ESL-TR-99/12-07

Report of Energy Efficiency Study and Metering/Utilities Profile for Electricity Deregulation at the Texas A&M University - Kingsville (TAMU-K) Kingsville, Texas

Submitted to

Texas A&M University - Kingsville
The Texas A&M University System

Submitted by

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Acknowledgement

The Electric Utility Regulation and Energy Efficiency Study for all universities in the TAMU System was initiated in May 1999 and is funded through an interagency agreement between the Chancellor's office and TEES's Energy Systems Laboratory. Detailed site visits were made to all system universities throughout the summer and fall. The Energy Systems Laboratory wants to thank all physical plant directors and their staff for their cooperation and support during the site visits.

Executive Summary

The physical plant director and staff at Texas A&M University - Kingsville (TAMU-K) do a very good job of maintaining TAMU-K facilities and keeping expenses down. During our visit, however, we were able to identify several opportunities for improving energy efficiency.

Energy Savings Potential for the Campus

1. Estimated savings will be about 10% of the energy cost.

Special Recommendation

1. Commissioning should be performed after the completion of the current construction retrofits and EMCS upgrades.

Commissioning Targets Ranked by Potential Energy Savings

1. Chilled water loop
2. Student Union/Bookstore
3. Steinke PE Center
4. Jernigan Library
5. Old Gym
6. Jones Auditorium
7. Nierman Hall
8. Rhode Hall

Building in Critical Need of Improvement in Indoor Air Quality

1. Poteet Hall

Metering Recommendations for Electric Deregulation

Several options exist – Use ESL meters or purchase the utility interval data from CP & L. If the energy efficiency study is pursued, then hourly gas data will be necessary. Our recommendation is to use the ESL metering system and meter both the total gas and total electrical consumption for the campus. Fifteen minute electrical data are needed for any electrical deregulation program.

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Energy Efficiency Study

General Introduction

The Texas A&M University- Kingsville campus is located in Kingsville, Texas. The southern Texas location allows for weather that is hot and very humid in the summer and warm in the winter.

There are 63 buildings on the campus with a total conditioned area of approximately 1,600,000 square feet of which 90%, or about 1,450,000 square feet with central air conditioning.

The electricity and gas costs for 1998 were about $1,623,589 and $52,353 respectively. This translates to about $1/yr/sq-ft for all of the buildings on the campus.

The campus is currently undergoing remodeling and upgrading construction projects worth about $8 million. The projects include an extensive piping project where they are connecting the two main chiller plants, replacing all chillers, pumps, and piping inside the plants, converting hot water heated buildings to electrical resistance heating, and installing a major energy management system (EMS) upgrade. They are using the Landis APOGEE DDC control system in the upgrade. Construction is expected to be completed by December 2000.

There are two central chiller plants which provide chilled water (ChW) through two separate primary loops to the campus. The current ChW capacity for both energy plants is 4200 tons. The HVAC systems in most buildings are controlled by pneumatic controllers. Only one building was controlled by a Landis and Staefa Insight EMS. However, the current construction projects include upgrading to the APOGEE energy management system for 30 of the buildings on campus.

From August 9 to August 12, 1999, we conducted a commissioning survey for the campus. A total of 25 major buildings with 1,230,000 ft^2 and two central plants were visited during the trip. The major buildings were surveyed in detail and measurements were taken for most air-handlers and pumps also.

Based on our survey results, no concurrent heating consumption was found except in the student Union building, and PE building. Most building air-handling equipment is currently equipped with manual timers, though some were disabled. Poteet Hall was found to have noticeable indoor air quality problems, high RH, bad odors, and high space temperatures. The IAQ problem is very likely due to improper chilled water loop balancing. In general, the campus mechanical systems are well maintained. But, some energy savings potential have still been identified and a summary of the results follows.

The layout of TAMU-K campus is shown in Figure 1.

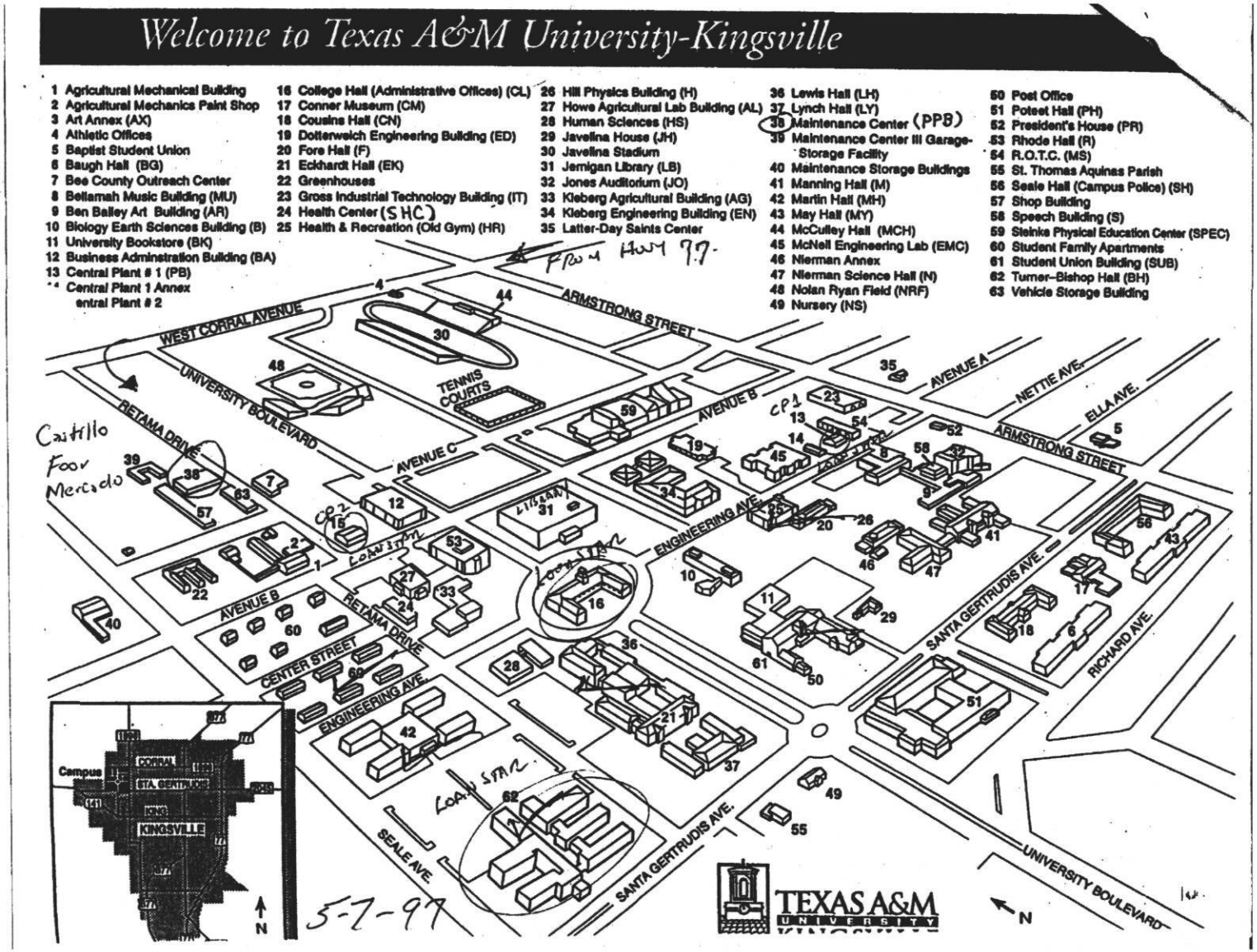

Figure 1. TAMU-K Campus and the Buildings

Energy Savings Potential for the Campus and Top Commissioning Targets

Energy Savings Potential for the Campus

1. Estimated savings will be about 10% of the energy cost.

Special Recommendation

1. Commissioning should be performed after the completion of the current construction retrofits and EMCS upgrades.

Top Commissioning Targets Ranked by Potential Energy Savings

1. Chilled water loop
2. Student Union/Bookstore
3. Steinke PE Center
4. Jernigan Library
5. Old GYM
6. Jones Auditorium
7. Nierman Hall
8. Rhode Hall

Building in Critical Need of Improvement in Indoor Air Quality

1. Poteet Hall

Summary of Building Information and Major Recommended Energy Measures

Lewis Hall (dorm rooms)

Building Information
It is a 3-story building with an area of 60,064 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water (ChW) from the primary campus ChW loop. The system is a two-pipe system with ChW provided to the air handler units (AHUs) in the summer and hot water (HW) provided to the coils in the winter. The duct electrical resistance heater was being installing during the time of our visit. This means that the hot water supply to the AHU coils will eventually be disconnected.

A total of eight multi-zone AHUs and one single duct, constant volume (SDCV) AHU serve the building. For the multi-zone AHUs, the measured cold deck temperatures were found to be 55°F to 57°F for most of units.

Recommended Energy Measures

1. Balance the zones.
2. Reset cold deck and hot deck after the EMCS upgrade is completed.

Eckhardt Hall (offices)

Building Information
It is a 2-story building with an area of 19,868 ft^2. This building was originally used as a dorm and is now used as office space. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The system is a two-pipe system with ChW provided to the AHU coils in the summer and HW provided to the coils in the winter. The duct electrical resistance heater was being installing during the time of our visit. This means that the hot water supply to the AHU coils will eventually be disconnected

A total of four multi-zone AHUs serve the building. The measured cold deck temperatures were found to be 55°F to 63°F for different units. A timer is used for the 2-zone unit located on the first floor.

Recommended Energy Measures

1. Balance the zones.
2. Use timer to control all AHUs.

Steinke PE Center (gym, weights areas, bowling areas, offices, and swimming pool)

Building Information
It is a 2-story building with an area of 99,034 ft^2. The HVAC systems are currently controlled by pneumatic controllers. A total of 13 AHUs serve the building.

The building receives chilled water from the primary campus ChW loop. The ChW pumps were off at the time of the visit. It appears that chilled water flow is provided to the building by primary loop pressure. One boiler is located in this building and it provides HW to the swimming pool and to the heating coils of the building.

Two large SDCV units serve the Gym. A thermostat controls the cooling and heating coils. AHUs-1 & 2 (SDCV) serve the bowing area. AHUs-3 & 4 serve the weight-lifting area. Two SDCV units serve the balcony area. Two multi-zone units, numbers 10 & 7 serve the hallway, offices, classrooms, and locker rooms. AHU-9 serves the racquetball courts. The OA damper was fully open for the Gym unit and two units on the balcony. This higher OA intake will result in higher cooling energy consumption.

For the swimming pool area, there are two SDCV heating only units, which were off at the time of our visit.

Recommended Energy Measures

1. For the present time, use the existing manual timers to control on/off for the units based on facility use schedules. Use the DDC system to control the on/off schedule after the EMCS upgrade is completed.
2. Balance the zones for AHUs-10 & 7.

3. Reset cold deck temperature for multi-zone units after the EMCS upgrade.
4. Optimize the OA intake for the AHUs.

Jernigan Library (library, book stacks, offices)

Building Information
It is a 3-story building with an area of 140,147 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the campus primary ChW loop. The ChW pump was off at the time of the visit. It appears that chilled water flow is provided to the building by primary loop pressure.

Two DDVAV and two SDCV AHUs with terminal box reheat serve the building. For the SDCV units, the discharge air temperature was controlled by pneumatic controllers. The measured temperature was 53°F. Room thermostats control the terminal reheat boxes. The SDCV units serve the 3rd floor with room temperatures of 67°F. For the DDVAV units, the static pressure setpoint was 2" and 2.4" with VAV control provided through inlet vanes. The measured cold deck temperatures were 51°F and 52.5°F. According to the operator, the 3rd floor was cold in the winter and lighting on this floor was used to help warm the room during cold weather.

Recommended Energy Measures
1. Adjust the room temperature for the building.
2. Reset the discharge air temperature setpoint for all SDCV units after the EMCS upgrade.
3. Reset cold deck setpoint after the EMCS upgrade.
4. Shut the system down based on the occupancy schedule.

Kleburg Engineering Hall (offices and classrooms)

Building Information
It is a 1-story building with an area of 41,254 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on and the HW had been disconnected. Electrical reheat was being installed during the site visit.

Two multi-zone units and two SDCV with duct reheat AHUs serve the building. The cold deck temperature ranged from 55°F to 57°F. The discharge air temperatures were from 55°F to 59°F for two SDCV units. Exterior lights were on during daytime hours at an outside hallway.

Recommended Energy Measures
1. Shut down the system based on the schedule.
2. Reset cold deck and hot deck setpoints after the EMCS upgrade.
3. Implement lighting control for the outside hallway.

McNeil Engineering Lab (labs, offices and classrooms)

Building Information
It is a 1-story building with an area of 14,873 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. There was no ChW pump and the HW had been disconnected. The electrical reheat was being installed during the site visit.

One SDCV with reheat serves the building. The cold deck temperature was 60°F. The AHU timer was disabled.

Recommended Energy Measures

1. Shut down the system based on the schedule.
2. Enable the timer.
3. Check OA intake.

Health & Recreation (Old Gym) (gym, dance rooms, offices and classrooms)

Building Information
It is a 1-story building with an area of 32,436 ft^2. The HVAC systems are currently controlled by pneumatic controllers. The APOGEE DDC system was being installed in this building during the site visit.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on and the differential pressure across the building ChW pump was 25 psi. The supply and return ChW temperatures were 48°F and 56.6°F, respectively.

One SDCV unit serves the GYM. The GYM temperature was 67°F with no occupancy. The air supply was about 3 CFM/ft^2 for the Gym. Two multi-zone units serve the office, dance room and classroom. The cold deck temperature was found to be about 56°F. A timer was used to shut down the system at night and Sunday.

Recommended Energy Measures

1. Shut the systems down based on the schedule.
2. Reset cold deck and hot deck temperatures after the EMCS upgrade is completed.
3. Reduce the operating hours for the Gym AHU.
4. Balance the zones.
5. Balance the ChW loop.

Fore Hall (offices and classrooms)

Building Information
It is a 2-story building with an area of 23,312 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on.

One multi-zone unit serves the building. The cold deck temperature was 58°F. The OA damper was closed and most of the zone balancing dampers were 100% open. The air supply was determined to be about 1.6 CFM/ft^2.

Recommendation for Energy Solutions

1. Shut the system down based on the occupancy schedule.
2. Reset cold deck and hot deck setpoints after the EMCS upgrade.
3. Balance the zones.

Speech/Music Building (offices and classrooms)

Building Information

It is a 2-story building with an area of 41,792 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on and the hot water pump had been disconnected. The electrical reheat retrofit was being installed during the site visit.

Two multi-zone units serve the building. The cold deck temperatures ranged from 57°F to 62°F and the room temperature was 69°F for the space served by AHU-7.

Recommended Energy Measures

1. Shut the systems down based on the schedule.
2. Reset cold deck and hot deck setpoints after the EMCS upgrade is completed.
3. Balance the zones.
4. Balance the ChW loop.

Business Administration (classrooms, Personal Computer labs)

Building Information

It is a 2-story building with an area of 42,595 ft^2. The HVAC systems are currently controlled by Honeywell pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was off because the loop pressure is adequate for flow through the building. The HW had been disconnected because the electrical reheat retrofit was being installed during the site visit.

Four multi-zone units serve the building. The cold deck temperatures ranged from 49.6°F to 51.6°F for three units. The cold deck temperature was 71°F for the 1st floor South unit. The OA dampers were open from 25% to 75% for the various AHUs. The manual timer control had been disabled.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Reset cold deck and hot deck setpoints after the EMCS upgrade is completed.
3. Balance the zones.
4. Consider installing or retrofitting tinted glass for the exterior windows.
5. Verify the OA intake volumes for each AHU.

Kleburg Building for Agriculture (Old Ag) (offices, auditorium)

Building Information

It is a 1-story building with an area of 21,203 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The HW has been disconnected for this building. The electrical reheat retrofit was being installed during the site visit.

One multi-zone unit and two other SDCV units serve the building. The discharge air temperatures ranged from 52°F to 53°F for SDCV units. One SDCV unit serves the auditorium with discharge air temperature of 52.4°F. The timer is used for the auditorium unit control.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Check the control of the electric reheat elements.
3. Balance the zones.
4. Check the control of the SDCV units.

Howe Agriculture Building (New Ag) (offices, classrooms, labs)

Building Information

It is a 2-story building with an area of 21,913 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on but there is no HW pump for this building. There are one large and one small boiler for lab use and domestic HW. The large boiler is used in winter while the small one is used in summer.

Two DDCV AHUs serve the building. The cold deck temperatures were 48.6°F and 50.6°F for two units. The timer is used for two units with an operation schedule of 0600 to 2200.

Recommended Energy Measures

1. Shut the systems down based on the schedule.
2. Reset cold deck and hot deck setpoints after the EMCS upgrade is completed.
3. Check the OA intake settings.

Rhode Hall (offices, classrooms)

Building Information
It is a 3-story building with an area of 76,032 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was off and the HW had been disconnected. The electrical reheat retrofit was being installed during the site visit.

Twelve multi-zone units serve the building with four on each floor. The cold deck temperatures were found to be 48°F to 53°F for different AHUs. Timers are used for unit control.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Reset cold deck & hot deck setpoints after the EMCS upgrade is completed.
3. Balance the zones.

College Hall (offices)

Building Information
It is a 2-story building with an area of 49,999 sq-ft. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on.

Four multi-zone units and one SDCV unit serve the building. The cold air temperatures ranged from 51°F to 60°F for different units.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Balance the zones.

Bookstore

Building Information
It is a 1-story building connected to the Student Union Building. The HVAC systems are currently controlled by a pneumatic controller.

One SDCV unit serves the building. The discharge air temperature was 57°F. The room temperature was 69.2°F. There was considerable leakage of outside air into the storage area at the back of the bookstore which was causing mold growth on the ductwork and air terminals.

Recommended Energy Measures

1. Seal and insulate the outside rolling door for the storage area of bookstore.
2. Adjust the room temperature setpoint.

Student Union Building (game rooms, kitchen and food service, offices, ballrooms, snack bar, post office and women's center)

Building Information

It is a 3-story building with an area of 91,887 ft^2. The HVAC systems are currently controlled by pneumatic controllers. A total of 14 AHUs serve the building.

The building receives chilled water from the primary campus ChW loop. One of two ChW pumps was on. The ChW supply pressure was 94 psi, which was the highest pressure measured on the campus. This translates to approximately 110 feet of head on the pump. There were two boilers, which were on line for the kitchen, and heating needs. The heating HW pump was off.

AHUs-1 & 2 (multi-zone & SDCV) serve the café and snack bar. The cold deck for this unit was 58°F. AHUs-6 & 7 (SDCV) serve the food service area. The discharge air temperatures were 55°F to 58°F. AHUs-8 & 9 (SDCV & multi-zone) serve the office area. The discharge and cold deck temperatures were 62°F and 53°F for those two units. AHU-5 (multi-zone) serves the post office and women's center with a 55°F cold deck temperature and 66°F return air temperature. AHUs-13 & 17 (SDCV) serve the ballroom A & B. The ballroom temperatures were from 67°F to 68.9°F with no occupancy. AHU- 16 serves the game room. No audit details are available for other units because of construction during the visit.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Reset the cold and hot deck temperatures after the EMCS upgrade is completed.
3. Control the ballroom units based on the event schedules.
4. Optimize the OA intake for the snack bar unit.

Poteet Hall (Academic High School) (offices, classrooms)

Building Information

It is a 3-story building with an area of 71,648 ft^2. The building was originally used as a dormitory and is now used as offices and classrooms for an Academic High School. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on with supply ChW temperature of 54°F.

About ten multi-zone and SDCV AHUs serve this building. For the SDCV units, the discharge air temperatures were from 67°F to 70°F. For the multi-zone unit, the cold deck temperature was 67.2°F. The zone control dampers were all disconnected. The rooms were found to have noticeable indoor air quality problems, high RH, bad odors, and high space room temperatures. The IAQ problem is very likely due to improper ChW loop balancing. Most of the mechanical equipment was in poor condition.

Recommendation for Solving IAQ Problems

1. Balance the ChW loop.
2. Repair/upgrade the HVAC controls and mechanical equipment.
3. Improve the control of the AHUs.
4. Conduct a detailed investigation of the room conditions to further develop solutions for the IAQ problems.

Art Building (offices, classrooms)

Building Information

It is a 1-story building with an area of about 20,000 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. One ChW pump serves the gallery area, and another serves the art area. The HW had been disconnected. The electrical reheat retrofit was being installed during the site visit.

Three multi-zone units serve the building. The cold air temperatures ranged from 56.2°F to 58.2°F. The room temperatures were found to be 68°F to 70°F.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule.
2. Balance the zones.
3. Optimize OA intake for the unit.

Jones Auditorium

Building Information

It is a 1-story building with an area of 23,020 ft^2. The HVAC systems are currently controlled by pneumatic controllers. The building was being upgraded to the Landis APOGEE DDC system.

The building receives chilled water from the primary campus ChW loop.

Two DDCV units and one SDCV unit serve the building which include an auditorium and little theatre. The auditorium has 900 seats and had a room temperature of 68°F with no occupancy.

Recommended Energy Measures

1. Shut the systems down based on the occupancy schedule and events.
2. Improve the air temperature controls.

Nierman Hall (offices, classrooms)

Building Information

This is a 2-story building with an area of 41,288 ft^2. The HVAC systems are controlled by the Landis & Staefa Insight 600 system - DDC control.

The building receives chilled water from the primary campus ChW loop. The HW had been

disconnected. The electrical reheat was being installed during the site visit.

Four multi-zone units and one SDCV unit serve the building. The cold deck temperatures ranged from 57.9°F to 60°F for the multi-zone units. The OA intakes were over 20% for most of units. There are exhaust doors on the return duct for the purpose of exhaust. However, it pulls air in from the attic which is usually very warm. This causes an additional load on the cooling equipment.

Recommended Energy Measures

1. Cap or seal the exhaust door on the return duct.
2. Check the control of the electric reheat elements.
3. Balance the zones.
4. Optimize the OA intake.

Turner-Bishop Hall (dorm rooms)

Building Information

It is a building with an area of 163,370 ft^2. The HVAC systems are currently controlled by pneumatic controllers. It is currently being upgraded to the Landis & Staefa APOGEE DDC control system. Because of construction, the power was disconnected at the time of the site visit.

Lynch Hall (dorm rooms)

Building Information

It is a 2-story building with an area of 47,391 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

The building receives chilled water from the primary campus ChW loop. The ChW pump was on.

Six multi-zone units serve the building. The cold air temperatures ranged from 55°F to 61°F. The OA dampers were all closed except one that was 90% closed. The filters were very dirty.

Recommendation for maintenance

1. Replace the air filters regularly.

Martin Hall (dorm rooms)

Building Information

It is a 2-story building with an area of 87,650 ft^2. The HVAC systems are currently controlled by pneumatic controllers.

No details on the building HVAC systems were available during the visit due to construction.

Electricity Deregulation Metering options

Two options:

1. Use the existing LoanSTAR energy metering equipment. Under the LoanSTAR program, extensive energy metering was installed in both central energy plants as well as in several buildings on campus. This metering includes the primary campus electric and gas meters. Two years of continuing metering with the existing system would involve ongoing maintenance, polling, data quality checking, and reporting of data. Estimated costs for this effort would be $7,500 per year.

2. Electrical energy data could be purchased from CP&L. However, this option pre-supposes that the existing CP&L metering is capable of recording and providing the desired data. In addition, gas data would also have to be purchased from the gas utility. Our experience is not optimistic regarding obtaining this type of data from a gas utility.

The Energy Systems Laboratory would recommend continuing to obtain energy metering data from the existing LoanSTAR equipment

Utility Bill Summary

Kingsville							
Month	Energy -kwh	EnergyCosts $	Demand-kW	DemandCosts $	Gas-kCF	Gas Costs $	Total costs
Jan-98	1,861,200	103,362.46	5,041		2,707	9,335.61	112,698.07
Feb-98	2,032,500	107,890.94	5,072		1,649	6,085.64	113,976.58
Mar-98	2,202,600	110,214.68	5,420		1,510	5,509.89	115,724.57
Apr-98	2,699,400	130,413.79	5,617		1,819	6,545.36	136,959.15
May-98	3,073,200	137,610.90	5,434		835	3,002.45	140,613.35
Jun-98	3,142,500	146,623.42	6,164		952	3,219.10	149,842.52
Jul-98	3,675,900	161,813.35	6,302		714	2,857.92	164,671.27
Aug-98	3,736,800	161,536.65	6,131		705	2,333.25	163,869.90
Sep-98	3,417,900	146,163.82	6,296		903	2,554.77	148,718.59
Oct-98	3,480,000	146,358.52	6,195		1,016	3,473.84	149,832.36
Nov-98	2,976,000	132,214.77	5,950		1,276	4,616.52	136,831.29
Dec-98	3,024,000	139,386.09	5,700		796	2,819.09	142,205.18
Tol/Max	**35,322,000**	**1,623,589.39**	**6,302**		**14,882**	**52,353.44**	**1,675,942.83**
CP&L: Central Power and Light							