EFFECTIVE LOAD MANAGEMENT FOR THE CITY OF COLLEGE STATION

Orlin D. Hecox
Energy Analyst
Texas Engineering Extension Service
College Station, TX

Valerie Bauer
Chairman
College Station Energy Management Committee
College Station, TX

ABSTRACT

A successful electrical demand management program for the City of College Station in 1984 employed techniques proven in the industrial and commercial sectors that have seldom been used at the community level. The program, with technical assistance from the Texas Engineering Extension Service and the combined support of citizens, local media, city officials, and city employees, is a working model for other communities.

INTRODUCTION

Electrical load demand management is one of the prime opportunities available to Texas electrical utility suppliers and wholesale customers to reduce the overall cost of producing and distributing power. Demand reduction comes as the result of wise management of power and therefore helps not only the consumer by reducing costs but also the supplier by decreasing system demand during peak load situations.

The electrical demand management program for the City of College Station in 1984 was a comprehensive effort receiving the support of the College Station City Council, the Mayor, the citizens of College Station, local newspaper, TV and radio stations, and city employees. Group effort for a common cause helped to reduce the peak demand for the city from an expected 92 megawatts to 81.6 megawatts, saving the city over $400,000 for the year.

The success of the program was chiefly due to support received from top city management, news media, and the citizens themselves. All techniques that were used are time-tested and proven successful in the industrial and commercial sectors but have seldom been applied to the community sector simply because of the complexity and amount of public support that must be generated.

The objective was to control electrical demand during the period of August 20th to September 20th and show a reduction in the anticipated demand peak of 10 to 15%. This period is historically the time when the peak is set because of (1) high humidity and high temperatures creating peak cooling loads and (2) the large influx of Texas A&M University (TAMU) students establishing residence.

To insure complete market penetration and to muster support, the program attacked the problem in five major areas:

(1) Development of a plan of action to inform city supervisors of program details and elicit their support through separate actions.

(2) Municipal aspects
   a. Complete energy survey of all facilities whose utilities the city pays to establish load reduction possibilities.
   b. Sub-station load surveillance and system voltage control.

(3) Personal discussions with the ten largest consumers on short-range load reduction opportunities and long-term conservation.

(4) Commercial customers
   a. Mailing campaign to 480 commercial demand accounts.
   b. Two meetings with commercial customers to explain the program and demand reduction opportunities and request their participation and support.
   c. Meeting with Apartment Owners Association's executive staff, followed by a presentation to all apartment owners to solicit support and provide demand reduction information.

(5) An all-media campaign including an initial press conference, flyers and handouts to all new customers explaining the program, and use of local television, radio, and newspaper for publicity.

These five areas separately would not have produced the results needed, expected, or achieved; but the total comprehensive effort had a synergistic effect. These results can successfully be replicated in other communities. The greatest impact can be achieved in communities that purchase wholesale power from a separate utility supplier and have their own billing and meter reading department, and thus a real incentive to save.

DEVELOPING A PLAN

BACKGROUND

College Station is a municipal utility with a population of 43,000. The city purchases electricity wholesale from Gulf States Utilities and resells the power to local commercial and residential customers. (There are no industrial electricity customers.) As with most large electricity consumers, College Station's contract with its supplier includes a ratchet clause whereby the city is billed each month a minimum of 75% of its peak demand in the preceding 12-month period. Historically, the city hits its demand peak during the billing period of August 20 to September 20 and between 4:00 p.m. and 8:00 p.m. This is the season of the area's highest temperatures and also the beginning of the fall semester at TAMU. Although the University does not purchase power from the city, many students move into College Station and open utility accounts. Four of the five years preceding the program, the city's demand peak occurred within two days of the first day of classes. (See figures 1-6.)

Proceedings of the Second Symposium on Improving Building Systems in Hot and Humid Climates, College Station, TX, September 24-26, 1985

Date TAMU Opened	City Peak Demand From GSU
September 3, 1979	August 31, 1979
September 1, 1980	September 18, 1980
August 31, 1981	September 2, 1981
August 30, 1982	September 2, 1982
August 29, 1983	August 31, 1983
August 27, 1984	?????

Fig. 1 Historical peak load

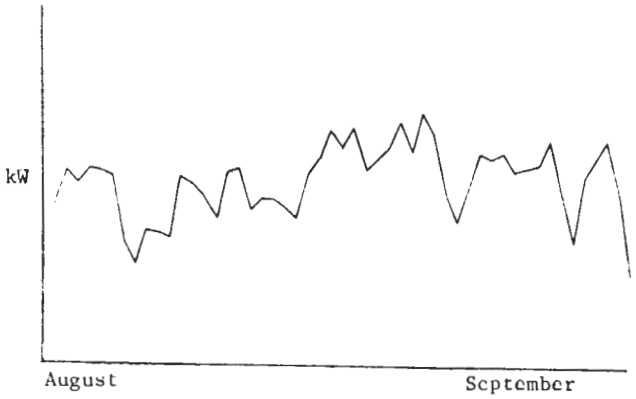

Fig. 2 1982 kilowatt demand chart

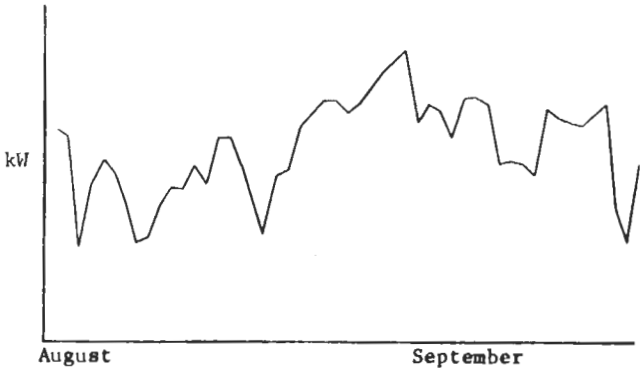

Fig. 3 1983 kilowatt demand chart

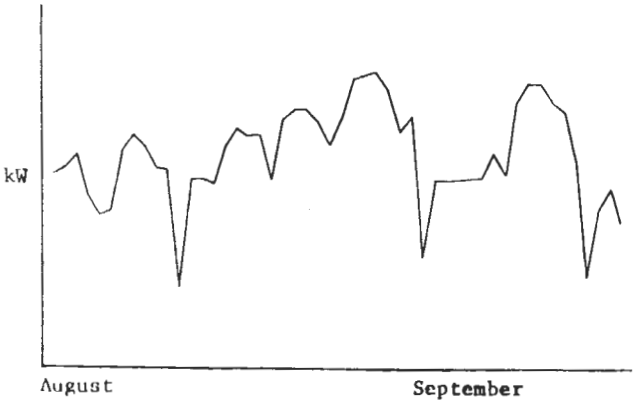

Fig. 4 1984 kilowatt demand chart

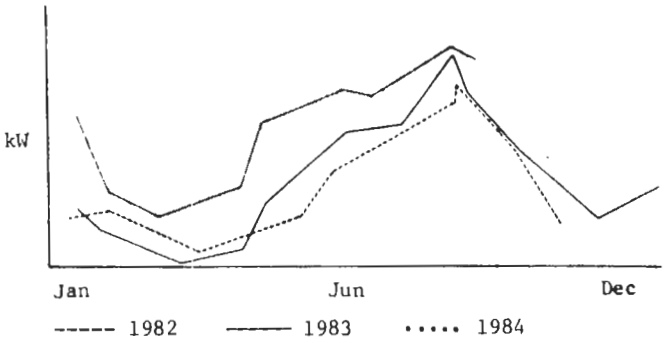

Fig. 5 1982-1984 monthly demand peaks

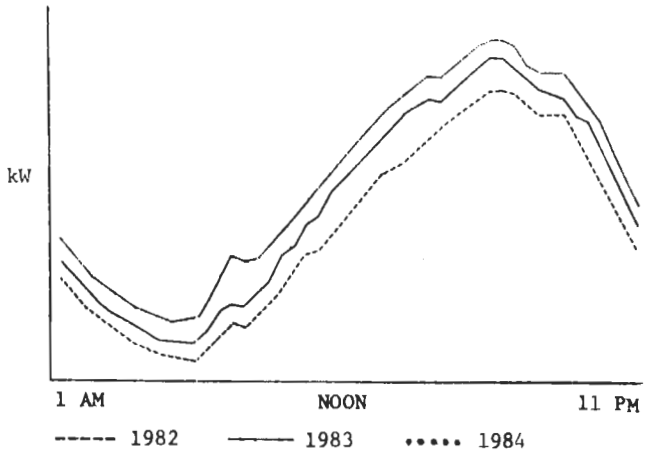

Fig. 6 Peak demand time period

IMPLEMENTING THE LOAD MANAGEMENT PROGRAM

The goals of the load management program were to publicize and explain the yearly demand peak and to elicit the cooperation of municipal, commercial, and residential electricity customers in reducing this demand peak.

To reach most effectively as many people as possible, the city's electricity accounts were divided into four target groups: 1) municipal electricity accounts, 2) the top ten commercial electricity users, 3) all other commercial users, and 4) residential electricity consumers.

MUNICIPAL ASPECTS

CITY PROGRAM

There were two major aspects to coordinating the municipal effort. The first was to gain the support of all the city Directors and Department Heads. Some initially resisted the idea of a load management program; but memos from the city manager and the utilities office manager, outlining the program and explaining its importance and the potential monetary savings, helped to overcome any resistance.

The second aspect of the municipal effort began with identifying all electricity accounts charged to the city and determining which city department was

responsible for each account. In addition, the Texas Engineering Extension Service was contacted for technical assistance, resulting in Orlin D. Hecox assisting throughout the summer.

Several meetings were arranged in June with city department heads to provide them with billing histories and meter sheets on their facilities and to outline the timetable for implementing the load management program. Floor plans and mechanical drawings for each city facility were located and placed either at the facility or at City Hall. In addition, department heads were asked to fill out energy use forms and return them to the project coordinator. Files were set up on all municipal facilities, including the name and location of the contact person and/or department head, energy use forms, billing histories, and meter sheets.

A week was set aside during July to tour all the facilities and explain to each staff that the success of the load management program depended on their implementation of recommendations. As soon as a preliminary report was available, copies were sent to all city department heads (Table 1). In addition, city staff put together a slide presentation based on the recommendations to show actions the city would take to reduce energy consumption in municipal facilities during the peak month. These slides proved useful in explaining to the media, the city council, and the commercial customers, how the city government was supporting the load management program. The fact that all city departments were supporting the program was used to encourage support from other electricity consumers.

LOAD SHEDDING VIA VOLTAGE REDUCTION

As part of the overall electrical demand load shedding program for the 1984 peak billing period, the City of College Station employed voltage reduction on its primary distribution system to aid in the reduction of peak demand loading. This program was implemented and monitored on behalf of the city by Electric Power Engineers, Inc. of College Station.

Wholesale power purchases are made at a city-owned 138 KV switch station. The city has independent 138 KV transmission line taps extending to the Highway 30 substation (75 MVA capacity) and the south substation (50 MVA capacity). Seventeen individual large capacity distribution feeder circuits emanate from these substations to service the city's approximately 16,000 electrical customers. Nominal voltage output at the city's electrical substations is typically maintained in the range of 125-127 volts (120 volt base) during times of peak system loading.

This voltage output is necessary to achieve minimal acceptable voltage levels at the service drop because of line loss, transformer loss, etc. Although 125-127 volts are not required at the service drop, nominal voltage will reach 110-117 volts by the time it traverses the distribution system.

During the September billing period, the peak demand loading of the system was monitored daily via recording chart devices installed at each of the city's substations. On days that the system demand loading approached the previously established peak KW value, voltage reduction was employed from approximately 4:00 p.m. to 8:00 p.m., the historical period of peak system loading. Output voltage levels were manually lowered during the same period via the power transformer load tap changer control to 120-122 volts, which was the city's overall goal to realize an approximate four percent reduction in voltage level during the peak load period.

The city's feeder circuits, constructed using 477 MCM AAC conductors, average three miles long. Feeder loadings are maintained at or under 50% of the conductor thermal rating to facilitate possible load transfer between circuits during emergencies. In general, conductor loading and not voltage drop constraint is the main criterion used in the design of the city's feeder circuit capacity and the load levels to be placed thereon. This design criterion is noted to emphasize that the city has not recently experienced major feeder voltage drop problems on its electric distribution system, even during the peak periods when voltage levels have been reduced to affect load shedding. Regular monitoring of voltage levels at the ends of distribution feeder circuits during the periods of shaved voltage reduction ensure that adequate customer service levels are being maintained.

Peak load reduction during the September 1984 billing period from voltage reduction was 3 to 4%, or approximately the same as the reduction of the system output voltage level. Based on the forecasted load level for 1984, this translates to an overall load reduction of 3,000 to 4,000 KW. As shown from the equation P(in watts) = I(amps) X E(volts), a reduction in E (volts) will make a direct impact on P (watts), discounting for distribution losses, etc.

Voltage reduction as a way to accomplish load reduction is a time tested technique applicable to any consumer having control of voltage requirements.

Although this was a manual effort, the City of College Station is developing specifications for a computer controlled system called Supervisory Control and Data Acquisition (SCADA), which will be utilized in automatic system control to achieve maximum possible load reduction during peak load periods.

THE TOP TEN COMMERCIAL ELECTRICITY USERS

Since the involvement of the largest electricity consumers was essential to the success of the program, the top ten commercial users were isolated as a special group. These customers were contacted several times telephone by the city manager and the utilities office manager. In addition, the utilities office manager and Mr. Hecox made personal visits to each of these customers to tour their facilities and make specific recommendations. The importance of their support to the success of the load management program was emphasized. City staff continued contact with these customers throughout the summer to maintain interest and support.

These customers were asked to provide written plans of the steps they could take to reduce their load during the peak period. Plans were turned in to the project coordinators before August 20 and reviewed to ensure that their simultaneous implementation would not cause a new peak at some other time. In addition, some of the top ten customers indicated additional loads they could shed for short periods with 15 minutes notice from the city (Table 2).

SMALLER COMMERCIAL DEMAND ACCOUNTS

Since personal contact with the approximately 480 other commercial demand accounts was impossible, an initial letter was mailed to determine who would most likely assist in reducing the city's demand peak. This letter briefly explained the program and a reply form at the bottom asked if the customer was interested in attending a seminar on commercial electricity billing procedures and energy use. Sixty-one positive responses representing eighty accounts were received.

For each of these accounts, as for the municipal and top ten accounts, city staff set up files and gathered billing information and meter sheets. The respondents received a packet that included a billing history and meter sheets, a more detailed explanation of the program, and explanation of electrical demand and demand billing, and information on the upcoming Commercial Accounts Seminar. In addition to this mailing, a flyer on the seminar was sent to all the city's commercial electricity customers.

Two commercial Accounts Seminars were planned on the same day, one in the morning and one in the afternoon. Approximately 30 people attended each two-hour seminar. Participants received information packets including a program, an evaluation form, and a College Station Commercial Billing Handbook. In addition, each participant received one of two books: How to Reduce Energy Costs in your Building (for commercial facilities) or Reducing Energy Costs in Religious Buildings, both available from The Center for Information Sharing (77 North Washington Street, Boston, MA 02114).

The seminars featured city staff members who gave short presentations on the municipal effort to reduce the August demand peak, reading demand meters, and commercial billing procedures. Each session concluded with a short talk by Mr. Hecox and a question and answer session on commercial energy conservation.

As the peak demand period approached, a final mailing to the participating commercial customers re-emphasized the importance of their continued support. Included was a list of basic energy conservation measures and bright 8-1/2 X 11 inch posters to inform the public of that facility's participation in the load management program.

MEDIA CAMPAIGN

REACHING THE RESIDENTIAL SECTOR

To reach the residential customers, extensive use was made of local media. City staff kept media representatives informed of all activities related to the load management program throughout the summer. This generated a number of newspaper editorials, newspaper articles, and interviews with city staff members. A press conference during the first week of July brought together media representatives, community leaders, and city staff members to discuss the program. The slide presentation on the municipal effort was used again, and information packets containing copies of relevant memos and news articles went to all participants.

In addition, the entire August 1984 edition of the City Newsletter was devoted to energy conservation tips and an explanation of the load management program. A proclamation was written, and at the beginning of August, the Mayor officially declared August 20 to September 20 as Energy Conservation Month in College Station. During the first week of the peak period, the city's energy character, Felipa da Switch, handed out information on the load management program and energy saving tips in the form of a flyer designed to look like a check. This character attracted the attention of college students coming to the Utilities Department to have their electricity turned on for the fall semester.

During the weekend before the first week of classes, an information booth was set up at a local shopping mall. The booth was manned by city staff members and Felipa da Switch who passed out information on the load management program and energy conservation. One portion of the paid advertising effort was a two-hour remote broadcast from this booth by a local radio station. Other paid advertising included thirty second radio spots on each of six local stations. These spots were broadcast five days a week between 5:00 and 5:15 p.m. from August 20 to September 20. Some began with a ringing alarm and the speaker exclaiming "It's demand alert time!" The radio spots featured city officials, council members, and community leaders asking College Station residents to cut back on their electricity consumption between 4:00 p.m. and 8:00 p.m. To help maintain momentum even after the peak week (the first week of classes at TAMU) a half-page ad in a Sunday edition of the local paper at the end of August listed and thanked all the commercial customers who were participating in the program.

RECOGNIZING PARTICIPANTS

At the end of the peak period, city staff members tabulated the levels of electrical demand registered by all municipal facilities and participating commercial customers. These demand readings were compared to those for the same period in 1983. The accounts were divided into three groups: 1) municipal facilities, 2) top ten commercial customers, and 3) all other commercial demand accounts. In each group, the electricity user showing the greatest percentage decrease in demand level was selected for special recognition. A press release went out and at a city council meeting in October, the Mayor presented plaques to the City of College Station Water Production Division, the College Station Independent School District, and the Kiddie Castle Day Care Center.

Table 1 Municipal aspects

This part of the city-wide load management program included the following steps:

(1) Initial meeting and determination of contact person for all city offices;
(2) Thorough review of each facility to include:
a) As built drawings to include
b) Insulation,
c) Choice of construction materials,
d) Mechanical equipment specifications,
e) HVAC zoning,
f) Electrical load distribution and control, and
g) Emergency power;
(3) Walkthrough audit of each facility with the contact person and a representative from the city utility department;
(4) Development of electrical load management scenario;
(5) Review of usage and demand profiles.

City Hall - Electrical Demand Load Shedding

Item	KW Demand
1. Twenty 150-watt incandescent fixtures outside City Manager's Office in hall	3.0
2. Thirty-three 150-watt incandescent fixtures outside council room	5.0
3. Sixty 150-watt incandescent fixtures in council room	9.0
4. Approximately 23 150-watt incandescent fixtures in City Manager's Office, secretary areas, and Legal Office	3.4
5. Fourteen fluorescent fixtures in new foyer area	2.5
6. Chilled water compressors in new section: one 35-hp and one 40-hp	56.0
Proposed Modifications	5.0
Expected Load Shedding Capability	83.9
Possible Value	$480.75

Fire Stations - Electrical Demand Load Shedding

1. Reschedule training classes other than during peak demand periods and turn off the 3-ton air conditioner supplying this area.	10.0
2. Ensure 5-hp air compressor for compressed air tanks is not operated during this peak demand time.	3.0
3. Ensure south entrance incandescents and all other non-essential lights are turned off.	0.8
4. Modify existing circuitry to allow emergency generator to be used for load shedding.	5.0
Expected Load Shedding Capability	18.8
Possible Value	$107.73

Police Station - Electrical Demand Load Shedding

1. Reset thermostats to 76°F throughout the facility, and up to 80°F during demand management period.	6.0
2. Utilize Onan diesel emergency generator unit during load shedding by modifying existing circuitry.	15.0
Total Expected Load Reduction	21.0
Possible Value	$120.33

Wastewater Treatment Plant - Electrical Demand Load Shedding

1. Reschedule use of 5-hp transfer pump to off-peak time.	3.5
2. Duty cycle secondary blower motors on 2-hour cycle and throttle back to 20%.	60.0
Total Expected Load Reduction	63.5
Possible Value	$363.86

Dowling Road Water Pump Station - Electrical Demand Load Shedding

1. Alter operating practices of the three installed pumps to allow #2 pump to stay off.	186.5
2. Turn off HVAC unit supplying switch.	6.4
Total Expected Load Reduction	192.9
Possible Value	$1,104.54

City Warehouse - Electrical Demand Load Shedding

1. Alter operating hours for all staff to be able to close and turn HVAC and lighting off at 4:00 p.m.	18.0
2. Install time clock to turn off 40-gallon hot water heater at 3:00 p.m.	1.0
3. Turn off 3-hp air compressor at 4:00 p.m.	2.0
4. Turn off two commercial ice machines by time clocks at 3:00 p.m.	14.0
Total Expected Load Reduction	35.0
Possible Value	$200.55

Parks and Recreation - Electrical Load Shedding

A. Main Complex	
1. Change main office operating hours to close by 4:00 p.m.	28.0
2. Turn off the six 150-watt track lights in the foyer area.	0.9
B. Bee Creek Park	
1. Turn off five 400-watt security lights.	2.0
2. Turn off pool circulating pump and chlorinator at 7:00 p.m.	7.0
C. Thomas Park	
Turn off pool circulating pump and chlorinator at 7:00 p.m.	7.0
D. Lincoln Center	
1. Close the game room and turn off 3-ton HVAC System and 768 watts of lighting.	3.0
2. Turn off park maintenance office air conditioner at 4:00 p.m.	2.2
Total Expected Load Reduction	50.1
Possible Value	$287.07

Table 2 Sample plans submitted by our top ten commercial customers

Customer "A"

1. Cut off one-half of our HVAC units (9 total) beginning at 3:45 Monday through Saturday. Sunday all units are cut off.
2. Cut off HVAC units for 15 minutes out of every hour beginning at 3:45 Monday through Saturday. Some 108 HVAC units will be duty cycled during this procedure.
3. Approximately 20% of all Common Area lighting will cut off at 3:45 p.m. Monday through Saturday.
4. Approximately 40% of the parking lot lights will be cut off and only security lighting in these areas will be on during the hours that the parking lot lights are on.
5. Thermostats will be set 3° higher than normal during this period and not lower than 78° for cooling.

Customer "B"

We have completed a study, run load reduction tests, and have taken measurements of the resulting KW reductions. The total reduction we feel we can make is 250 KW. These reductions are coming mainly from lighting and air conditioning and can be implemented within 15 minutes of receiving notification from the city. However, this reduction can only be maintained from 60-90 minutes after implementation.

We anticipate that the actual KW reduction will be higher than the above figure by about 20% during the first 30 minutes of implementation. This is due to an immediate shutdown of all air conditioning to allow the building to warm 2° (about 30 minutes). After this we will begin to stage "on" air conditioning units in 15 minute increments. The 250 KW figure represents the load reduction after 60 minutes and is therefore conservative initially.

Customer "C"

Following are loads that we will shed from August 20 through September 20, 1984 to help reduce the demand for the City of College Station from 4:00 p.m. to 8:00 p.m. each day.

1. Turn off one 25 HP air handling unit (AHV-2).
2. Turn off mercury vapor lamps in the atrium when there is enough outside light.
3. Turn off office and factory lights as soon as possible after everyone has left the plant.
4. Reduce the domestic hot water temperature in the office to 120°F.
5. Turn off three heat pumps to 3500 sq. ft. house.
6. Turn off electric hot water heaters in the house.
7. Set time clock for HVAC in fitness building and kitchen so they will be off on weekends when not in use.
8. Check for proper operation of our optimum start/stop control for the office HVAC.

Due to our temperature and humidity restrictions in the factory, very little can be done with our HVAC to reduce demand.

Customer "D"

1. Lights:
   a. Turn vestibule lights off from 4:00 p.m. to 8:00 p.m.
   b. Turn every 3rd row of lights off for entire month. If not possible for entire month, make sure we can turn them off from 4:00 p.m. to 6:00 a.m.
   c. Turn lights off in the Bakery, Produce, Meat, and Deli preparation areas after working hours. Hours are to be filled in by Unit Manager.
   d. Turn any unnecessary lights off in walkways, restrooms, etc. (try motion detectors if applicable).
   e. In preparation areas, if the light level is high, reduce to 60 footcandles and lower light level in other non-heavily used areas. (Use phantom tubes to do this).
   f. Any lights under curtain walls? Reduce two tubes to one. (Use phantom tubes to do this).
   g. Do not reduce any case lights unless they are overilluminated and only after talking to Unit Manager.
   h. Study backroom areas--may be able to reduce lights.
   i. Keep sales area floor clean to reflect more light.
2. Refrigeration and air conditioning:
   a. Use tinted plastic shades on glass windows to reduce sun load on A/C.
   b. Check preparation area exhaust fans--can be turned off after hours.
   c. Reduce fresh air intake, (if possible) to reduce A/C load.
   d. Check case temperatures--if too low, adjust to where they should be.
   e. If the anti-sweat heaters have their own circuits, turn them off between 4:00 p.m. and possibly longer.
   f. Display merchandise in cases below the safe load limit. Do not block the air flow in the cases.
   g. Defrost times can be changed so that we can defrost cases from 4:00 p.m. to 8:00 p.m. This would reduce usage during that period.
3. Other:
   a. Any electric hot water heaters? Reduce water temperature down to 120°F, if that does not cause any problems.
   b. Put signs up to let the customers know that we are participating in the energy conservation program as requested by the City of College Station.