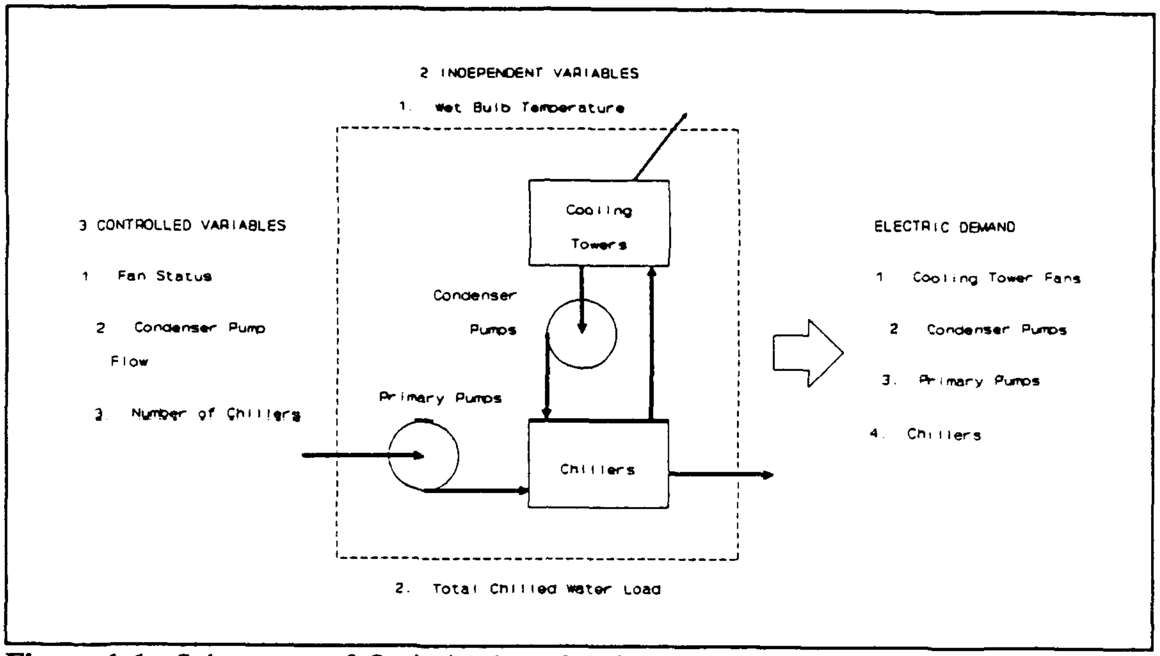

Figure 1.1. Subsystem of Optimization Studies [Lau et al., 1985]

Simulations involving cooling systems have been primarily used for equipment selection and building design. Most of the control studies which have been performed have been concerned with the local-loop control of an individual component or subsystem needed to maintain a prescribed set point, rather than the global determination of optimum set points that minimize operating costs. Global optimum plant control has been studied by Sud [1984], Lau et al. [1985], Hackner et al. [1984, 1985], and Johnson [1985].

Braun [1988] provided the most complete consideration of the optimized design and control of central chiller plants. His central objective was optimal control. The system optimization involved minimizing the total instantaneous energy consumption without considering annual energy costs or capital costs.

The power consumption of the chiller is sensitive to the condensing water temperature, which is in turn affected by both the condensing water and tower air flow rates. Increasing either of these flows reduces the chiller power requirement but at the expense of an increase in the pump or fan power consumption. At any given load, chilled water set point temperature, and wet bulb temperature, there exists an optimum operating point.

Hackner et al. [1985b] stated that the correct control strategy to minimize energy use of the chiller/cooling tower subsystem is to minimize the sum of the chiller plus cooling tower fan power consumption. They also showed, through the use of computer simulations using various combinations of chilled water load, OSA wet bulb temperatures, cooling tower fan speeds, and number of operating chillers, it is often more energy efficient to turn off some of the tower fans to optimize cooling tower fan status. Once the optimum cooling tower fan status is determined at a given load, it will remain the optimum tower fan status for any OSA wet bulb temperature unless the chiller power draw limit is reached [Hackner et al., 1985b].

Cascia [1988] illustrated how actual chiller plant performance data collected from an energy management system can be used to adapt chiller plant control to optimize energy savings. He presented a direct digital control (DDC) algorithm to optimize the condenser water temperature by minimizing the sum of the chiller and cooling tower fan energy consumption. His strategy cycled cooling tower fans based on the change in the total energy consumption of the chiller plant.

The following generalizations can be made about all the previous studies:

- They were based on computer model simulations to determine the energy savings of the hypothesized control strategy. Minimal field data was reported to validate the computer simulations.

- They all identified control strategies for complex systems based on computer control algorithms. The strategies were specific to a particular system based on variable speed fans, variable speed pumps, and multiple chillers. Control parameters included condenser water flow rate, tower air flow rate, and multiple chiller control.

- They used field data to develop empirical component models for use in the computer simulation. The curve fits were applicable only to the specific equipment and site. The models were not based on fundamental equations of heat transfer and thermodynamics.

In this study, the focus was on a single control parameter, the minimum entering condenser water set point temperature. The minimum entering condenser water set point temperature is the temperature at which the cooling tower fans were cycled on and off. Referring to Figure 1.1, two of the three controlled variables were constant, the condenser pump flow and the number of chillers. The fan status was changed to maintain the minimum condenser water set point temperature. The independent variables and the means of evaluating the control strategy remained the same.

This study differed from the previous studies in several ways. Field data was collected to validate the proposed control strategy. The analytical model used was based on fundamental equations for the chilled water system components, not on empirical relationships specific to a particular equipment or site.

The analytical model used in this study was developed by Weber [1988] and modified by Joyce [1990]. Weber investigated design optimization techniques for the condenser water flow rate and tower air flow rate involving condenser side components of a central chilled water system. Joyce investigated methodologies for the optimized design of a central chilled water plant based on annual operating costs, capital construction costs, and simple payback analysis.

1.2 Objectives

One of the major factors that effects the energy consumption of the chilled water system is the control of the cooling tower fans. The control point at which the cooling tower fans are cycled on and off has a major impact on this energy consumption. It not only affects the cooling tower fan energy use, but also the chiller energy use. The overall goal of this study is to experimentally determine the global optimum minimum entering condenser water set point temperature at which the cooling tower fans are cycled on and off.

The proposed study will meet the following three objectives:

- Experimentally determine this global optimum from experimental field data. As discussed in the previous section, several people have used analytical models to determine the optimum control point, but there has been no experimental field validation of these models.

- Compare the field results to results generated using an analytical chilled water system model developed by Weber [1988] and Joyce [1990]. Using actual field component performance data in the analytical model, the results from the model can be compared to the actual field results to determine the accuracy of the model. Using manufacturer's component performance data in the analytical model, the results can be compared to actual field results to determine the accuracy of the manufacturer's performance data.

- Use the validated analytical model with manufacturer's component performance data to determine the annual optimum constant set point temperature for an entire year.

1.3 Proposed Study

The proposed study was designed to meet the three stated objectives. It will examine the effect of four entering condenser water set point temperatures on a large chilled water system. Field data will be collected using the chilled water system at the Westin Peachtree Plaza Hotel in Atlanta, Georgia. The study will utilize the existing chilled water system, controls, and energy management system. The field data will include the OSA temperature and humidity, the CHWS, CHWR, CWS, and CWR temperatures, the chilled water flow, the chiller amperage, and the cooling tower fan run times.

The field data will be used to calculate chiller, cooling tower fan, and total system efficiencies where the efficiency is defined as the ratio of the energy consumption to the chilled water load. These efficiencies have units of kilowatts per refrigeration ton (KW/RT). Based on total system efficiency, the optimum entering condenser water set point temperature will be determined.

Two simulations of the analytical model will be run. The first will use actual field weather data and actual field chilled water system component performance data. The second will use standard weather data and manufacturer's component performance data.

CHAPTER II

FIELD EXPERIMENT

This study was performed at the Westin Peachtree Plaza Hotel, a large 1200 room convention hotel in Atlanta, Georgia. The study utilized the existing chilled water system, controls, and energy management system. Data was collected for twenty days from November 6, 1990 to November 25, 1990. A detailed analysis of the system and experimental procedures will now be given.

2.1 Chilled Water System

A schematic of the chilled water plant at the Peachtree Plaza Hotel is shown in Figure 2.1. Three chillers, two 750 refrigeration ton (RT) steam-driven absorption chillers and one 1000 RT electric centrifugal chiller, supply chilled water to the building. The two absorption chillers share a chilled water pump, and each has an associated condenser water pump. The electric chiller has an associated chilled water pump and condenser water pump.

Eight cooling tower fan cells that share a common sump cool condenser water for the chillers. A common condenser water return pipe returns water to each of the tower cells. An individual condenser water supply pipe runs to each chiller directly from one of three tower cell sumps.

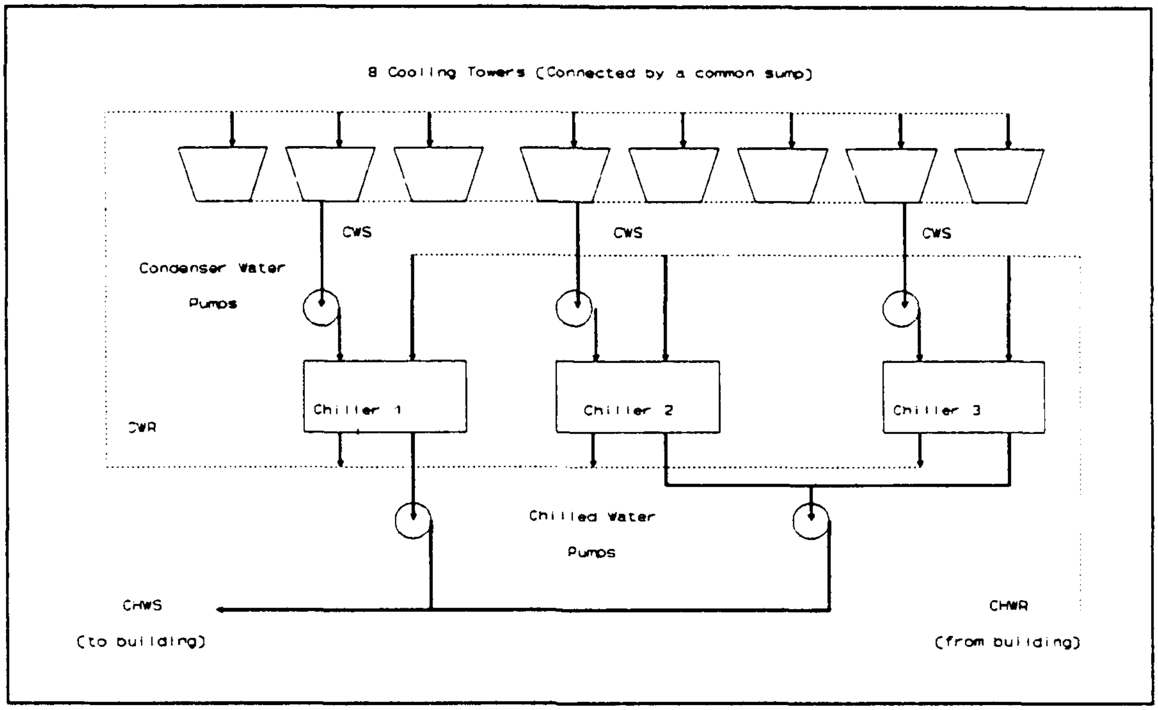

Figure 2.1. Schematic of Peachtree Plaza Chilled Water Plant

A Trane Tracer Energy Management System monitors numerous chilled water system temperatures, flows, and currents. The Tracer system has the capability to control the chillers, pumps, and cooling tower fans. However, during this study, it only controlled the cooling tower fans.

2.2 Operation

2.2.1 Chiller Control

The electric chiller serves as the primary chiller for the hotel and runs twenty-four hours per day except for hours during which free cooling is possible.

The boiler room operator manually sets the chilled water supply temperature at the chiller control panel. The chiller has an economizer or free cooling mode that is manually activated.

When the electric chiller reaches its maximum capacity, one absorption chiller can be brought "on-line" manually by a boiler room operator. The electric chiller will generally reach its maximum capacity at OSA temperatures greater than 85 °F. The second absorption chiller is available, but is only required during heavy load conditions, such as during the summer months.

During this study, the chilled water supply (CHWS) temperature was set to a constant value of 44 °F for OSA temperatures above 42 °F. Below OSA temperatures of 42 °F, the chiller was manually turned off to start free cooling. If the chiller was deactivated, it was not until the OSA temperature reached 47 °F that the chiller would be brought back "on-line". It should be noted that during the period of this study, the electric chiller was never fully loaded, and, therefore, the absorption chillers did not run.

2.2.2 Cooling Tower Fan Control

One of the objectives of this study was to experimentally determine the optimum entering condenser water set point temperature. Thus, a major focus was placed on the control of the cooling tower fans. A control strategy was desired to produce data to predict this optimum set point temperature. The entering condenser water set point temperature is the cycling temperature for the cooling tower fans.

The Trane Tracer Energy Management System is used to control the eight cooling tower fans in this system. The system was configured with three digital output relays which allowed for only on-off fan control. The eight fans are grouped in three sets, one set of two fans and two sets of three fans.

Prior to this study, the fans were controlled using a "minimum-maximum" control strategy which is outlined in Table 2.1. A set of fans was turned on when the condenser water temperature returning to the cooling towers rose above a specified set point temperature. The same set of fans was turned off when the temperature dropped below a lower set point temperature.

This strategy presented several problems for determining an optimum set point temperature. The condenser water temperature was not constant, but fluctuated by approximately $\pm$ 20°F as the fans cycled on and off. This "minimum-maximum" control strategy was a "first on, last off" strategy, that is the longest running set of fans was turned off last. The first set of fans brought "on-line" would often run continuously, while the other sets of fans would be continuously cycling.

For the purposes of this study, a single entering condenser water set point temperature was used to simplify the optimization procedure. This single set point temperature was chosen to be the cycling temperature for the cooling tower

Table 2.1. Minimum-Maximum Tower Fan Control Strategy

FAN SET	OFF (CWR TEMP)[1]	ON (CWR TEMP)[2]
1	78	80
2	85	87
3	94	96

[1]Fan set off if temperature drops below this temperature.

[2]Fan set on if temperature rises above this temperature.

fans. To maintain similar operation times for each fan set, the first set of fans to be brought "on-line" would be cycled off first. This "first on, first off" strategy ensured that all three fan sets would be utilized equally. Obviously, this strategy could lower maintenance costs for the fan sets.

The strategy devised for this study used two control routines of the Tracer Energy Management System. A direct digital control (DDC) algorithm determined the required tower fan capacity to maintain the entering condenser water set point temperature. Then, a process control language (PCL) routine used the required capacity from the DDC algorithm to control the cooling tower fans in order to maintain this set point temperature.

The DDC algorithm uses the following equation for proportional-integral-derivative (PID) control:

$$dG = K_p * dE + K_I * E + K_D * d(\frac{dE}{dT}) \tag{2.1}$$

where dG = change in output

K_p = proportional gain

dE = change in error

K_I = integral gain

E = error

dT = time interval

K_D = derivative gain

d(dE/dT) = rate of change in error

The DDC algorithm adjusts the output from its current value to a new value based on the calculated change in output [Trane, 1987].

As mentioned above, the DDC algorithm calculated the percent capacity of cooling tower fans required to maintain the condenser water set point temperature. The proportional gain, integral gain, derivative gain, and sampling time are determined by trial and error. These parameters were determined by minimizing the overshoot of the set point temperature and cycling only one set of fans. For example, an OSA temperature might require that one set of fans run continuously, while a second set of fans would cycle. The set of fans chosen to be running and the set being cycled were rotated depending on run-time.

The output of the DDC algorithm which was the required cooling tower fan capacity was used in a PCL routine to control the fans. In simulating a continuous degree of control from 0% capacity (no fans on) to 100% capacity (all fans on), four steps were established using a second PCL routine (Table 2.2). The first PCL routine compared the required capacity (percent output) to the actual tower fan capacity and then cycled a fan set on or off as required. In addition, the control strategy used in this study compared the run times of the fan sets and cycled the set with the longest run time off first.

Table 2.2. Single Set Point Tower Fan Control Strategy

FAN SETS ON	ACTUAL TOWER FAN CAPACITY (%)[1]
0	0
1	17
2	50
3	83

[1]PCL routine cycles one set of fans off or on respectively if required capacity is less than or greater than actual capacity.

2.3 Data Acquisition System

The Trane Tracer Energy Management System served as the data acquisition system. Table 2.3 gives a list of the analog input parameters. Using a PCL routine, the parameters for Chiller #1 and the cooling tower fans were monitored every minute. These data were then summed, and an average for each hour was computed. The average hourly values were then stored in a "trend-log" report for use in this study. These average hourly parameters are shown in Table 2.4.

Table 2.3. Tracer Analog Inputs

ANALOG INPUT NAME
OUTSIDE AIR TEMP
OUTSIDE AIR HUMIDITY
CH-1 CHW LVG TEMP
CH-2 CHW LVG TEMP
CH-3 CHW LVG TEMP
COMMON CW LVG TEMP
CH-1 CW ENT TEMP
CH-2 CW ENT TEMP
COMMON CW LVG TEMP
CH-1 CHW FLOW
CH-2 CHW FLOW
CH-1 CURRENT (AMPS)

Table 2.4.. Tracer Trend Log Reports

TREND LOGS
AVG OSA TEMP
AVG OSA HUMIDITY
AVG CH-1 CHW LVG TEMP
AVG COMMON CHW RETURN TEMP
AVG CH-1 CW ENT TEMP
AVG COMMON CW LVG TEMP
AVG CH-1 CHW FLOW
AVG CH-1 CURRENT (AMPS)
FAN 3-6 RUN TIME
FAN 1-4-7 RUN TIME
FAN 2-5-8 RUN TIME

2.4 Data Acquisition Methodology

This study examined four entering condenser water set point temperatures. These set point temperatures were 70°F, 75°F, 80°F, 85°F. In collecting data, the same set point temperature was maintained for a 24 hour period. At the end of each 24 hour period, the Tracer automatically changed the set point temperature at 12:01 am each day by using a PCL routine.

For each day, the average values were imported into a spreadsheet. From these values, the chilled water load (RT), chiller energy demand (KW_C), and tower fan energy demand (KW_F) were calculated. The chilled water load was calculated using the following equation for the heat transfer rate through the evaporator [Clifford, 1990]:

$$Q_E = \dot{m}_{CHW} * C_{p_w} * \Delta T_{CHW} \tag{2.2}$$

where Q_E = chilled water load

$\dot{m}_{CHW}$ = mass flow rate of the chilled water through the evaporator

ΔT = chilled water temperature rise through the evaporator

c_{pw} = constant specific heat of water

The chilled water load had units of refrigeration tons (RT). The average value of the chilled water load for each hour was assumed to be the refrigeration ton-hours (RT-hours) produced by the chiller during that hour.

The energy used by the chiller (KW_C) was calculated from the measured average three phase current consumed by the chiller. This value was calculated using the following expression [Baumeister, 1978]:

$$KW_C = \sqrt{3} * V * A * PF \tag{2.3}$$

where V = chiller voltage (470 V)

A = chiller current (amps)

PF = power factor

In this study, the power factor was assumed to be the commonly accepted value of 0.95. The hourly energy demand was considered to be the chiller energy use for that hour (KWH_C).

The energy consumed by the cooling tower fans was calculated using the total time the cooling tower fans were in use. The hourly fan run-time for each fan was multiplied by the electrical input in KW for each fan to calculate the hourly energy use for each fan. The energy use for each fan was summed to calculate the total fan energy use (KWH_F). Each cooling tower fan is driven by an 18 horsepower (HP) AC motor. This HP rating equates to an input of 22 KW of electrical power, assuming a motor efficiency of 0.85. To validate this assumption, the amperage of each tower fan motor was measured. The results of these measurements and their corresponding calculated electrical input in KW are shown in Table 2.5.

In this study, the parameters used to determine the optimum condenser water set point temperature were the chiller efficiency, cooling tower fan efficiency, and total system efficiency. Each efficiency was defined as the ratio of the respective energy use to refrigeration ton-hours (RT-hours). This was performed on both an hourly and daily basis. The efficiencies were in units of KWH/RT-hour which is equivalent to KW/RT. The total system energy use (KWH_T) is the sum of the energy consumed by the chiller and the cooling tower fans.

Table 2.5. Tower Fan Current

TOWER FAN #	CURRENT (AMPS)	KW DEMAND (KW)[1]
1	28	22.1
2	29	22.9
3	25	19.7
4	38	30.0
5	21	16.6
6	28	22.1
7	30	23.7
8	32	25.3
AVG		**22.8**

[1]Calculated using equation 2.3 (V = 480 V).

CHAPTER III

SIMULATION MODEL

This study uses the analytical model for a chilled water system developed by Weber [1988] and Joyce [1990]. A review this analytical model will now be given. The complete system model consists of four component models. These component models are a crossflow cooling tower model, an evaporator model, a condenser model, and a compressor model. A brief outline of the development of each component model is presented; however, the reader should consult Weber [1988] and Joyce [1990] for the complete development. The modifications and additions to these component models needed for this study will be given in detail.

3.1 Crossflow Cooling Tower Model

There are two generally accepted approaches to the modeling of cooling towers. These two approaches, as outlined in the ASHRAE Equipment Handbook [1988], are those based on the assumptions made by Merkel and those based on a more detailed approach which makes few assumptions. The ASHRAE Equipment Handbook [1988] uses the model developed by Merkel in its treatment of cooling tower theory and presents a thorough explanation of the cooling tower thermodynamic process. The cooling tower model developed by Weber[1988] and Joyce [1990] uses a more detailed approach.

The principle elements and solution methodology of the cooling tower model used in this study are as follows:

- A fundamental analysis of the mass and energy balances in the cooling tower with mass diffusion and convective heat transfer as the driving forces is used. This analysis results in three coupled partial differential equations.

- The three differential equations are solved by finite difference using the Van Wijngaarden-Decker-Brent method [Press et al, 1986]. A finite difference grid size of 10x10 is used in this study as recommended by Weber.

- The correlation presented by Lowe and Christie [1961] is used to calculate a volume transfer coefficient from a given cooling tower's tower coefficient (k) and tower exponent (n). The tower coefficient and tower exponent are calculated from manufacturer's performance data for a given cooling tower.

- The tower fan operation time required to maintain a minimum condenser water supply temperature is then calculated.

3.1.1 Calculation of Tower Coefficient

The solution of the differential equations developed by Weber requires the value of the tower coefficient ($f_d a$) as defined by Lowe and Christie [1961] where f_d is the water vapor mass transfer coefficient for the water droplet to air-vapor mixture and a is the ratio of the surface area of the water droplets to the tower volume where heat and mass transfer takes place. They showed this tower coefficient can be expressed as a function of the mass flow rates of the air and water entering the tower, the tower constant (k), and the tower exponent (n):

$$\frac{f_d a}{\dot{m}_w} = k * \left(\frac{\dot{m}_w}{\dot{m}_a}\right)^{-n} \tag{3.1}$$

The tower constant and exponent are fixed for a given tower.

The values of the tower constant and exponent for the tower at the Peachtree Plaza Hotel were obtained by calculating the tower coefficient at 14 operating points given in manufacturer's performance specifications. In order to be compatible with the tower model, the eight cells at the Peachtree Plaza Hotel were treated as a single tower in the analytical model. The tower model used the inlet and outlet water temperatures, the water and air flow rates, and the air inlet wet and dry bulb temperatures from the manufacturer's specifications to calculate the tower coefficient. The tower routine used a modified bisection method to iterate on the tower coefficient value until the calculated water exit temperature matched the given water exit temperature within 0.0001 °F. The calculated tower coefficients at each operating point were used to plot the ratio of $f_d a/\dot{m}_w$ versus the ratio of $\dot{m}_w/\dot{m}_a$. Linear regression was used to calculate the slope of the line or the tower exponent and the intercept of the line or the tower constant (Figure 3.1). For the tower at the Peachtree Plaza Hotel, using the manufacturer's specifications resulted in a tower exponent (n) of 1.12983 and a tower constant (k) of 2.167380.

3.1.2 Tower Fan Model

The tower model calculates the fan shaft power (HP) from the air flow rate through the tower. A correlation of the fan shaft power to the air flow rate through the tower was obtained from a curve fit of manufacturer's performance specifications for the tower at the Peachtree Plaza Hotel. Figure 3.2 is a graph of ln(cooling tower fan HP) versus ln(cooling tower cfm) for the Plaza's cooling tower. A reduction of the curve fit formula similar to the one done by Weber [1988] shows horsepower as a function of air flow rate raised to the 3.8 power. The theoretical value, as stated by Weber, is 3.0.

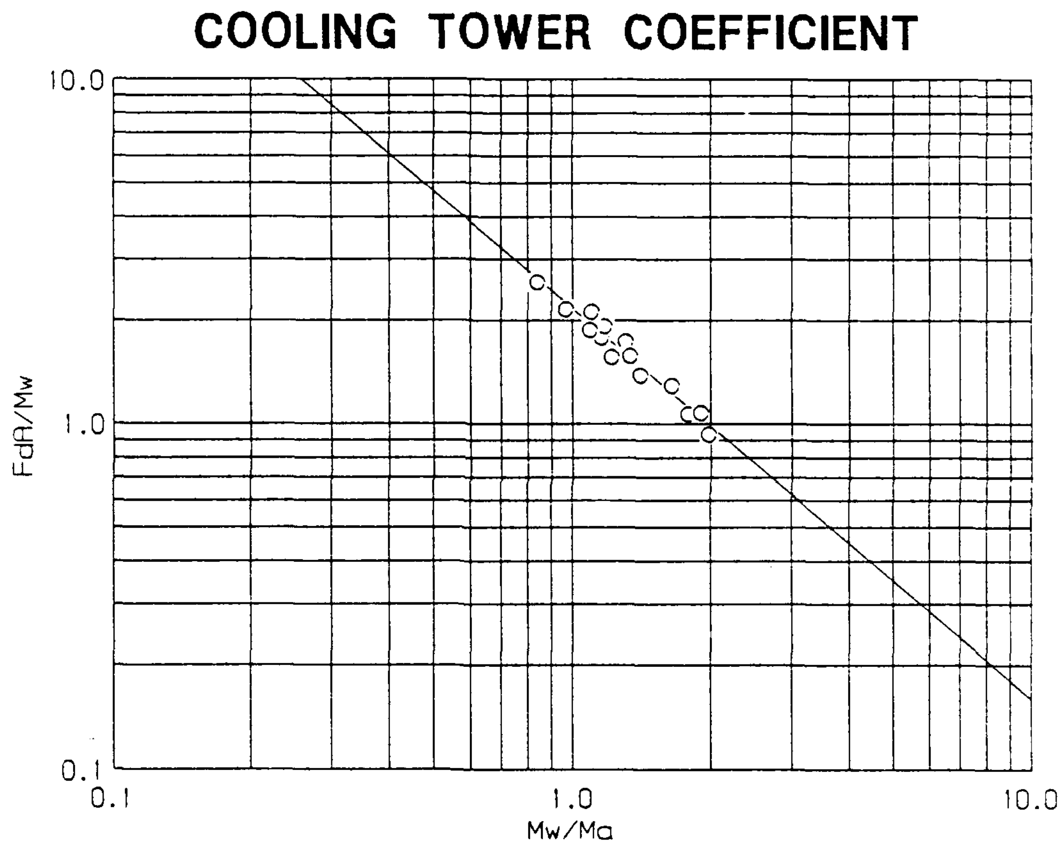

Figure 3.1. Cooling Tower Coefficient

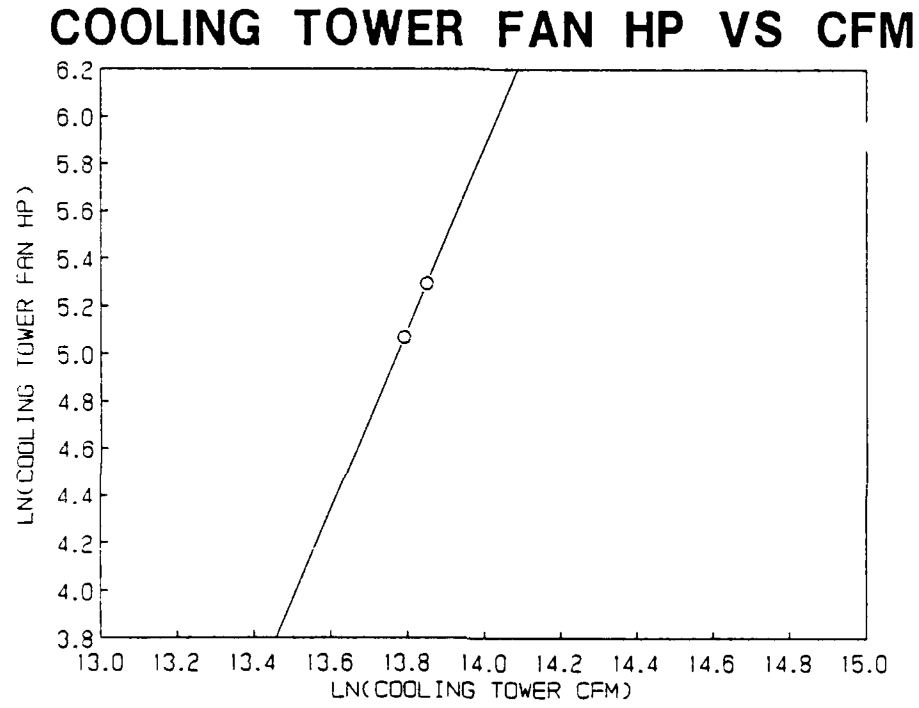

Figure 3.2. Cooling Tower Fan Horsepower vs. Tower Air Flow Rate

3.2 Chiller Model

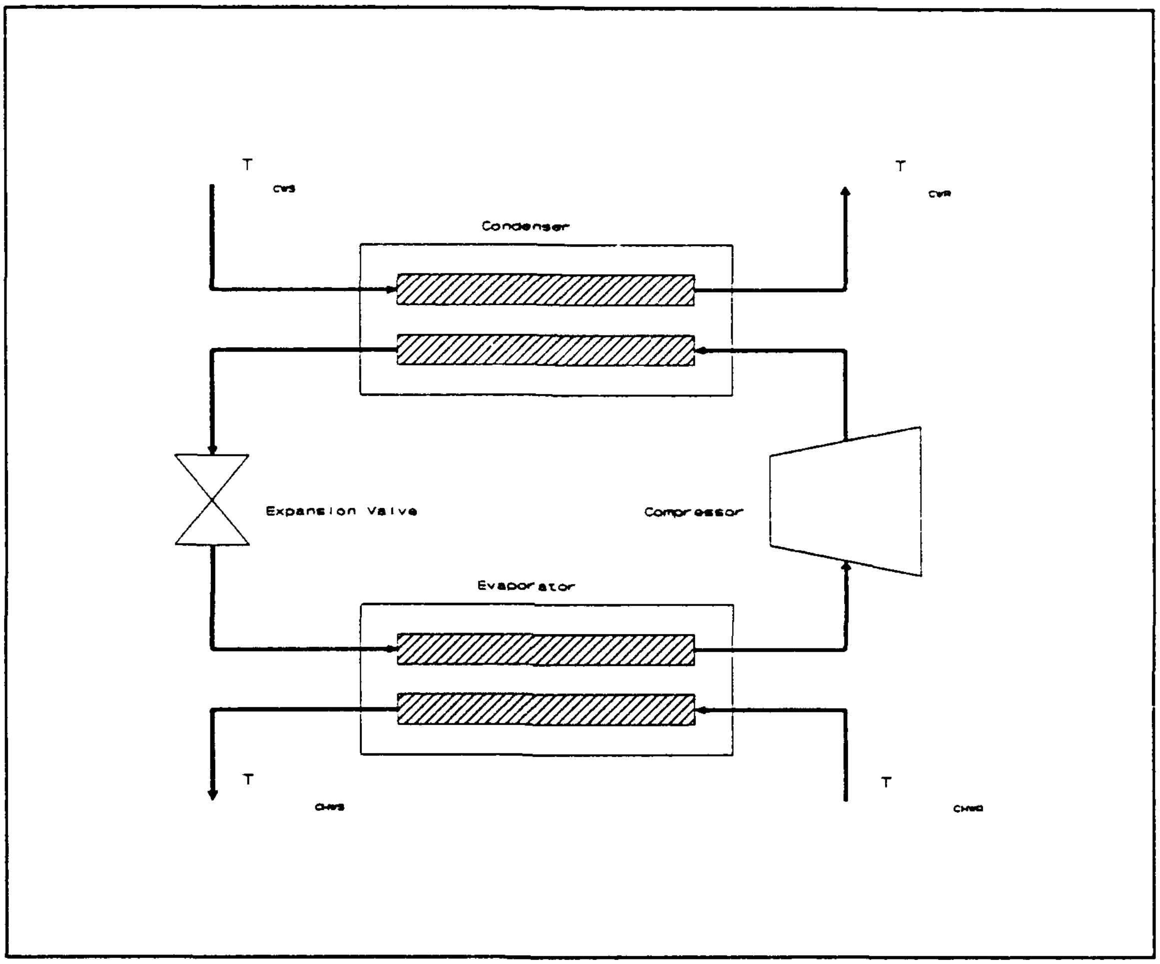

Figure 3.3. Chiller Schematic [Weber, 1988]

The chiller component model developed by Weber (Figure 3.3) is composed of three sub-component models; one for the evaporator, condenser, and compressor. One of the advantages of this approach is that modifications made to any of the subcomponents can be accurately modeled and show the effects on the chiller performance.

3.2.1 Manufacturer's Performance Specifications

Table 3.1. Normalized Manufacturer's Performance Data

PART LOAD	ELECTRICAL POWER (KW/RT)	T_{CWS} (°F)	GPM_C (GPM/RT)	T_C (°F)	T_E (°F)
1.000	0.6300	85	3	97.75	40.24
1.000	0.6840	92.5	3	105.38	40.24
1.000	0.5900	75	3	87.7	40.24
1.000	0.6200	85	5.948	93.61	40.24
1.000	0.6580	85	1.81	103.53	40.24
0.666	0.5976	85	3	93.2	41.03
0.334	0.7006	85	3	89.18	41.37

T_{CHWS}=44°F, GPM_E=2.4 GPM/RT, ΔT_{CHW}=10°F @ FULL LOAD

Weber obtained manufacturer's performance specifications for a 500 RT chiller at various load levels, entering condenser water temperatures, and condenser water flow rates. These data include compressor electrical power, condensing temperature, and the evaporator suction temperature as shown in Table 3.1. For the purposes of this study, the chiller load in RT, the electrical power in KW and the condenser flow rate in GPM were normalized by the chiller size of 500 RT.

3.2.2 Evaporator Model

The evaporator model proposed by Weber considered the evaporator to be a flooded shell and tube heat exchanger. The following two expressions for the evaporator heat transfer rate were employed in his model:

$$Q_E = \dot{m}_{CHW} * C_{P_w} * \Delta T_{CHW} \tag{3.2}$$

$$Q_E = UA_E * LMTD_E \tag{3.3}$$

where Q_E = the chilled water load

$\dot{m}_{CHW}$ = mass flow rate of the chilled water through the evaporator

ΔT_{CHW} = the chilled water temperature rise through the evaporator

UA_E = evaporator overall heat conductance

$LMTD_E$ = evaporator log mean temperature difference

Equation 3.2 allowed the temperature decrease of the chilled water flowing through the evaporator tubes to be calculated for a given cooling load and chilled water flow rate. For the purposes of this study, the chilled water flow rate and the chilled water supply temperature were held constant. Equation 3.3 can then be viewed as the relationship between the variation in the chilled water temperature to the product of the overall evaporator conductance and the evaporator log mean temperature difference ($LMTD_E$). When the flow rate was held constant, Weber showed that the UA_E was only a function of the refrigeration capacity. This relationship was also assumed to be correct in this study.

Using the normalized manufacturer's performance data shown in Table 3.1 and equations 3.2 and 3.3, the normalized evaporator conductance was calculated. A plot of UA_E versus part load is shown in Figure 3.4. A curve fit was made to determine an expression for UA_E as a function of part load (PL). This expression was found to be:

$$UA_E = 268.23206 + 2568.6836 * PL - 1281.09948 * PL^2 \tag{3.4}$$

where PL is the part load fraction (PL = Model Chiller Load/Nominal Chiller Size) and UA_E has units of BTUH/(°F * RT).

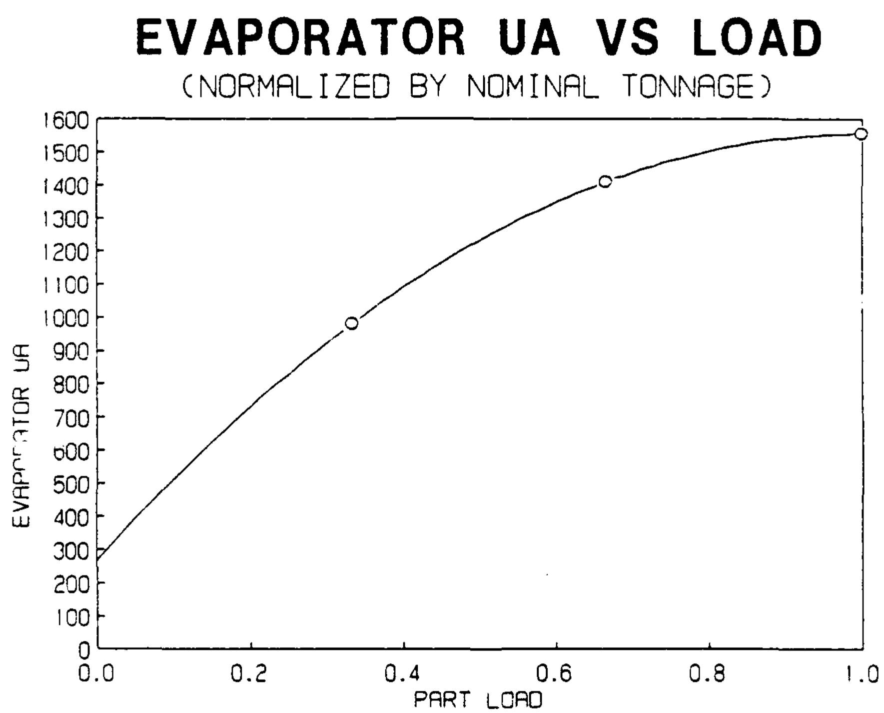

Figure 3.4. Normalized Evaporator UA vs. Load

3.2.3 Condenser Model

The condenser model used by Weber also considered the condenser to be a flooded shell and tube heat exchanger. The critical difference from the evaporator model was that a variation in the number of condenser passes was permitted to maintain a minimum water velocity in the tubes of the condenser. The heat transfer rate in the condenser is given by an energy balance on the chiller as follows:

$$Q_C = Q_E + KW_C \tag{3.5}$$

where Q_C = condenser heat transfer rate

KW_C = power consumption of the compressor

The expressions used to approximate the condenser performance were very similar to those for the evaporator model and are given by:

$$Q_C = \dot{m}_{CW} * c_{p_w} * \Delta T_{CW} \tag{3.6}$$

$$Q_C = UA_C * LMTD_C \tag{3.7}$$

where $\dot{m}_{CW}$ = condenser water flow rate

ΔT_{CW} = the temperature rise of the condenser water

UA_C = overall conductance of the condenser

$LMTD_C$ = condenser log mean temperature difference

Unlike in the evaporator, where the chilled water flow rate is held constant, the condenser water flow rate is allowed to vary. As a result, in the model by Weber it was found that the UA_C is a function of both the heat transfer rate and the velocity of the condenser water. The velocity of the condenser water is proportional to the condenser water flow rate divided by the number of passes in the condenser.

Using the normalized manufacturer's performance data shown in Table 3.1 and equations 3.5 - 3.7, the normalized condenser conductance was calculate at various loading and condenser water velocity conditions. A plot of UA_C versus condenser water velocity at various part loads is shown in Figure 3.5. A curve fit was used to determine an expression for UA_C as a function of part load and condenser water velocity. The expression was found to be:

$$\begin{aligned} UA_C = {} & 1217.09668 + 261.29712 * PL - 384.41132 * PL^2 \\ & + 802.5367 * \left(\frac{GPM_C}{PASSES}\right) - 123.8789 * \left(\frac{GPM_C}{PASSES}\right)^2 \end{aligned} \tag{3.8}$$

where GPM_C has units of GPM/RT and UA_C has units of BTUH/(°F * RT).

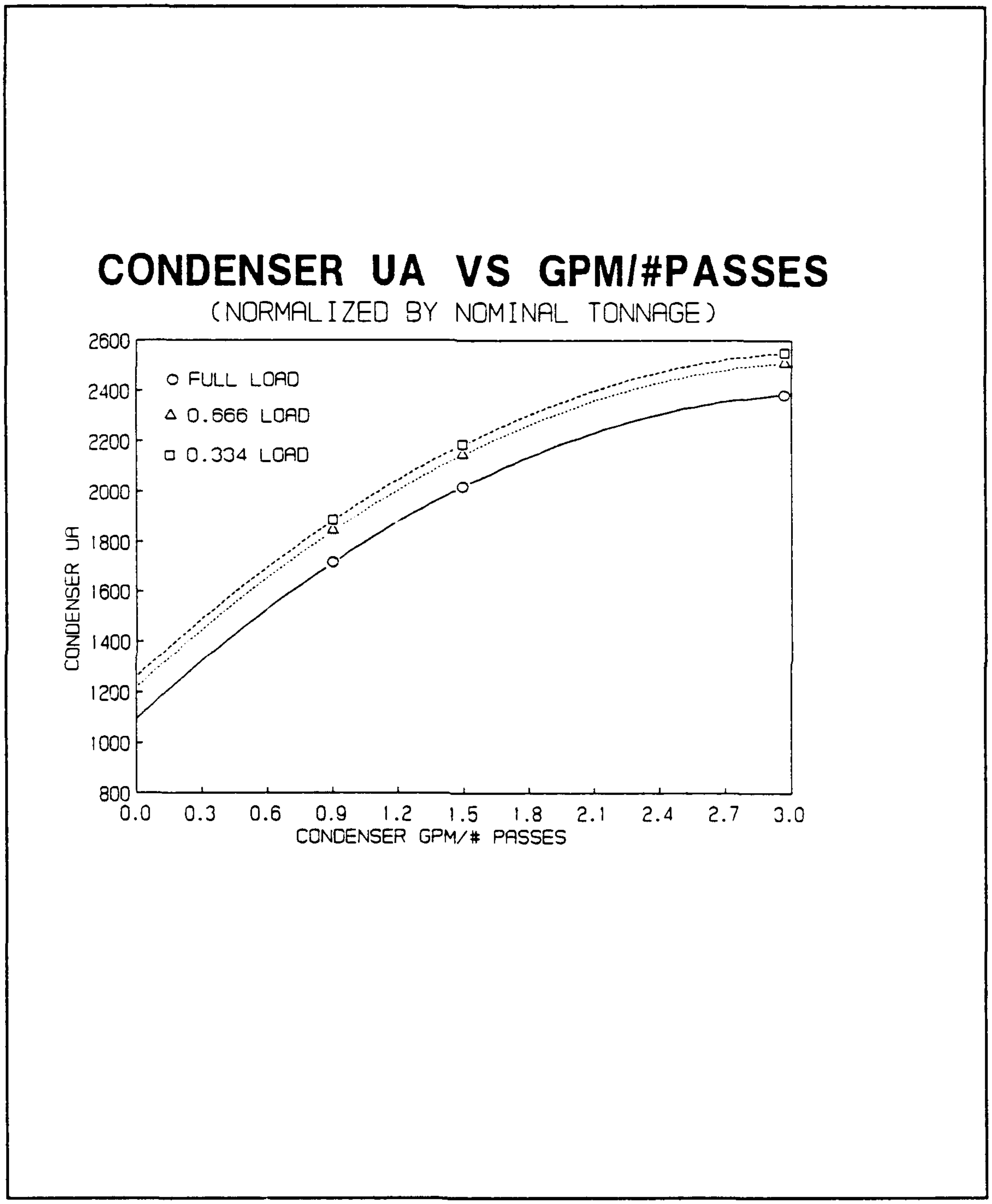

Figure 3.5. Normalized Condenser UA vs. Water Flow Rate/# Passes

3.2.4 Compressor Model

In the compressor model developed by Weber, the Carnot efficiency governing the performance of the refrigeration devices was used with two efficiencies to correlate the compressor performance based on manufacturer's performance data. The values for these efficiencies were found using the manufacturer's data in Table 3.1. In the development of the compressor model, the compressor was assumed to be adiabatic.

Weber used the Carnot cycle to develop the ideal, or Carnot based, kilowatts per ton of cooling load. This assumed isentropic compression, constant temperature heat rejection at T_C, and constant temperature heat addition at T_E. Weber then related the Carnot based KW/RT to the manufacturer's KW/RT using two efficiencies, a compressor isentropic efficiency at design full load ($\eta_{isent,\ model}$) and a varying part load efficiency ($\eta_{ton,\ model}$) based on the chiller load. The $\eta_{isent,\ model}$ is based on input power to the electric motor, not the input power to the compressor shaft. The part load efficiency accounts for the decrease in the efficiency of the compressor at part load conditions. The equations for $\eta_{isent,\ model}$ and $\eta_{ton,\ model}$ are found using polynomial equation curve fits to the manufacturer's performance data in Table 3.1 (Figures 3.6 and 3.7). Since the manufacturer's design full load KW/RT for the chiller at the Peachtree Plaza is 0.65 KW/RT, the equation found from Weber's model data is multiplied by a ratio of the manufacturer's design KW/RT for the model chiller to the manufacturer's KW/RT for the chiller at the Peachtree Plaza (0.63/0.65). This resulting equation is plotted in Figure 3.6 and given below.

The model KW/RT is then determined by:

$$\left(\frac{KW}{RT}\right)_{model}=\frac{\left(\frac{KW}{RT}\right)_{carnot}}{\eta_{isent,model} * \eta_{ton,model}} \tag{3.9}$$

where

$$\left(\frac{KW}{RT}\right)_{carnot}=\left[\frac{T_C}{T_E}-1\right] * 3.517 \tag{3.10}$$

(T_C and T_E are absolute temperatures and $(KW/RT)_{carnot}$ has units of KW/RT.)

$$\eta_{isent,model}=0.50013+\left[1.5454 * \left(\left(\frac{KW}{RT}\right)_{carnot}-0.3\right)\right]-\left[3.613 * \left(\left(\frac{KW}{RT}\right)_{carnot}-0.3\right)^2\right] \tag{3.11}$$

($[KW/RT]_{carnot}$ has units of KW/RT.)

$$\eta_{ton,model}=[4.5869 * PL]-[8.16536 * PL^{2}]+[6.65014 * PL^{3}]-[2.07617 * PL^{4}] \tag{3.12}$$

(PL is the previously defined chiller part load fraction.)

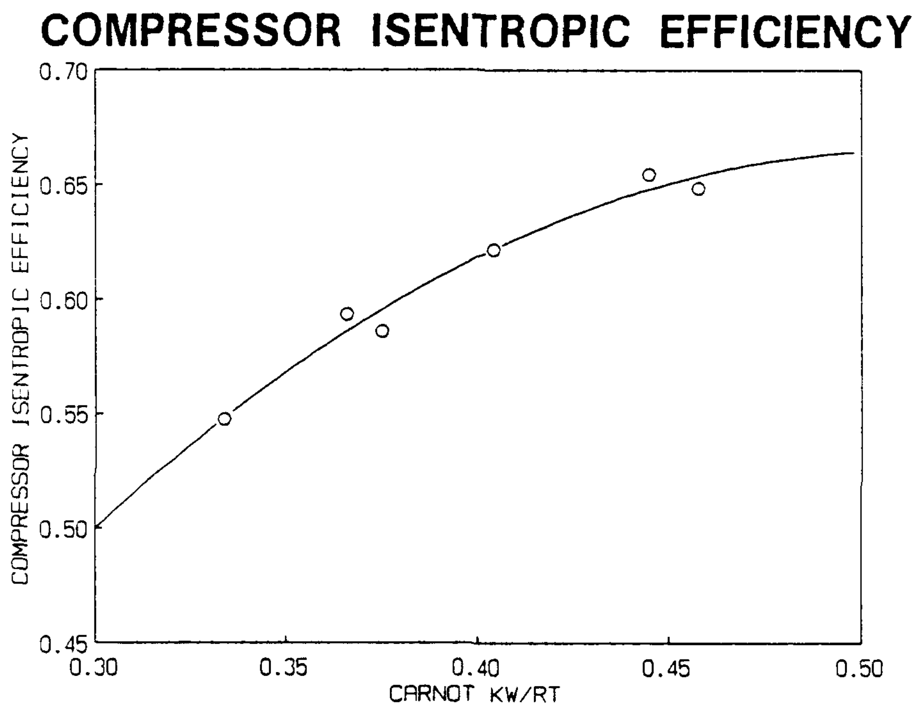

Figure 3.6. Compressor Isentropic Efficiency

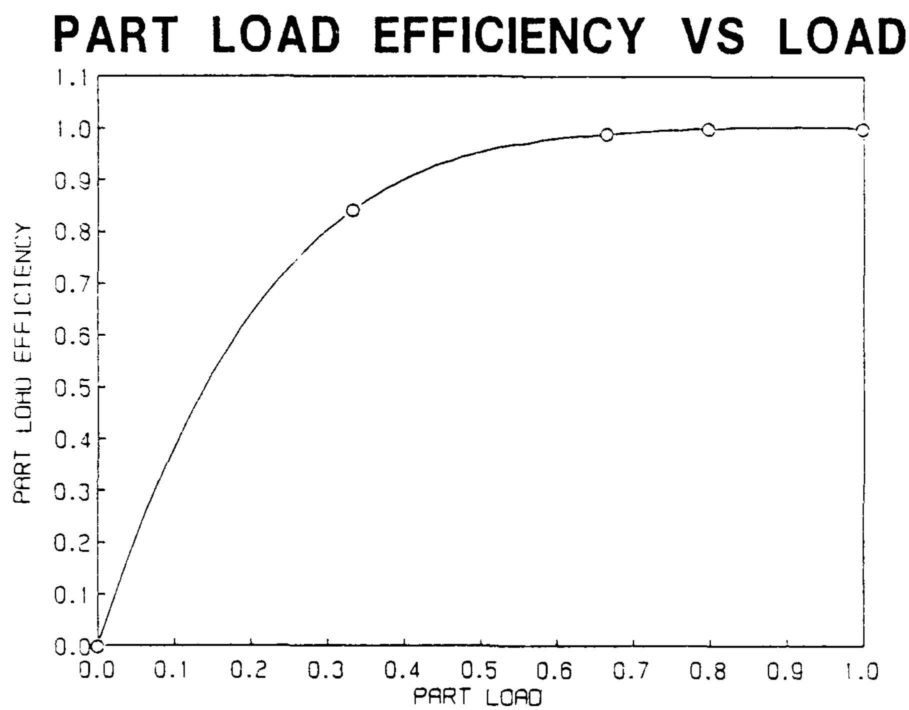

Figure 3.7. Part Load Efficiency

3.3 Analytical Model Simulations

Two simulations were performed using the complete chilled water system analytical model. The first simulation used actual field weather data and actual field chiller component performance data obtained at the Peachtree Plaza Hotel. The second simulation used standard weather data in conjunction with the manufacturer's chiller component performance data. Both simulations utilized manufacturer's cooling tower performance data. Table 3.2 lists the variables required for each simulation. Both simulations used building load profiles developed from measured field data.

Using experimental data in simulation 1 and comparing the results to actual field data can be used to validate the analytical model developed by Weber. Once this analytical model is validated, using manufacturer's performance data and standard weather data in simulation 2 permits an estimate of the yearly performance of the system. Comparing simulation 2 results to actual field data shows how accurately the manufacturer's performance data predict actual field performance.

3.3.1 Weather Data

3.3.1.1 Simulation 1: Weather data for simulation 1 are tabulated from the twenty days of experimental data collected at the Peachtree Plaza Hotel. The dry bulb temperature bins and mean coincident wet bulb (MCWB) temperatures were the same as those used in the standard weather data given in U.S. Air Force Manual

Table 3.2. Simulation Variables

Variable	Simulation 1	Simulation 2[2]
Nominal Chiller Tonnage	900 RT[1]	1000 RT
Chiller Efficiency	0.85 KW/RT[1]	0.65 KW/RT
Evaporator GPM	2444 GPM[1]	2400 GPM
CHWS Temperature	44 °F[1]	44 °F
Condenser Passes[*]	2	2
Condenser GPM	3441 GPM[1]	3093 GPM
CWS Pipe Diameter[*]	12"	12"
CWS Set Point	70/75/80/85/90 °F	70/75/80/85/90 °F
Tower Fan CFM	1,036,960 CFM[2]	1,036,960 CFM

[*]Based on actual system design.

[1]Based on actual field component performance data.

[2]Based on manufacturer's component performance data.

88-29 [1978]. The summary of data are shown in Table 3.3.

3.3.1.2 Simulation 2: Weather data used for simulation 2 are obtained from the U.S. Air Force Manual 88-29. The total number of hours in each dry bulb 5 °F temperature range, or "bin," was used as the Peachtree Plaza Hotel chilled water system operates twenty-four hours per day. A computer algorithm calculated the total number of hours for each bin and the cumulative number of hours for each month of the year.

Table 3.3. Experimental Weather Data

OSA T_{DB} Bin	MCWB Temperature	Hours[1]
72	60	1
67	60	80
62	57	100
57	52	140
52	47	77
47	42	52
42	38	4
Total Number of Hours: 454		

[1]Total number of mechanical cooling hours observed in OSA T_{DB} bin. (Free cooling hours are excluded.)

3.3.2 Building Load Profile

The actual building load profile was found by plotting the average hourly chiller tonnage (RT) versus the average hourly OSA temperature from the experimental data (Figure 3.8). The building load profiles for simulation 1 and simulation 2 are shown in Figures 3.9 and 3.10 respectively. The profile for simulation 1 is normalized by a nominal chiller tonnage of 900 RT; whereas the one for simulation 2 by a nominal tonnage of 1000 RT. Both profiles assume free cooling to be used below an OSA temperature of 42 °F.

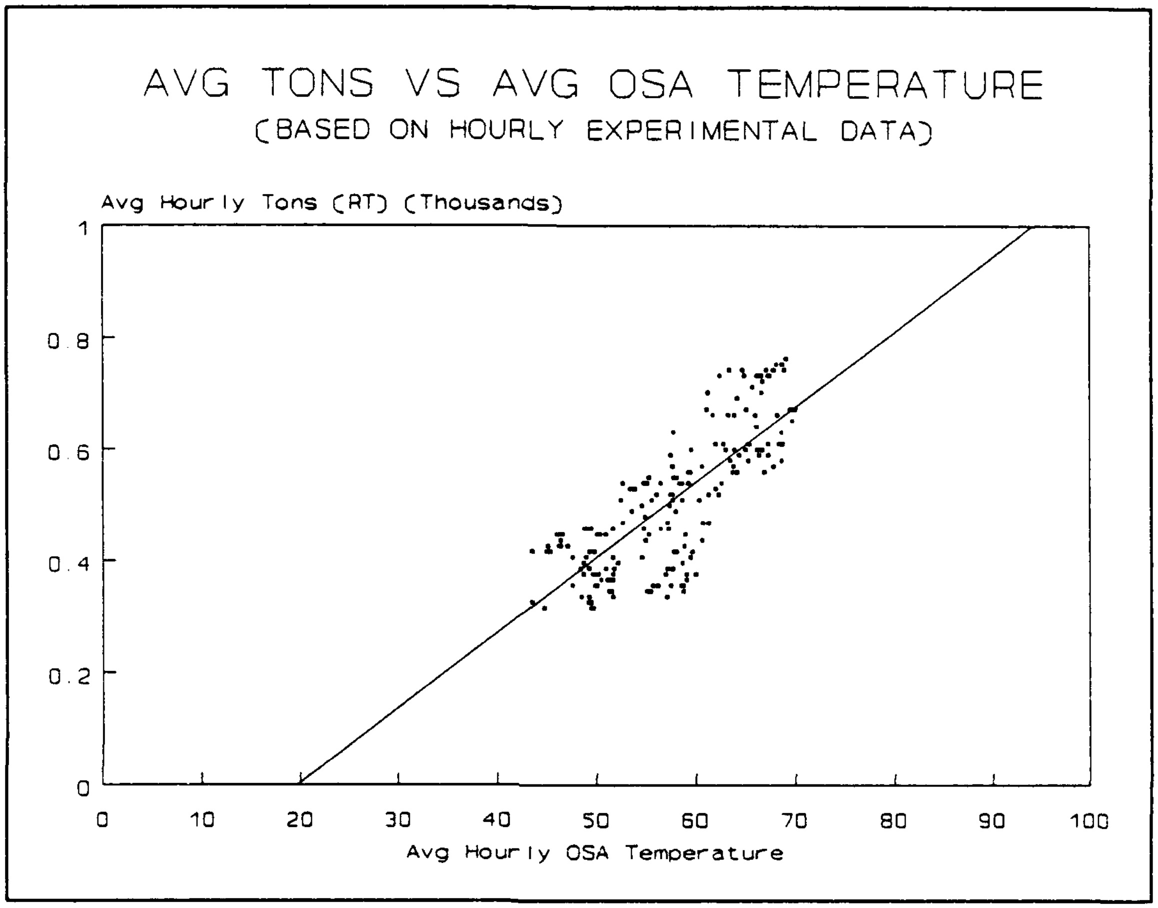

Figure 3.8. Experimental Building Load Profile

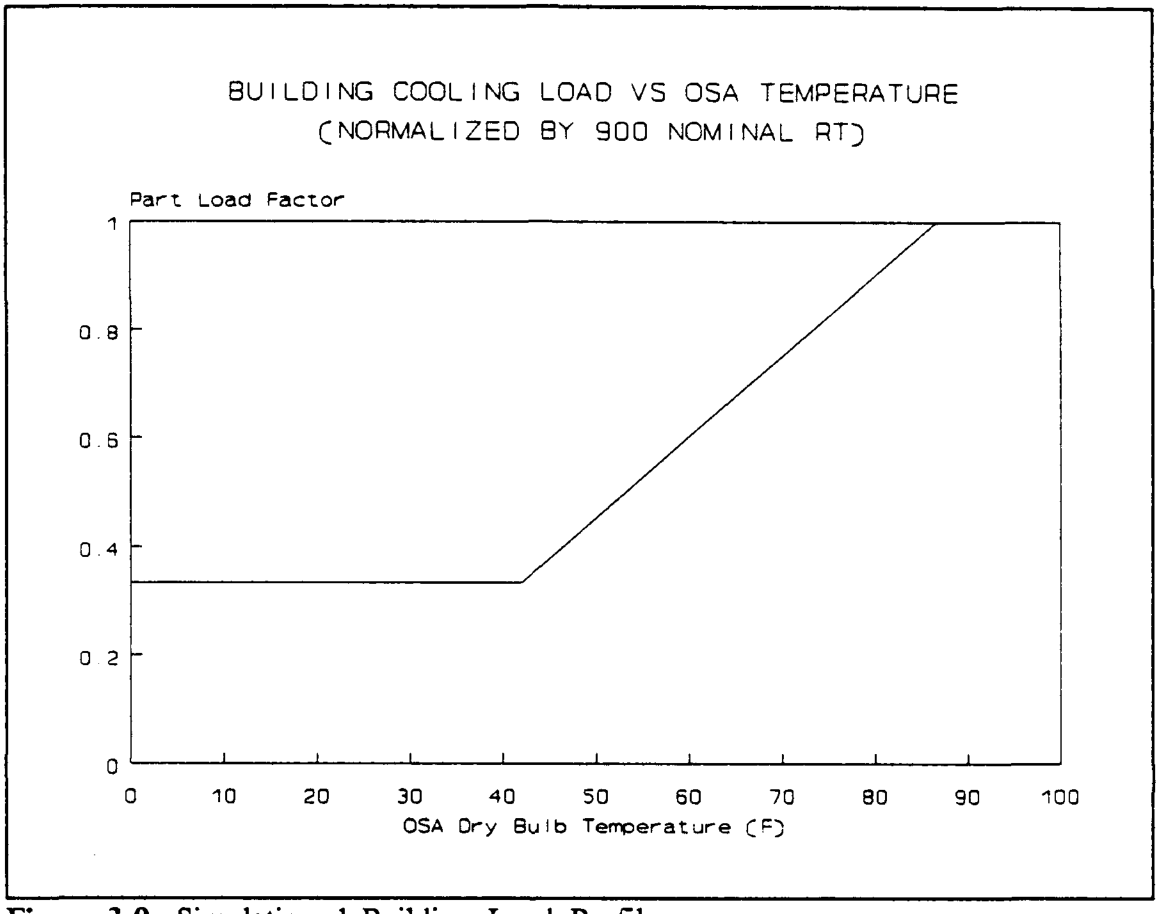

Figure 3.9. Simulation 1 Building Load Profile

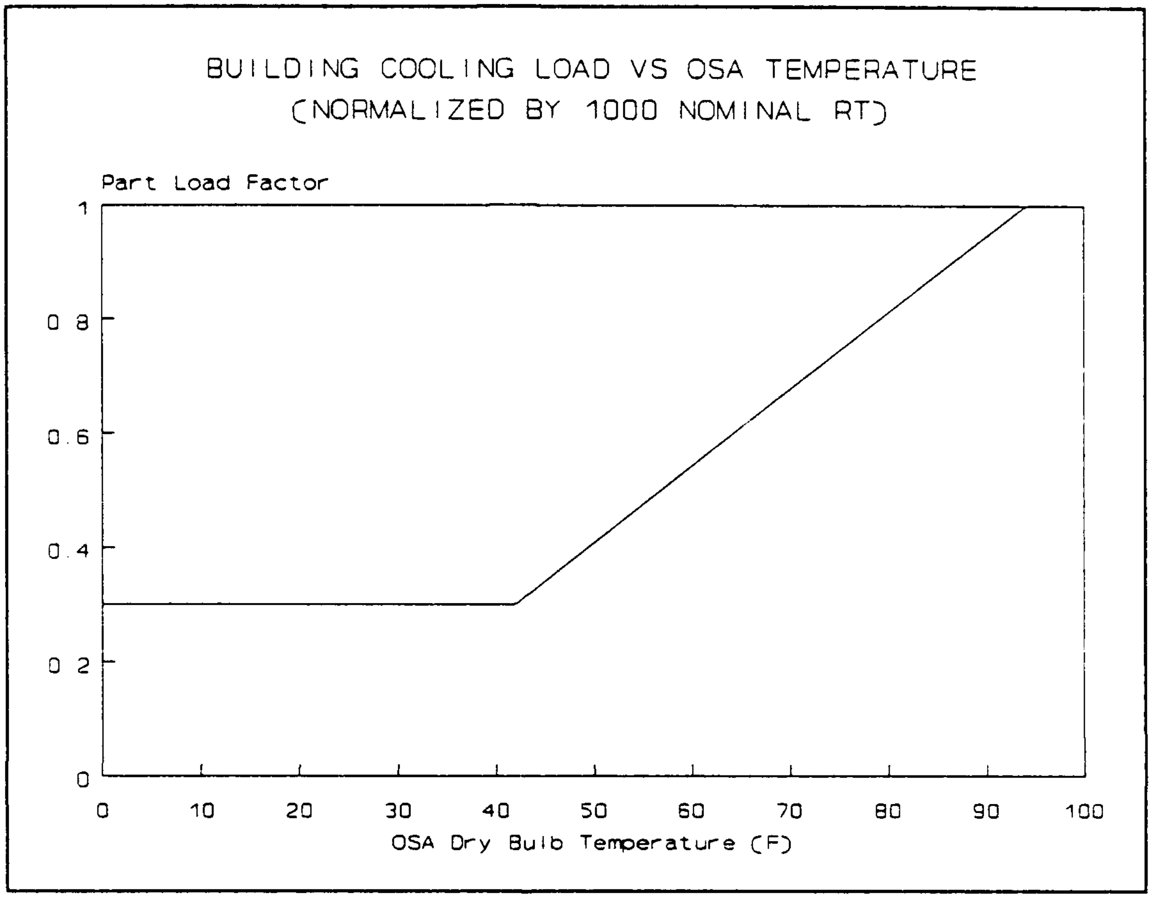

Figure 3.10. Simulation 2 Building Load Profile

CHAPTER IV

RESULTS

4.1 Daily Data

As discussed in Chapter II, data was collected for the twenty days from November 6, 1990 to November 24, 1990. For each day, one of the four entering condenser water set point temperatures (70, 75, 80, 85 °F) was maintained. The hourly field data for each day is tabulated in Appendix 1. Table 4.1 gives a daily summary of the field data.

A major objective of this study was to determine the optimum condenser water set point temperature. In this work, the total system efficiency was chosen as the criterion for determining this optimum. The "total system" was defined as the combination of the chiller and the cooling tower fans. The chilled water pumps and condenser water pumps were not considered since their energy use was constant for all cases. The total system efficiency is defined as the ratio of the total system energy use to the total refrigeration ton-hours and has units of KW/RT.

Plotting the chiller efficiency, cooling tower fan efficiency, and total system efficiency as a function of the four set point temperatures (Figures 4.1, 4.2, 4.3) shows clearly the following trends. For the chiller energy consumption, the chiller efficiency initially decreased as the set point temperature decreased from 85 °F to

75 °F. The chiller efficiency, however, then increased with further set point temperature decreases. The tower fan energy consumption (the energy use per RT-hour produced, KW_F/RT) increased as the set point temperature decreased. The total system efficiency showed the same trends as the chiller, first increasing as the set point temperature was lowered from 85 °F to 80 °F, followed by an increase in efficiency as the set point was further decreased. Although the chiller was more efficient at a set point temperature of 75 °F, the total system efficiency was maximized at an 80 °F set point temperature. This fact is explained by the large increase in fan energy consumption from 80 °F to 75 °F outweighing the energy savings in chiller energy for this temperature range.

These trends are consistent with known chiller operation [Trane, 1989]. Lowering the condenser water temperature lowers the head pressure on the condenser and consequently increases the chiller efficiency. The energy used by the chiller is used to compress the refrigerant gas from low pressure in the evaporator to high pressure in the condenser. Decreasing the condenser water temperature will lower the saturation temperature in the condenser, thereby decreasing the pressure differential between the evaporator and the condenser. This pressure differential decrease reduces the work required by the compressor and the energy consumption of the compressor. The total result is to lower the chiller efficiency (KW_C/RT).

As seen in the experimental data, there are limitations to lowering the condenser water temperature. A minimum pressure differential is required between the evaporator and the condenser to assure adequate refrigerant flow through the orifice acting as the throttling device. If this minimum pressure differential is not maintained, insufficient refrigerant is returned to the evaporator resulting in low evaporation pressures. As the level of the liquid refrigerant drops, the evaporator tubes are no longer fully covered, causing a decrease in the effective surface area used to evaporate the refrigerant. This decrease will result in a reduction of the chiller efficiency.

Table 4.1. Summary of Field Data

DATE	SET POINT	AVG OSA TEMP	TONHRS	AVG TON (RT)	CHILLER KWH	FAN KWH	TOTAL KWH	CHILLER KW/RT	FAN KW/RT	TOTAL KW/RT
6 NOV	85	56.1	12261	511	12174	318	12492	0.9929	0.0259	1.0188
10 NOV	85	48.8	9124	380	10722	4	10726	1.1751	0.0004	1.1755
14 NOV	85	60.7	13921	580	13244	585	13829	0.9514	0.0420	0.9934
18 NOV	85	58.0	7464	574	6847	216	7063	0.9517	0.0292	0.9809
22 NOV	85	62.9	12251	510	12476	648	13124	1.0184	0.0529	1.0713
AVG		57.3	11004	511	11093	354	11447	1.0179	0.0301	1.0480
7 NOV	80	60.1	12688	529	12243	700	12943	0.9649	0.0551	1.0200
11 NOV	80	58.1	7709	514	7117	355	7471	0.9880	0.0460	1.0340
15 NOV	80	61.4	13870	578	12809	957	13766	0.9235	0.0690	0.9925
19 NOV	80	58.8	9491	527	9187	399	9586	0.9695	0.0421	1.0117
23 NOV	80	61.1	13003	542	12462	857	13319	0.9584	0.0659	1.0243
AVG		59.9	11352	538	10764	654	11417	0.9609	0.0556	1.0165
8 NOV	75	54.4	11619	484	11535	766	12301	0.9928	0.0659	1.0587
12 NOV	75	59.4	12261	511	11794	951	12745	0.9619	0.0776	1.0395
16 NOV	75	63.0	15153	631	12871	1502	14373	0.8494	0.0991	0.9485
20 NOV	75	61.8	12200	508	11900	1154	13054	0.9754	0.0946	1.0700
24 NOV	75	58.7	11915	496	11645	832	12478	0.9774	0.0699	1.0473
AVG		59.5	12630	526	11949	1041	12990	0.9514	0.0814	1.0328
9 NOV	70	48.2	10112	421	10746	927	11673	1.0627	0.0917	1.1543
13 NOV	70	57.6	12831	535	11866	1352	13218	0.9248	0.1054	1.0302
17 NOV	70	53.0	12627	526	11676	1056	12732	0.9247	0.0937	1.0083
21 NOV	70	61.0	11924	497	11595	1951	13456	0.9724	0.1636	1.1360
25 NOV	70	61.7	12627	526	11695	1438	13133	0.9261	0.1139	1.0400
AVG		56.3	12024	501	11516	1345	12842	0.9621	0.1117	1.0738

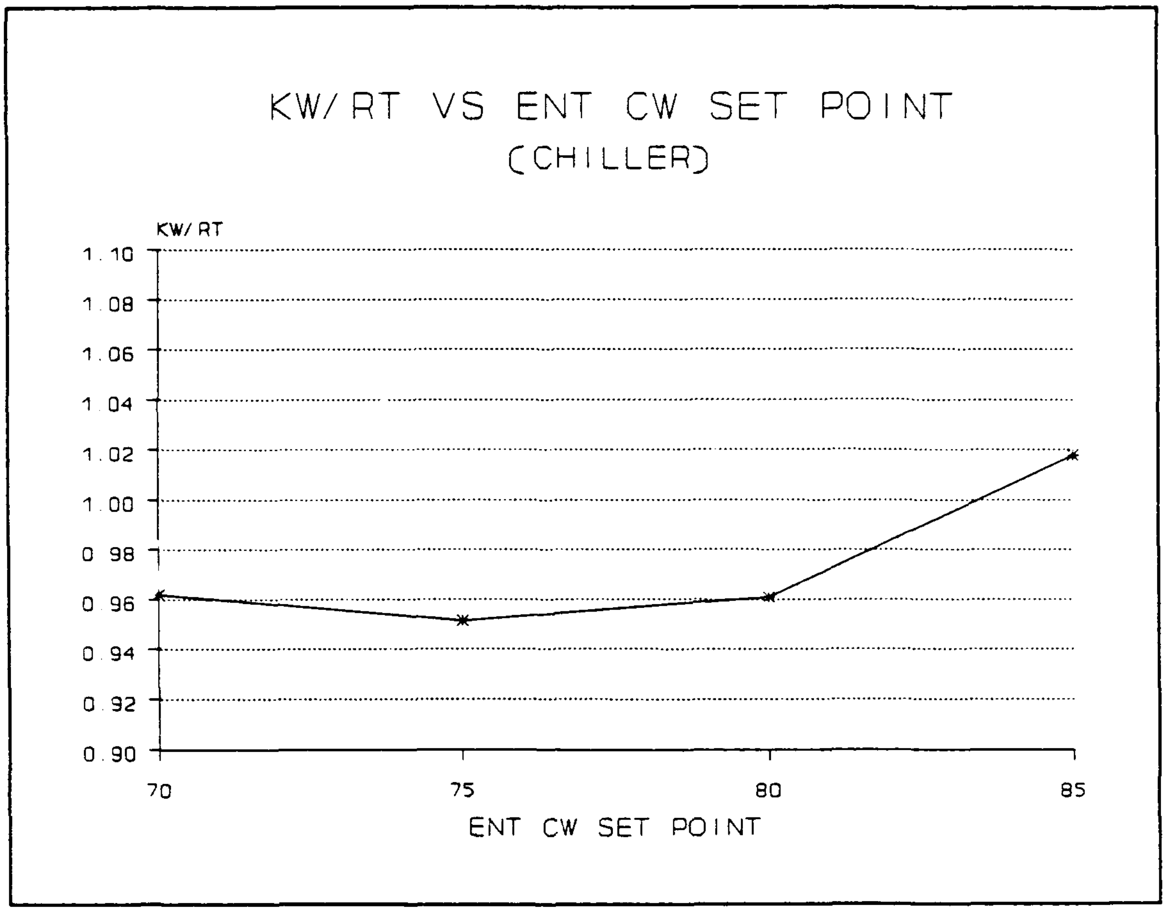

Figure 4.1.. Daily Average Chiller Efficiency at Each Set Point Temperature

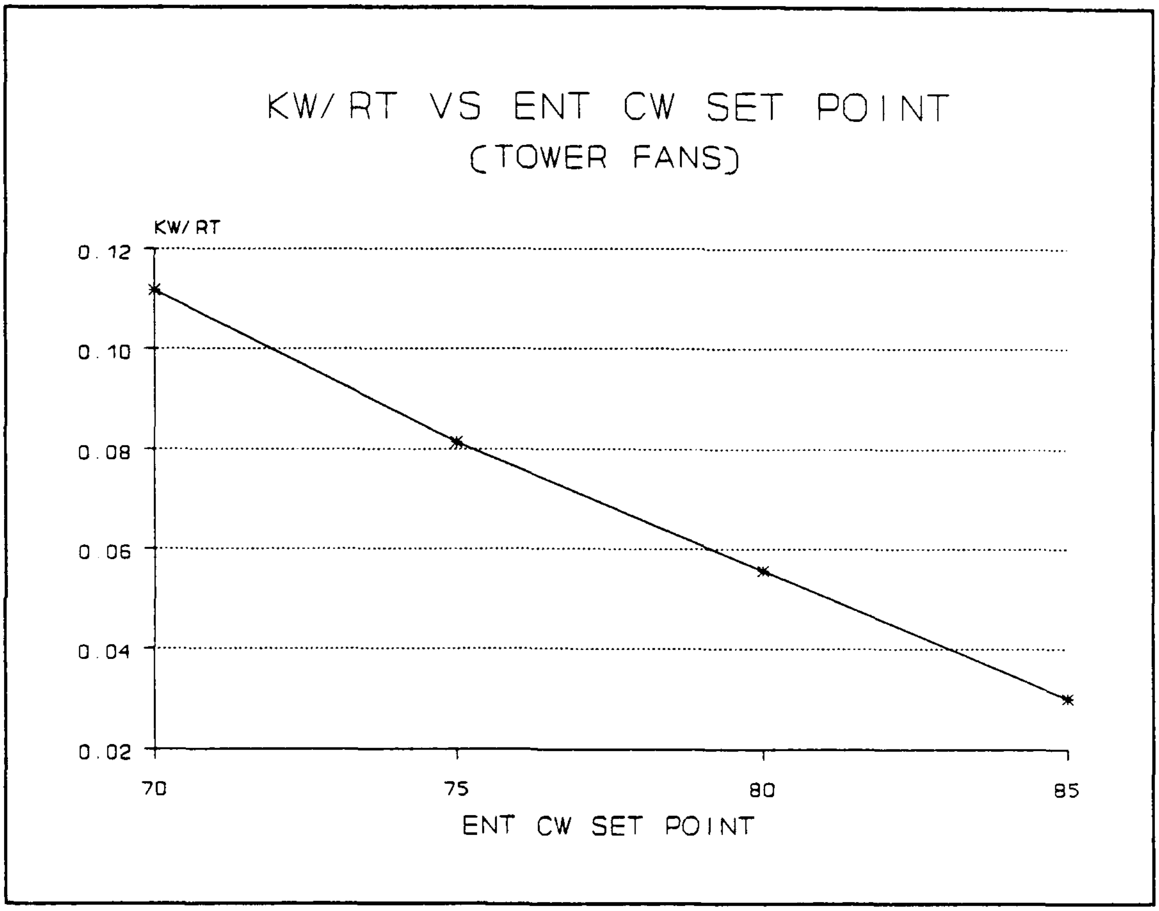

Figure 4.2. Daily Average Cooling Tower Fan Efficiency at Each Set Point Temperature

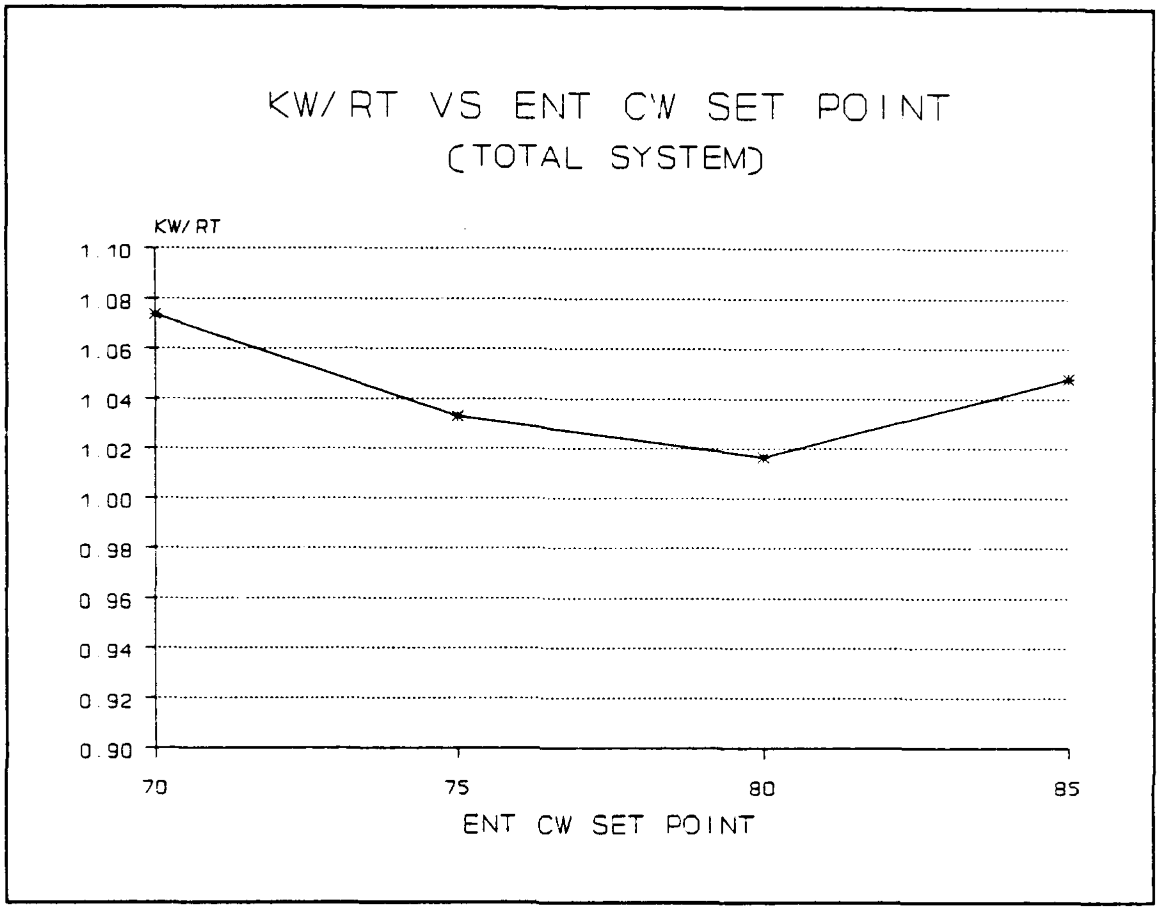

Figure 4.3. Daily Average Total System Efficiency at Each Set Point Temperature

4.2 Statistical Analysis

Statistical inference is the expression used to describe a process by which information from sample data is used to draw conclusions about the population from which the sample was selected. One of the techniques of statistical inference is called "parameter estimation", which is estimating the parameter of interest to be within a calculated range. In this study, the parameters of interest are the chiller efficiency, the cooling tower fan efficiency, and the total system efficiency. To meet the first objective of the study, the efficiencies at each of the four entering condenser water set points should be statistically independent. One method of examining this statistical independence is the use of "confidence intervals".

The confidence interval is the measure of the variation in the data. The unknown parameter then lies in the observed interval with a given confidence. The size of the observed confidence interval is an important measure of the quality of the information obtained from the sample. The larger the confidence interval, the more certain the interval actually contains the true value of the parameter. However, the larger intervals provide less information about the true value of the parameter. The most information is obtained when a relatively small interval has a high degree of confidence.

The construction of the confidence interval assumes the population is normally distributed. Tuve and Domholdt [1966] state four criteria for determining whether the assumption of normal distribution is appropriate. The criteria are as follows:

- The values comprise a population of some size or a fairly large and representative sample from the total population.

- The deviations from the average in this representative sample are small, random, and uncoupled and are due to a variety of causes.

- The range of values from highest to lowest looks reasonable.

• An examination of the highest and lowest values shows no significant bias or skew.

The data collected in this study are assumed to meet these criteria.

To find the confidence interval for the mean of a normal distribution from a random sample of size n where the population variance is unknown, the sample mean, $\bar{X}$, and the sample variance, S^2, are employed in the following equation:

$$X - \frac{t_{\frac{\alpha}{2},n-1} * S}{\sqrt{n}} \leq \mu \leq X + \frac{t_{\frac{\alpha}{2},n-1} * S}{\sqrt{n}} \tag{4.1}$$

where $t_{\alpha/2,n-1}$ is the t-distribution from Table IV in the Appendix of Hines and Montgomery [1990].

Figures 4.4 - 4.6 show the chiller, cooling tower fan, and total system efficiencies as functions of the four entering condenser water set point temperatures with 95% confidence intervals. From the definition, the mean efficiency for the entire population of possible efficiencies at each set point is between the upper and lower limits of the interval with a confidence of 95%. This statement can also be interpreted as, the mean lies within the interval 95% of the time. In this case, the high confidence produces a large interval.

Figures 4.6 - 4.9 show the total system efficiency as a function of the four set point temperatures with decreasing confidence levels. Since the size of the confidence interval measures the precision of the estimation, the precision is inversely related to the size of confidence interval. Simply stated, the large confidence intervals are less precise than small confidence intervals. Therefore, it is highly desirable to obtain a confidence interval that is small enough for decision-making purposes that also has adequate confidence. In Figure 4.9, a set point temperature of 80 °F has a lower total system efficiency than 70 °F with 50% confidence.

The conclusions drawn from the experimental data are therefore believed to be valid, despite the large confidence intervals at higher confidence levels. It is difficult to obtain measurements with high confidence in the systems studied here, since many variables affect the overall efficiency. More measurements must be performed if one wishes to reduce the variation resulting in smaller confidence intervals at higher confidence levels.

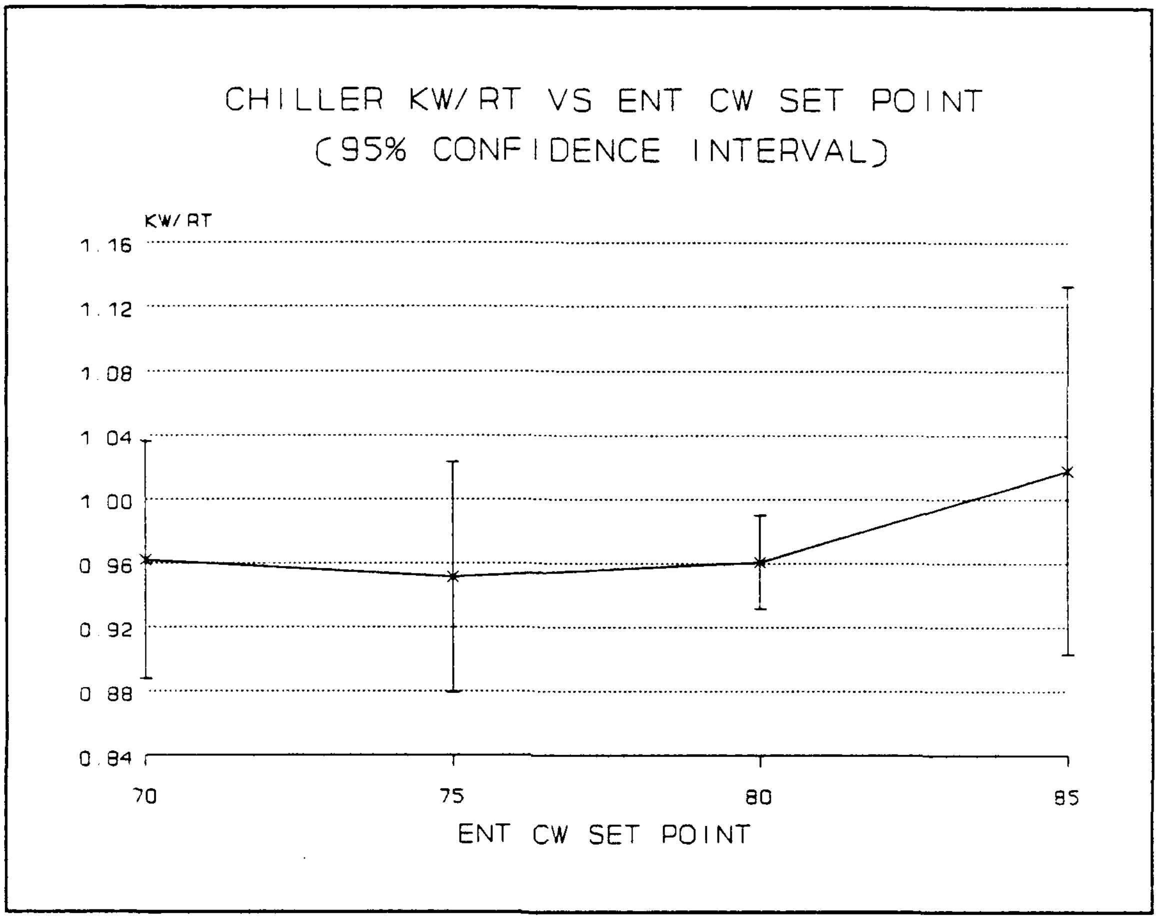

Figure 4.4. 95% Confidence Intervals for Daily Average Chiller Efficiency at Each Set Point Temperature

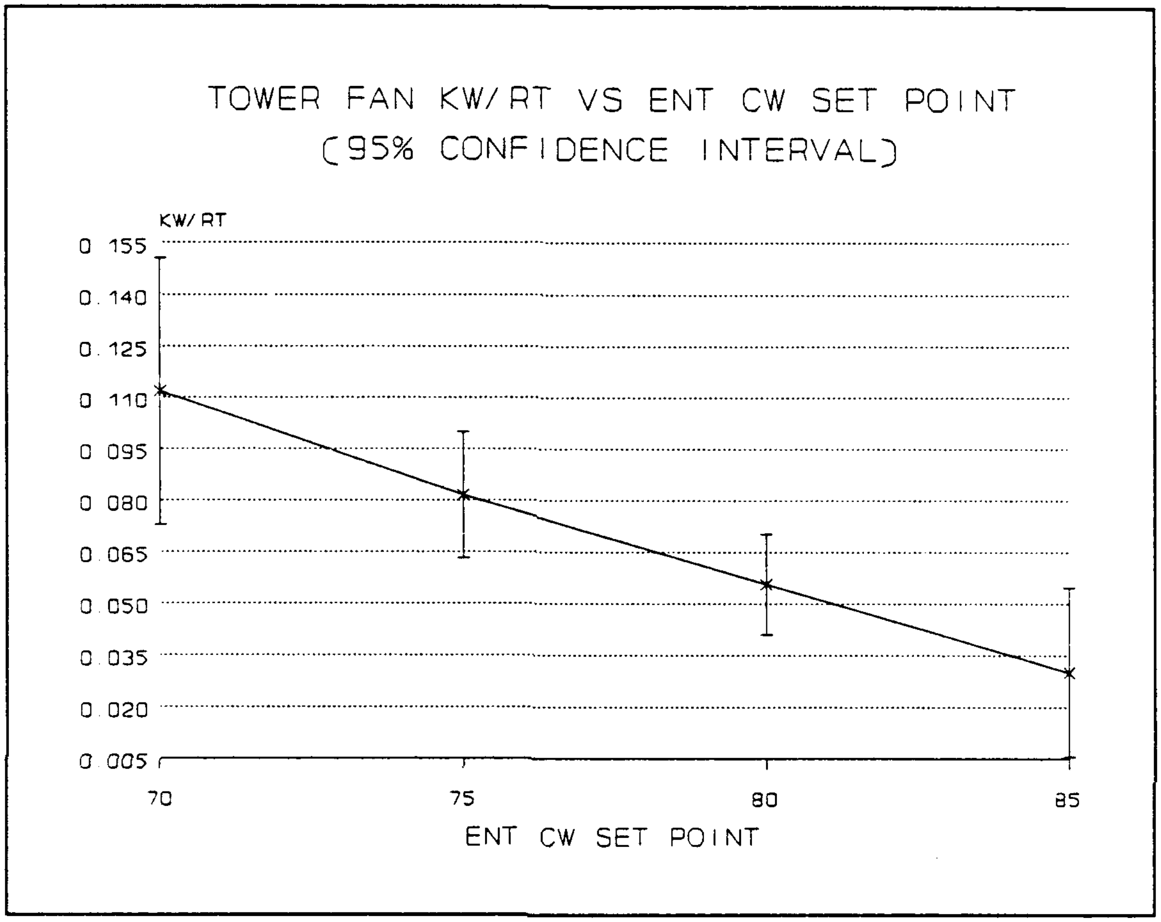

Figure 4.5. 95% Confidence Intervals for Daily Average Cooling Tower Fan Efficiency at Each Set Point Temperature.

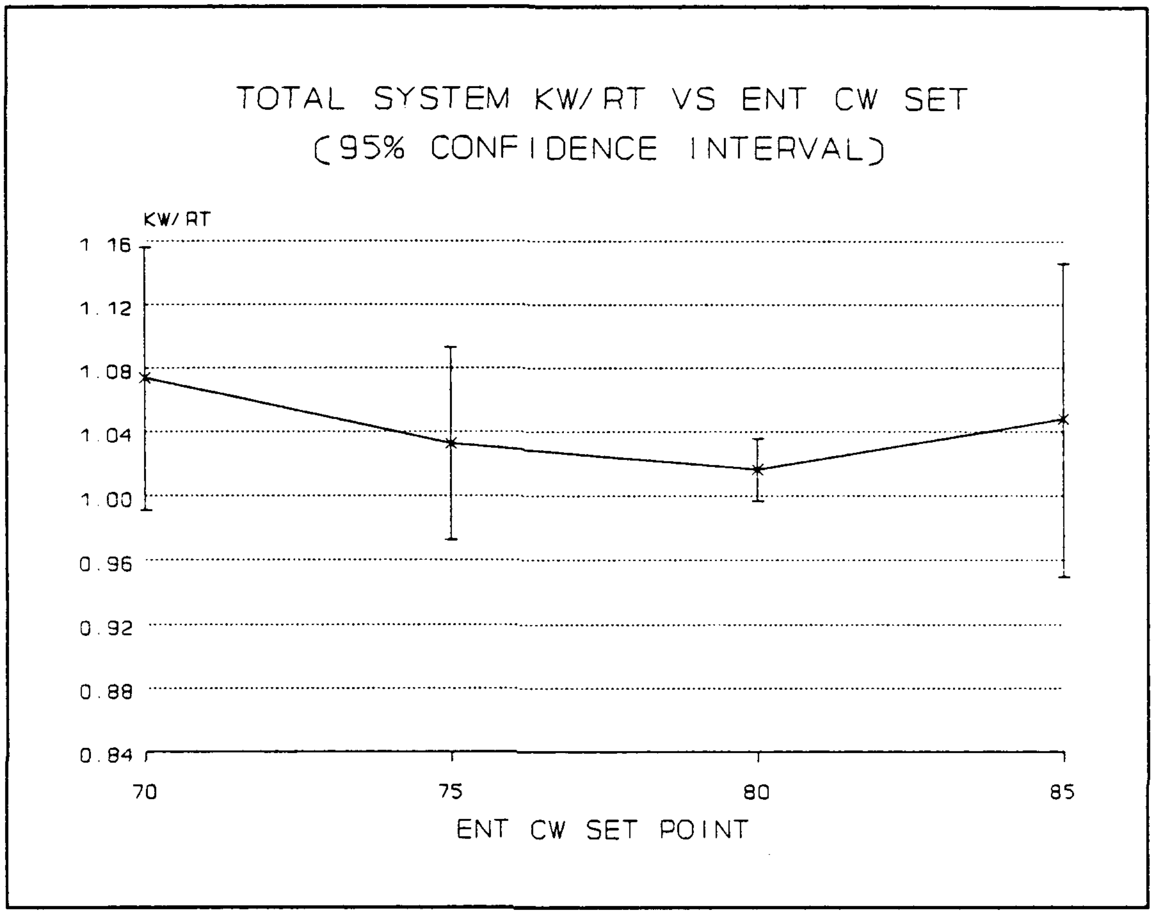

Figure 4.6. 95% Confidence Intervals for Daily Average Total System Efficiency at Each Set Point Temperature

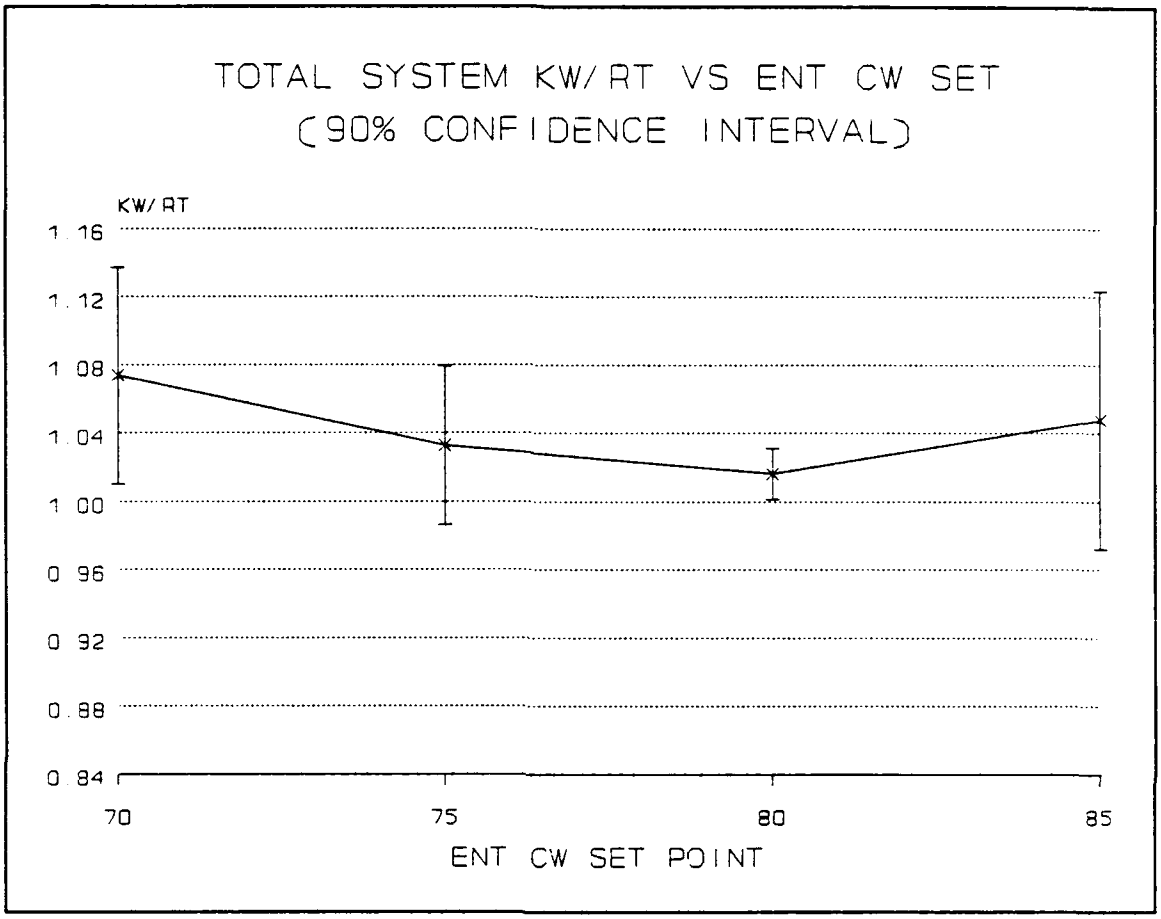

Figure 4.7. 90% Confidence Intervals for Daily Average Total System Efficiency at Each Set Point Temperature

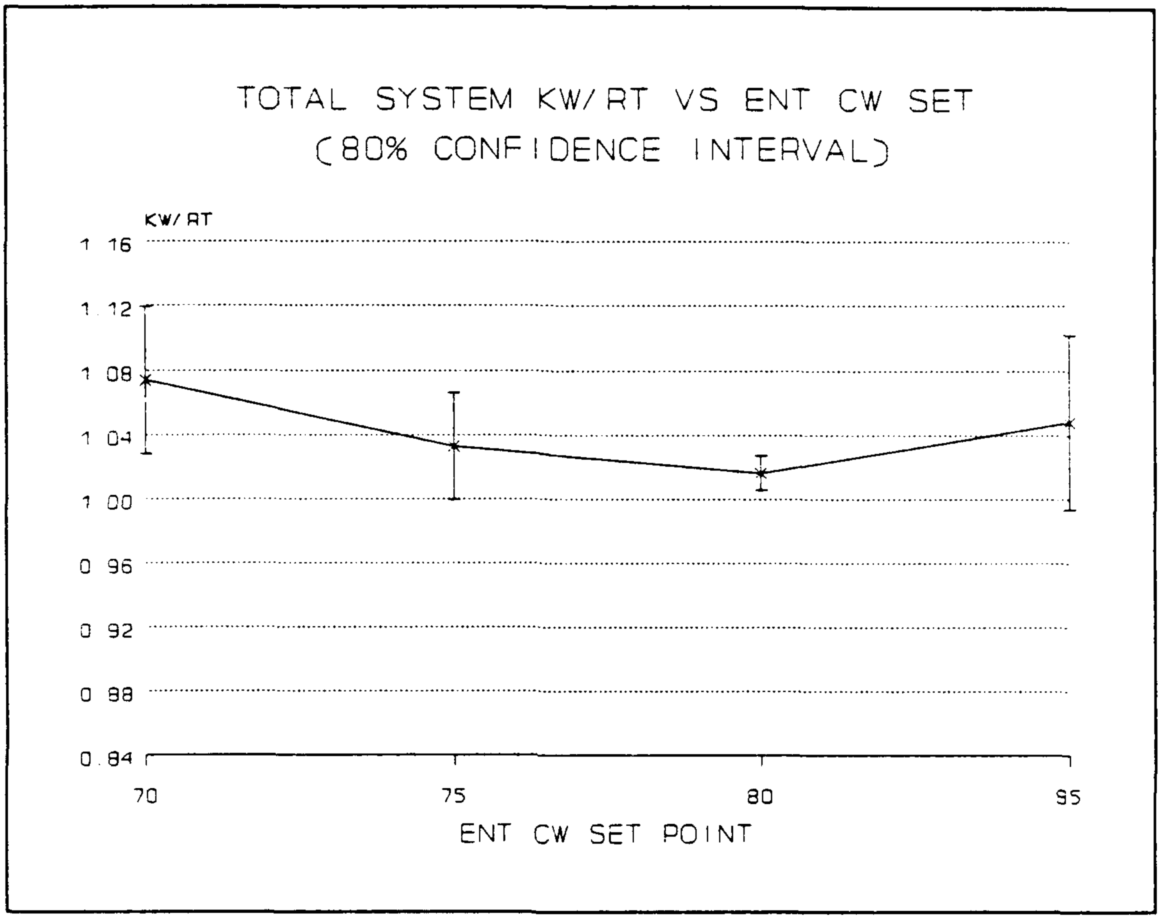

Figure 4.8. 80% Confidence Intervals for Daily Average Total System Efficiency at Each Set Point Temperature

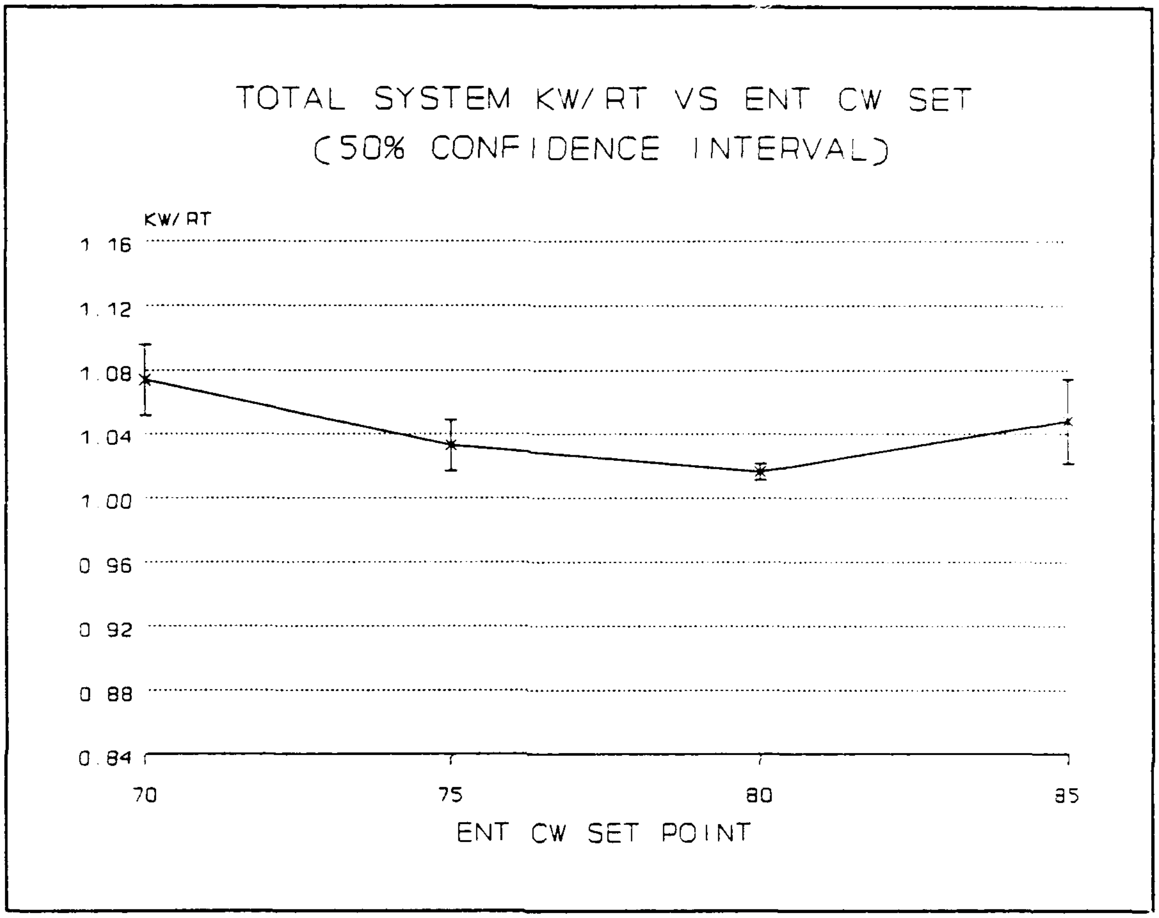

Figure 4.9. 50% Confidence Intervals for Daily Average Total System Efficiency at Each Set Point Temperature

4.3 Hourly Data

Due to the large variation in daily data, the hourly field data was examined. The data was disaggregated by hourly average OSA dry bulb temperature and hourly average chiller tonnage (RT). The OSA temperature was disaggregated using 5 °F temperature bins as in the standard weather data. The average chiller tonnage was disaggregated into 50 RT bins. The chiller efficiency, cooling tower fan efficiency, and the total system efficiencies were calculated as described in *Section 2.4, Data Acquisition Methodology*. Each efficiency was defined as the respective hourly energy use divided by the hourly RT-hours of chilled water load and had the units of KW/RT.

The chiller efficiency is known to be a function of the chiller chilled water load and the entering condenser water set point temperature. It was found that by plotting the KW_C versus the chiller load for each temperature bin and at each entering condenser water set point temperature, a smooth curve was generated (Figures 4.10 - 4.13). Figure 4.14 summarizes these data by using a second order curve fit for each set point temperature.

Figure 4.14 shows that the optimum entering condenser water set point temperature based solely on chiller energy consumed is 70 °F. This differs from the daily data results, which showed an optimum of 75 °F. This difference is due to the chiller efficiency being a function of both chiller loading as well as the set point temperature.

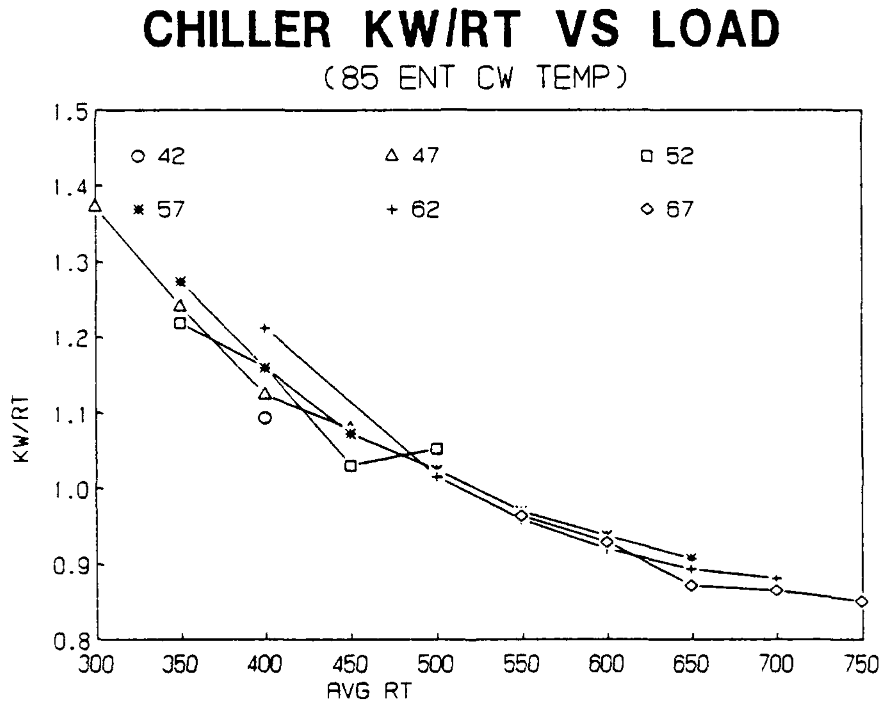

Figure 4.10. Chiller Efficiency vs. Part Load for 85 °F Ent CW Set Point Temperature

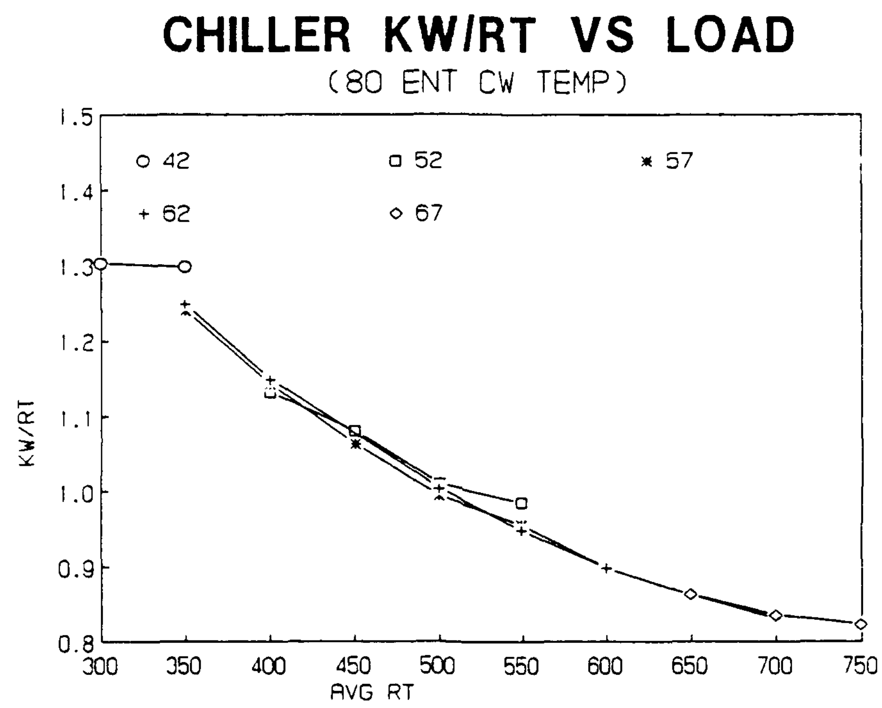

Figure 4.11. Chiller Efficiency vs. Part Load for 80 °F Ent CW Set Point Temperature

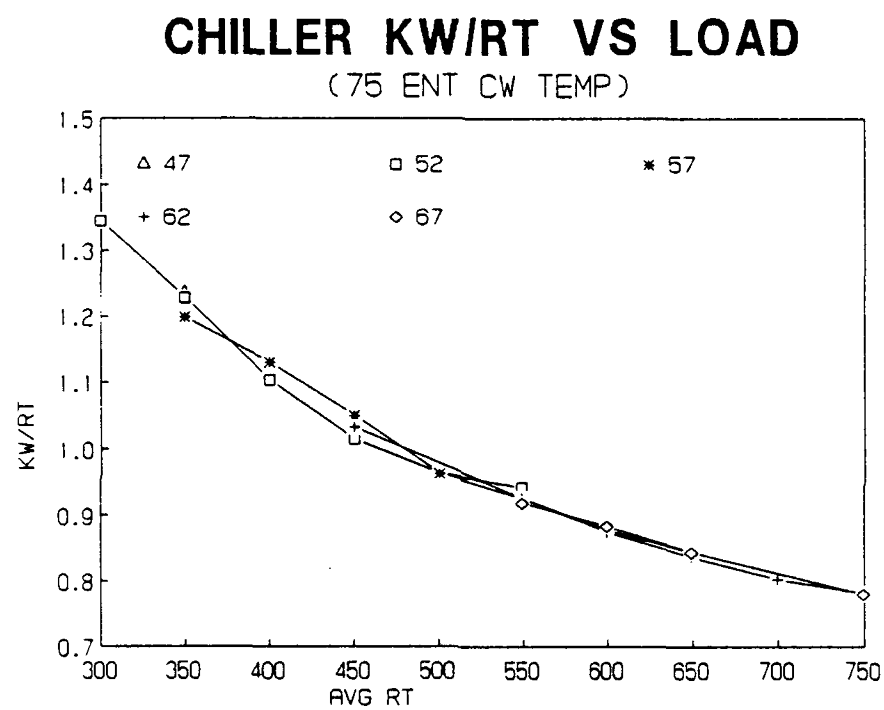

Figure 4.12. Chiller Efficiency vs. Part Load for 75 °F Ent CW Set Point Temperature

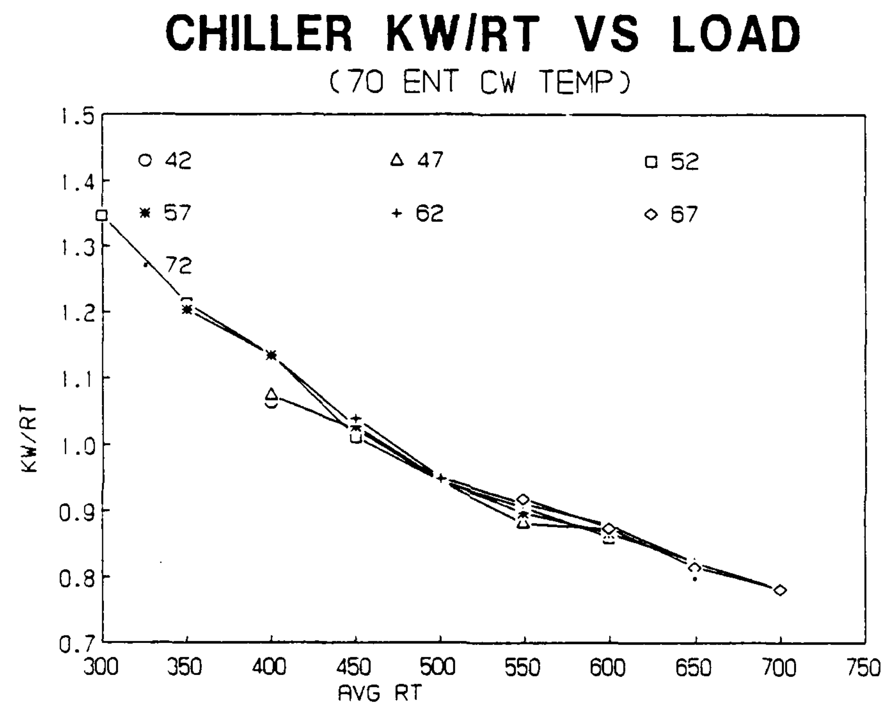

Figure 4.13. Chiller Efficiency vs. Part Load for 70 °F Ent CW Set Point Temperature

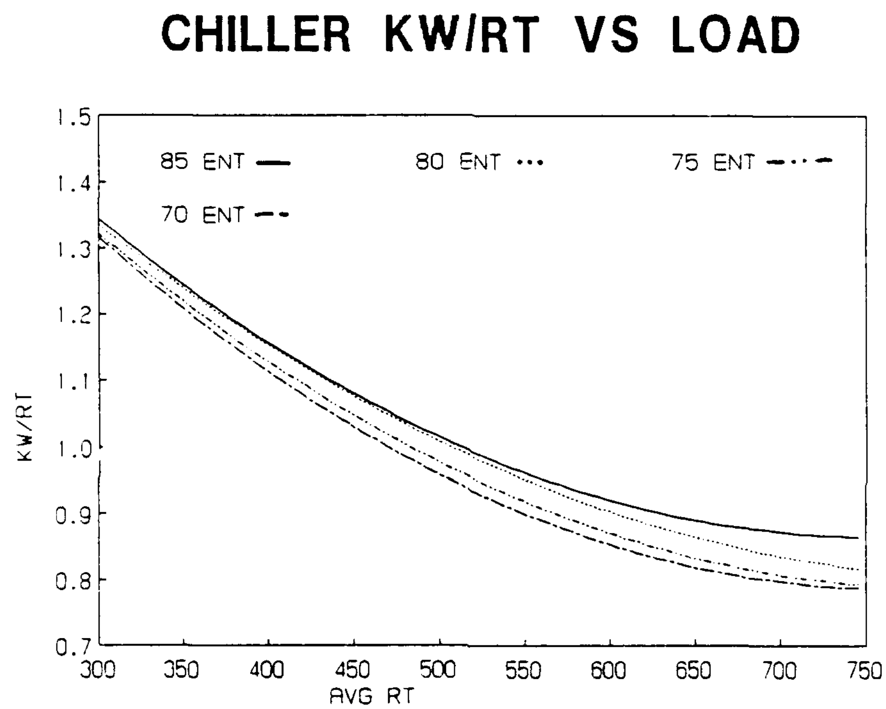

Figure 4.14. Chiller Efficiency vs. Part Load for Each Ent CW Set Point Temperature

In the daily data, the chiller loading varied during each day. Ideally, this variance and tne daily average for each day would be the same. However, the data show this situation was not the case. For example, the average daily chiller tonnage (RT) at 75 °F is 526 RT, whereas the average tonnage at 70 °F is 501 RT. The hourly data removes the effect of variation in the efficiency due to changing load. Although the variation in efficiency due to changing load is small compared to the efficiency change due to changing set point temperature, the varying load causes scatter in the daily data and accounts for the difference in the optimum between daily and hourly data.

The data show there are two competing effects which to contribute to the overall increase in the measure of chiller efficiency as part load is decreased. As part load decreases, the compressor operates less efficiently causing an increase in the required KW/RT to operate the compressor. In ontrast, the evaporator temperature (T_E) increases and the condenser temperature (T_C) decreases causing the pressure difference between the evaporator and condenser to decrease as the chiller loading decreases. This decrease in the pressure rise across the compressor results in less KW/RT to operate the compressor as described previously in *Section 4.1, Daily Data*. The combined effect causes the chiller KW/RT to initially decrease as the loading decreases and then to increase. The effect of the compressor inefficiencies is much larger than, and quickly overcomes, the effect due to the temperature difference. In Figure 4.14, the initial decrease in KW/RT is not evident due to no data being available at full load condition.

The cooling tower fan operation time is a function of OSA temperature and entering condenser water set point temperature. Although the cooling tower performance is more directly a function of OSA wet bulb temperature, the accuracy of the humidity sensor at the Peachtree Plaza was questionable and could not be calibrated; therefore, the OSA dry bulb temperature is used to correlate the cooling tower fan performance. It was found that by plotting the KW_F/RT as a function of OSA temperature bin for each refrigeration ton bin and at each set point temperature, a straight line was generated (Figures 4.15 - 4.18). Figure 4.19 shows a linear regression curve fit for each set point temperature. As expected considering cooling tower performance, the tower fan efficiency (KW_F/RT) increases as the entering condenser water set point temperature is decreased.

The total system efficiency is known to be a function of the chiller chilled water load, the OSA temperature, and the entering condenser water set point temperature. Plotting the KW_T/RT as a function of the chiller load for each temperature bin and at each entering condenser water set point temperature generated a smooth curve using a second order curve fit for each set point temperature (Figure 4.20).

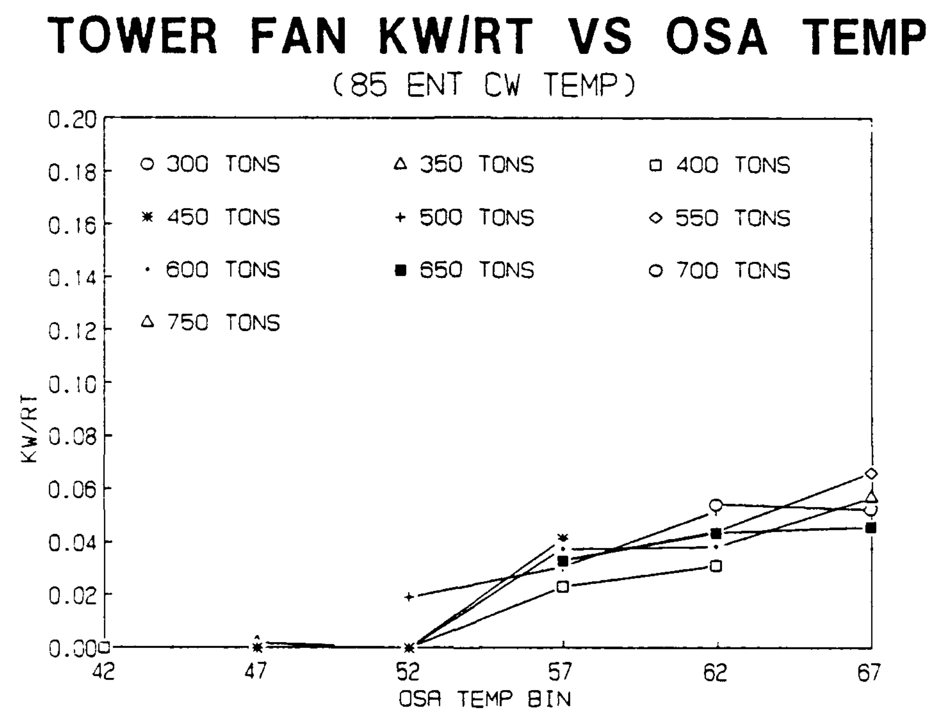

Figure 4.15. Tower Fan Efficiency vs. OSA Temp Bin for 85 °F Ent CW Set Point Temperature

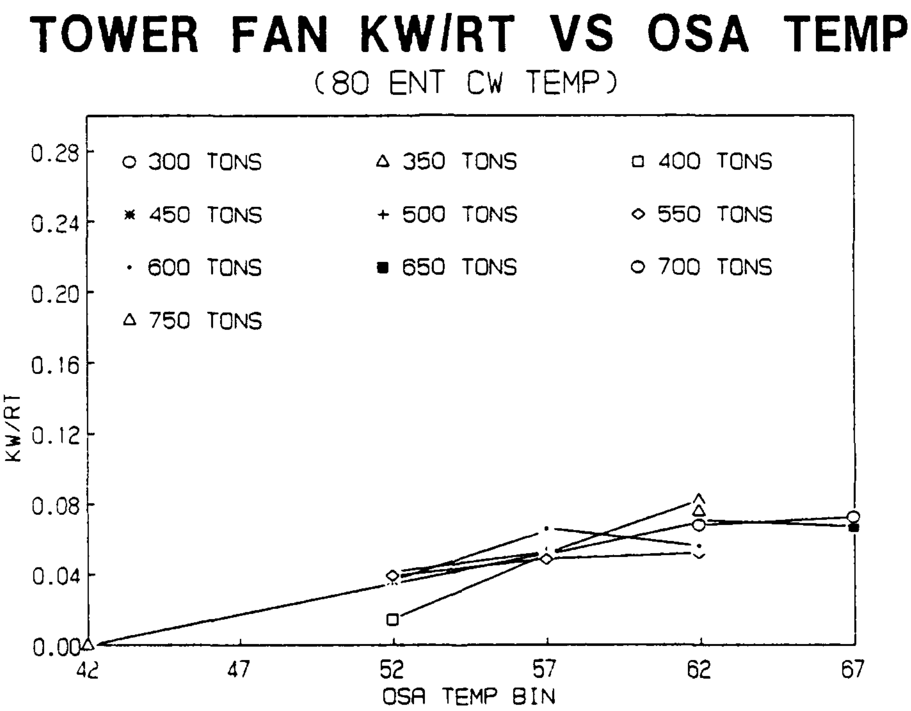

Figure 4.16. Tower Fan Efficiency vs. OSA Temp Bin for 80 °F Ent CW Set Point Temperature

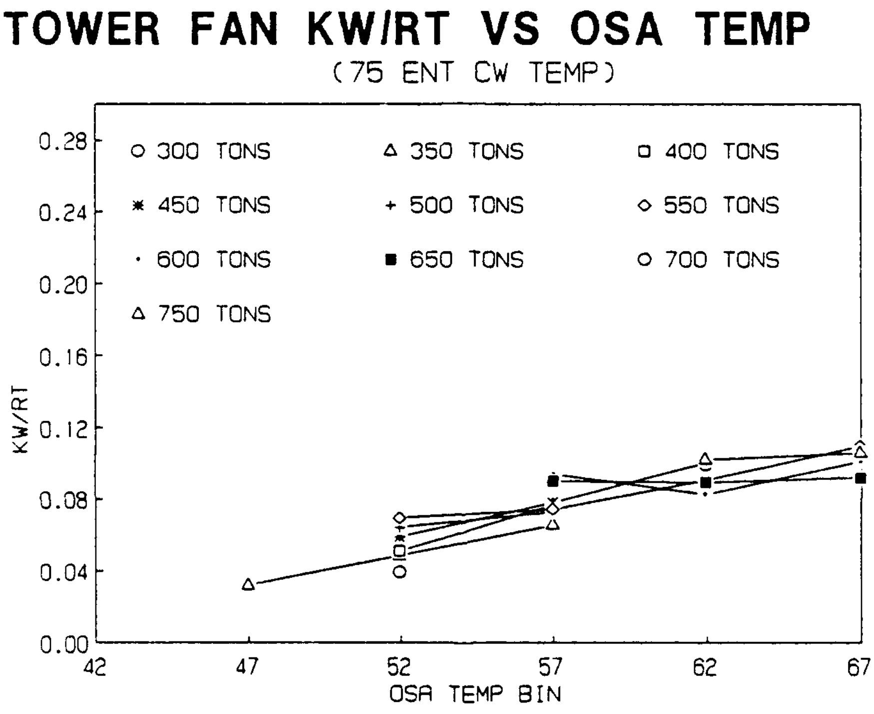

Figure 4.17. Tower Fan Efficiency vs. OSA Temp Bin for 75 °F Ent CW Set Point Temperature

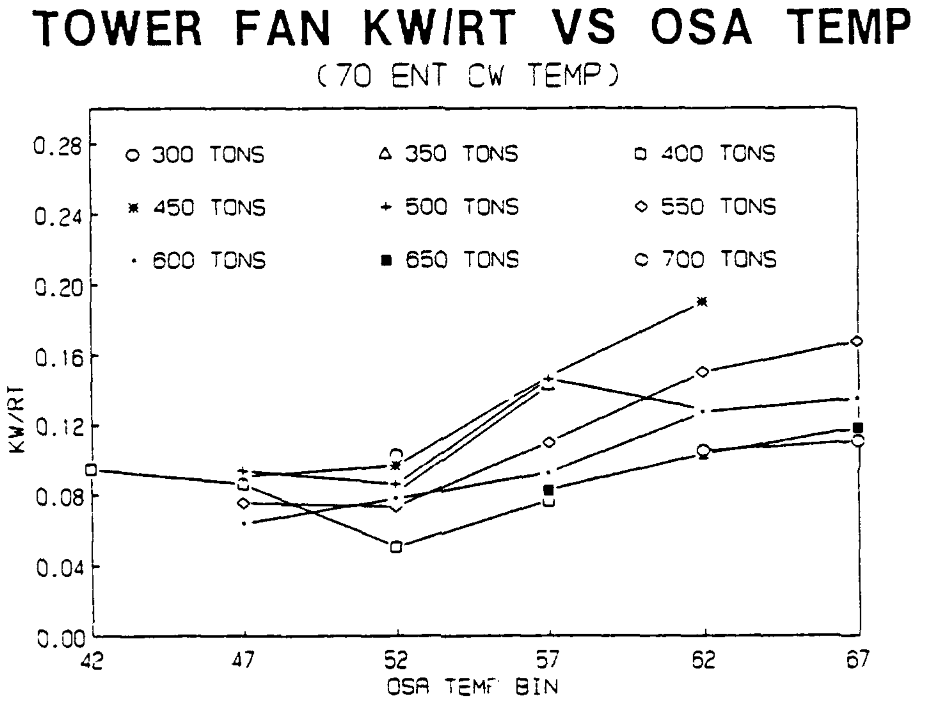

Figure 4.18. Tower Fan Efficiency vs. OSA Temp Bin for 70 °F Ent CW Set Point Temperature

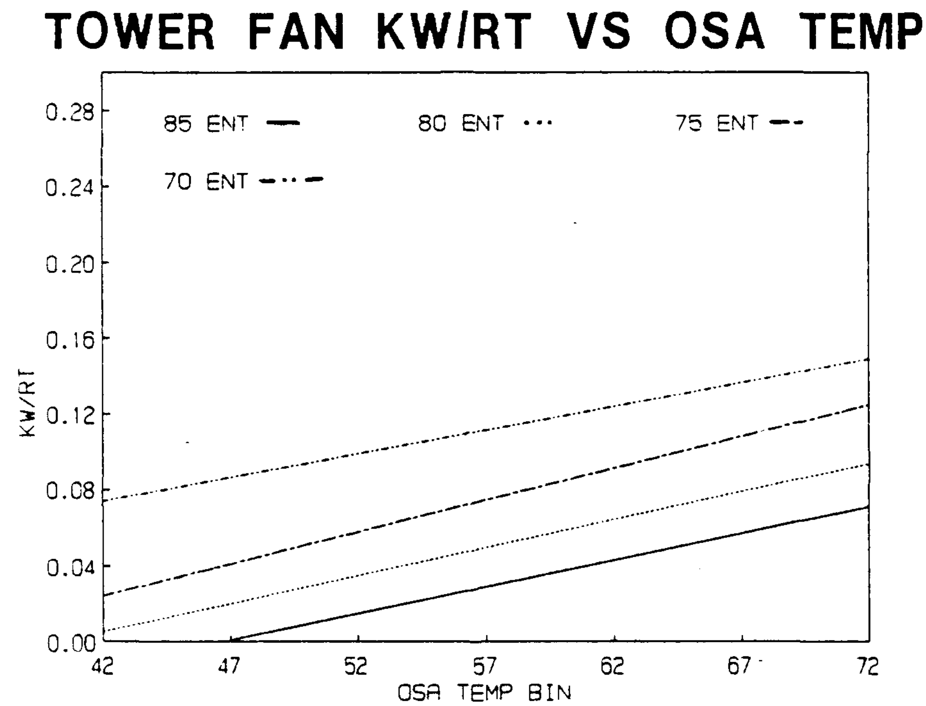

Figure 4.19. Tower Fan Efficiency vs. OSA Temp Bin for Each Ent CW Set Point Temperature

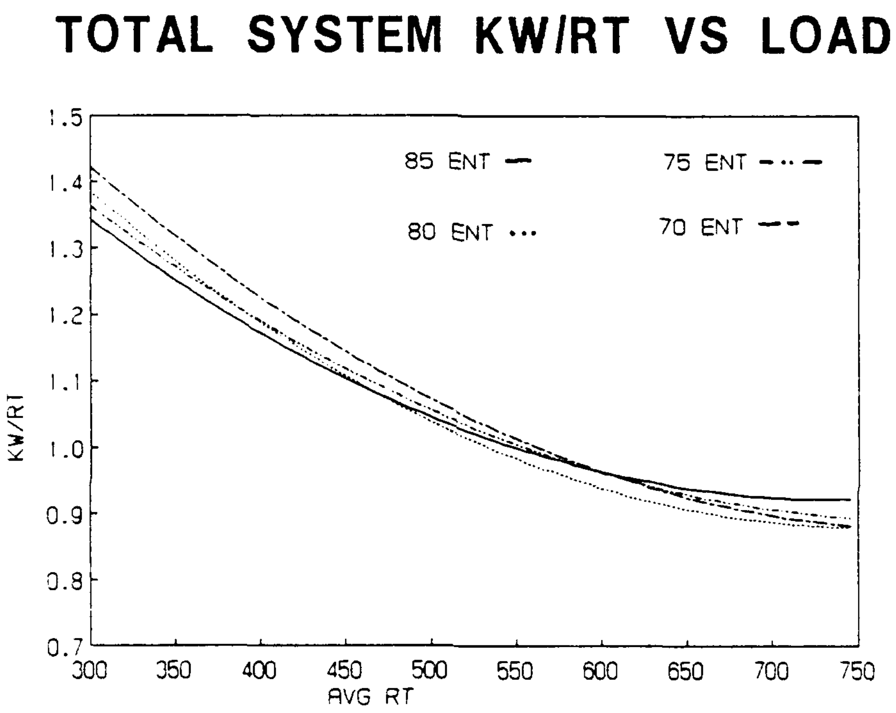

Figure 4.20. Total System Efficiency vs. Part Load for Each Ent CW Set Point Temperature

The resulting curves in Figure 4.20 show an optimum entering condenser water set point temperature of 85 °F below 450 RT and an optimum of 80 °F above 450 RT. This result indicates the benefit of varying the set point temperature with the chiller load, the OSA temperature, or possibly both. The ideal control strategy would be to vary the set point temperature based on chiller load and OSA temperature.

4.4 Analytical Model

4.4.1 Simulation 1

As described in Chapter III, simulation 1 used measured weather data and measured chiller component performance data obtained at the Peachtree Plaza Hotel in the chilled water system analytical model used in this study. The operating parameters are shown in Table 3.3. The compressor model was changed to more accurately reflect field chiller performance data.

In the compressor model, the isentropic efficiency predicted by the analytical model, $\eta_{isent,\ model}$, was adjusted by a ratio of the manufacturer's full load design efficiency (0.65 KW/RT in this case) to the actual full load chiller efficiency at standard conditions (85 °F entering CW temperature, 45 °F CHWS temperature) as reflected in the field data. Since no full load efficiency data was collected, the full load chiller efficiency was assumed to be 0.85 KW/RT which was the chiller efficiency at the greatest load measured (750 RT) at a set point temperature of

85 °F. This assumption seems reasonable since the part load efficiency does not change significantly above a part load of 80%. To summarize, the ratio used in this study was 0.65/0.85.

The part load efficiency, η_{ton}, was also adjusted to agree with the measured decrease in compressor efficiency with decreasing loads. The actual part load efficiency, $\eta_{ton,\ actual}$, is given as:

$$\eta_{ton} = \frac{(KW/RT)_{carnot}}{(KW/RT)_{actual} * \eta_{isent\ ,model}} = \frac{\eta_{isent,actual}}{\eta_{isent,model}} \tag{4.2}$$

The model isentropic efficiency, $\eta_{isent,\ model}$, was then calculated as described above. The actual isentropic efficiency, $\eta_{isent,\ actual}$, was calculated using field data at three part load conditions (300, 600, and 700 or 750 RT) for each set point. Then, the data was analyzed to produce an empirical expression for $\eta_{ton,\ actual}$ by using a second order polynomial curve fit to the data points (Figure 4.21).

The data clearly show that the manufacturer's part load efficiency is optimistic. The fact that the part load efficiency can be well represented as a function of the part load parameter only shows the validity of the chiller model.

The results of simulation 1 are shown graphically in Figures 4.22 - 4.24 (Numerical results are included in Appendix 2). The results for the chiller and total system efficiencies produced by this simulation closely approximate the field data results.

The simulation results for the tower fan efficiency differ from the measured data in this work. This difference can be explained by the fact that the cooling tower is performing less efficiently than the specification given by the manufacturer. The original fill material in the cooling tower cells at the Peachtree Plaza was replaced. The new fill material causes the water to fall in sheets rather than droplets, and results in a less efficient cooling process.

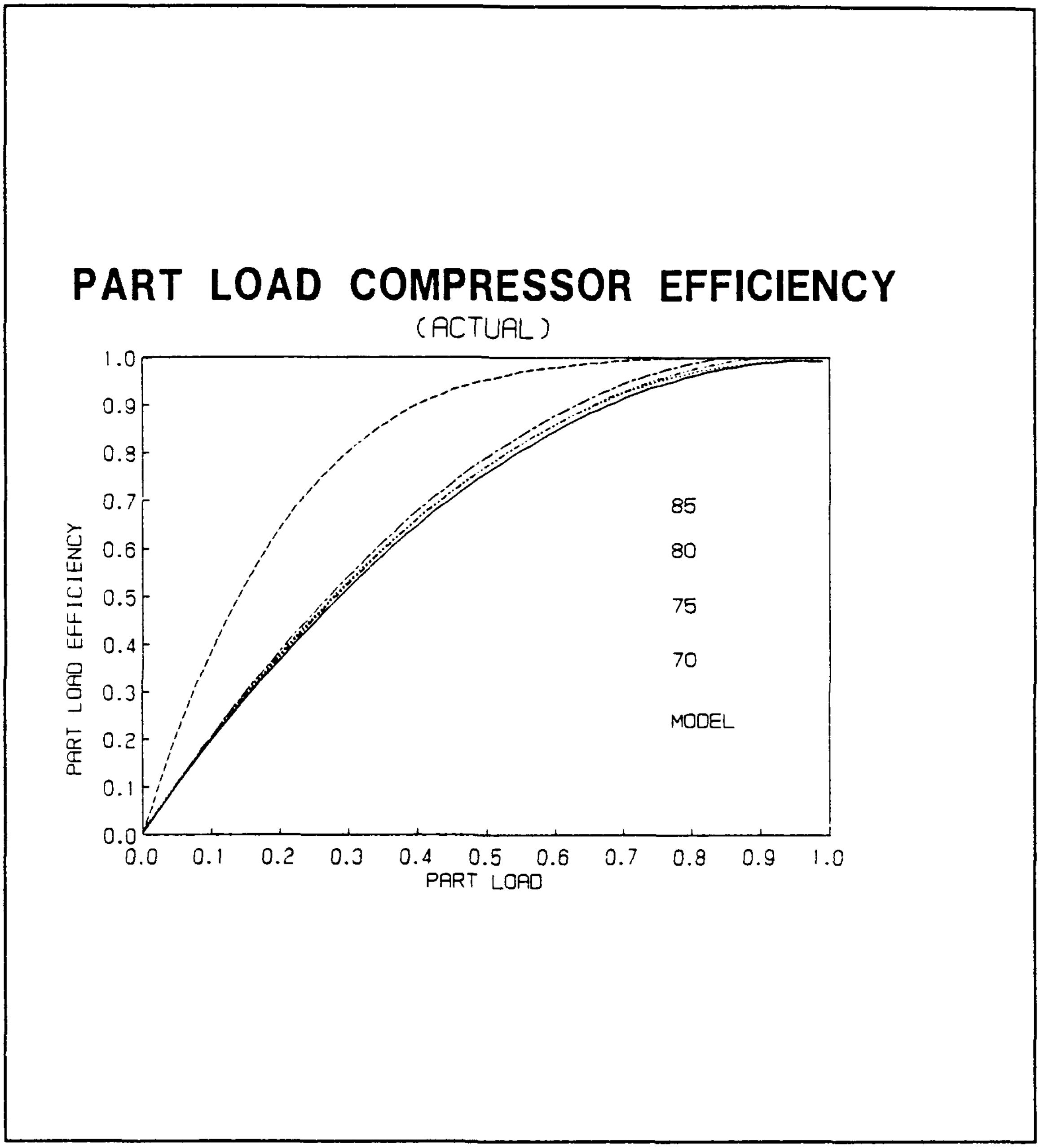

Figure 4.21. Actual Part Load Efficiency

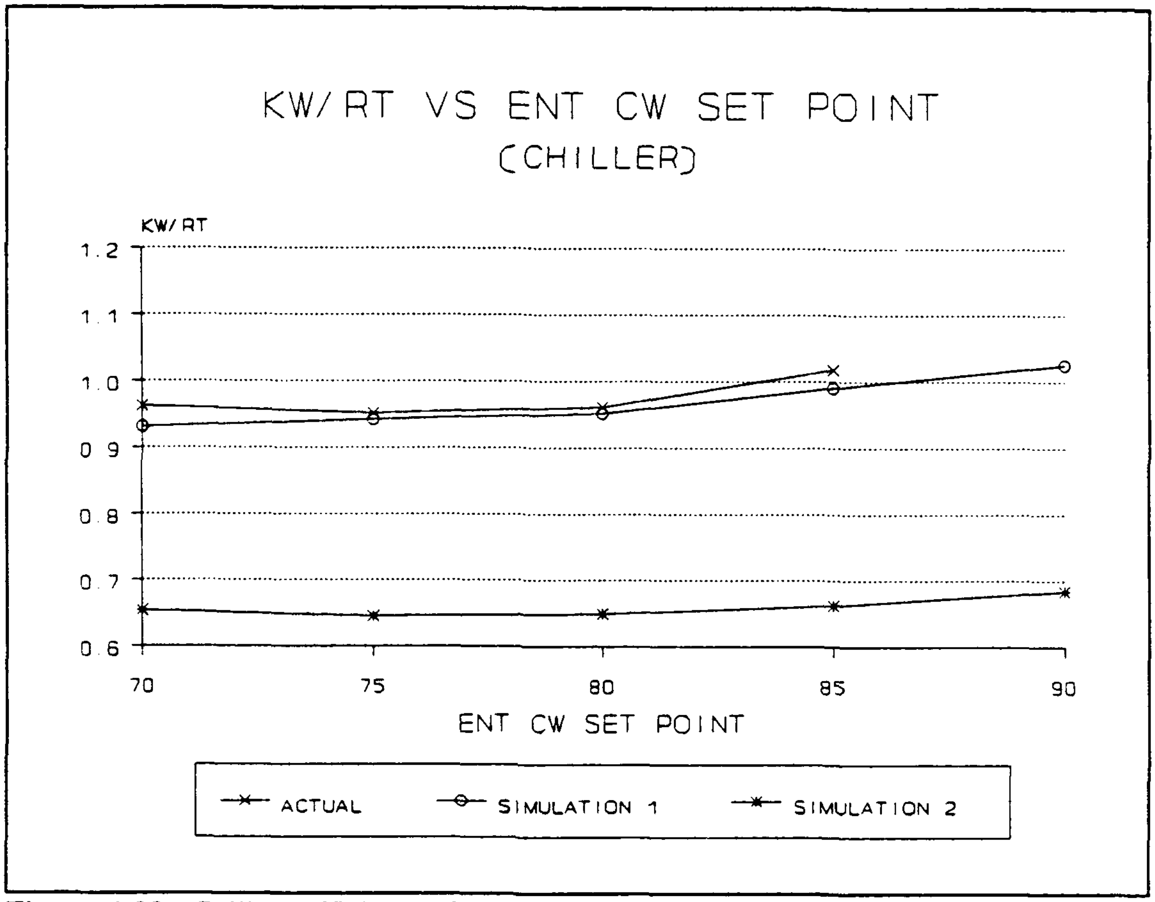

Figure 4.22. Chiller Efficiency Comparison to Daily Field Results

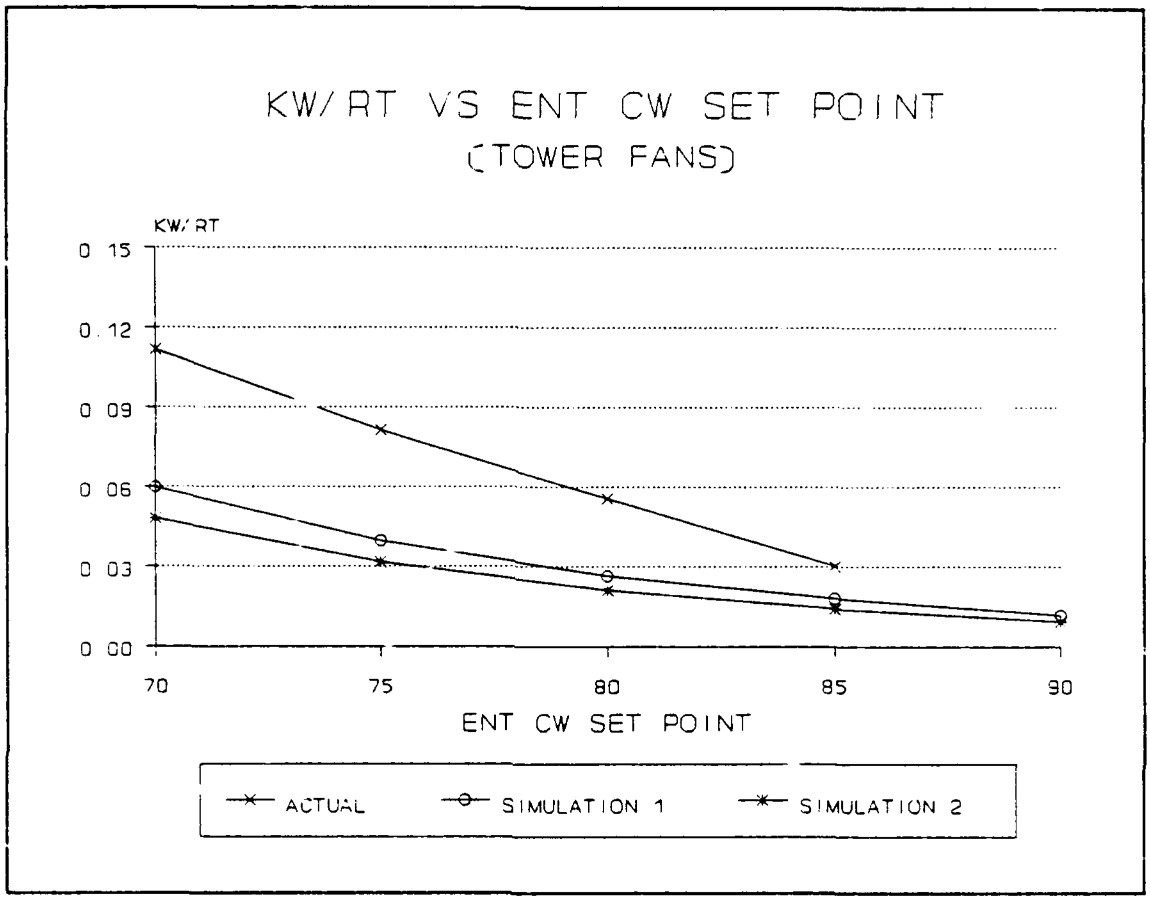

Figure 4.23. Tower Fan Efficiency Comparison To Daily Field Results

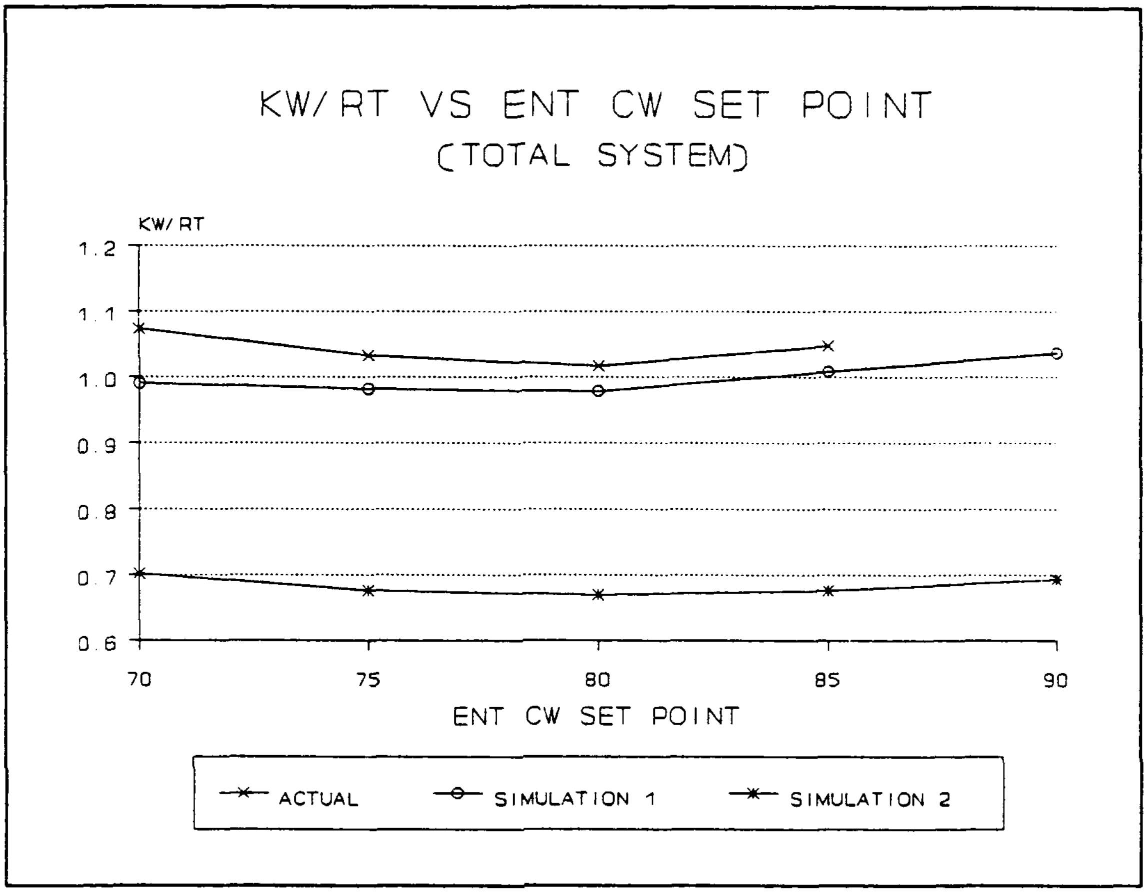

Figure 4.24. Total System Efficiency Comparison to Daily Field Results

4.4.2 Simulation 2

Simulation 2 used standard weather data and manufacturer's component data as outlined in Chapter III. The analytical model was run as discussed in Chapter III. The simulation calculated the monthly and yearly chiller, tower fan, and total system energy use. The results of the simulation are shown graphically in Figures 4.25 - 4.28 (Numerical results are included in Appendix 2). The monthly energy use for November was used to calculate chiller, tower fan, and total system efficiencies. These efficiencies are also plotted on Figures 4.22 - 4.24.

As illustrated in Figures 4.22, the manufacturer's data for chiller performance is optimistic. The manufacturer's full load design efficiency is 0.65 KW/RT compared to an actual full load efficiency of 0.85 KW/RT at standard rating conditions. The part load compressor performance is also significantly less for manufacturer and field data. Although the absolute chiller efficiency is underpredicted by the analytical model when using manufacturer's data, the observed trends for the simulation match the trends shown in the field data.

The monthly energy use profiles (Figures 4.26 - 4.28) show that the sensitivity due to the effect of changing the set point temperature is greater during the peak cooling periods. Although the change in chiller energy due to decreasing set point temperature is not significant, the energy penalty due to the increase in cooling tower fan run-time is severe. Running away from the optimum set point during the summer months results in a larger peak electrical demand than running at the optimum. This peak could result in high electrical demand charges which are paid throughout the year. The monthly energy use profile also further shows that the condenser water set point temperature should be ideally varied based on chiller loading and OSA temperature.

Looking at the yearly energy use in Figure 4.28, the chiller energy use decreases for decreasing set point until 75 °F and then increases. The tower fan energy use increases with decreasing set point. The total system energy use decreases for decreasing set point until 85 °F and then increases. The decrease in chiller energy use from 85 °F to 75 °F is overcome by the increase in tower fan energy. The annual optimum constant entering condenser water set point temperature based on total system energy use is 85 °F.

The yearly simulation results show that it is more advantageous to select a higher entering condenser water set point temperature when considering the total energy consumption of the system. This result is contrary to the customary practice in the field. Operators tend to select lower set point temperatures to avoid perceived problems in chiller operation. This practice is costly. In decreasing the set point temperature from 85 °F to 70 °F, the total system energy use is predicted to increase by 320,000 KWH/year. At an average cost of 8 ¢/KWH, the yearly increase in energy cost would be $25,000.

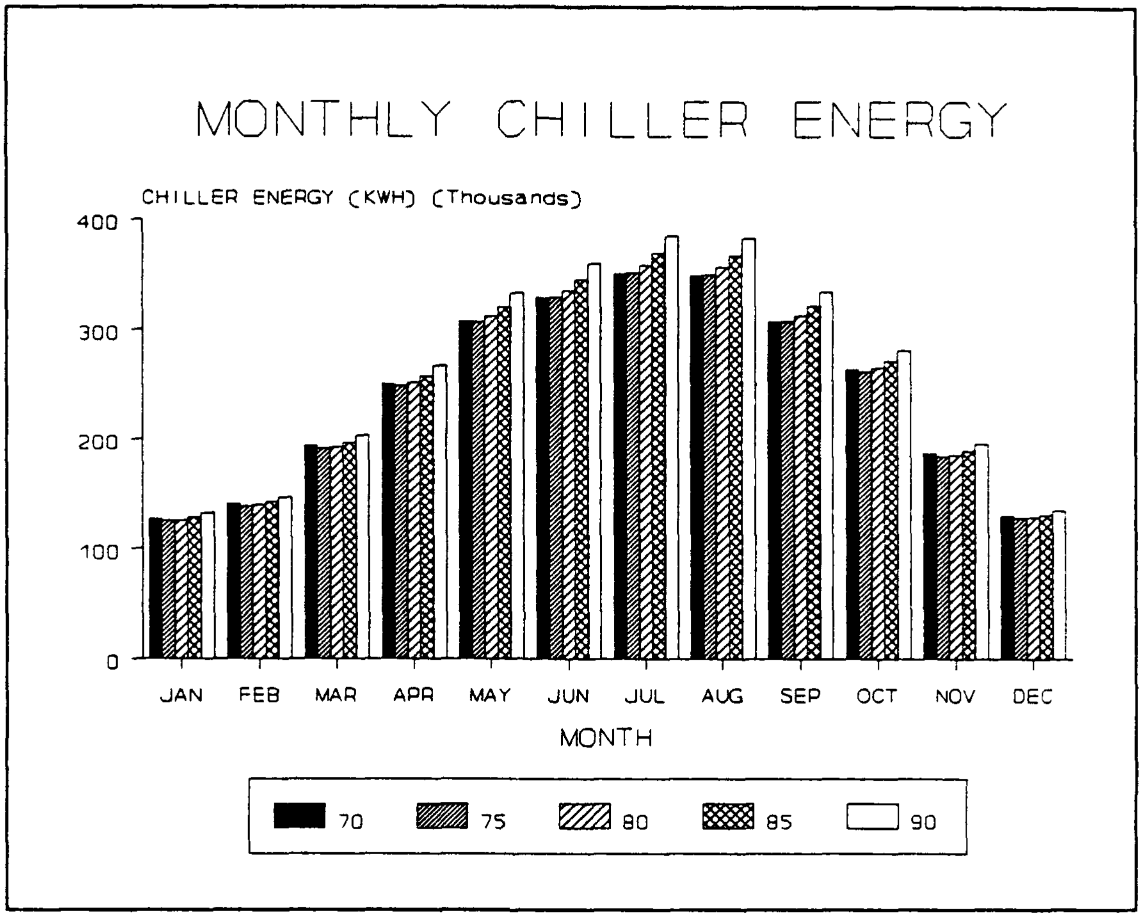

Figure 4.25. Predicted Monthly Chiller Energy

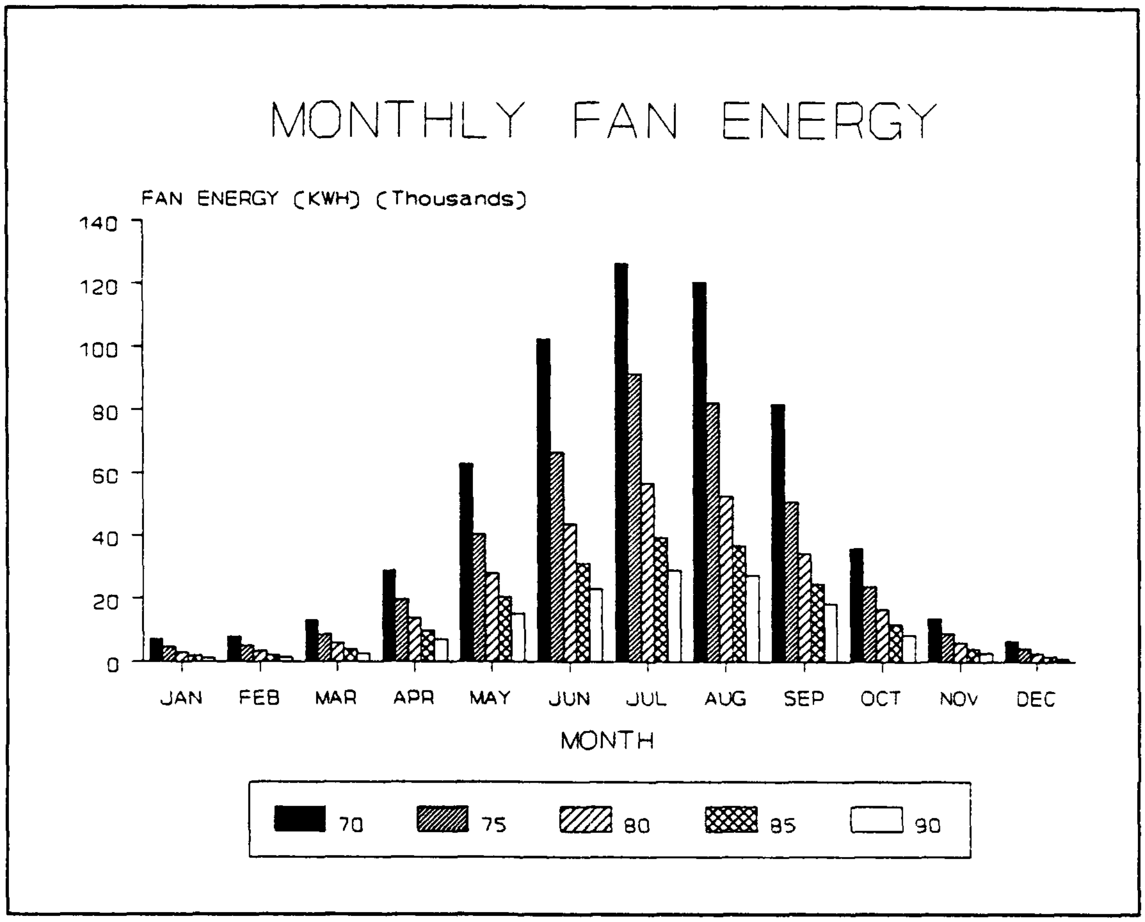

Figure 4.26. Predicted Monthly Fan Energy

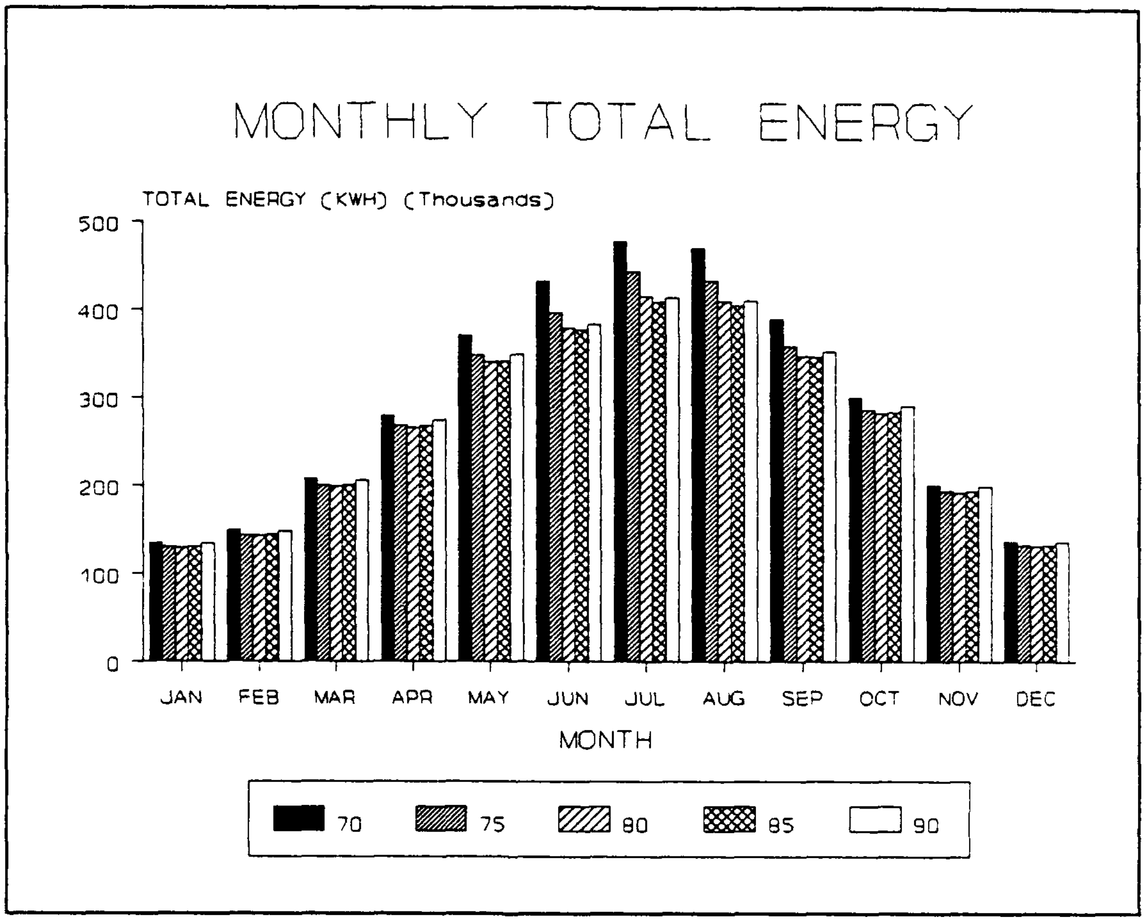

Figure 4.27. Predicted Monthly Total System Energy

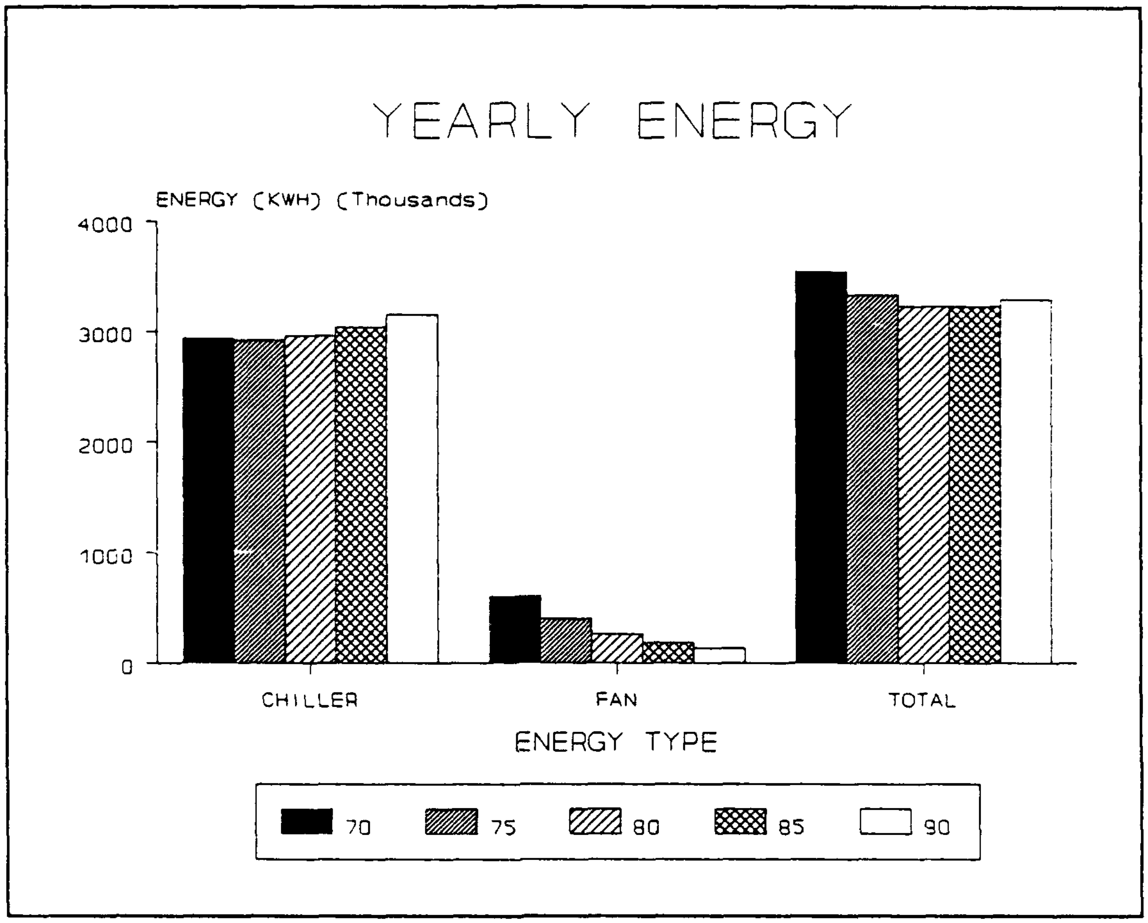

Figure 4.28. Predicted Yearly Energy

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions are drawn from this study:

- Based on the field data taken during twenty winter days, the optimum constant entering condenser water set point temperature is 80 °F for winter months. (No field data was taken during summer months.) Although greater chiller energy savings are possible by lowering the set point temperature further, these savings are outweighed by the significant increase in cooling tower fan energy use.

- Analysis of the data on an hourly basis illustrates the effects of both chiller loading and entering condenser water set point temperature on the energy use. Based on the total system energy consumed for part loads less than 50%, the optimum entering condenser water set point temperature was found to be 85 °F; for part loads greater than 50%, the optimum was found to be 80 °F.

- The chilled water system analytical model developed by Weber predicts trends and optimums in agreement with the field data. A comparison between actual field results and the results produced by a simulation based on field weather data and field chiller component performance data confirms the validity of the analytical model proposed by Weber. In contrast, the energy use from the simulation based on standard weather data and manufacturer's performance data were found to be optimistic when compared to actual field results. However, the general trends are the same. The use of this model, therefore, will accurately predict the optimum set point temperature, but the data show that the absolute energy use will be under predicted.

• Using a constant entering condenser water set point temperature over the entire year, the analytical model predicts the optimum set point temperature to be 85 °F based on total system energy use. A comparison between total energy use for lower set points and 85 °F shows that lowering the set point further would cost approximately $25,000/year for a 1000 RT chiller. In practice, the current tendency to set condenser water set point temperatures lower should be avoided. The data show the energy use penalty for set point temperatures above the optimum is less than for set points below the optimum. Simply stated, when in doubt, choose the higher entering condenser water set point temperature. However, the chiller manufacturer's recommendation regarding the maximum condenser water set point temperature should not be exceeded. This temperature is typically 85 °F - 95 °F.

• The optimum condenser water set point temperature is of greater importance in the summer months when the energy penalty for increased tower fan run-time at lower set point temperatures is significantly greater. This result further emphasizes the need to avoid the current practice of setting the condenser water set point temperature as low as possible.

5.2 Recommendations

The results of this study have provoked questions which need further study. The recommendations of the author for further study are as follows.

- More field data should be gathered for a greater variety of chiller loads, OSA temperatures, and buildings.

- Since the cooling tower fan energy use is more directly related to OSA wet bulb temperature, wet bulb temperature should be measured. The data should be analyzed relative to the wet bulb temperature rather than the dry bulb temperature.

- The analysis of the data should be based on actual entering condenser water temperature, rather than minimum set point temperature. The chiller performance is known to be directly related to the actual water temperature entering the condenser, and this temperature may be higher than the minimum set point temperature during peak cooling periods. This correlation would be necessary to develop a more accurate chiller performance map based on field data.

- In practice, cooling tower fans are controlled by the entering condenser water temperature. However, it would be instructive to explore possible advantages in controlling the cooling tower fans using the water temperature leaving the condenser. For certain chiller load and OSA temperature combinations, the energy consumed by the total system may be less for cooling tower fan control using a leaving condenser water set point temperature.

- The field and simulation results suggest that the optimum control strategy would vary the condenser water set point temperature based on OSA temperature and chiller loading. A greater range of field data would show this dependence and provide further information necessary to develop a general strategy to optimize the chilled water plant.

APPENDIX A

FIELD DATA

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 6 NOV 90 CONDENSER WATER SETPOINT: 85 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDSR CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDSR CW LVG	CW TEMP DIFF
1	51.1	96.0	43.1	47.1	4.0	2444.0	407.3	509.0	455.5	79.6	83.0	3.4
2	50.3	96.0	43.4	47.2	3.8	2444.0	387.0	541.0	419.3	78.7	81.8	3.1
3	49.4	96.0	43.0	46.6	3.6	2444.0	366.6	566.0	437.7	77.2	80.3	3.1
4	49.0	96.0	43.0	46.4	3.4	2444.0	346.2	515.0	421.5	74.4	77.6	3.2
5	48.4	96.0	43.2	46.6	3.4	2444.0	346.2	538.0	416.1	73.0	76.0	3.0
6	46.7	96.0	44.0	47.5	3.5	2444.0	356.4	541.0	418.4	73.2	76.1	2.9
7	46.0	96.0	44.3	48.4	4.1	2444.0	417.5	579.0	447.8	76.1	79.2	3.1
8	49.6	96.0	43.6	47.6	4.0	2444.0	407.3	580.0	448.5	78.1	82.1	4.0
9	49.4	95.0	44.1	48.1	4.0	2444.0	407.3	583.0	450.9	79.3	84.1	4.8
10	54.0	91.0	44.8	49.3	4.5	2444.0	458.3	611.0	472.5	82.0	87.0	5.0
11	53.0	74.0	44.4	49.2	4.8	2444.0	488.8	642.0	496.5	85.1	88.8	3.7
12	57.2	54.0	44.3	49.2	4.9	2444.0	499.0	648.0	501.1	85.2	88.9	3.7
13	60.2	48.0	44.9	50.2	5.3	2444.0	539.7	[illegible]	524.3	84.6	88.9	4.3
14	62.2	46.0	44.9	50.4	5.5	2444.0	560.1	[illegible]	532.1	84.8	89.3	4.5
15	63.8	43.0	44.5	51.1	6.6	2444.0	672.1	757.0	585.4	84.3	90.4	6.1
16	65.3	44.0	44.0	50.4	6.4	2444.0	692.5	778.0	601.7	84.7	91.0	6.3
17	66.2	44.0	44.2	51.0	6.8	2444.0	692.5	780.0	603.2	84.5	90.7	6.2
18	65.5	37.0	44.2	50.9	6.8	2444.0	692.5	778.0	601.7	84.5	91.0	6.5
19	63.5	65.0	43.3	49.7	6.4	2444.0	651.7	762.0	589.3	84.8	90.7	5.9
20	60.6	72.0	43.3	[illegible]	6.0	2444.0	611.0	726.0	561.5	84.8	90.3	5.5
21	58.1	78.0	43.6	49.4	5.8	2444.0	590.6	714.0	552.2	84.6	89.8	5.2
22	58.5	78.0	43.4	49.2	5.8	2444.0	590.6	713.0	551.4	85.0	90.0	5.0
23	58.9	76.0	43.6	49.2	5.6	2444.0	570.3	696.0	538.3	84.6	89.3	4.7
24	58.5	80.0	43.7	48.7	5.0	2444.0	509.2	668.0	516.6	85.0	89.2	4.2
TOTAL							12260.7		12173.5			
AVG	56.1						510.9			81.6	86.1	

TONERS: 12260.7
KWH/CHILLER: 12173.5
KWH/FANS: 317.5
KWH/TOTAL: 12491.0

KWHC/TONERS: 0.9929
KWHF/TONERS: 0.0259
KWHT/TONERS: 1.0188

6 NOV 90/85 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	515.0	1629.0	1.1183	0.0000	1.1183
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	472.0	846.0	1.1611	0.0000	1.1611
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	476.0	2739.0	1.1940	0.0000	1.1940
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	539.0	3044.0	1.2173	0.0000	1.2173
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	873.0	1010.0	1.2017	0.0000	1.2017
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	671.0	3598.0	1.1739	0.0000	1.1739
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	787.0	1506.0	1.0725	0.0000	1.0725
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3333.0	3018.0	1.1012	0.0000	1.1012
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3459.0	2726.0	1.1069	0.0000	1.1069
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1606.0	919.0	1.0311	0.0000	1.0311
11	0.0	0.0	2.0	2.2	0.0	0.0	0.1	2.2	4028.0	537.0	1.0157	0.0045	1.0202
12	4.0	2.9	2.0	2.2	3.0	3.3	0.4	8.4	2324.0	388.0	1.0043	0.0169	1.0212
13	5.0	3.7	6.0	6.6	5.0	5.5	0.7	15.8	3018.0	3759.0	0.9715	0.0292	1.0007
14	7.0	5.1	6.0	6.6	7.0	7.7	0.9	19.4	3396.0	2115.0	0.9500	0.0347	0.9847
15	6.0	4.4	14.0	15.4	13.0	14.3	1.6	34.1	1195.0	2928.0	0.8711	0.0507	0.9218
16	12.0	8.8	10.0	11.0	14.0	15.4	1.6	35.2	1834.0	1802.0	0.8689	0.0508	0.9197
17	8.0	5.9	12.0	13.2	12.0	13.2	1.5	32.3	3271.0	3042.0	0.8711	0.0466	0.9177
18	8.0	5.9	14.0	15.4	12.0	13.2	1.6	34.5	1513.0	543.0	0.8689	0.0498	0.9187
19	10.0	7.3	10.0	11.0	8.0	8.8	1.2	27.1	1224.0	226.0	0.9042	0.0416	0.9458
20	8.0	5.9	8.0	8.8	8.0	8.8	1.1	23.5	3237.0	1433.0	0.9189	0.0384	0.9573
21	6.0	4.4	6.0	6.6	8.0	8.8	0.9	19.8	1099.0	815.0	0.9349	0.0335	0.9684
22	8.0	5.9	8.0	8.8	8.0	8.8	1.1	23.5	1434.0	1660.0	0.9336	0.0397	0.9733
23	6.0	4.4	10.0	11.0	8.0	8.8	1.1	24.2	827.0	867.0	0.9439	0.0424	0.9863
24	6.0	4.4	6.0	6.6	6.0	6.6	0.8	17.6	466.0	922.0	1.0146	0.0346	1.0492
TOTAL	3.1	68.9	5.7	125.4	5.6	123.2	14.4	317.5	41589	42099			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 7 NOV 90 CONDENSER WATER SETPOINT: 80 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHR TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	56.9	84.0	43.4	47.4	4.0	2444.0	407.3	591.0	458.6	79.9	83.8	3.9
2	55.5	89.0	43.8	47.7	3.9	2444.0	397.2	584.0	451.6	79.9	83.4	3.5
3	55.2	92.0	43.3	47.0	3.7	2444.0	376.8	575.0	444.7	79.8	83.0	3.2
4	55.2	95.0	43.7	47.1	3.4	2444.0	346.2	567.0	438.5	80.1	83.1	3.0
5	55.4	94.0	43.6	47.1	3.5	2444.0	356.4	565.0	436.9	80.0	82.8	2.8
6	57.9	90.0	43.8	47.4	3.6	2444.0	366.6	570.0	440.8	80.0	82.9	2.9
7	55.9	88.0	44.4	49.4	5.0	2444.0	509.2	653.0	505.0	79.7	84.0	4.3
8	54.4	88.0	43.3	48.3	5.0	2444.0	509.2	649.0	501.9	80.0	84.2	4.2
9	56.2	87.0	43.9	48.8	4.9	2444.0	499.0	629.0	486.4	80.1	84.1	4.0
10	57.0	84.0	44.7	49.8	5.1	2444.0	519.3	649.0	501.9	79.6	83.8	4.2
11	59.5	69.0	44.5	50.1	5.6	2444.0	570.3	687.0	531.3	80.0	85.1	5.1
12	62.1	53.0	44.5	50.4	5.9	2444.0	600.8	692.0	535.2	80.2	85.6	5.4
13	64.4	49.0	44.6	50.7	6.1	2444.0	621.2	705.0	545.2	79.7	85.7	6.0
14	66.3	46.0	44.7	50.9	6.2	2444.0	631.4	718.0	555.3	80.2	86.3	6.1
15	67.5	45.0	44.6	51.0	6.4	2444.0	651.7	727.0	562.2	80.1	86.6	6.5
16	68.4	44.0	44.0	50.3	6.3	2444.0	641.5	721.0	557.6	79.8	86.5	6.7
17	68.8	50.0	44.1	50.6	6.5	2444.0	661.9	723.0	559.1	79.8	86.4	6.6
18	66.5	54.0	43.8	50.2	6.4	2444.0	651.7	721.0	557.6	80.0	86.4	6.4
19	64.5	67.0	43.1	49.2	6.1	2444.0	621.2	706.0	546.0	80.0	86.3	6.3
20	63.1	72.0	43.1	48.8	5.7	2444.0	580.4	688.0	532.1	79.9	85.7	5.8
21	60.9	72.0	43.5	49.1	5.6	2444.0	570.3	687.0	531.3	79.7	85.1	5.4
22	58.7	76.0	43.6	49.2	5.6	2444.0	570.3	687.0	531.3	80.0	85.3	5.3
23	56.9	80.0	43.2	48.5	5.3	2444.0	539.7	685.0	529.8	79.9	84.8	4.9
24	54.8	79.0	43.1	47.9	4.8	2444.0	488.8	650.0	502.7	79.9	85.4	5.5
TOTAL							12688.4		12243.1			
AVG	60.1						528.7			79.9	84.8	

TONHRS: 12688.4
KWH/CHILLER: 12243.1
KWH/FANS: 699.6
KWH/TOTAL: 1294..7

KWHC/TONHRS: 0.9649
KWHF/TONHRS: 0.0551
KWHT/TONHRS: 1.0200

7 NOV 90/80 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	10.0	7.3	5.0	5.5	10.0	11.0	1.1	23.8	532.0	336.0	1.1259	0.0585	1.1844
2	8.0	5.9	7.0	7.7	6.0	6.6	0.9	20.2	462.0	591.0	1.1372	0.0504	1.1880
3	4.0	2.9	6.0	6.6	6.0	6.6	0.7	16.1	736.0	2118.0	1.1802	0.0428	1.2230
4	6.0	4.4	4.0	4.4	4.0	4.4	0.6	13.2	390.0	603.0	1.2665	0.0381	1.3046
5	4.0	2.9	4.0	4.4	5.0	5.5	0.6	12.8	1131.0	1583.0	1.2259	0.0360	1.2620
6	4.0	2.9	4.0	4.4	5.0	5.5	0.6	12.8	1003.0	597.0	1.2024	0.0350	1.2374
7	8.0	5.9	10.0	11.0	8.0	8.8	1.2	25.7	996.0	2333.0	0.9918	0.0504	1.0422
8	8.0	5.9	8.0	8.8	10.0	11.0	1.2	25.7	2009.0	2812.0	0.9858	0.0504	1.0362
9	8.0	5.9	9.0	9.9	8.0	8.8	1.1	24.6	1729.0	1620.0	0.9749	0.0492	1.0241
10	8.0	5.9	11.0	12.1	10.0	11.0	1.3	29.0	2929.0	2326.0	0.9664	0.0558	1.0222
11	12.0	8.8	14.0	15.4	12.0	13.2	1.7	37.4	1870.0	2118.0	0.9317	0.0656	0.9973
12	10.0	7.3	13.0	14.3	17.0	18.7	1.8	40.3	3027.0	935.0	0.8907	0.0671	0.9579
13	12.0	8.8	17.0	18.7	13.0	14.3	1.9	41.8	3572.0	1457.0	0.8777	0.0673	0.9450
14	17.0	12.5	12.0	13.2	16.0	17.6	2.0	43.3	2528.0	1468.0	0.8795	0.0685	0.9480
15	19.0	13.9	13.0	14.3	16.0	17.6	2.1	45.8	1270.0	[illegible]	0.8627	0.0703	0.9330
16	14.0	10.3	19.0	20.9	15.0	16.5	2.2	47.7	1606.0	1185.0	0.8691	0.0743	0.9434
17	12.0	8.8	14.0	15.4	17.0	18.7	2.0	42.9	3170.0	1323.0	0.8447	0.0648	0.9095
18	11.0	8.1	14.0	15.4	15.0	16.5	1.8	40.0	1887.0	3265.0	0.8556	0.0613	0.9169
19	13.0	9.5	10.0	11.0	16.0	17.6	1.7	38.1	1214.0	1075.0	0.8790	0.0614	0.9403
20	12.0	8.8	8.0	8.8	12.0	13.2	1.4	30.8	2668.0	1263.0	0.9167	0.0531	0.9697
21	6.0	4.4	10.0	11.0	9.0	9.9	1.2	25.3	1751.0	97.0	0.9317	0.0444	0.9760
22	10.0	7.3	8.0	8.8	10.0	11.0	1.3	27.1	1620.0	364.0	0.9317	0.0476	0.9792
23	8.0	5.9	8.0	8.8	6.0	6.6	1.0	21.3	535.0	3076.0	0.9815	0.0394	1.0209
24	4.0	2.9	4.0	4.4	6.0	6.6	0.6	13.9	701.0	550.0	1.0284	0.0285	1.0569
TOTAL	7.6	167.2	11.6	255.2	12.6	277.2	31.8	699.6	38343	34438			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 8 NOV 90 CONDENSER WATER SETPOINT: 75 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHW TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	54.5	79.0	43.1	47.1	4.0	2444.0	407.3	540.0	410.5	75.1	81.4	6.3
2	51.6	81.0	43.2	47.2	4.0	2444.0	407.3	572.0	412.4	74.8	80.3	5.5
3	50.4	83.0	43.0	46.6	3.6	2444.0	366.6	560.0	413.1	75.1	78.9	3.8
4	49.8	83.0	43.1	46.6	3.5	2444.0	356.4	550.0	411.5	75.0	78.8	3.8
5	49.2	84.0	43.3	46.6	3.3	2444.0	336.1	549.0	424.6	74.9	79.0	4.9
6	50.0	84.0	44.4	47.9	3.5	2444.0	356.4	562.0	434.6	74.9	80.4	5.5
7	50.9	81.0	33.8	48.2	4.4	2444.0	448.1	600.0	464.0	74.6	80.2	5.6
8	51.6	80.0	43.6	48.1	4.5	2444.0	454.3	600.0	464.0	74.6	79.3	4.7
9	52.6	76.0	44.3	48.9	4.6	2444.0	468.4	605.0	467.9	74.8	79.1	4.3
10	54.5	66.0	44.7	49.6	4.9	2444.0	499.0	617.0	477.2	74.7	79.4	4.7
11	56.0	60.0	44.6	49.7	5.1	2444.0	519.4	635.0	491.1	75.0	79.9	4.9
12	57.4	58.0	44.6	49.7	5.1	2444.0	519.4	633.0	489.5	74.6	79.8	5.2
13	58.1	56.0	44.5	49.8	5.3	2444.0	539.7	646.0	499.6	75.0	80.1	5.1
14	58.6	54.0	44.2	49.5	5.3	2444.0	539.7	651.0	503.5	74.9	80.2	5.3
15	59.2	53.0	44.4	49.7	5.3	2444.0	539.7	656.0	507.3	75.2	80.4	5.2
16	59.1	57.0	44.7	50.2	5.5	2444.0	560.1	665.0	511.3	74.9	80.4	5.5
17	59.2	58.0	44.3	49.8	5.5	2444.0	560.1	667.0	515.4	75.1	80.3	5.2
18	57.7	59.0	44.1	49.5	5.4	2444.0	549.9	655.0	506.6	74.9	80.3	5.4
19	56.4	60.0	43.7	49.0	5.3	2444.0	539.7	661.0	511.2	74.8	80.1	5.3
20	55.0	61.0	43.5	48.8	5.3	2444.0	539.7	660.0	510.4	75.1	80.1	5.0
21	53.8	64.0	43.3	48.5	5.2	2444.0	529.5	657.0	508.1	75.0	80.1	5.1
22	53.3	64.0	43.2	48.4	5.2	2444.0	529.5	644.0	501.1	75.0	79.7	4.7
23	52.6	64.0	43.1	48.4	5.3	2444.0	539.7	644.0	498.0	74.6	79.7	5.1
24	52.4	64.0	43.1	48.1	5.0	2444.0	509.2	635.0	491.1	75.3	81.3	6.0
TOTAL							11619.2		11535.4			
AVG	54.4						484.1			74.9	80.0	

TONHRS: 11619.2
KWH/CHILLER: 11535.4
KWH/FANS: 766.0
KWH/TOTAL: 12301.4

KWHC/TONHRS: 0.9928
KWHF/TONHRS: 0.0659
KWHT/TONHRS: 1.0587

8 NOV 90/75 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	8.0	5.9	9.0	9.9	6.0	6.6	1.0	22.4	718.0	1567.0	1.1012	0.0549	1.1561
2	6.0	4.4	5.0	5.5	6.0	6.6	0.8	16.5	668.0	571.0	1.0860	0.0405	1.1265
3	4.0	2.9	4.0	4.4	3.0	3.3	0.5	10.6	694.0	84.0	1.1813	0.0290	1.2104
4	4.0	2.9	4.0	4.4	3.0	3.3	0.5	10.6	513.0	1750.0	1.2108	0.0298	1.2406
5	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	615.0	218.0	1.2634	0.0349	1.2983
6	4.0	2.9	8.0	8.8	8.0	8.8	0.9	20.5	703.0	1751.0	1.2194	0.0574	1.2771
7	8.0	5.9	7.0	7.7	10.0	11.0	1.1	24.6	793.0	2457.0	1.0356	0.0548	1.0904
8	11.0	8.1	11.0	12.1	10.0	11.0	1.4	31.2	2083.0	1858.0	1.0126	0.0680	1.0806
9	9.0	6.6	7.0	7.7	10.0	11.0	1.2	25.3	1870.0	2217.0	0.9988	0.0540	1.0528
10	11.0	8.1	9.0	9.9	12.0	13.2	1.4	31.2	2099.0	3433.0	0.9563	0.0625	1.0187
11	7.0	5.1	13.0	14.3	15.0	16.5	1.6	35.9	3018.0	1353.0	0.9456	0.0692	1.0148
12	10.0	7.3	15.0	16.5	15.0	16.5	1.8	40.3	2434.0	3046.0	0.9426	0.0777	1.0203
13	12.0	8.8	16.0	17.6	14.0	15.4	1.9	41.8	3107.0	2763.0	0.9257	0.0774	1.0031
14	12.0	8.8	16.0	17.6	16.0	17.6	2.0	44.0	2928.0	2544.0	0.9328	0.0815	1.0143
15	18.0	13.2	12.0	13.2	14.0	15.4	1.9	41.8	2753.0	2436.0	0.9400	0.0774	1.0174
16	20.0	14.7	12.0	13.2	16.0	17.6	2.1	45.5	1506.0	1858.0	0.9182	0.0812	0.9994
17	12.0	8.8	17.0	18.7	15.0	16.5	2.0	44.0	1132.0	1494.0	0.9210	0.0786	0.9996
18	17.0	12.5	13.0	14.3	14.0	15.4	1.9	42.2	1290.0	1136.0	0.9212	0.0767	0.9979
19	13.0	9.5	10.0	11.0	13.0	14.3	1.5	34.8	1956.0	1707.0	0.9471	0.0727	1.0198
20	13.0	9.5	12.0	13.2	14.0	15.4	1.7	38.1	3237.0	2118.0	0.9457	0.0707	1.0164
21	13.0	9.5	10.0	11.0	16.0	17.6	1.7	38.1	1631.0	2400.0	0.9595	0.0720	1.0315
22	10.0	7.3	12.0	13.2	12.0	13.2	1.5	33.7	1506.0	1591.0	0.9464	0.0637	1.0101
23	6.0	4.4	16.0	17.6	16.0	17.6	1.8	39.6	880.0	3138.0	0.9228	0.0734	0.9962
24	10.0	7.3	13.0	14.3	14.0	15.4	1.7	37.0	601.0	1394.0	0.9645	0.0727	1.0372
TOTAL	8.1	177.5	12.8	200.5	14.0	300.0	34.8	766.0	39038	44906			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 9 NOV 90 CONDENSER WATER SETPOINT: 70 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CWRS	COMMON CWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	52.1	66.0	43.2	47.1	3.9	2444.0	397.1	564.0	439.1	69.8	78.2	8.4
2	51.7	68.0	43.2	47.0	3.8	2444.0	387.0	564.0	436.2	70.1	78.0	7.9
3	51.4	68.0	43.1	46.7	3.6	2444.0	366.6	551.0	426.1	69.6	78.0	8.4
4	51.5	68.0	43.6	47.0	3.4	2444.0	346.2	545.0	421.5	69.5	78.1	8.6
5	51.6	69.0	43.7	47.0	3.3	2444.0	336.0	546.0	422.3	69.8	78.4	8.6
6	51.2	71.0	43.7	47.1	3.4	2444.0	346.2	551.0	426.1	70.0	77.5	7.5
7	50.3	72.0	44.3	48.7	4.4	2444.0	448.1	590.0	456.3	70.1	76.6	6.5
8	50.0	76.0	43.7	48.1	4.4	2444.0	440.1	592.0	457.8	69.8	76.6	6.8
9	50.1	82.0	43.7	48.1	4.4	2444.0	448.1	593.0	458.6	70.0	76.9	6.9
10	49.4	90.0	44.0	48.5	4.5	2444.0	458.3	595.0	460.1	69.9	76.5	6.6
11	48.9	96.0	44.0	48.5	4.5	2444.0	458.3	596.0	460.9	69.9	76.5	6.6
12	48.7	96.0	44.0	48.5	4.5	2444.0	458.3	596.0	460.9	69.9	76.5	6.6
13	46.5	96.0	43.6	48.0	4.4	2444.0	448.1	594.0	459.4	69.9	76.3	6.4
14	45.3	96.0	43.7	47.8	4.1	2444.0	417.5	581.0	449.3	70.1	75.8	5.7
15	45.2	96.0	44.3	48.4	4.1	2444.0	417.5	577.0	446.2	69.7	75.6	5.9
16	44.9	96.0	44.7	48.8	4.1	2444.0	417.5	574.0	443.9	70.0	75.6	5.6
17	45.3	96.0	44.8	48.9	4.1	2444.0	417.5	580.0	448.5	70.2	75.6	5.4
18	46.0	96.0	44.6	49.0	4.4	2444.0	448.1	584.0	451.7	70.0	75.6	5.6
19	46.3	96.0	43.8	48.1	4.3	2444.0	437.9	588.0	454.7	69.8	75.6	5.8
20	46.1	96.0	43.5	47.7	4.2	2444.0	427.7	587.0	454.0	70.2	75.7	5.5
21	45.9	96.0	43.7	48.1	4.4	2444.0	448.1	586.0	453.2	69.8	75.6	5.8
22	46.1	96.0	43.8	48.2	4.4	2444.0	448.1	586.0	453.2	70.2	75.7	5.5
23	46.0	96.0	43.8	48.2	4.4	2444.0	448.1	584.0	451.6	70.3	76.0	5.7
24	46.1	96.0	43.8	48.1	4.3	2444.0	437.9	583.0	450.9	70.3	77.6	7.3
TOTAL							10112.1		10745.0			
AVG	48.2						421.3			70.0	76.6	

TONHRS: 10112.1
KWH/CHILLER: 10745.0
KWH/FANS: 926.9
KWH/TOTAL: 11672.0

KWHC/TONHRS: 1.0627
KWHF/TONHRS: 0.0917
KWHT/TONHRS: 1.1543

9 NOV 90/70 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	14.0	10.3	17.0	18.7	18.0	19.8	2.2	48.8	509.0	2957.0	1.1061	0.1228	1.2288
2	12.0	8.8	10.0	11.0	15.0	16.5	1.7	36.3	644.0	1443.0	1.1272	0.0938	1.2210
3	8.0	5.9	8.0	8.8	11.0	12.1	1.2	26.8	579.0	1739.0	1.1624	0.0730	1.2354
4	8.0	5.9	9.0	9.9	11.0	12.1	1.3	27.9	450.0	2610.0	1.2173	0.0805	1.2978
5	8.0	5.9	10.0	11.0	11.0	12.1	1.3	29.0	814.0	3388.0	1.2565	0.0862	1.3427
6	10.0	7.3	7.0	7.7	10.0	11.0	1.2	26.0	926.0	1700.0	1.2307	0.0752	1.3059
7	12.0	8.8	11.0	12.1	15.0	16.5	1.7	37.4	2643.0	2726.0	1.0183	0.0835	1.1018
8	14.0	10.3	13.0	14.3	13.0	14.3	1.8	38.9	3560.0	3459.0	1.0218	0.0867	1.1085
9	14.0	10.3	20.0	22.0	22.0	24.2	2.6	56.5	3265.0	1721.0	1.0235	0.1260	1.1495
10	12.0	8.8	13.0	14.3	16.0	17.6	1.8	40.7	4095.0	161.0	1.0041	0.0888	1.0930
11	15.0	11.0	10.0	11.0	14.0	15.4	1.7	37.4	2593.0	1645.0	1.0058	0.0816	1.0874
12	16.0	11.7	11.0	12.1	16.0	17.6	1.9	41.4	2134.0	1768.0	1.0058	0.0904	1.0962
13	17.0	12.5	10.0	11.0	17.0	18.7	1.9	42.2	2227.0	1277.0	1.0252	0.0941	1.1193
14	11.0	8.1	10.0	11.0	13.0	14.3	1.5	33.4	3130.0	3396.0	1.0762	0.0799	1.1561
15	15.0	11.0	12.0	13.2	16.0	17.6	1.9	41.8	2618.0	579.0	1.0688	0.1001	1.1689
16	12.0	8.8	12.0	13.2	16.0	17.6	1.8	39.6	2842.0	629.0	1.0632	0.0948	1.1581
17	15.0	11.0	10.0	11.0	15.0	16.5	1.8	38.5	2920.0	3170.0	1.0743	0.0922	1.1665
18	11.0	8.1	14.0	15.4	14.0	15.4	1.8	38.9	2842.0	2434.0	1.0149	0.0867	1.1016
19	8.0	5.9	16.0	17.6	15.0	16.5	1.8	40.0	3560.0	2401.0	1.0385	0.0913	1.1298
20	12.0	8.8	10.0	11.0	16.0	17.6	1.7	37.4	1253.0	460.0	1.0614	0.0874	1.1488
21	12.0	8.8	12.0	13.2	18.0	19.8	1.9	41.8	1263.0	2618.0	1.0114	0.0933	1.1047
22	17.0	12.5	10.0	11.0	16.0	17.6	1.9	41.1	1253.0	2062.0	1.0114	0.0917	1.1031
23	19.0	13.9	8.0	8.8	20.0	22.0	2.0	44.7	808.0	1956.0	1.0080	0.0998	1.1078
24	15.0	11.0	14.0	15.4	13.0	14.3	1.9	40.7	724.0	1938.0	1.0297	0.0929	1.1226
TOTAL	10.2	225.1	13.9	304.7	18.1	397.1	42.1	926.9	47708	48719			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 10 NOV 90 CONDENSER WATER SETPOINT: 85 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	47.5	96.0	43.4	46.9	3.5	2444.0	356.4	565.0	436.9	77.6	82.5	4.9
2	48.4	96.0	43.7	47.0	3.3	2444.0	336.0	570.0	440.8	83.3	87.7	4.4
3	49.4	96.0	43.6	46.8	3.2	2444.0	325.9	570.0	440.8	84.7	88.2	3.5
4	49.1	96.0	43.3	46.5	3.2	2444.0	325.9	563.0	435.4	82.4	86.1	3.7
5	49.4	96.0	43.5	46.6	3.1	2444.0	315.7	561.0	433.9	82.2	85.5	3.3
6	49.6	96.0	43.8	46.9	3.1	2444.0	315.7	559.0	432.3	80.8	84.4	3.6
7	49.2	96.0	44.5	48.3	3.8	2444.0	387.0	588.0	451.6	79.5	83.7	4.2
8	49.7	96.0	43.5	47.6	4.1	2444.0	417.5	590.0	456.3	78.4	83.3	4.6
9	48.3	96.0	43.5	47.3	3.8	2444.0	387.0	573.0	443.1	76.2	80.1	3.9
10	48.6	96.0	43.6	47.5	3.9	2444.0	397.1	574.0	443.9	75.9	80.5	4.6
11	48.6	96.0	43.6	47.3	3.7	2444.0	376.8	569.0	440.0	75.3	80.4	5.1
12	49.6	96.0	43.8	47.5	3.7	2444.0	376.8	567.0	438.5	75.5	80.6	5.1
13	50.1	96.0	43.9	47.6	3.7	2444.0	376.8	568.0	439.3	75.3	80.6	5.3
14	51.1	90.0	43.9	47.5	3.6	2444.0	366.6	569.0	440.0	76.7	81.8	5.1
15	51.6	88.0	43.9	47.5	3.6	2444.0	366.6	571.0	441.6	78.0	83.0	5.0
16	51.6	78.0	44.4	48.1	3.7	2444.0	376.8	571.0	441.6	77.2	80.8	3.6
17	50.9	80.0	44.7	48.5	3.8	2444.0	387.0	575.0	444.7	77.8	80.9	3.1
18	49.2	89.0	44.5	48.6	4.1	2444.0	417.5	592.0	457.8	78.8	81.8	3.0
19	48.9	91.0	44.2	48.2	4.0	2444.0	407.3	596.0	460.9	79.2	82.2	3.0
20	47.5	93.0	44.1	48.1	4.0	2444.0	407.3	596.0	460.9	79.7	82.4	2.7
21	47.0	95.0	44.5	48.7	4.2	2444.0	427.7	597.0	461.7	79.3	82.1	2.8
22	46.3	93.0	44.7	48.9	4.2	2444.0	427.7	598.0	462.5	79.5	82.3	2.8
23	45.0	96.0	44.7	48.9	4.2	2444.0	427.7	596.0	460.9	78.3	82.4	4.1
24	43.4	96.0	44.3	48.4	4.1	2444.0	417.5	590.0	456.3	76.8	81.6	4.8
TOTAL							9124.3		10721.9			
AVG	48.8						380.2			78.7	82.7	

TONHRS: 9124.3
KWH/CHILLER: 10721.9
KWH/FANS: 4.0
KWH/TOTAL: 10725.9

KWHC/TONHRS: 1.1751
KWHF/TONHRS: 0.0004
KWHT/TONHRS: 1.1755

10 NOV 90/85 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	1.0	0.7	0.0	0.0	3.0	3.3	0.2	4.0	547.0	2424.0	1.2259	0.0113	1.2373
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	629.0	2040.0	1.3118	0.0000	1.3118
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	619.0	2345.0	1.3527	0.0000	1.3527
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	659.0	2367.0	1.3368	0.0000	1.3368
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	615.0	2153.0	1.3743	0.0000	1.3743
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	654.0	3078.0	1.3698	0.0000	1.3698
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3534.0	2680.0	1.1678	0.0000	1.1678
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1481.0	2504.0	1.0928	0.0000	1.0928
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1974.0	2315.0	1.1452	0.0000	1.1452
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1887.0	2401.0	1.1177	0.0000	1.1177
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1903.0	3726.0	1.1679	0.0000	1.1679
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2754.0	1129.0	1.1638	0.0000	1.1638
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2504.0	1887.0	1.1658	0.0000	1.1658
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1992.0	1370.0	1.2003	0.0000	1.2003
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3078.0	1323.0	1.2046	0.0000	1.2046
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2753.0	2247.0	1.1720	0.0000	1.1720
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1432.0	1610.0	1.1491	0.0000	1.1491
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1887.0	2870.0	1.0966	0.0000	1.0966
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1974.0	2037.0	1.1316	0.0000	1.1316
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1919.0	2227.0	1.1316	0.0000	1.1316
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2302.0	2480.0	1.0795	0.0000	1.0795
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1382.0	2281.0	1.0813	0.0000	1.0813
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1041.0	2173.0	1.0777	0.0000	1.0777
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1012.0	2457.0	1.0928	0.0000	1.0928
TOTAL	0.0	0.7	0.0	0.0	0.2	3.3	0.2	4.0	40386	53184			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 11 NOV 90 CONDENSER WATER SETPOINT: 80 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDSR CHWR	CHW TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDSR CW LVG	CW TEMP DIFF	
1	43.4	96.0	43.5	46.7	3.2	2444.0	325.9	547.0	423.0	75.7	79.8	4.1	
2	44.6	95.0	44.1	47.2	3.1	2444.0	315.7	532.0	411.4	74.0	78.2	4.2	FREE COOLING
3	43.1	95.0	47.7	49.5	1.8	2444.0	183.3	337.0	260.6	57.1	64.0	6.9	0200 - 1100
4	40.1	96.0	50.5	52.7	2.2	2444.0	224.0	217.0	167.3	41.4	49.7	8.3	
5	40.8	96.0	50.1	52.3	2.2	2444.0	221.0	217.0	167.8	41.3	49.4	8.1	
6	40.7	96.0	50.1	52.2	2.1	2444.0	213.9	217.0	167.8	41.4	49.3	7.9	
7	40.5	96.0	50.4	52.6	2.2	2444.0	224.0	217.0	167.8	41.4	49.4	8.0	
8	42.2	94.0	51.8	54.3	2.5	2444.0	254.6	217.0	167.8	41.9	50.2	8.3	
9	44.4	89.0	53.0	55.7	2.7	2444.0	275.0	217.0	167.3	43.0	51.3	8.3	
10	46.3	87.0	54.1	57.0	2.9	2444.0	295.3	217.0	167.8	44.3	52.3	8.0	
11	50.7	73.0	46.7	52.6	5.9	2444.0	600.8	663.0	512.7	67.1	74.9	7.8	
12	54.7	55.0	43.5	48.8	5.3	2444.0	539.7	648.0	532.1	79.9	85.9	6.0	
13	58.0	51.0	43.9	49.3	5.4	2444.0	549.9	648.0	532.1	79.9	86.4	6.5	
14	60.6	48.0	44.7	50.3	5.6	2444.0	570.3	647.0	534.3	79.9	85.2	5.3	
15	62.8	45.0	44.7	50.7	6.0	2444.0	611.0	690.0	533.6	79.7	85.5	5.8	
16	63.9	46.0	44.1	50.0	5.9	2444.0	600.8	693.0	535.9	79.9	85.5	5.6	
17	64.4	47.0	43.6	49.4	5.8	2444.0	590.6	691.0	534.4	80.0	85.5	5.5	
18	63.5	55.0	43.4	49.1	5.7	2444.0	580.5	688.0	532.1	79.4	85.0	5.6	
19	62.0	61.0	43.5	48.7	5.2	2444.0	529.5	684.0	529.0	80.3	85.3	5.0	
20	61.3	64.0	43.4	48.5	5.1	2444.0	519.4	670.0	518.2	80.0	84.9	4.9	
21	60.3	66.0	43.7	48.7	5.0	2444.0	509.2	666.0	515.1	79.4	84.2	4.8	
22	58.8	70.0	43.8	48.8	5.0	2444.0	509.2	664.0	513.5	79.9	84.5	4.6	
23	57.3	75.0	43.5	48.4	4.9	2444.0	499.0	641.0	495.7	79.5	83.9	4.4	
24	56.4	77.0	43.5	48.0	4.5	2444.0	458.3	619.0	478.7	80.0	83.9	3.9	
TOTAL							7708.8		7616.1				
AVG	54.1						513.9			79.2	84.2		

TONHRS: 7708.8
KWH/CHILLER: 7616.1
KWH/FANS: 354.6
KWH/TOTAL: 7970.6

KWHC/TONHRS: 0.9880
KWHF/TONHRS: 0.0460
KWHT/TONHRS: 1.0340

11 NOV 90/80 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1167.0	2261.0	1.2982	0.0000	1.2982
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	891.0	2027.0	1.3033	0.0000	1.3033
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	763.0	1766.0	1.4218	0.0000	1.4218
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	501.0	836.0	0.7491	0.0000	0.7491
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	834.0	2009.0	0.7491	0.0000	0.7491
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1218.0	2780.0	0.7848	0.0000	0.7848
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	796.0	2706.0	0.7491	0.0000	0.7491
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3078.0	3170.0	0.6592	0.0000	0.6592
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1642.0	2100.0	0.6104	0.0000	0.6104
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1444.0	1938.0	0.5683	0.0000	0.5683
11	2.0	1.5	3.0	3.3	2.0	2.2	0.3	7.0	1766.0	2618.0	0.8534	0.0116	0.8650
12	8.0	5.9	7.0	7.7	7.0	7.7	1.0	21.3	2552.0	1992.0	0.9858	0.0394	1.0252
13	8.0	5.9	8.0	8.8	7.0	7.7	1.0	22.4	3305.0	2457.0	0.9676	0.0407	1.0083
14	8.0	5.9	10.0	11.0	10.0	11.0	1.3	27.9	2585.0	2193.0	0.9317	0.0489	0.9805
15	8.0	5.9	12.0	13.2	12.0	13.2	1.5	32.3	2593.0	3099.0	0.8734	0.0528	0.9262
16	9.0	6.6	12.0	13.2	10.0	11.0	1.4	30.8	3099.0	1887.0	0.8920	0.0513	0.9433
17	7.0	5.1	10.0	11.0	11.0	12.1	1.3	28.2	1105.0	1606.0	0.9048	0.0478	0.9526
18	6.0	4.4	14.0	15.4	13.0	14.3	1.6	34.1	1382.0	619.0	0.9167	0.0587	0.9754
19	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	1418.0	1338.0	0.9990	0.0554	1.0543
20	8.0	5.9	10.0	11.0	10.0	11.0	1.3	27.9	1130.0	1736.0	0.9977	0.0537	1.0513
21	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	1494.0	1906.0	1.0116	0.0576	1.0692
22	6.0	4.4	9.0	9.9	10.0	11.0	1.2	25.3	984.0	1273.0	1.0085	0.0497	1.0582
23	9.0	6.6	9.0	9.9	8.0	8.8	1.2	25.3	754.0	2134.0	0.9935	0.0507	1.0442
24	7.0	5.1	6.0	6.6	8.0	8.8	0.9	20.5	769.0	1218.0	1.0446	0.0448	1.0895
TOTAL	3.5	76.3	6.4	139.7	6.3	130.6	16.1	354.6	35382	47039			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 12 NOV 90 CONDENSER WATER SETPOINT: 75 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHW TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	54.8	80.0	43.4	47.0	3.6	2444.0	366.6	565.0	436.9	75.2	79.3	4.1
2	54.2	81.0	43.4	46.9	3.5	2444.0	356.4	563.0	435.4	74.8	79.0	4.2
3	54.1	80.0	43.6	46.8	3.2	2444.0	325.9	545.0	421.5	75.0	79.0	4.0
4	53.8	81.0	44.1	47.2	3.1	2444.0	315.7	540.0	417.6	74.8	79.3	4.5
5	53.7	86.0	44.3	47.3	3.0	2444.0	305.5	540.0	417.6	75.2	80.5	5.3
6	52.2	91.0	44.5	47.6	3.1	2444.0	315.7	545.0	421.5	74.8	80.6	5.8
7	51.6	88.0	43.4	47.5	4.1	2444.0	417.5	586.0	453.3	75.1	80.3	5.2
8	51.7	87.0	43.8	47.8	4.0	2444.0	407.3	580.0	448.5	74.9	80.0	5.1
9	52.6	87.0	44.9	49.6	4.7	2444.0	478.6	609.0	471.0	74.6	80.3	5.7
10	55.2	81.0	45.0	50.0	5.0	2444.0	509.2	630.0	487.2	75.3	80.6	5.3
11	58.3	72.0	44.9	50.3	5.4	2444.0	549.9	647.0	500.4	75.0	80.5	5.5
12	62.2	55.0	45.0	50.8	5.8	2444.0	590.6	680.0	525.9	74.8	80.8	6.0
13	65.2	50.0	45.0	51.2	6.2	2444.0	631.4	691.0	534.4	75.0	81.5	6.5
14	67.4	50.0	44.6	51.0	6.4	2444.0	651.7	699.0	540.6	74.9	81.8	6.9
15	68.5	49.0	43.7	49.9	6.2	2444.0	631.4	697.0	539.0	75.0	81.7	6.7
16	68.8	48.0	43.5	49.6	6.1	2444.0	621.2	689.0	533.0	74.5	81.5	7.0
17	64.0	52.0	44.1	49.9	5.8	2444.0	590.6	685.0	529.0	75.3	81.6	6.3
18	66.8	62.0	44.8	51.0	6.2	2444.0	631.4	691.0	536.7	74.9	81.7	6.8
19	64.7	67.0	44.0	50.3	6.3	2444.0	641.5	703.0	543.7	74.8	81.9	7.1
20	63.6	67.0	43.4	49.7	6.3	2444.0	641.5	697.0	539.0	74.7	81.5	6.8
21	61.8	67.0	43.4	49.6	6.2	2444.0	631.4	695.0	537.5	75.0	81.7	6.7
22	60.0	69.0	43.6	49.6	6.0	2444.0	611.0	680.0	532.1	75.1	81.4	6.3
23	58.5	67.0	43.4	48.9	5.5	2444.0	560.1	671.0	518.9	74.9	80.6	5.7
24	58.0	62.0	43.4	48.1	4.7	2444.0	478.6	613.0	472.5	74.8	80.0	5.2
TOTAL							12260.7		11793.0			
AVG	59.4						510.9			74.9	80.7	

TONHRS: 12260.7
KWH/CHILLER: 11793.0
KWH/FANS: 951.1
KWH/TOTAL: 12744.1

KWHC/TONHRS: 0.9619
KWHF/TONHRS: 0.0776
KWHT/TONHRS: 1.0395

12 NOV 90/75 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (1-02)	GAS USAGE (1-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	8.0	5.9	8.0	8.8	6.0	6.6	1.0	21.3	673.0	1099.0	1.1919	0.0580	1.2499
2	6.0	4.4	8.0	8.8	7.0	7.7	1.0	20.9	711.0	1276.0	1.2216	0.0586	1.2802
3	5.0	3.7	6.0	6.6	5.0	5.5	0.7	15.8	802.0	1453.0	1.2934	0.0484	1.3418
4	5.0	3.7	4.0	4.4	6.0	6.6	0.7	14.7	543.0	1887.0	1.3229	0.0465	1.3694
5	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	1090.0	943.0	1.3670	0.0384	1.4054
6	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	1060.0	2402.0	1.3351	0.0372	1.3723
7	8.0	5.9	10.0	11.0	8.0	8.8	1.2	25.7	2247.0	2412.0	1.0854	0.0615	1.1469
8	9.0	6.6	8.0	8.8	8.0	8.8	1.1	24.2	3423.0	2577.0	1.1012	0.0594	1.1606
9	7.0	5.1	10.0	11.0	10.0	11.0	1.2	27.1	3135.0	2207.0	0.9840	0.0567	1.0407
10	10.0	7.3	9.0	9.9	13.0	14.3	1.4	31.5	1518.0	2118.0	0.9569	0.0619	1.0188
11	13.0	9.5	13.0	14.3	15.0	16.5	1.8	40.3	2099.0	2234.0	0.9099	0.0733	0.9833
12	20.0	14.7	14.0	15.4	20.0	22.0	2.4	52.1	3331.0	3134.0	0.8904	0.0882	0.9785
13	17.0	12.5	19.0	20.9	24.0	26.4	2.7	59.8	1506.0	1887.0	0.8464	0.0947	0.9411
14	22.0	16.1	18.0	19.8	22.0	24.2	2.7	60.1	3572.0	1371.0	0.8294	0.0923	0.9217
15	18.0	13.2	20.0	22.0	21.0	23.1	2.7	58.3	2643.0	1154.0	0.8538	0.0923	0.9461
16	20.0	14.7	21.0	23.1	21.0	23.1	2.8	60.9	3109.0	2027.0	0.8578	0.0980	0.9558
17	20.0	14.7	17.0	18.7	20.0	22.0	2.5	55.4	1798.0	943.0	0.8969	0.0937	0.9907
18	26.0	19.1	20.0	22.0	20.0	22.0	2.9	63.1	2134.0	1543.0	0.8501	0.0999	0.9500
19	28.0	20.5	22.0	24.2	20.0	22.0	3.0	66.7	1677.0	2552.0	0.8474	0.1040	0.9515
20	20.0	14.7	17.0	18.7	18.0	19.8	2.4	53.2	1263.0	664.0	0.8402	0.0829	0.9231
21	15.0	11.0	20.0	22.0	22.0	24.2	2.6	57.2	1531.0	1003.0	0.8513	0.0906	0.9419
22	15.0	11.0	17.0	18.7	20.0	22.0	2.4	51.7	1606.0	1887.0	0.8708	0.0846	0.9554
23	17.0	12.5	11.0	12.1	13.0	14.3	1.6	38.9	853.0	2379.0	0.9265	0.0694	0.9959
24	8.0	5.9	10.0	11.0	11.0	12.1	1.3	29.0	508.0	1707.0	0.9873	0.0605	1.0478
TOTAL	10.8	236.3	15.5	341.0	16.9	374.8	43.2	951.1	42739	42743			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 13 NOV 90 CONDENSER WATER SETPOINT: 70 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDSR CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDSR CW LVG	CW TEMP DIFF
1	56.7	60.0	43.5	47.2	3.7	2444.0	376.8	561.0	433.9	70.2	77.1	6.9
2	55.3	63.0	43.5	47.0	3.5	2444.0	356.4	553.0	427.7	69.8	76.7	6.9
3	54.0	64.0	43.6	46.7	3.1	2444.0	315.7	519.0	416.0	70.3	76.4	6.1
4	53.7	65.0	44.1	47.0	2.9	2444.0	295.3	529.0	409.1	69.9	75.5	5.6
5	51.4	65.0	44.2	47.2	3.0	2444.0	305.5	528.0	404.3	70.0	75.6	5.6
6	50.2	66.0	44.5	48.0	3.5	2444.0	356.4	557.0	430.4	70.1	76.5	6.4
7	49.9	65.0	44.1	48.5	4.4	2444.0	448.1	601.0	461.8	70.1	78.2	8.1
8	48.9	65.0	44.2	48.7	4.5	2444.0	458.3	603.0	466.3	70.1	77.9	7.8
9	49.2	65.0	44.5	49.2	4.7	2444.0	478.6	606.0	468.7	70.3	78.1	7.8
10	52.6	59.0	44.9	49.9	5.0	2444.0	509.2	625.0	483.4	70.4	79.0	8.6
11	56.3	52.0	44.9	50.3	5.4	2444.0	549.9	653.0	505.0	69.9	79.2	9.3
12	60.2	42.0	44.8	50.7	5.9	2444.0	600.8	682.0	527.4	70.2	79.4	9.2
13	63.1	43.0	44.9	51.1	6.2	2444.0	631.4	686.0	530.5	70.0	78.6	8.6
14	64.2	41.0	44.9	51.3	6.4	2444.0	651.7	684.0	532.1	70.0	78.4	8.4
15	65.6	40.0	44.8	51.3	6.5	2444.0	661.9	690.0	533.6	69.9	78.4	8.5
16	66.2	41.0	44.4	51.3	6.9	2444.0	702.6	712.0	550.6	70.1	78.6	8.5
17	64.0	43.0	44.3	51.2	6.9	2444.0	702.7	709.0	548.3	69.7	78.3	8.6
18	64.4	51.0	43.9	50.8	6.9	2444.0	702.6	710.0	549.1	70.1	78.6	8.5
19	62.1	54.0	43.5	50.1	6.6	2444.0	671.1	699.0	540.6	70.1	75.3	5.2
20	60.9	60.0	43.4	49.7	6.3	2444.0	641.6	689.0	532.8	69.6	78.1	8.5
21	59.5	61.0	43.4	49.5	6.1	2444.0	621.2	685.0	529.8	69.9	77.9	8.0
22	58.5	61.0	43.5	49.5	6.0	2444.0	611.0	685.0	529.8	70.2	78.0	7.8
23	57.9	61.0	43.6	49.6	6.0	2444.0	611.0	688.0	530.5	70.0	77.9	7.9
24	57.0	61.0	43.4	49.0	5.6	2444.0	570.3	667.0	515.8	70.0	77.8	7.8
TOTAL							12831.0		11865.7			
AVG	57.6						534.6			70.0	77.9	

TONHRS: 12831.0
KWH/CHILLER: 11865.7
KWH/FANS: 1352.3
KWH/TOTAL: 13217.9

KWHC/TONHRS: 0.9248
KWHF/TONHRS: 0.1054
KWHT/TONHRS: 1.0302

13 NOV 90/70 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	13.0	9.5	12.0	13.2	17.0	18.7	1.9	41.4	554.0	318.0	1.1515	0.1100	1.2614
2	20.0	14.7	14.0	15.4	15.0	16.5	2.1	46.6	535.0	550.0	1.1999	0.1307	1.3306
3	17.0	12.5	11.0	12.1	12.0	13.2	1.7	37.8	631.0	1620.0	1.3204	0.1196	1.4400
4	22.0	16.1	5.0	5.5	4.0	4.4	1.2	26.0	342.0	670.0	1.3853	0.0882	1.4735
5	18.0	13.2	8.0	8.8	8.0	8.8	1.4	30.8	713.0	1125.0	1.3366	0.1008	1.4374
6	20.0	14.7	8.0	8.8	9.0	9.9	1.5	33.4	933.0	2918.0	1.2086	0.0936	1.3022
7	20.0	14.7	16.0	17.6	15.0	16.5	2.2	48.8	2080.0	3265.0	1.0373	0.1088	1.1462
8	26.0	19.1	8.0	8.8	14.0	15.4	2.0	43.3	3326.0	2619.0	1.0176	0.0944	1.1121
9	28.0	20.5	12.0	13.2	14.0	15.4	2.2	49.1	1787.0	2744.0	0.9792	0.1027	1.0818
10	20.0	14.7	9.0	9.9	20.0	22.0	2.1	46.6	2674.0	2170.0	0.9493	0.0915	1.0408
11	22.0	16.1	20.0	22.0	20.0	22.0	2.7	60.1	1798.0	2213.0	0.9184	0.1094	1.0277
12	24.0	17.6	22.0	24.2	25.0	27.5	3.2	69.3	2367.0	1620.0	0.8779	0.1153	0.9932
13	21.0	15.4	22.0	24.2	21.0	23.1	2.9	62.7	1023.0	1597.0	0.8403	0.0993	0.9396
14	23.0	16.9	22.0	24.2	26.0	28.6	3.2	69.7	1887.0	1225.0	0.8164	0.1069	0.9233
15	26.0	19.1	23.0	25.3	28.0	30.8	3.4	75.2	2700.0	668.0	0.8062	0.1136	0.9197
16	28.0	20.5	25.0	27.5	27.0	29.7	3.5	77.7	3396.0	1319.0	0.7837	0.1106	0.8943
17	26.0	19.1	25.0	27.5	29.0	31.9	3.6	78.5	3017.0	2721.0	0.7803	0.1117	0.8920
18	28.0	20.5	24.0	26.4	25.0	27.5	3.4	74.4	1751.0	2015.0	0.7815	0.1059	0.8874
19	23.0	16.9	22.0	24.2	26.0	28.6	3.2	69.7	3702.0	2357.0	0.8013	0.1037	0.9050
20	20.0	14.7	25.0	27.5	23.0	25.3	3.1	67.5	2227.0	1420.0	0.8306	0.1052	0.9357
21	21.0	15.4	21.0	23.1	26.0	28.6	3.1	67.1	1506.0	2268.0	0.8528	0.1080	0.9608
22	22.0	16.1	19.0	20.9	23.0	25.3	2.8	62.3	1175.0	2268.0	0.8670	0.1020	0.9690
23	25.0	18.3	19.0	20.9	20.0	22.0	2.8	61.2	638.0	2010.0	0.8683	0.1002	0.9685
24	20.0	14.7	16.0	17.6	19.0	20.9	2.4	53.2	576.0	604.0	0.9045	0.0932	0.9978
TOTAL	17.8	390.9	20.4	448.8	23.3	512.6	61.5	1352.3	42192	42824			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 14 NOV 90 CONDENSER WATER SETPOINT: 85 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHW TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	56.7	65.0	43.6	47.7	4.1	2444.0	417.5	591.0	457.1	76.0	80.5	4.5
2	56.3	67.0	44.1	48.0	3.9	2444.0	397.1	595.0	460.1	81.0	83.9	2.9
3	55.7	71.0	43.6	47.4	3.8	2444.0	387.0	592.0	457.8	82.5	85.3	2.8
4	54.8	68.0	43.4	47.0	3.6	2444.0	366.6	583.0	450.9	81.9	84.6	2.7
5	53.9	71.0	43.4	46.9	3.5	2444.0	356.4	572.0	442.4	79.4	82.2	2.8
6	54.0	73.0	44.2	47.9	3.7	2444.0	376.8	582.0	450.1	80.5	83.3	2.8
7	54.2	71.0	44.7	49.4	4.7	2444.0	478.6	662.0	512.0	84.6	87.7	3.1
8	54.6	70.0	44.8	49.6	4.8	2444.0	488.9	670.0	521.3	84.8	88.5	3.7
9	55.6	70.0	44.7	49.8	5.1	2444.0	519.3	686.0	530.5	85.0	88.6	3.6
10	56.4	70.0	44.1	49.2	5.1	2444.0	519.4	686.0	530.5	85.1	88.9	3.8
11	59.4	62.0	44.9	50.5	5.6	2444.0	570.3	695.0	537.5	85.1	89.4	4.3
12	62.7	47.0	45.0	51.1	6.1	2444.0	621.2	727.0	562.2	84.5	89.8	5.3
13	65.3	43.0	44.9	51.5	6.6	2444.0	672.3	757.0	585.4	84.6	90.0	5.4
14	66.7	42.0	44.7	51.7	7.0	2444.0	712.8	788.0	609.4	84.6	91.2	6.6
15	68.0	42.0	44.6	51.8	7.2	2444.0	733.2	806.0	623.3	85.0	91.4	6.4
16	68.4	42.0	44.5	51.7	7.2	2444.0	733.2	813.0	628.7	85.1	91.7	6.6
17	68.3	45.0	44.6	52.0	7.4	2444.0	753.6	818.0	632.6	84.6	91.7	7.1
18	67.4	56.0	44.6	52.0	7.4	2444.0	753.6	827.0	639.6	85.1	92.1	7.0
19	66.2	60.0	43.8	51.0	7.2	2444.0	733.2	819.0	633.4	84.5	91.5	7.0
20	65.4	62.0	43.4	50.5	7.1	2444.0	723.0	806.0	623.3	85.0	91.6	6.6
21	64.0	65.0	43.4	50.2	6.8	2444.0	692.5	787.0	608.6	84.6	90.9	6.3
22	62.8	68.0	43.2	49.9	6.7	2444.0	682.3	779.0	602.4	84.6	90.7	6.1
23	61.0	70.0	43.5	49.9	6.4	2444.0	651.7	758.0	586.2	84.4	90.3	5.9
24	59.9	72.0	43.2	48.9	5.7	2444.0	580.4	718.0	555.3	84.6	89.4	4.8
TOTAL							13920.6		13243.8			
AVG	60.7						580.0			83.6	88.6	

TONHRS: 13920.6
KWH/CHILLER: 13241.8
KWH/FANS: 584.5
KWH/TOTAL: 13826.3

KWHC/TONHRS: 0.9511
KWHF/TONHRS: 0.0420
KWHT/TONHRS: 0.9931

14 NOV 90/85 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (1-02)	GAS USAGE (1-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	3.0	2.2	0.0	0.0	4.0	4.4	0.3	6.6	547.0	1587.0	1.0947	0.0158	1.1105
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	423.0	972.0	1.1586	0.0000	1.1586
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	638.0	1079.0	1.1831	0.0000	1.1831
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	965.0	1532.0	1.2299	0.0000	1.2299
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1057.0	980.0	1.2413	0.0000	1.2413
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1043.0	2504.0	1.1946	0.0000	1.1946
7	2.0	1.5	3.0	3.3	2.0	2.2	0.3	7.0	846.0	2603.0	1.0697	0.0146	1.0842
8	6.0	4.4	7.0	7.7	6.0	6.6	0.9	18.7	2180.0	2315.0	1.0727	0.0383	1.1110
9	6.0	4.4	4.0	4.4	4.0	4.4	0.6	13.2	1456.0	2315.0	1.0215	0.0254	1.0469
10	4.0	2.9	6.0	6.6	6.0	6.6	0.7	16.1	980.0	1751.0	1.0215	0.0311	1.0526
11	10.0	7.3	8.0	8.8	8.0	8.8	1.1	24.9	3397.0	1583.0	0.9425	0.0437	0.9862
12	12.0	8.8	8.0	8.8	14.0	15.4	1.5	33.0	1757.0	1253.0	0.9051	0.0531	0.9582
13	12.0	8.8	8.0	8.8	12.0	13.2	1.4	30.8	3231.0	1543.0	0.8711	0.0458	0.9169
14	16.0	11.7	12.0	13.2	16.0	17.6	1.9	42.5	2552.0	1955.0	0.8549	0.0597	0.9146
15	16.0	11.7	9.0	9.9	16.0	17.6	1.8	39.2	3109.0	1444.0	0.8501	0.0535	0.9037
16	19.0	13.9	9.0	9.9	17.0	18.7	1.9	42.5	1818.0	1700.0	0.8575	0.0580	0.9155
17	17.0	12.5	10.0	11.0	19.0	20.9	2.0	44.4	3598.0	1889.0	0.8395	0.0589	0.8984
18	20.0	14.7	8.0	8.8	19.0	20.9	2.0	44.4	3237.0	2447.0	0.8487	0.0589	0.9076
19	16.0	11.7	9.0	9.9	17.0	18.7	1.8	40.3	3196.0	1306.0	0.8619	0.0550	0.9169
20	17.0	12.5	9.0	9.9	16.0	17.6	1.8	40.0	2780.0	2536.0	0.8621	0.0553	0.9174
21	16.0	11.7	8.0	8.8	16.0	17.6	1.7	38.1	1333.0	1166.0	0.8789	0.0551	0.9340
22	15.0	11.0	7.0	7.7	16.0	17.6	1.7	36.3	1420.0	1610.0	0.8830	0.0532	0.9362
23	16.0	11.7	7.0	7.7	16.0	17.6	1.7	37.0	1117.0	1003.0	0.8995	0.0568	0.9563
24	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	547.0	1301.0	0.9566	0.0505	1.0072
TOTAL	7.8	170.9	7.1	156.2	11.7	257.4	26.6	584.5	41877	40394			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 15 NOV 90 CONDENSER WATER SETPOINT: 80 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDSR CHWR	CHW TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDSR CW LVG	CW TEMP DIFF
1	54.9	72.0	43.1	47.5	4.4	2444.0	448.1	620.0	479.5	79.8	84.2	4.4
2	58.0	72.0	43.5	47.6	4.1	2444.0	417.5	599.0	463.2	79.1	83.1	4.0
3	57.6	72.0	43.5	47.3	3.8	2444.0	387.0	590.0	456.3	80.0	85.2	5.2
4	57.4	74.0	43.7	47.2	3.5	2444.0	356.4	560.0	439.3	79.7	85.5	5.8
5	57.0	76.0	44.3	47.6	3.3	2444.0	336.1	564.0	436.2	79.8	85.8	6.0
6	55.6	78.0	44.5	48.0	3.5	2444.0	356.4	571.0	441.6	80.0	84.9	4.9
7	54.9	80.0	44.0	48.3	4.3	2444.0	437.9	607.0	469.4	79.2	83.3	4.1
8	54.8	80.0	44.2	48.9	4.7	2444.0	478.6	629.0	486.4	79.2	83.5	4.3
9	55.5	75.0	44.5	49.5	5.0	2444.0	509.2	646.0	499.6	79.4	83.9	4.5
10	57.6	67.0	44.6	50.2	5.6	2444.0	570.3	684.0	529.0	79.4	84.6	5.2
11	59.5	60.0	44.6	50.5	5.9	2444.0	600.8	692.0	535.2	78.4	84.1	5.7
12	61.7	49.0	44.6	51.1	6.5	2444.0	661.9	727.0	562.2	79.6	85.5	5.9
13	64.2	47.0	44.6	51.4	6.8	2444.0	692.5	744.0	575.4	79.4	85.9	6.5
14	65.7	44.0	44.5	51.5	7.0	2444.0	712.8	759.0	587.0	78.6	86.1	7.5
15	66.7	42.0	44.5	51.6	7.1	2444.0	723.0	779.0	602.4	80.2	87.1	6.9
16	67.3	42.0	44.6	51.8	7.2	2444.0	733.2	780.0	603.3	79.1	86.5	7.4
17	67.8	44.0	44.6	51.9	7.3	2444.0	743.4	788.0	609.4	79.7	87.1	7.4
18	67.4	52.0	44.0	51.2	7.2	2444.0	733.2	785.0	607.1	79.6	87.1	7.5
19	66.6	56.0	43.3	50.2	6.9	2444.0	702.7	760.0	587.8	79.2	86.4	7.2
20	66.0	57.0	43.8	50.3	6.5	2444.0	661.9	744.0	575.4	80.1	86.6	6.5
21	65.1	57.0	44.0	50.6	6.6	2444.0	672.1	743.0	574.6	80.0	86.7	6.7
22	63.9	59.0	43.7	50.2	6.5	2444.0	661.9	740.0	572.3	79.8	86.3	6.5
23	63.3	61.0	43.4	49.9	6.5	2444.0	661.9	737.0	570.0	79.4	86.1	6.7
24	62.0	63.0	43.2	49.2	6.0	2444.0	611.0	707.0	546.8	79.2	85.0	5.8
TOTAL							13869.7		12809.2			
AVG	61.8						577.9			79.5	85.4	

TONHRS: 13869.7
KWH/CHILLER: 12809.2
KWH/FANS: 957.0
KWH/TOTAL: 13766.2

KWHC/TONHRS: 0.9235
KWHF/TONHRS: 0.0690
KWHT/TONHRS: 0.9925

15 NOV 90/80 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	10.0	7.3	9.0	9.9	15.0	16.5	1.5	33.7	624.0	1657.0	1.0701	0.0753	1.1454
2	6.0	4.4	9.0	9.9	9.0	9.9	1.0	24.2	543.0	1721.0	1.1095	0.0580	1.1675
3	8.0	5.9	9.0	9.9	8.0	8.8	1.1	24.6	469.0	996.0	1.1791	0.0635	1.2426
4	6.0	4.4	7.0	7.7	6.0	6.6	0.9	18.7	649.0	818.0	1.2325	0.0525	1.2849
5	6.0	4.4	6.0	6.6	6.0	6.6	0.8	17.6	707.0	1103.0	1.2979	0.0524	1.3503
6	6.0	4.4	5.0	5.5	6.0	6.6	0.8	16.5	631.0	2367.0	1.2390	0.0463	1.2853
7	8.0	5.9	8.0	8.8	10.0	11.0	1.2	25.7	473.0	2367.0	1.0720	0.0586	1.1307
8	12.0	8.8	6.0	6.6	12.0	13.2	1.3	28.6	3560.0	2726.0	1.0164	0.0598	1.0761
9	12.0	8.8	7.0	7.7	12.0	13.2	1.4	29.7	3038.0	2561.0	0.9812	0.0583	1.0395
10	14.0	10.3	11.0	12.1	14.0	15.4	1.7	37.8	3522.0	2302.0	0.9276	0.0662	0.9938
11	16.0	11.7	13.0	14.3	14.0	15.4	1.9	41.4	3940.0	1956.0	0.8907	0.0690	0.9597
12	12.0	8.8	14.0	15.4	17.0	18.7	2.0	42.9	1751.0	1834.0	0.8494	0.0648	0.9142
13	15.0	11.0	18.0	19.8	15.0	16.5	2.2	47.3	3767.0	2009.0	0.8309	0.0683	0.8992
14	19.0	13.9	18.0	19.8	22.0	24.2	2.6	57.9	2138.0	1580.0	0.8234	0.0813	0.9047
15	21.0	15.4	12.0	13.2	19.0	20.9	2.3	49.5	1070.0	1457.0	0.8332	0.0685	0.9017
16	17.0	12.5	18.0	19.8	19.0	20.9	2.4	53.2	3017.0	1736.0	0.8227	0.0725	0.8952
17	17.0	12.5	18.0	19.8	20.0	22.0	2.5	54.3	1956.0	752.0	0.8198	0.0730	0.8928
18	20.0	14.7	19.0	20.9	23.0	25.3	2.8	60.9	1333.0	1657.0	0.8280	0.0830	0.9110
19	15.0	11.0	16.0	17.6	21.0	23.1	2.2	51.7	1543.0	1494.0	0.8365	0.0736	0.9101
20	17.0	12.5	14.0	15.4	20.0	22.0	2.3	49.9	1519.0	1429.0	0.8693	0.0753	0.9446
21	20.0	14.7	16.0	17.6	16.0	17.6	2.3	49.9	1543.0	2289.0	0.8549	0.0742	0.9291
22	19.0	13.9	12.0	13.2	18.0	19.8	2.1	46.9	1870.0	2512.0	0.8446	0.0709	0.9155
23	18.0	13.2	20.0	22.0	18.0	19.8	2.5	55.0	1349.0	1117.0	0.8611	0.0831	0.9442
24	16.0	11.7	11.0	12.1	14.0	15.4	1.8	39.2	919.0	606.0	0.8949	0.0642	0.9591
TOTAL	11.0	212.0	14.8	325.6	17.7	389.4	43.5	957.0	42241	41046			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 16 NOV 90 CONDENSER WATER SETPOINT: 75 EWT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDON CW LVG	CW TEMP DIFF
1	61.3	63.0	43.5	48.1	4.6	2444.0	464.4	619.0	470.7	75.4	80.8	5.4
2	60.7	63.0	43.5	48.1	4.6	2444.0	464.4	615.0	475.6	74.7	79.9	5.2
3	60.6	66.0	43.2	47.5	4.3	2444.0	437.9	600.0	461.0	74.8	80.4	5.6
4	59.6	71.0	43.3	47.4	4.1	2444.0	417.5	591.0	457.1	75.0	81.4	6.4
5	59.4	70.0	43.6	47.6	4.0	2444.0	407.3	583.0	450.9	74.5	81.3	6.8
6	58.8	73.0	44.1	48.3	4.2	2444.0	427.7	587.0	454.0	75.1	81.3	6.2
7	57.9	74.0	44.4	49.2	4.8	2444.0	488.8	619.0	470.7	74.4	79.9	5.5
8	57.6	75.0	44.6	49.7	5.1	2444.0	519.4	626.0	484.1	74.9	80.2	5.3
9	57.4	74.0	44.6	50.4	5.8	2444.0	590.6	670.0	518.2	74.4	80.6	6.2
10	57.7	78.0	44.7	50.9	6.2	2444.0	631.4	690.0	533.6	75.2	81.3	6.1
11	61.1	78.0	44.8	51.4	6.6	2444.0	672.1	706.0	546.0	75.0	81.3	6.3
12	64.9	62.0	44.8	52.0	7.2	2444.0	733.2	742.0	573.8	75.1	82.6	7.5
13	67.1	58.0	44.8	52.1	7.3	2444.0	743.4	754.0	583.1	75.1	83.2	8.1
14	68.1	54.0	44.4	51.8	7.4	2444.0	753.6	755.0	583.9	74.8	83.0	8.2
15	68.9	51.0	44.1	51.4	7.3	2444.0	743.4	753.0	582.3	75.2	83.2	8.0
16	69.1	52.0	44.4	51.9	7.5	2444.0	763.8	754.0	586.2	75.2	83.1	7.9
17	68.7	57.0	44.1	51.5	7.4	2444.0	753.6	759.0	587.0	74.8	83.0	8.2
18	67.9	64.0	43.5	50.8	7.3	2444.0	743.4	752.0	581.6	74.8	82.8	8.0
19	66.6	65.0	44.0	51.3	7.3	2444.0	743.4	745.0	576.3	75.5	83.4	7.9
20	66.2	72.0	44.5	51.7	7.2	2444.0	733.2	748.0	578.5	74.9	82.7	7.8
21	64.7	77.0	44.5	51.8	7.3	2444.0	743.4	749.0	579.2	75.1	82.8	7.7
22	63.4	82.0	44.5	51.8	7.3	2444.0	743.4	746.0	576.9	74.6	82.7	8.1
23	62.4	87.0	44.4	51.6	7.2	2444.0	733.2	746.0	576.9	74.8	82.3	7.5
24	61.2	90.0	43.5	50.4	6.9	2444.0	702.6	730.0	564.6	75.0	82.4	7.4
TOTAL							15152.8		12871.0			
AVG	63.0						631.4			74.9	81.9	

TONHRS: 15152.8
KWH/CHILLER: 12871.0
KWH/FANS: 1501.5
KWH/TOTAL: 14372.5

KWHC/TONHRS: 0.8494
KWHF/TONHRS: 0.0991
KWHT/TONHRS: 0.9485

16 NOV 90/75 EWT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	14.0	10.3	17.0	18.7	18.0	19.8	2.2	48.8	554.0	537.0	1.0219	0.1041	1.1260
2	18.0	13.2	14.0	15.4	16.0	17.6	2.1	46.2	447.0	2589.0	1.0153	0.0986	1.1140
3	14.0	10.3	16.0	17.6	14.0	15.4	2.0	43.3	539.0	1893.0	1.0597	0.0988	1.1585
4	11.0	8.1	14.0	15.4	14.0	15.4	1.8	38.9	415.0	833.0	1.0947	0.0931	1.1878
5	13.0	9.5	13.0	14.3	14.0	15.4	1.8	39.2	1175.0	1187.0	1.1069	0.0963	1.2032
6	14.0	10.3	8.0	8.8	14.0	15.4	1.6	34.5	847.0	1481.0	1.0614	0.0806	1.1420
7	14.0	10.3	14.0	15.4	15.0	16.5	1.9	42.2	1243.0	2501.0	0.9794	0.0863	1.0656
8	10.0	7.3	14.0	15.4	17.0	18.7	1.9	41.4	2643.0	2988.0	0.9322	0.0798	1.0120
9	22.0	16.1	16.0	17.6	20.0	22.0	2.5	55.7	1721.0	1707.0	0.8773	0.0944	0.9716
10	16.0	11.7	18.0	19.8	23.0	25.3	2.6	56.8	3388.0	2178.0	0.8452	0.0900	0.9352
11	16.0	11.7	17.0	18.7	21.0	23.1	2.4	53.5	2954.0	2213.0	0.8124	0.0797	0.8920
12	28.0	20.5	26.0	28.6	29.0	31.9	3.7	81.0	2281.0	1729.0	0.7826	0.1105	0.8932
13	33.0	24.2	34.0	37.4	31.0	34.1	4.4	95.7	2842.0	1854.0	0.7844	0.1287	0.9131
14	31.0	22.7	29.0	31.9	30.0	33.0	4.0	87.6	3423.0	1728.0	0.7748	0.1163	0.8911
15	24.0	17.6	25.0	27.5	26.0	28.6	3.4	73.7	3361.0	1642.0	0.7834	0.0991	0.8825
16	22.0	16.1	23.0	25.3	23.0	25.3	3.0	66.7	1782.0	1586.0	0.7675	0.0874	0.8549
17	24.0	17.6	28.0	30.8	26.0	28.6	3.5	77.0	1974.0	1252.0	0.7789	0.1022	0.8811
18	26.0	19.1	26.0	28.6	25.0	27.5	3.4	75.2	1751.0	1195.0	0.7823	0.1011	0.8834
19	22.0	16.1	28.0	30.8	28.0	30.8	3.5	77.7	2099.0	153.0	0.7858	0.1060	0.8918
20	26.0	19.1	23.0	25.3	29.0	31.9	3.5	76.3	1420.0	1745.0	0.7890	0.1040	0.8930
21	25.0	18.3	28.0	30.8	24.0	26.4	3.4	75.5	1519.0	303.0	0.7792	0.1016	0.8808
22	27.0	19.8	24.0	26.4	30.0	33.0	3.6	79.2	1263.0	121.0	0.7761	0.1065	0.8826
23	22.0	16.1	23.0	25.3	22.0	24.2	3.0	65.6	1049.0	2044.0	0.7869	0.0895	0.8764
24	20.0	14.7	22.0	24.2	28.0	30.8	3.2	69.7	445.0	2221.0	0.8035	0.0991	0.9026
TOTAL	18.4	360.1	25.0	550.0	26.9	590.7	68.3	1501.5	41539	37665			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 17 NOV 90 CONDENSER WATER SETPOINT: 70 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CDWS	CONDLR CDWR	CDL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDOR CW LVG	CW TEMP DIFF
1	59.0	95.0	83.5	89.0	5.5	2444.0	560.1	635.0	489.5	70.1	77.0	6.9
2	55.7	95.0	83.3	88.5	5.2	2444.0	529.5	625.0	483.4	69.9	76.6	6.7
3	53.9	91.0	83.1	87.6	4.5	2444.0	458.3	585.0	452.4	69.2	75.4	6.2
4	52.8	95.0	83.4	87.1	3.7	2444.0	376.8	563.0	435.4	70.3	75.9	5.6
5	51.3	95.0	83.4	87.1	3.7	2444.0	376.8	562.0	434.6	69.5	75.8	6.3
6	50.2	91.0	83.5	87.0	3.5	2444.0	356.4	557.0	430.8	70.0	76.2	6.2
7	48.9	90.0	84.0	88.1	4.1	2444.0	417.5	575.0	444.7	68.5	75.8	7.3
8	48.5	90.0	83.2	87.2	4.0	2444.0	407.3	570.0	443.9	69.8	77.0	7.2
9	48.9	86.0	84.3	88.5	4.2	2444.0	427.7	576.0	445.5	70.5	77.3	6.8
10	49.8	77.0	84.6	89.4	4.8	2444.0	488.8	605.0	467.9	69.0	77.6	8.6
11	51.8	68.0	84.7	89.7	5.0	2444.0	509.2	614.0	474.8	68.9	77.7	8.8
12	54.2	53.0	84.7	90.0	5.3	2444.0	539.7	633.0	489.5	68.7	77.3	8.6
13	55.9	49.0	84.6	90.3	5.7	2444.0	580.4	653.0	505.0	68.7	76.4	7.7
14	57.1	47.0	84.2	90.2	6.0	2444.0	611.0	676.0	522.8	69.7	77.1	7.4
15	58.3	45.0	83.7	89.5	5.8	2444.0	590.6	674.0	521.3	69.8	78.4	8.6
16	58.2	46.0	84.1	90.0	5.9	2444.0	600.8	677.0	523.6	69.4	77.3	7.9
17	57.8	48.0	84.3	90.6	6.3	2444.0	641.6	690.0	533.6	69.5	77.0	7.5
18	56.0	56.0	83.2	89.6	6.4	2444.0	651.7	688.0	532.1	68.8	76.8	8.0
19	54.0	62.0	83.2	89.2	6.0	2444.0	611.0	670.0	518.2	69.6	76.5	6.9
20	52.3	65.0	83.6	89.5	5.9	2444.0	600.8	671.0	518.9	69.5	76.5	7.0
21	51.1	67.0	83.3	89.1	5.8	2444.0	590.6	664.0	513.5	68.9	76.3	7.4
22	49.4	68.0	83.1	88.8	5.7	2444.0	580.4	655.0	506.6	68.9	75.8	6.9
23	48.8	69.0	83.2	88.8	5.6	2444.0	570.3	646.0	499.6	69.0	75.9	6.9
24	47.7	70.0	83.1	88.5	5.4	2444.0	549.9	632.0	488.8	68.3	75.2	6.9
TOTAL							12627.3		11676.2			
AVG	53.0						526.1			69.4	76.6	

TONHRS: 12627.3
KWH/CHILLER: 11676.2
KWH/FANS: 1056.4
KWH/TOTAL: 12732.6

KWHC/TONHRS: 0.9247
KWHF/TONHRS: 0.0837
KWHT/TONHRS: 1.0083

17 NOV 90/70 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	21.0	16.9	28.0	30.8	27.0	29.7	3.5	77.4	433.0	1154.0	0.8740	0.1381	1.0122
2	22.0	16.1	20.0	22.0	20.0	22.0	2.7	60.1	472.0	317.0	0.9128	0.1136	1.0263
3	15.0	11.0	14.0	15.4	14.0	15.4	1.9	41.8	585.0	124.0	0.9473	0.0912	1.0385
4	9.0	6.6	8.0	8.8	10.0	11.0	1.2	26.4	356.0	1264.0	1.1556	0.0701	1.2256
5	11.0	8.1	9.0	9.9	12.0	13.2	1.4	31.2	664.0	1021.0	1.1535	0.0827	1.2362
6	12.0	8.8	9.0	9.9	9.0	9.9	1.3	28.6	799.0	2925.0	1.2086	0.0802	1.2888
7	12.0	8.8	14.0	15.4	11.0	12.1	1.7	36.3	3515.0	134.0	1.0651	0.0869	1.1520
8	7.0	5.1	10.0	11.0	12.0	13.2	1.3	29.3	2988.0	2929.0	1.0898	0.0720	1.1618
9	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	1569.0	3017.0	1.0415	0.0686	1.1101
10	15.0	11.0	12.0	13.2	16.0	17.6	1.9	41.8	3361.0	2302.0	0.9572	0.0855	1.0427
11	14.0	10.3	14.0	15.4	14.0	15.4	1.9	41.1	3231.0	1253.0	0.9326	0.0807	1.0132
12	12.0	8.8	14.0	15.4	14.0	15.4	1.8	39.6	1662.0	2027.0	0.9070	0.0734	0.9804
13	16.0	11.7	16.0	17.6	16.0	17.6	2.1	46.9	2009.0	2040.0	0.8700	0.0809	0.9509
14	18.0	13.2	18.0	19.8	20.0	22.0	2.5	55.0	2812.0	1889.0	0.8556	0.0900	0.9456
15	17.0	12.5	14.0	15.4	15.0	16.5	2.0	44.4	1956.0	1640.0	0.8825	0.0751	0.9576
16	16.0	11.7	20.0	22.0	21.0	23.1	2.6	56.8	2726.0	1243.0	0.8714	0.0946	0.9660
17	18.0	13.2	16.0	17.6	17.0	18.7	2.3	49.5	2044.0	853.0	0.8318	0.0772	0.9089
18	17.0	12.5	20.0	22.0	21.0	23.1	2.6	57.6	1903.0	1567.0	0.8164	0.0883	0.9047
19	12.0	8.8	14.0	15.4	17.0	18.7	2.0	42.9	2187.0	116.0	0.8480	0.0702	0.9183
20	12.0	8.8	16.0	17.6	16.0	17.6	2.0	44.0	2695.0	110.0	0.8637	0.0732	0.9369
21	17.0	12.5	19.0	20.9	19.0	20.9	2.5	54.3	1333.0	3767.0	0.8694	0.0919	0.9613
22	12.0	8.8	14.0	15.4	12.0	13.2	1.7	37.4	1322.0	3170.0	0.8727	0.0644	0.9371
23	18.0	13.2	14.0	15.4	17.0	18.7	2.2	47.3	880.0	133.0	0.8761	0.0829	0.9590
24	9.0	6.6	13.0	14.3	15.0	16.5	1.7	37.4	873.0	2662.0	0.8888	0.0680	0.9568
TOTAL	11.5	252.3	17.0	391.6	18.4	412.5	48 ^	1056.4	42375	37933			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 18 NOV 90 CONDENSER WATER SETPOINT: 85 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF	
1	47.9	71.0	43.8	47.4	3.6	2444.0	366.6	549.0	424.6	77.2	80.6	3.4	FREE COOLING
2	46.9	69.0	53.3	55.3	2.0	2444.0	203.7	217.0	167.8	44.5	52.5	8.0	0100 - 1200
3	46.0	69.0	53.8	56.3	2.5	2444.0	254.6	217.0	167.8	43.8	52.2	8.4	
4	45.9	71.0	53.6	56.0	2.4	2444.0	244.4	217.0	167.8	43.5	52.0	8.5	
5	44.8	74.0	53.2	55.7	2.5	2444.0	254.6	217.0	167.8	43.4	49.2	5.8	
6	43.0	81.0	52.9	55.1	2.4	2444.0	244.4	217.0	167.8	43.1	48.2	5.1	
7	43.7	81.0	52.8	55.4	2.6	2444.0	264.8	217.0	167.8	42.8	49.1	6.3	
8	43.9	79.0	53.7	56.6	2.9	2444.0	295.3	217.0	167.8	43.2	51.1	7.9	
9	44.8	73.0	53.9	57.0	3.1	2444.0	315.7	217.0	167.8	43.1	51.3	8.2	
10	46.6	70.0	54.9	58.1	3.2	2444.0	325.9	217.0	167.8	44.2	52.7	8.5	
11	51.3	54.0	55.3	59.5	4.2	2444.0	427.7	343.0	265.3	46.9	56.9	10.0	
12	56.5	39.0	43.4	50.2	6.8	2444.0	692.5	780.0	603.2	82.9	89.8	6.9	
13	56.3	37.0	43.7	49.8	6.1	2444.0	621.3	733.0	566.5	85.0	90.5	5.5	
14	58.0	41.0	44.3	50.5	6.2	2444.0	631.4	737.0	570.0	85.0	90.2	5.2	
15	59.4	34.0	44.0	50.1	6.1	2444.0	621.2	734.0	567.6	84.8	90.2	5.4	
16	61.0	36.0	44.3	50.4	6.1	2444.0	621.2	737.0	570.0	85.1	90.2	5.1	
17	61.3	44.0	44.0	50.6	6.6	2444.0	672.1	765.0	591.6	84.6	90.4	5.8	
18	60.6	54.0	43.1	49.4	6.3	2444.0	641.5	755.0	583.9	85.0	90.5	5.5	
19	60.2	54.0	43.0	48.8	5.8	2444.0	590.6	718.0	555.3	85.1	90.1	5.0	
20	58.8	55.0	43.2	48.9	5.7	2444.0	580.4	713.0	551.4	85.1	90.1	5.0	
21	58.3	54.0	43.1	48.7	5.6	2444.0	570.3	703.0	543.7	84.9	89.8	4.9	
22	57.4	52.0	43.1	48.3	5.2	2444.0	529.5	689.0	532.8	85.0	89.4	4.4	
23	57.2	57.0	43.2	48.4	5.2	2444.0	529.5	687.0	531.3	85.0	89.3	4.3	
24	56.6	62.0	42.9	47.7	4.8	2444.0	488.8	666.0	515.1	84.7	88.8	4.1	
TOTAL							7464.4		7104.1				
AVG	54.0						571.2			84.3	89.2		

TONHRS:	7464.4
KWH/CHILLER:	7104.1
KWH/FANS:	217.8
KWH/TOTAL:	7321.9
KWHC/TONHRS:	0.9517
KWHF/TONHRS:	0.0292
KWHT/TONHRS:	0.9809

18 NOV 90/85 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	2.0	1.5	0.0	0.0	0.0	0.0	0.1	1.5	478.0	720.0	1.1581	0.0040	1.1621
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	601.0	3138.0	0.8240	0.0000	0.8240
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	708.0	429.0	0.6592	0.0000	0.6592
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	453.0	498.0	0.6867	0.0000	0.6867
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	648.0	3042.0	0.6592	0.0000	0.6592
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1090.0	912.0	0.6867	0.0000	0.6867
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	827.0	1294.0	0.6338	0.0000	0.6338
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1233.0	3047.0	0.5683	0.0000	0.5683
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2958.0	2480.0	0.5316	0.0000	0.5316
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2788.0	2099.0	0.5150	0.0000	0.5150
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1270.0	1610.0	0.6202	0.0000	0.6202
12	2.0	1.5	4.0	4.4	4.0	4.4	0.5	10.3	1394.0	1803.0	0.8711	0.0148	0.8859
13	6.0	4.4	6.0	6.6	6.0	6.6	0.8	17.6	2926.0	1838.0	0.9126	0.0283	0.9409
14	7.0	5.1	6.0	6.6	6.0	6.6	0.8	18.3	3368.0	2062.0	0.9028	0.0290	0.9318
15	7.0	5.1	8.0	8.8	8.0	8.8	1.0	22.7	2988.0	1662.0	0.9138	0.0366	0.9504
16	8.0	5.9	6.0	6.6	6.0	6.6	0.9	19.1	2842.0	1992.0	0.9176	0.0307	0.9482
17	8.0	5.9	6.0	6.6	9.0	9.9	1.0	22.4	1714.0	1531.0	0.8803	0.0333	0.9135
18	8.0	5.9	8.0	8.8	7.0	7.7	1.0	22.4	1956.0	2168.0	0.9101	0.0349	0.9450
19	6.0	4.4	6.0	6.6	7.0	7.7	0.9	18.7	1678.0	2412.0	0.9401	0.0317	0.9718
20	6.0	4.4	7.0	7.7	7.0	7.7	0.9	19.8	1518.0	1887.0	0.9500	0.0341	0.9841
21	6.0	4.4	7.0	7.7	6.0	6.6	0.9	18.7	1700.0	2099.0	0.9534	0.0328	0.9862
22	6.0	4.4	4.0	4.4	4.0	4.4	0.6	13.2	1111.0	519.0	1.0063	0.0249	1.0312
23	4.0	2.9	4.0	4.4	5.0	5.5	0.6	12.8	381.0	1159.0	1.0033	0.0242	1.0276
24	4.0	2.9	4.0	4.4	3.0	3.3	0.5	10.6	346.0	90.0	1.0537	0.0218	1.0755
TOTAL	2.6	57.2	3.6	79.2	3.7	81.4	9.9	217.8	36960	40533			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 19 NOV 90 CONDENSER WATER SETPOINT: 80 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDEN CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDEN CW LVG	CW TEMP DIFF	
1	55.5	61.0	43.2	47.2	4.0	2444.0	407.3	594.0	459.4	79.8	83.6	3.8	FREE COOLING
2	54.6	64.0	43.4	47.3	3.9	2444.0	397.1	590.0	459.4	79.9	83.6	3.7	0130 - 0620
3	52.0	66.0	47.7	49.6	1.9	2444.0	193.5	316.0	290.8	64.4	69.5	5.1	
4	50.7	63.0	54.9	57.0	2.1	2444.0	213.9	217.0	167.8	46.3	51.2	4.9	
5	50.1	66.0	55.0	57.3	2.3	2444.0	234.2	217.0	167.8	46.0	51.0	5.0	
6	50.0	66.0	54.8	57.1	2.3	2444.0	234.2	217.0	167.8	45.8	52.7	6.9	
7	49.4	71.0	47.1	52.0	4.9	2444.0	499.0	545.0	452.4	63.7	69.9	6.2	
8	50.3	74.0	44.0	48.0	4.0	2444.0	407.3	596.0	460.9	80.3	83.9	3.6	
9	50.6	80.0	44.5	48.7	4.2	2444.0	427.7	602.0	465.6	79.6	83.7	4.1	
10	52.7	77.0	44.5	49.2	4.7	2444.0	478.6	624.0	482.6	79.6	84.7	5.1	
11	55.9	67.0	44.7	49.6	4.9	2444.0	499.0	659.0	509.6	80.0	86.2	6.2	
12	58.4	49.0	44.6	49.9	5.3	2444.0	539.7	683.0	528.2	80.2	86.9	6.7	
13	60.6	41.0	44.6	50.2	5.6	2444.0	570.3	685.0	529.8	79.7	85.7	6.0	
14	61.9	41.0	44.4	50.2	5.8	2444.0	590.6	682.0	527.4	80.0	85.9	5.9	
15	63.4	38.0	44.4	50.2	5.8	2444.0	590.6	682.0	527.4	79.9	86.5	6.6	
16	64.2	37.0	44.3	50.0	5.7	2444.0	580.5	685.0	529.8	80.0	85.2	5.2	
17	64.0	38.0	44.2	49.9	5.7	2444.0	580.4	688.0	532.1	79.7	84.9	5.2	
18	63.3	46.0	43.7	49.3	5.6	2444.0	570.3	688.0	532.1	80.2	85.1	4.9	
19	62.3	48.0	43.4	48.9	5.5	2444.0	560.1	687.0	531.3	79.9	84.8	4.9	
20	61.1	48.0	43.1	48.7	5.4	2444.0	570.3	684.0	529.0	79.5	84.5	5.0	
21	59.9	53.0	43.7	49.0	5.3	2444.0	539.7	673.0	520.5	80.0	84.4	4.4	
22	59.3	59.0	43.8	49.1	5.3	2444.0	539.7	672.0	519.7	79.8	84.2	4.4	
23	58.0	65.0	43.6	48.9	5.3	2444.0	539.7	665.0	514.3	79.7	84.1	4.4	
24	57.1	61.0	43.3	48.2	4.9	2444.0	499.0	645.0	501.9	80.1	84.1	4.0	
TOTAL							9490.9		9201.4				
AVG	56.8						527.3			79.9	84.9		

TONHRS: 9490.9
KWH/CHILLER: 9201.4
KWH/FANS: 400.0
KWH/TOTAL: 9601.5

KWHC/TONHRS: 0.9695
KWHF/TONHRS: 0.0421
KWHT/TONHRS: 1.0117

19 NOV 90/80 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	2.0	1.5	6.0	6.6	6.0	6.6	0.7	14.7	307.0	3299.0	1.1276	0.0360	1.1636
2	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	339.0	2142.0	1.1567	0.0295	1.1862
3	2.0	1.5	2.0	2.2	2.0	2.2	0.3	5.9	392.0	1792.0	1.5029	0.0303	1.5332
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.0	2436.0	0.7848	0.0000	0.7848
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	631.0	2593.0	0.7165	0.0000	0.7165
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	631.0	2700.0	0.7165	0.0000	0.7165
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	814.0	1920.0	0.9067	0.0000	0.9067
8	2.0	1.5	2.0	2.2	2.0	2.2	0.3	5.9	1671.0	2744.0	1.1316	0.0144	1.1460
9	3.0	2.2	2.0	2.2	2.0	2.2	0.3	6.6	1726.0	1850.0	1.0885	0.0154	1.1040
10	5.0	3.7	4.0	4.4	4.0	4.4	0.6	12.5	3509.0	3433.0	1.0081	0.0260	1.0341
11	4.0	2.9	6.0	6.6	6.0	6.6	0.7	16.1	3714.0	98.0	1.0214	0.0323	1.0537
12	6.0	4.4	4.0	4.4	5.0	5.5	0.7	14.3	1620.0	983.0	0.9787	0.0265	1.0052
13	7.0	5.1	10.0	11.0	9.0	9.9	1.2	26.0	1870.0	1215.0	0.9290	0.0457	0.9746
14	9.0	6.6	8.0	8.8	10.0	11.0	1.2	26.4	1420.0	996.0	0.8930	0.0447	0.9377
15	12.0	8.8	12.0	13.2	8.0	8.8	1.4	30.8	1311.0	979.0	0.8930	0.0521	0.9451
16	12.0	8.8	12.0	13.2	7.0	7.7	1.4	29.7	1138.0	250.0	0.9127	0.0512	0.9638
17	12.0	8.8	6.0	6.6	13.0	14.3	1.4	29.7	2680.0	2957.0	0.9167	0.0512	0.9678
18	12.0	8.8	11.0	12.1	8.0	8.8	1.4	29.7	1035.0	3170.0	0.9330	0.0521	0.9851
19	15.0	11.0	7.0	7.7	13.0	14.3	1.5	33.0	1166.0	365.0	0.9486	0.0589	1.0075
20	7.0	5.1	12.0	13.2	11.0	12.1	1.4	30.4	1233.0	1815.0	0.9276	0.0534	0.9810
21	10.0	7.3	8.0	8.8	7.0	7.7	1.1	23.8	1273.0	93.0	0.9643	0.0442	1.0085
22	8.0	5.9	8.0	8.8	8.0	8.8	1.1	23.5	1057.0	175.0	0.9628	0.0435	1.0064
23	8.0	5.9	9.0	9.9	9.0	9.9	1.2	25.7	718.0	347.0	0.9529	0.0476	1.0004
24	8.0	5.9	7.0	7.7	7.0	7.7	1.0	21.3	521.0	2139.0	1.0059	0.0426	1.0485
TOTAL	4.7	104.1	6.7	107.4	6.8	148.5	18.2	400.0	27369.0	27951.0			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 20 NOV 90 CONDENSER WATER SETPOINT: 75 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	56.9	67.0	43.5	47.4	3.9	2444.0	397.1	579.0	447.8	73.8	80.1	6.3
2	56.6	65.0	43.9	47.8	3.9	2444.0	397.1	542.0	450.1	74.9	81.2	6.3
3	56.5	64.0	43.3	47.0	3.7	2444.0	376.8	579.0	447.8	75.1	81.2	6.1
4	56.6	63.0	43.2	46.8	3.6	2444.0	366.6	570.0	440.8	74.7	80.6	5.9
5	56.4	59.0	43.0	46.6	3.6	2444.0	366.6	568.0	439.3	75.0	80.8	5.8
6	56.8	60.0	43.5	47.1	3.6	2444.0	366.6	566.0	437.7	75.0	80.6	5.6
7	56.9	62.0	44.5	48.8	4.3	2444.0	437.9	597.0	461.7	74.6	81.4	6.8
8	56.6	62.0	44.5	48.9	4.4	2444.0	448.1	601.0	464.8	74.3	82.0	7.7
9	57.7	61.0	44.5	49.2	4.7	2444.0	478.6	615.0	475.6	74.3	81.9	7.6
10	57.8	62.0	44.7	49.6	4.9	2444.0	499.0	628.0	485.7	74.9	82.5	7.6
11	60.4	59.0	44.6	49.9	5.3	2444.0	539.7	644.0	498.0	74.4	82.5	8.1
12	63.4	53.0	44.7	50.2	5.5	2444.0	560.1	668.0	516.6	75.2	83.0	7.8
13	65.9	52.0	44.6	50.4	5.8	2444.0	590.6	686.0	530.5	74.6	82.9	8.3
14	67.3	52.0	44.5	50.3	5.8	2444.0	590.6	685.0	529.8	75.2	82.6	7.4
15	67.8	55.0	44.7	50.7	6.0	2444.0	611.0	687.0	531.3	75.1	82.4	7.3
16	68.7	57.0	44.4	50.4	6.0	2444.0	611.0	688.0	532.1	74.8	81.9	7.1
17	68.4	60.0	43.8	49.7	5.9	2444.0	600.8	686.0	530.5	74.7	81.5	6.8
18	67.8	69.0	43.2	49.0	5.8	2444.0	590.6	687.0	531.3	75.3	81.7	6.4
19	66.3	73.0	43.3	48.0	5.7	2444.0	580.4	686.0	530.5	74.9	81.9	7.0
20	65.2	75.0	43.5	49.0	5.5	2444.0	560.1	676.0	522.8	74.8	81.8	7.0
21	64.7	77.0	43.5	49.0	5.5	2444.0	560.1	679.0	525.1	75.1	82.2	7.1
22	64.1	78.0	43.5	49.0	5.5	2444.0	560.1	680.0	525.9	75.0	82.2	7.2
23	63.2	78.0	43.7	49.3	5.6	2444.0	570.3	682.0	527.4	74.6	82.4	7.8
24	63.3	86.0	43.4	48.7	5.3	2444.0	539.7	668.0	516.6	75.3	82.5	7.2
TOTAL							12199.6		11899.7			
AVG	61.8						508.3			74.8	81.8	

TONHRS: 12199.6
KWH/CHILLER: 11899.7
KWH/FANS: 1153.9
KWH/TOTAL: 13053.6

KWHC/TONHRS: 0.9754
KWHF/TONHRS: 0.0946
KWHT/TONHRS: 1.0700

20 NOV 90/75 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/TONHR	KWHF/TONHR	KWHT/TONHR
1	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	301.0	2948.0	1.1275	0.0739	1.2013
2	8.0	5.9	10.0	11.0	9.0	9.9	1.2	26.8	490.0	2988.0	1.1333	0.0674	1.2007
3	9.0	6.6	8.0	8.8	8.0	8.8	1.1	24.2	381.0	3138.0	1.1884	0.0642	1.2526
4	9.0	6.6	8.0	8.8	9.0	9.9	1.2	25.3	426.0	2354.0	1.2024	0.0690	1.2715
5	8.0	5.9	8.0	8.8	7.0	7.7	1.0	22.4	763.0	2870.0	1.1942	0.0610	1.2552
6	8.0	5.9	8.0	8.8	9.0	9.9	1.1	24.6	729.0	149.0	1.1940	0.0670	1.2610
7	10.0	7.3	10.0	11.0	11.0	12.1	1.4	30.4	1992.0	3469.0	1.0544	0.0695	1.1239
8	10.0	7.3	12.0	13.2	16.0	17.6	1.7	38.1	3018.0	3560.0	1.0373	0.0851	1.1224
9	12.0	8.8	12.0	13.2	12.0	13.2	1.6	35.2	1432.0	537.0	0.9937	0.0735	1.0673
10	10.0	7.3	13.0	14.3	15.0	16.5	1.7	38.1	2009.0	2928.0	0.9733	0.0764	1.0497
11	14.0	10.3	17.0	18.7	17.0	18.7	2.2	47.7	3767.0	341.0	0.9228	0.0883	1.0111
12	14.0	10.3	18.0	19.8	21.0	23.1	2.4	53.2	1301.0	2292.0	0.9224	0.0949	1.0173
13	20.0	14.7	22.0	24.2	22.0	24.2	2.9	63.1	1787.0	2[illegible]24.0	0.8982	0.1068	1.0050
14	18.0	13.2	19.0	20.9	22.0	24.2	2.7	58.3	2153.0	892.0	0.8969	0.0987	0.9956
15	27.0	19.8	24.0	26.4	22.0	24.2	3.2	70.4	814.0	3170.0	0.8696	0.1152	0.9848
16	19.0	13.9	22.0	24.2	23.0	25.3	2.9	63.4	1117.0	609.0	0.8708	0.1038	0.9746
17	23.0	16.9	25.0	27.5	22.0	24.2	3.1	68.6	1117.0	667.0	0.8830	0.1181	0.9911
18	22.0	16.1	23.0	25.3	22.0	24.2	3.0	65.6	3138.0	1613.0	0.8995	0.1111	1.0107
19	25.0	18.3	21.0	23.1	23.0	25.3	3.0	66.7	1129.0	3227.0	0.9140	0.1150	1.0290
20	19.0	13.9	22.0	24.2	27.0	29.7	3.1	67.8	1338.0	454.0	0.9334	0.1211	1.0545
21	20.0	14.7	20.0	22.0	20.0	22.0	2.7	58.7	1606.0	2280.0	0.9376	0.1047	1.0423
22	18.0	13.2	19.0	20.9	21.0	23.1	2.6	57.2	971.0	3109.0	0.9389	0.1021	1.0411
23	24.0	17.6	21.0	23.1	21.0	23.1	3.0	66.0	701.0	304.0	0.9249	0.1157	1.0406
24	[illegible]	13.2	17.0	18.7	19.0	20.9	2.4	52.8	406.0	213.0	0.9572	0.0978	1.0550
TOTAL	[illegible]	275.0	[illegible]	430.1	[illegible]	448.8	52.5	1153.9	32900	46176			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 21 NOV 90 CONDENSER WATER SETPOINT: 70 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	CONDSR CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	CONDSR CW LVG	CW TEMP DIFF
1	60.5	86.0	43.0	47.3	4.3	2144.0	437.9	549.0	455.5	70.0	78.2	8.2
2	59.6	87.0	43.0	47.2	4.2	2144.0	427.7	542.0	450.1	69.9	77.6	7.7
3	57.2	93.0	43.0	46.8	3.8	2144.0	387.0	564.0	436.2	70.0	76.9	6.9
4	57.4	95.0	43.6	47.2	3.6	2144.0	366.6	555.0	429.2	69.9	76.4	6.5
5	57.0	96.0	43.5	47.0	3.5	2144.0	354.4	551.0	428.4	70.1	76.4	6.3
6	56.0	96.0	43.6	47.2	3.6	2144.0	366.6	554.0	428.4	69.9	76.2	6.3
7	55.5	96.0	44.6	48.8	4.2	2144.0	427.7	581.0	449.3	70.0	77.4	7.4
8	55.3	96.0	44.4	48.9	4.5	2144.0	458.3	595.0	460.1	70.0	77.4	7.4
9	55.1	93.0	44.2	48.7	4.5	2144.0	454.3	597.0	461.7	70.4	78.3	7.9
10	56.7	86.0	44.3	49.2	4.9	2144.0	499.0	611.0	472.5	70.0	78.7	8.7
11	59.1	75.0	44.5	49.5	5.0	2144.0	509.2	621.0	480.3	70.4	78.9	8.5
12	62.4	56.0	44.6	50.0	5.4	2144.0	519.9	649.0	501.9	70.3	79.8	9.5
13	64.1	58.0	44.6	50.3	5.7	2144.0	580.4	675.0	522.0	70.0	79.7	9.7
14	65.4	53.0	44.0	50.0	6.0	2318.0	579.5	667.0	515.8	70.2	78.4	8.2
15	66.3	54.0	44.6	50.2	5.6	2144.0	570.3	685.0	529.8	70.5	80.6	10.1
16	66.7	57.0	44.2	49.8	5.6	2144.0	570.3	685.0	529.8	70.2	80.3	10.1
17	66.8	57.0	43.9	49.5	5.6	2144.0	570.3	685.0	529.8	70.0	79.8	9.8
18	66.2	64.0	43.7	49.2	5.5	2144.0	560.1	657.0	508.1	69.7	79.9	10.2
19	65.2	67.0	43.6	49.1	5.5	2144.0	560.1	656.0	507.3	70.3	79.9	9.6
20	63.4	68.0	43.2	48.6	5.4	2144.0	549.9	655.0	506.6	69.9	80.1	10.2
21	62.7	70.0	43.4	48.8	5.4	2144.0	549.9	657.0	508.1	70.1	80.2	10.1
22	62.3	71.0	43.2	48.6	5.4	2144.0	549.9	654.0	505.8	70.1	80.2	10.1
23	61.5	72.0	43.1	48.4	5.3	2144.0	539.7	641.0	495.7	70.0	79.9	9.9
24	60.6	73.0	43.2	48.1	4.9	2144.0	499.0	624.0	482.6	69.7	78.8	9.1
TOTAL							11923.7		11595.0			
AVG	61.0						496.8			70.1	78.8	

TONHRS:	11923.7
KWH/CHILLER:	11595.0
KWH/FANS:	1950.7
KWH/TOTAL:	13545.7
KWHC/TONHRS:	0.9724
KWHF/TONHRS:	0.1636
KWHT/TONHRS:	1.1360

21 NOV 90/70 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	28.0	20.5	29.0	31.9	28.0	30.8	3.8	83.2	346.0	89.0	1.0403	0.1901	1.2303
2	24.0	17.6	28.0	30.8	26.0	28.6	3.5	77.0	370.0	281.0	1.0524	0.1800	1.2324
3	16.0	11.7	28.0	31.3	25.0	27.5	3.9	65.4	554.0	87.0	1.1273	0.1639	1.2911
4	19.0	13.9	22.0	24.2	24.0	26.4	2.9	64.5	392.0	107.0	1.1700	0.1760	1.3460
5	18.0	13.2	19.0	20.9	24.0	26.4	2.8	60.5	713.0	2068.0	1.2021	0.1697	1.3718
6	19.0	13.9	21.0	23.1	22.0	24.2	2.8	61.2	688.0	2460.0	1.1687	0.1670	1.3357
7	23.0	16.9	24.0	26.4	24.0	26.4	3.2	69.7	658.0	435.0	1.0506	0.1629	1.2134
8	22.0	16.1	22.0	24.2	22.0	24.2	2.9	64.5	1111.0	3217.0	1.0041	0.1408	1.1450
9	24.0	15.4	22.0	24.2	24.0	26.4	3.0	66.0	1371.0	223.0	1.0075	0.1440	1.1515
10	24.0	17.6	25.0	27.5	30.0	33.0	3.6	78.1	1518.0	814.0	0.9470	0.1565	1.1035
11	25.0	18.3	23.0	25.3	23.0	25.3	3.1	68.9	1678.0	803.0	0.9432	0.1354	1.0786
12	30.0	22.0	30.0	33.0	30.0	33.0	4.0	88.0	1311.0	822.0	0.9127	0.1600	1.0728
13	31.0	22.7	32.0	35.2	31.0	34.1	4.2	92.0	2064.0	104.0	0.8993	0.1586	1.0579
14	35.0	25.7	32.0	35.2	36.0	39.6	4.6	100.5	1469.0	654.0	0.8901	0.1734	1.0635
15	29.0	21.3	33.0	36.3	32.0	35.2	4.2	92.8	1043.0	262.0	0.9290	0.1627	1.0916
16	36.0	26.4	30.0	33.0	36.0	39.6	4.5	99.0	847.0	2134.0	0.9290	0.1736	1.1026
17	36.0	26.4	30.0	33.0	33.0	36.3	4.4	95.7	1818.0	491.0	0.9290	0.1678	1.0968
18	34.0	24.9	33.0	36.3	35.0	38.5	4.5	99.7	1019.0	2118.0	0.9072	0.1781	1.0853
19	29.0	21.3	29.0	31.9	32.0	34.4	4.0	87.3	1319.0	843.0	0.9058	0.1558	1.0616
20	34.0	24.9	31.0	34.1	32.0	35.2	4.3	94.2	1284.0	2138.0	0.9212	0.1714	1.0925
21	31.0	22.7	31.0	34.1	32.0	35.2	4.2	92.0	1126.0	1476.0	0.9240	0.1674	1.0913
22	30.0	22.0	30.0	33.0	30.0	33.0	4.0	88.0	1195.0	1409.0	0.9198	0.1600	1.0798
23	31.0	22.7	30.0	33.0	30.0	33.0	4.0	88.7	286.0	3237.0	0.9185	0.1644	1.0829
24	25.0	18.3	27.0	29.7	25.0	27.5	3.4	75.5	327.0	384.0	0.9671	0.1514	1.1185
TOTAL	21.7	476.7	32.8	720.5	34.3	753.5	88.7	1950.7	21526	26734			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 22 NOV 90 CONDENSER WATER SETPOINT: 85 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	60.0	74.0	43.8	47.5	3.7	2444.0	376.8	591.0	457.1	82.1	85.2	3.1
2	59.0	76.0	44.4	48.1	3.7	2444.0	376.8	597.0	461.7	84.9	87.8	2.9
3	59.0	76.0	43.5	47.1	3.6	2444.0	366.6	593.0	457.8	84.9	87.5	2.6
4	58.7	76.0	43.2	46.6	3.4	2444.0	346.2	584.0	451.6	84.9	87.5	2.6
5	58.7	79.0	43.3	46.8	3.5	2444.0	356.4	583.0	450.9	85.0	87.5	2.5
6	58.5	78.0	43.7	47.2	3.5	2444.0	356.4	588.0	454.7	84.8	87.5	2.7
7	57.3	83.0	44.6	48.7	4.1	2444.0	417.5	616.0	476.4	84.4	87.7	3.3
8	57.2	91.0	44.5	49.0	4.5	2444.0	458.3	643.0	497.3	84.8	88.4	3.6
9	57.1	94.0	44.3	48.9	4.6	2444.0	468.4	642.0	496.5	85.1	88.6	3.5
10	57.6	92.0	44.3	49.3	5.0	2444.0	509.2	679.0	525.1	84.9	88.9	4.0
11	61.3	80.0	44.4	49.5	5.1	2444.0	519.4	682.0	527.4	84.6	88.7	4.1
12	64.2	67.0	44.6	50.1	5.5	2444.0	560.1	697.0	539.0	85.0	89.0	4.0
13	66.7	41.0	44.6	50.5	5.9	2444.0	600.8	712.0	550.6	84.0	89.0	5.0
14	67.3	66.0	44.3	50.3	6.0	2444.0	611.0	729.0	563.8	84.6	90.0	5.4
15	68.4	57.0	43.6	49.6	6.0	2444.0	611.0	735.0	568.4	84.9	90.5	5.6
16	68.7	57.0	43.4	49.4	6.0	2444.0	611.0	734.0	567.6	84.9	90.6	5.7
17	68.6	59.0	43.2	48.9	5.7	2444.0	580.4	716.0	553.7	84.9	90.1	5.2
18	67.8	65.0	43.2	48.8	5.6	2444.0	570.3	709.0	548.3	84.7	90.1	5.4
19	66.9	67.0	43.7	49.2	5.5	2444.0	560.1	700.0	541.4	85.1	90.2	5.1
20	66.2	70.0	44.6	50.5	5.9	2444.0	600.8	721.0	559.9	84.7	90.1	5.4
21	65.4	73.0	44.1	50.1	6.0	2444.0	611.0	728.0	563.0	84.8	90.5	5.7
22	65.3	76.0	44.0	50.0	6.0	2444.0	611.0	726.0	561.5	84.5	89.9	5.4
23	65.0	78.0	43.9	49.8	5.9	2444.0	600.8	725.0	560.7	84.9	90.3	5.4
24	63.8	82.0	43.5	49.1	5.6	2444.0	570.3	700.0	541.4	84.2	89.4	5.2
TOTAL							12250.6		12475.9			
AVG	62.9						510.4			84.7	89.0	

TONHRS: 12250.6
KWH/CHILLER: 12475.9
KWH/FANS: 648.3
KWH/TOTAL: 13124.1

KWHC/TONHRS: 1.0184
KWHF/TONHRS: 0.0529
KWHT/TONHRS: 1.0713

22 NOV 90/85 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/TONHR	KWHF/TONHR	KWHT/TONHR
1	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	339.0	1693.0	1.2130	0.0311	1.2442
2	7.0	5.1	6.0	6.6	7.0	7.7	0.9	19.4	336.0	2105.0	1.2254	0.0516	1.2769
3	4.0	2.9	5.0	5.5	5.0	5.5	0.6	13.9	276.0	2115.0	1.2489	0.0380	1.2869
4	6.0	4.4	5.0	5.5	6.0	6.6	0.8	16.5	320.0	1099.0	1.3044	0.0477	1.3521
5	4.0	2.9	4.0	4.4	3.0	3.3	0.5	10.6	505.0	1721.0	1.2650	0.0298	1.2948
6	4.0	2.9	4.0	4.4	5.0	5.5	0.6	12.8	950.0	453.0	1.2759	0.0360	1.3119
7	8.0	5.9	6.0	6.6	7.0	7.7	0.9	20.2	787.0	2358.0	1.1410	0.0483	1.1893
8	6.0	4.4	6.0	6.6	7.0	7.7	0.9	18.7	1035.0	2233.0	1.0852	0.0408	1.1260
9	6.0	4.4	8.0	8.8	6.0	6.6	0.9	19.8	1920.0	527.0	1.0599	0.0423	1.1022
10	12.0	8.8	8.0	8.8	9.0	9.9	1.3	27.5	1657.0	741.0	1.0313	0.0540	1.0853
11	10.0	7.3	7.0	7.7	11.0	12.1	1.2	27.1	1234.0	1494.0	1.0156	0.0522	1.0678
12	16.0	11.7	9.0	9.9	13.0	14.3	1.6	35.9	1494.0	1637.0	0.9624	0.0642	1.0266
13	12.0	8.8	12.0	13.2	9.0	9.9	1.5	31.9	752.0	1844.0	0.9165	0.0531	0.9696
14	16.0	11.7	8.0	8.8	14.0	15.4	1.6	35.9	821.0	334.0	0.9227	0.0588	0.9815
15	16.0	11.7	12.0	13.2	12.0	13.2	1.7	38.1	713.0	757.0	0.9303	0.0624	0.9927
16	14.0	10.3	14.0	15.4	14.0	15.4	1.9	41.1	643.0	1992.0	0.9290	0.0672	0.9963
17	12.0	8.8	8.0	8.8	14.0	15.4	1.5	33.0	828.0	1392.0	0.9540	0.0569	1.0108
18	16.0	11.7	12.0	13.2	12.0	13.2	1.7	38.1	769.0	1240.0	0.9615	0.0669	1.0284
19	16.0	11.7	12.0	13.2	11.0	12.1	1.7	37.0	682.0	1382.0	0.9666	0.0661	1.0327
20	12.0	8.8	10.0	11.0	11.0	12.1	1.5	31.9	619.0	1629.0	0.9319	0.0531	0.9850
21	16.0	11.7	6.0	6.6	14.0	15.4	1.5	33.7	644.0	1909.0	0.9215	0.0552	0.9767
22	12.0	8.8	12.0	13.2	10.0	11.0	1.5	33.0	483.0	1135.0	0.9189	0.0540	0.9729
23	10.0	7.3	9.0	9.9	14.0	15.4	1.5	32.6	501.0	1792.0	0.9332	0.0543	0.9875
24	12.0	8.8	7.0	7.7	10.0	11.0	1.3	27.5	304.0	2345.0	0.9493	0.0482	0.9975
TOTAL	8.4	184.3	9.7	213.4	11.4	250.8	29.5	648.3	18610	35077			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 23 NOV 90 CONDENSER WATER SETPOINT: 80 EWT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	63.4	88.0	43.3	47.3	4.0	2444.0	407.3	600.0	464.0	79.9	84.3	4.4
2	62.8	88.0	43.3	47.3	3.9	2444.0	397.3	596.0	460.9	79.6	83.8	4.0
3	61.4	84.0	43.2	46.7	3.4	2444.0	346.6	578.0	447.0	79.6	83.3	3.7
4	60.1	96.0	43.4	46.8	3.4	2444.0	346.2	573.0	443.1	80.1	83.6	3.5
5	59.4	96.0	43.5	47.0	3.5	2444.0	356.4	573.0	443.1	80.0	83.3	3.3
6	58.5	96.0	43.9	47.5	3.6	2444.0	366.6	578.0	447.0	79.5	83.0	3.5
7	58.6	96.0	44.5	48.8	4.3	2444.0	437.9	610.0	471.8	80.0	84.1	4.1
8	58.0	96.0	44.6	49.6	5.0	2444.0	509.2	662.0	512.0	79.9	84.9	5.0
9	57.4	96.0	44.6	49.8	5.2	2444.0	529.5	675.0	522.0	80.0	85.0	5.0
10	58.5	96.0	44.7	50.3	5.6	2444.0	570.3	683.0	528.2	79.7	85.2	5.5
11	59.6	96.0	44.7	50.6	5.9	2444.0	600.8	694.0	536.7	80.0	85.8	5.8
12	60.7	96.0	44.7	50.8	6.1	2444.0	621.2	709.0	548.3	80.0	85.7	5.7
13	62.0	93.0	44.3	51.0	6.3	2444.0	641.5	717.0	554.5	80.1	86.3	6.2
14	64.0	88.0	44.5	51.0	6.5	2444.0	661.9	720.0	563.0	79.8	85.9	6.1
15	64.7	75.0	44.1	50.7	6.6	2402.0	660.6	731.0	565.3	79.7	85.4	5.7
16	65.9	62.0	43.0	49.8	6.8	2444.0	692.5	759.0	587.0	79.7	87.1	7.4
17	65.8	66.0	43.0	49.4	6.4	2444.0	651.7	734.0	567.6	80.1	86.8	6.7
18	64.4	78.0	43.2	49.4	6.2	2444.0	631.4	724.0	559.9	79.7	86.0	6.3
19	63.0	84.0	43.1	49.5	6.1	2444.0	621.2	715.0	553.0	79.9	86.1	6.2
20	61.7	88.0	43.8	49.9	6.1	2444.0	621.2	712.0	550.6	80.3	85.9	5.6
21	60.5	91.0	43.3	49.4	6.1	2444.0	621.2	700.0	547.5	79.8	85.5	5.7
22	59.8	88.0	43.5	49.3	5.8	2444.0	590.6	696.0	538.3	80.1	85.3	5.2
23	58.2	88.0	43.3	48.9	5.6	2444.0	570.3	689.0	532.8	80.0	85.1	5.1
24	57.5	88.0	43.4	48.6	5.2	2444.0	529.5	670.0	518.2	79.8	84.5	4.7
TOTAL							13002.7		12461.9			
AVG	61.1						541.8			79.9	85.1	

TONHRS: 13002.7
KWH/CHILLER: 12461.9
KWH/FANS: 856.5
KWH/TOTAL: 13318.5

KWHC/TONHRS: 0.9584
KWHF/TONHRS: 0.0659
KWHT/TONHRS: 1.0243

23 NOV 90/80 EWT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/TONHR	KWHF/TONHR	KWHT/TONHR
1	11.0	8.1	10.0	11.0	10.0	11.0	1.4	30.1	166.0	1920.0	1.1392	0.0738	1.2130
2	8.0	5.9	8.0	8.8	10.0	11.0	1.2	25.7	204.0	2168.0	1.1606	0.0646	1.2252
3	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	337.0	1750.0	1.2193	0.0800	1.2993
4	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	378.0	670.0	1.2799	0.0847	1.3646
5	10.0	7.3	10.0	11.0	10.0	11.0	1.3	29.3	349.0	198.0	1.2433	0.0823	1.3256
6	11.0	8.1	5.0	5.5	12.0	13.2	1.2	26.8	644.0	206.0	1.2193	0.0730	1.2923
7	14.0	10.3	9.0	9.9	11.0	12.1	1.5	32.3	814.0	1867.0	1.0773	0.0737	1.1510
8	12.0	8.8	14.0	15.4	17.0	18.7	2.0	42.9	1017.0	1939.0	1.0055	0.0843	1.0898
9	10.0	7.3	10.0	11.0	11.0	12.1	1.4	30.4	1333.0	1803.0	0.9858	0.0575	1.0433
10	12.0	8.8	12.0	13.2	13.0	14.3	1.7	36.3	1899.0	2345.0	0.9262	0.0637	0.9899
11	18.0	13.2	16.0	17.6	15.0	16.5	2.2	47.3	3361.0	1887.0	0.8933	0.0787	0.9720
12	14.0	10.3	11.0	12.1	17.0	18.7	1.9	41.1	1992.0	1531.0	0.8827	0.0661	0.9488
13	17.0	12.5	17.0	18.7	19.0	20.9	2.4	52.1	2009.0	1677.0	0.8643	0.0812	0.9455
14	16.0	11.7	17.0	18.7	17.0	18.7	2.2	49.1	1494.0	2207.0	0.8506	0.0742	0.9248
15	19.0	13.9	10.0	11.0	16.0	17.6	1.9	42.5	1138.0	1479.0	0.8558	0.0644	0.9202
16	20.0	14.7	13.0	14.3	17.0	18.7	2.2	47.7	1020.0	1939.0	0.8477	0.0688	0.9165
17	12.0	8.8	12.0	13.2	12.0	13.2	1.6	35.2	919.0	668.0	0.8710	0.0540	0.9250
18	12.0	8.8	10.0	11.0	15.0	16.5	1.7	36.3	1400.0	1338.0	0.8868	0.0575	0.9443
19	12.0	8.8	14.0	15.4	16.0	17.6	1.9	41.8	1328.0	1084.0	0.8902	0.0673	0.9575
20	13.0	9.5	10.0	11.0	14.0	15.4	1.6	35.9	1138.0	1322.0	0.8864	0.0578	0.9443
21	7.0	5.1	14.0	15.4	14.0	15.4	1.6	35.9	926.0	1728.0	0.8814	0.0578	0.9393
22	14.0	10.3	8.0	8.8	10.0	11.0	1.4	30.1	963.0	833.0	0.9113	0.0509	0.9622
23	8.0	5.9	10.0	11.0	10.0	11.0	1.3	27.9	562.0	1671.0	0.9344	0.0489	0.9832
24	8.0	5.9	6.0	6.6	8.0	8.8	1.0	21.3	684.0	1551.0	0.9785	0.0402	1.0187
TOTAL	9.9	218.5	13.3	292.6	15.7	345.4	30.9	856.5	27993	36888			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 24 NOV 90 CONDENSER WATER SETPOINT: 75 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	56.2	86.0	43.8	47.6	3.8	2444.0	387.0	570.0	440.8	74.0	78.6	4.6
2	54.9	89.0	43.7	47.5	3.8	2444.0	387.0	579.0	447.8	74.8	79.0	4.2
3	53.8	89.0	43.2	46.7	3.5	2444.0	356.4	563.0	435.4	74.9	78.9	4.0
4	52.9	89.0	43.8	46.9	3.1	2444.0	315.7	551.0	426.1	74.8	78.9	4.1
5	53.8	79.0	44.1	47.2	3.1	2444.0	315.7	552.0	426.9	75.3	79.0	3.8
6	53.3	82.0	44.1	47.4	3.3	2444.0	336.0	550.0	428.4	75.1	79.1	4.0
7	52.0	89.0	43.4	47.4	4.0	2444.0	407.3	583.0	450.9	74.8	79.2	4.4
8	51.1	91.0	44.1	48.1	4.0	2444.0	407.3	575.0	444.7	75.0	79.2	4.2
9	51.1	86.0	44.6	49.1	4.5	2444.0	458.3	599.0	463.2	74.5	79.1	4.5
10	52.4	82.0	44.6	49.5	4.9	2444.0	499.0	614.0	474.8	75.2	79.6	4.4
11	55.1	74.0	44.7	49.9	5.2	2444.0	529.5	635.0	491.1	75.0	79.8	4.8
12	59.4	47.0	44.5	50.1	5.6	2444.0	570.3	661.0	511.2	75.3	80.3	5.1
13	61.8	41.0	44.7	50.5	5.8	2444.0	590.6	672.0	519.7	74.4	80.1	5.7
14	64.1	38.0	44.7	50.8	6.1	2444.0	621.2	644.0	532.1	75.0	81.2	6.2
15	65.9	38.0	44.6	50.7	6.1	2444.0	621.2	689.0	532.8	74.0	80.2	6.2
16	66.8	40.0	44.4	50.6	6.2	2444.0	631.4	690.0	533.6	75.1	81.4	6.3
17	66.5	44.0	43.4	49.4	6.0	2444.0	611.0	686.0	530.5	74.6	80.8	6.2
18	65.5	45.0	43.4	48.9	5.5	2444.0	560.1	655.0	506.6	73.8	79.8	6.0
19	64.4	48.0	43.4	48.8	5.4	2444.0	549.9	652.0	504.2	74.2	80.0	5.8
20	63.1	50.0	43.8	49.2	5.4	2444.0	549.9	660.0	510.4	74.4	80.3	5.9
21	63.0	53.0	44.1	49.6	5.5	2444.0	560.1	661.0	511.2	74.4	80.0	5.6
22	62.1	55.0	44.2	49.6	5.4	2444.0	549.9	661.0	511.2	75.0	80.2	5.2
23	61.4	57.0	44.0	49.5	5.5	2444.0	560.1	656.0	507.3	74.0	79.9	5.9
24	59.8	62.0	43.4	48.7	5.3	2444.0	539.7	652.0	504.2	74.9	80.3	5.4
TOTAL							11914.5		11645.3			
AVG	58.7						496.4			74.7	79.8	

TONHRS:	11914.5
KWH/CHILLER:	11645.3
KWH/FANS:	832.3
KWH/TOTAL:	12477.6
KWHC/TONHRS:	0.9774
KWHT/TONHRS:	0.0699
KWHT/TONHRS:	1.0473

24 NOV 90/75 ENT

TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	8.0	5.9	10.0	11.0	8.0	8.8	1.2	25.7	204.0	1531.0	1.1392	0.0663	1.2055
2	6.0	4.4	5.0	5.5	6.0	6.6	0.8	16.5	409.0	2444.0	1.1574	0.0426	1.1990
3	4.0	2.9	5.0	5.5	4.0	4.4	0.6	12.8	266.0	1657.0	1.2216	0.0360	1.2576
4	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	389.0	2345.0	1.3498	0.0372	1.3870
5	4.0	2.9	4.0	4.4	4.0	4.4	0.5	11.7	370.0	2457.0	1.3523	0.0373	1.3895
6	7.0	5.1	6.0	6.6	6.0	6.6	0.8	18.3	799.0	980.0	1.2749	0.0546	1.3295
7	7.0	5.1	8.0	8.8	8.0	8.8	1.0	22.7	781.0	2335.0	1.1069	0.0558	1.1627
8	6.0	4.4	6.0	6.6	6.0	6.6	0.8	17.6	1610.0	1939.0	1.0917	0.0432	1.1349
9	10.0	7.3	8.0	8.8	10.0	11.0	1.2	27.1	2754.0	2187.0	1.0109	0.0592	1.0701
10	11.0	8.1	12.0	13.2	10.0	11.0	1.5	32.3	2118.0	2302.0	0.9516	0.0647	1.0163
11	12.0	8.8	10.0	11.0	14.0	15.4	1.6	35.2	2958.0	2247.0	0.9274	0.0665	0.9939
12	17.0	12.5	10.0	11.0	14.0	15.4	1.8	38.9	1003.0	548.0	0.8964	0.0682	0.9646
13	13.0	9.5	18.0	19.8	16.0	17.6	2.1	46.9	1620.0	1308.0	0.8799	0.0795	0.9594
14	15.0	11.0	16.0	17.6	19.0	20.9	2.3	49.5	1073.0	615.0	0.8565	0.0797	0.9362
15	17.0	12.5	16.0	17.6	17.0	18.7	2.2	48.8	1156.0	1599.0	0.8578	0.0785	0.9363
16	22.0	16.1	14.0	15.4	18.0	19.8	2.3	51.3	1360.0	861.0	0.8452	0.0813	0.9265
17	18.0	13.2	14.0	15.4	20.0	22.0	2.3	50.6	1138.0	1168.0	0.8683	0.0828	0.9511
18	18.0	13.2	17.0	18.7	21.0	23.1	2.5	55.0	1147.0	1798.0	0.9044	0.0982	1.0026
19	15.0	11.0	15.0	16.5	15.0	16.5	2.0	44.0	891.0	562.0	0.9170	0.0800	0.9970
20	20.0	14.7	15.0	16.5	19.0	20.9	2.4	52.1	1043.0	1010.0	0.9282	0.0947	1.0229
21	16.0	11.7	10.0	11.0	18.0	19.8	1.9	42.5	1003.0	521.0	0.9127	0.0759	0.9886
22	17.0	12.5	11.0	12.1	14.0	15.4	1.8	40.0	866.0	2424.0	0.9296	0.0727	1.0023
23	13.0	9.5	16.0	17.6	13.0	14.3	1.5	41.4	687.0	574.0	0.9058	0.0740	0.9798
24	12.0	8.8	12.0	13.2	16.0	17.6	1.8	39.6	323.0	696.0	0.9343	0.0734	1.0076
TOTAL	9.7	214.1	13.1	288.2	15.0	330.0	37.8	832.3	29002	35286			

PEACHTREE PLAZA CHILLED WATER SYSTEM
TREND LOG: 25 NOV 90 CONDENSER WATER SETPOINT: 70 ENT

TIME	OSA TEMP	OSA HUMIDITY	CH-1 CHWS	COMMON CHWR	CHL TEMP DIFF	CH-1 GPM	CH-1 TONS	CH-1 AMPS	CH-1 KW	CH-1 CW ENT	COMMON CW LVG	CW TEMP DIFF
1	54.6	65.0	43.5	47.4	3.9	2444.0	397.1	549.0	440.0	69.9	75.9	6.0
2	57.1	67.0	44.1	47.9	3.8	2444.0	387.0	547.0	438.5	69.1	75.8	6.7
3	56.9	70.0	43.2	46.9	3.7	2444.0	376.8	541.0	436.2	69.6	75.9	6.3
4	56.1	72.0	43.1	46.6	3.5	2444.0	356.4	550.0	431.5	70.2	76.6	6.4
5	55.4	75.0	43.3	46.7	3.4	2444.0	346.2	552.0	426.9	69.8	76.2	6.4
6	55.0	76.0	43.6	47.0	3.4	2444.0	346.2	555.0	429.2	69.9	76.2	6.3
7	55.2	77.0	43.8	48.2	4.4	2444.0	448.1	596.0	460.9	70.0	77.2	7.2
8	54.7	79.0	43.6	48.1	4.5	2444.0	458.3	597.0	461.7	70.1	77.4	7.3
9	53.5	81.0	44.4	49.2	4.8	2444.0	488.8	602.0	465.6	70.2	76.3	6.1
10	55.2	76.0	44.5	49.9	5.4	2444.0	549.9	631.0	488.0	70.0	77.0	7.0
11	59.2	66.0	44.7	50.2	5.5	2444.0	560.1	643.0	497.3	69.9	76.7	6.8
12	63.0	45.0	44.7	50.6	5.9	2444.0	600.8	670.0	518.2	70.1	76.9	6.8
13	66.1	40.0	44.7	51.0	6.3	2444.0	641.5	680.0	532.1	69.8	76.9	7.1
14	68.2	37.0	44.7	51.2	6.5	2444.0	661.9	691.0	534.4	70.3	77.4	7.1
15	69.5	34.0	44.7	51.3	6.6	2444.0	672.1	694.0	536.7	69.9	77.4	7.5
16	70.0	35.0	44.2	50.8	6.6	2444.0	672.1	693.0	535.9	70.0	77.5	7.5
17	69.7	36.0	43.4	49.8	6.4	2444.0	651.7	689.0	532.8	69.5	77.1	7.6
18	68.6	43.0	43.1	49.3	6.2	2444.0	631.4	686.0	530.5	70.2	77.3	7.1
19	67.3	46.0	43.2	49.0	5.8	2444.0	590.6	673.0	520.5	70.0	77.0	7.0
20	66.4	48.0	43.6	49.4	5.8	2444.0	590.6	656.0	507.3	70.0	76.6	6.6
21	65.3	53.0	43.2	48.9	5.7	2444.0	580.4	652.0	504.2	70.1	76.6	6.5
22	63.7	55.0	43.3	48.8	5.5	2444.0	560.1	638.0	493.4	69.9	76.5	6.6
23	62.6	58.0	43.6	48.9	5.3	2444.0	539.7	632.0	488.8	69.7	76.3	6.6
24	62.3	58.0	43.3	48.4	5.1	2444.0	519.4	626.0	484.1	70.1	76.4	6.3
TOTAL							12627.3		11694.0			
AVG	61.7						526.1			69.9	76.7	

TONHRS: 12627.3
KWH/CHILLER: 11694.0
KWH/FANS: 1438.1
KWH/TOTAL: 13132.0

KWHC/TONHRS: 0.9261
KWHF/TONHRS: 0.1139
KWHT/TONHRS: 1.0400

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TIME	FAN 3-6 RUN TIME	FAN 3-6 KWH	FAN 1-4-7 RUN TIME	FAN 1-4-7 KWH	FAN 2-5-8 RUN TIME	FAN 2-5-8 KWH	TOTAL FAN RUN TIME	TOTAL FAN KWH	GAS USAGE (3-02)	GAS USAGE (3-03)	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
1	15.0	11.0	15.0	16.5	11.0	15.4	2.0	42.9	235.0	2004.0	1.1080	0.1080	1.2160
2	15.0	13.0	17.0	16.7	18.0	19.8	2.3	49.5	384.0	1693.0	1.1332	0.1279	1.2611
3	14.0	10.3	14.0	15.4	14.0	15.4	1.9	41.1	353.0	1945.0	1.1576	0.1090	1.2666
4	9.0	6.6	16.0	17.6	16.0	17.6	1.9	41.8	269.0	452.0	1.2106	0.1174	1.3280
5	12.0	8.8	17.0	18.7	16.0	17.6	2.1	45.1	398.0	1523.0	1.2330	0.1303	1.3632
6	11.0	8.1	13.0	14.3	13.0	14.3	1.7	36.7	462.0	334.0	1.2397	0.1059	1.3456
7	12.0	8.8	18.0	19.8	19.0	20.9	2.3	49.5	654.0	1543.0	1.0287	0.1105	1.1392
8	10.0	7.3	18.0	19.8	16.0	17.6	2.0	44.7	1018.0	1956.0	1.0075	0.0976	1.1051
9	10.0	7.3	14.0	15.4	18.0	19.8	1.9	42.5	1149.0	1128.0	0.9525	0.0870	1.0395
10	22.0	16.1	21.0	23.1	21.0	23.1	2.8	62.3	950.0	1403.0	0.8871	0.1134	1.0004
11	18.0	13.2	17.0	18.7	18.0	19.8	2.4	51.7	926.0	218.0	0.8879	0.0923	0.9802
12	21.0	15.4	22.0	24.2	24.0	26.4	3.0	66.0	905.0	933.0	0.8634	0.1099	0.9733
13	23.0	16.9	26.0	28.6	25.0	27.5	3.3	73.0	1129.0	1150.0	0.8294	0.1137	0.9431
14	26.0	19.1	23.0	25.3	29.0	31.9	3.5	76.3	1371.0	1067.0	0.8073	0.1152	0.9226
15	28.0	20.5	27.0	29.7	28.0	30.8	3.7	81.0	1545.0	1504.0	0.7986	0.1206	0.9191
16	28.0	20.5	26.0	28.6	28.0	30.8	3.6	79.9	1224.0	1909.0	0.7974	0.1189	0.9163
17	28.0	20.5	28.0	30.8	30.0	33.0	3.8	84.3	1657.0	334.0	0.8176	0.1294	0.9470
18	27.0	19.8	26.0	28.6	23.0	25.3	3.4	73.7	1073.0	1536.0	0.8403	0.1167	0.9570
19	24.0	17.6	24.0	26.4	26.0	28.6	3.3	72.6	1204.0	2138.0	0.8812	0.1229	1.0041
20	22.0	16.1	20.0	22.0	28.0	30.8	3.1	68.9	775.0	1104.0	0.8590	0.1167	0.9757
21	26.0	19.1	25.0	27.5	25.0	27.5	3.4	74.1	724.0	1164.0	0.8687	0.1276	0.9963
22	21.0	15.4	18.0	19.8	24.0	26.4	2.8	61.6	364.0	1707.0	0.8809	0.1100	0.9909
23	21.0	15.4	21.0	23.1	23.0	25.3	2.9	63.8	334.0	1522.0	0.9126	0.1112	1.0238
24	18.0	13.2	20.0	22.0	18.0	19.8	2.5	55.0	235.0	1403.0	0.9322	0.1059	1.0381
TOTAL	15.4	330.1	24.3	534.6	25.7	565.4	65.4	1430.1	19331	33966			

APPENDIX B

SIMULATION RESULTS

TMIN COMPUTER MODEL RESULTS: SIMULATION 1
(BASED ON EXPERIMENTAL DATA)
(3441 GPM, 1036960 CFM, 900 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.22 - 4.24)

BIN	HOURS	PREDICTED TONS	TONHRS
72	1	703.30	703.30
67	80	636.14	50891.20
62	100	568.98	56898.00
57	140	501.82	70254.80
52	77	434.65	33468.05
47	52	367.49	19109.48
42	4	300.33	1201.32

TOTAL TONHRS: 232526

SIMULATION RESULTS:

SET POINT	KWHC	KWHF	KWHT	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
70	216432.3	13917.6	230349.9	0.9308	0.0599	0.9906
75	219136.9	9226.0	228362.9	0.9424	0.0397	0.9821
80	221349.0	6171.3	227520.3	0.9519	0.0265	0.9785
85	230351.1	4174.4	234525.5	0.9906	0.0180	1.0086
90	238399.3	2710.5	241109.8	1.0253	0.0117	1.0369

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.25 - 4.27)

MINIMUM COND WATER TEMP: 70

	MONTH	PUMP ENERGY	FAN ENERGY	CHILLER ENERGY	TOTAL ENERGY	CHILLER/ FAN ENERGY
1	JAN	16138.41	7231.15	127441.90	150811.46	134673.05
2	FEB	17390.84	7967.60	140927.40	166285.84	148895.00
3	MAR	22686.81	13177.96	194040.20	229904.97	207218.16
4	APR	25263.23	29036.68	250631.20	304931.11	279667.88
5	MAY	26623.01	62944.45	307583.50	397150.96	370527.95
6	JUN	25764.20	102528.20	328855.70	457148.10	431383.90
7	JUL	26730.36	126483.80	350870.90	504085.06	477354.70
8	AUG	26587.22	120571.00	348967.00	496125.22	469538.00
9	SEP	25692.63	81922.63	307444.90	415060.16	389367.53
10	OCT	26229.39	35992.36	263858.50	326080.25	299850.86
11	NOV	21935.36	13719.05	186866.70	222521.11	200585.75
12	DEC	16675.16	6663.49	130005.70	153344.35	136669.19
TOTAL		277716.62	608238.38	2937493.60	3823449	3545732

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.25 - 4.27)

MINIMUM COND WATER TEMP: 75

	MONTH	PUMP ENERGY	FAN ENERGY	CHILLER ENERGY	TOTAL ENERGY	CHILLER/ FAN ENERGY
1	JAN	16138.41	4596.12	125247.40	145981.93	129843.52
2	FEB	17390.84	5151.60	138660.30	161202.74	143811.90
3	MAR	22686.81	8722.57	191369.60	222778.98	200092.17
4	APR	25263.23	19618.46	248713.70	293595.39	268332.16
5	MAY	26623.01	40321.51	307115.20	374059.72	347436.71
6	JUN	25764.20	66638.15	329239.50	421641.85	395877.65
7	JUL	26730.36	91452.79	351388.90	469572.05	442841.69
8	AUG	26587.22	82432.61	349636.30	458656.13	432068.91
9	SEP	25692.63	50801.53	307337.30	383831.46	358138.83
10	OCT	26229.39	23797.69	261962.00	311989.08	285759.69
11	NOV	21935.36	9003.72	184256.10	215195.18	193259.82
12	DEC	16675.16	4210.51	127697.40	148583.07	131907.91
TOTAL		277716.62	406747.27	2922623.70	3607088	3329371

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.25 - 4.27)

MINIMUM COND WATER TEMP: 80

	MONTH	PUMP ENERGY	FAN ENERGY	CHILLER ENERGY	TOTAL ENERGY	CHILLER/ FAN ENERGY
1	JAN	16138.41	2893.37	125765.10	144796.88	128658.47
2	FEB	17390.84	3330.96	139342.80	160064.60	142673.76
3	MAR	22686.81	5826.03	192621.10	221133.94	198447.13
4	APR	25263.23	13755.92	251405.80	290424.95	265161.72
5	MAY	26623.01	28060.48	311798.30	366481.79	339858.78
6	JUN	[illegible]	43717.54	335233.20	404714.94	378950.74
7	JUL	26730.36	56778.35	358056.90	441565.61	414835.25
8	AUG	26587.22	52525.93	356286.00	435399.15	408811.93
9	[illegible]	25692.63	34278.84	312316.00	372287.47	346594.84
10	OCT	26229.39	16502.93	264884.60	307616.92	281387.53
11	NOV	21935.36	6001.36	185432.50	213369.22	191433.86
12	DEC	16675.16	2662.61	128178.60	147516.37	130841.21
TOTAL		277716.62	266334.32	2961320.90	3505372	3227655

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.25 - 4.27)

MINIMUM COND WATER TEMP: 85

	MONTH	PUMP ENERGY	FAN ENERGY	CHILLER ENERGY	TOTAL ENERGY	CHILLER/ FAN ENERGY
1	JAN	16138.41	1861.16	128190.30	146189.87	130051.46
2	FEB	17390.84	2158.51	142116.00	161665.35	144274.51
3	MAR	22686.81	3902.48	196699.10	223288.39	200601.58
4	APR	25263.23	9813.58	257578.70	292655.51	267392.28
5	MAY	26623.01	20398.31	320559.60	367580.92	340957.91
6	JUN	25764.20	31092.65	345460.00	402316.85	376552.65
7	JUL	26730.36	39348.87	369203.20	435282.43	408552.07
8	AUG	26587.22	36869.73	367391.10	430848.05	404260.83
9	SEP	25692.63	24597.47	321329.80	371619.90	345927.27
10	OCT	26229.39	11736.50	271456.80	309422.69	283193.30
11	NOV	21935.36	4034.52	189334.80	215304.68	193369.32
12	DEC	16675.16	1706.28	130615.00	148996.44	132321.28
TOTAL		277716.62	187520.06	3039934.40	3505171	3227454

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURES 4.25 - 4.27)

MINIMUM COND WATER TEMP: 90

	MONTH	PUMP ENERGY	FAN ENERGY	CHILLER ENERGY	TOTAL ENERGY	CHILLER/ FAN ENERGY
1	JAN	16138.41	1153.75	132201.10	149493.26	133354.85
2	FEB	17390.84	1342.86	146635.50	165369.20	147978.36
3	MAR	22686.81	2544.76	203163.10	228394.67	205707.86
4	APR	25263.23	7037.00	266780.40	299080.63	273817.40
5	MAY	26623.01	15170.24	332995.40	374788.65	348165.64
6	JUN	25764.20	23111.73	359597.30	408473.23	382709.03
7	JUL	26730.36	28892.84	384514.60	440137.80	413407.44
8	AUG	26587.22	27266.38	382641.40	436495.00	409907.78
9	SEP	25692.63	18247.84	334008.20	377948.67	352256.04
10	OCT	26229.39	8377.66	281211.80	315818.85	289589.46
11	NOV	21935.36	2653.82	195536.00	220125.18	198189.82
12	DEC	16675.16	1050.83	134671.90	152397.89	135722.73
TOTAL		277716.62	136849.70	3153956.70	3568523	3290806

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

(DATA USED IN FIGURE 4.28)

SET POINT	YEARLY CHILLER ENERGY	YEARLY FAN ENERGY	YEARLY TOTAL ENERGY
70	2937494	608238	3545732
75	2922624	406747	3329371
80	2961321	266334	3227655
85	3039934	187520	3227454
90	3153957	136850	3290806

TMIN COMPUTER MODEL RESULTS: SIMULATION 2
(BASED ON STANDARD WEATHER DATA; MANUFACTURER'S CHILLER DATA;)
(.65 KW/TON; ACTUAL BUILDING LOAD PROFILE)
(3093 GPM, 1036960 CFM, 1000 NOM TONS, 2 PASS CONDENSER, 12" PIPE DIAMETER)

PREDICTED ENERGY USE FOR NOVEMBER
(DATA USED IN FIGURES 4.22 - 4.24)

BIN	HOURS	PREDICTED TONS	TONHRS
82	1	837.67	837.67
77	6	770.50	4623.02
72	25	703.34	17583.48
67	54	636.17	34353.40
62	92	569.01	52348.83
57	111	501.84	55704.68
52	113	434.679	49118.73
47	117	367.514	42999.14
42	94	300.349	28232.81
TOTAL	613		285802

SET POINT	KWHC	KWHF	KWHT	KWHC/ TONHR	KWHF/ TONHR	KWHT/ TONHR
70	186866.7	13719.1	200585.8	0.6538	0.0480	0.7018
75	184256.1	9003.7	193259.8	0.6447	0.0315	0.6762
80	185432.5	6001.4	191433.9	0.6488	0.0210	0.6698
85	189334.8	4034.5	193369.3	0.6625	0.0141	0.6766
90	195536.0	2653.8	198189.8	0.6842	0.0093	0.6935

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