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

Submitted to

Texas A&M University at Galveston
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 at Galveston (TAMU-G) do a very good job of maintaining TAMU-G 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: $50,000/yr for the top commissioning targets in the campus.

Commissioning Targets Ranked by Potential Energy Savings

1. Plant
2. Library building
3. PE building
4. Engineering Laboratory
5. CLB building
6. Kirkham Hall
7. A&B Dorm
8. Student Center

Since Ft. Crockett may be given to the Community College, we have not included it as a potential commissioning site. We did also do a commissioning audit of the TEEX Bayou Building as part of the study.

Metering Recommendations for Electric Deregulation

Several options exist –reinstall ESL meters or purchase the utility interval data from Reliant Energy. If the energy efficiency study is pursued, then hourly gas data will be necessary. Our recommendation is to reinstall 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 TAMUG campus is located in Galveston, Texas. The weather is very hot and humid in the summer and mild and humid in the winter.

There is a total of 426,295 square feet of building area on the Galveston campus. This includes 340,742 square feet on the main campus, 77,312 square feet at the Ft. Crockett Marine Laboratory building and 8,241 square feet at the Bayou building. The Ft. Crockett and Bayou buildings are two separate single buildings at different locations within Galveston. For the main campus, about 70% of the area is central conditioned. Those areas receive chilled water and hot water from the central plant. Two small buildings away from the main campus (Ft. Crockett and Bayou) have individual chillers and heating sources.

For the main campus:
The electricity and gas costs for 1998 were $495,523 and $76,197. This translates to about $1.67/yr/sq-ft for all of the buildings on the main campus.
For Ft. Crockett:
The electricity costs for FY 1999 were about $84,376 and $2,728. This translates to about $1.12/yr/sq-ft for the building.
For Bayou building:
The electricity costs for 1998 were about $15,424. This translates to about $1.87/yr/sq-ft for the building.

For the main campus:
Two 250 ton and one 500 ton water-cooled chillers are located in the central plant and provide chilled water (ChW) to a loop for the campus. Two 150 hp boilers and one 300 hp boiler are located in the central plant and provide the hot water to the campus loop. Three constant volume ChW loop pumps are located in the central plant. There is a blending station for this ChW loop in the plant. Two cooling towers are equipped with two variable volume fans. Two constant volume hot water (HW) pumps and a blending station for the HW loop are located in the plant. Most of air handling units (AHUs) at the campus are multi-zone units, and a few are single duct units. The chilled water pumps are equipped with variable frequency drives (VFDs) for most of buildings.

The HVAC systems are controlled by a Landis Insight 600 DDC system. The Landis personnel maintain the control system as needed.

For the Ft. Crockett building:
This building is used for a marine laboratory. Two small water-cooled chillers provide chilled water to the building. One 2.8 MMBtu/hr hot water boiler provides hot water to the building. More than eight small AHUs serve the building. The pneumatic system is used to control the HVAC system.

For Bayou building:
The building is the Center of Marine Training and Safety, a branch of the Texas Engineering Extension Service. Rooftop units and split systems are used to condition the building. No gas is supplied to this building. Both cooling and heating use electricity. The HVAC systems are controlled by a pneumatic system.

On October 12 to 13, 1999, we conducted a commissioning survey for the campus. A total of 9 buildings and the central plant in the main campus were surveyed in detail and measurements were taken for most air-handlers and pumps. The survey for the two separate buildings was performed also.

According to the information from the DDC control system and from the plant operator, some of the buildings on the main campus have a nighttime shutdown schedule. The actual operation of the shut down needs to be verified.

Based on our survey results, the general mechanical systems are well maintained. However, some significant energy saving measures have been identified. Following is a summary of the results.

The layout of TAMUG campus is shown in Figure 1.

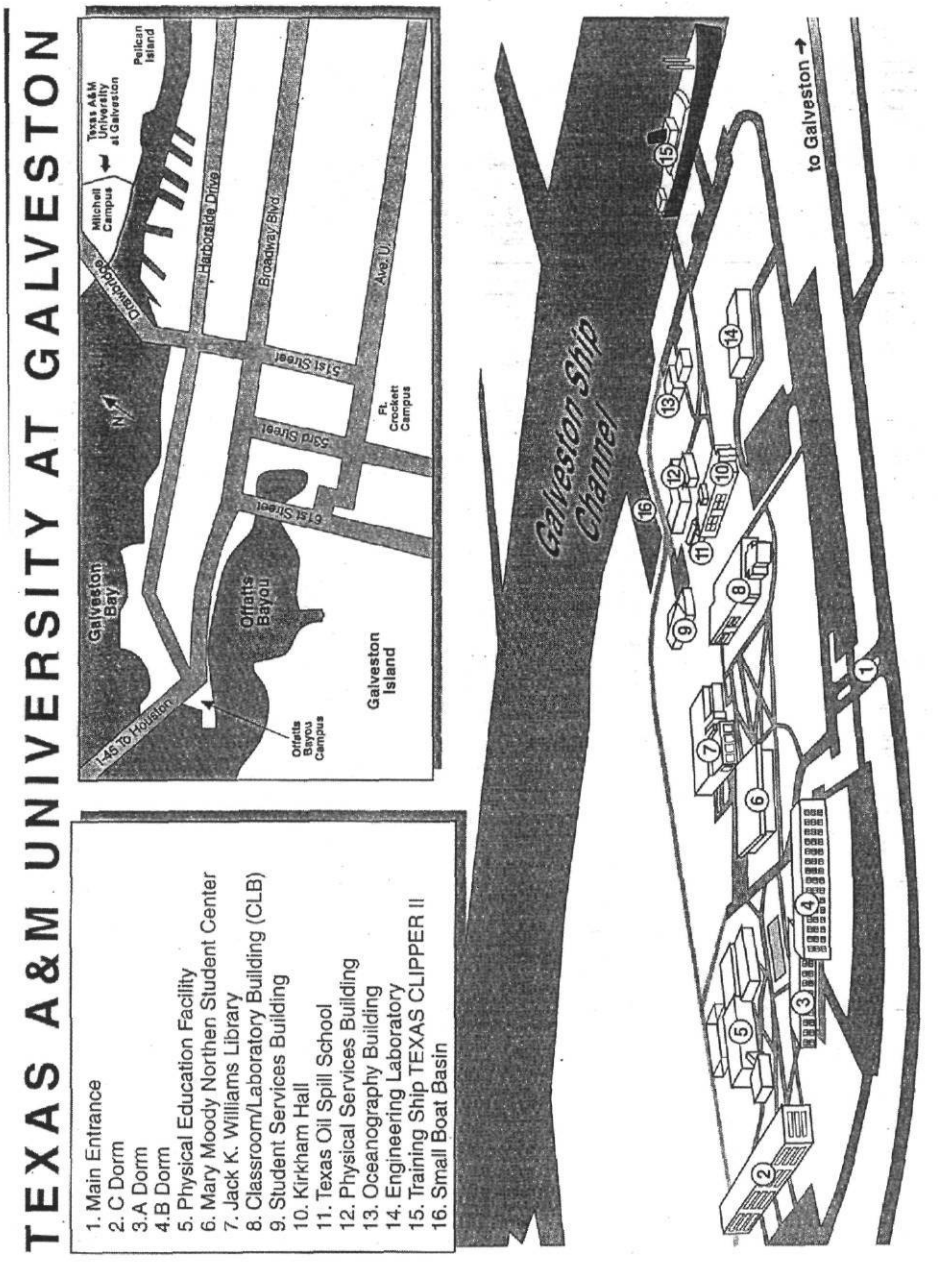

Figure 1. TAMUG Campus and the Buildings

The chilled water loop layout for the main campus is shown in Figure 2.

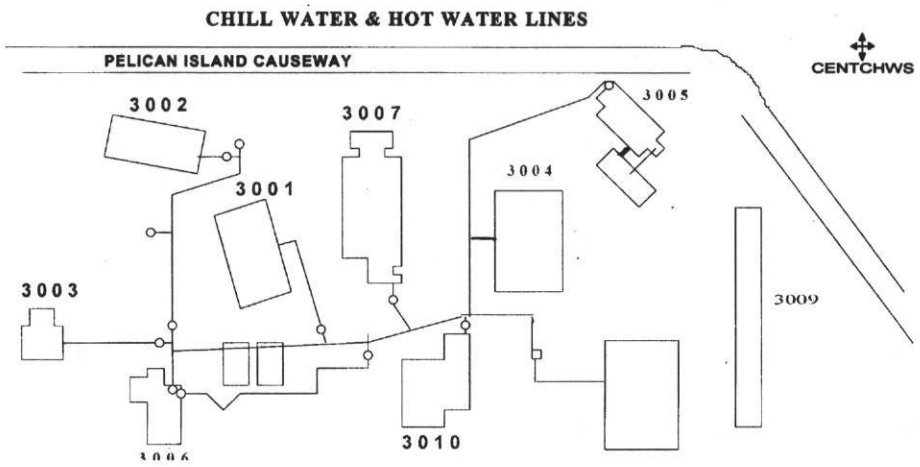

Figure 2. The Chilled Water Loop on the TAMUG Campus

Energy Savings Potential for the Campus and the Top Commissioning Targets

Energy Savings Potential for the Main Campus

1. Estimated electricity and gas savings: about $50,000/yr for the commissioning targets.

Top Commissioning Targets Ranked by Energy Savings Potential

1. Plant
2. Library building
3. PE building
4. Engineering Lab.
5. CLB building
6. Kirkham Hall
7. A&B Dorm
8. Student Center

Summary of Building Information and Major Recommended Energy Measures

Jack K. Williams Library (library, offices)

Building Information
It is a 1-story building with an area of 26,825 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. The constant volume hot water pump was running. The supply hot water (HW) temperature was 140°F. The chilled water (ChW) pump was running at 93% speed. The differential pressure was about 25 psi for the building ChW loop.

Two multi-zone air handling units (AHUs) (1-15 hp and 1- 30 hp) serve the library building. The system runs 24 hours a day, 7 days a week. The cold deck setpoints were 52°F for both AHUs. There is not a hot duct in the unit. There is a bypass duct in which the mixed air only flows through. Hot water reheat coils are installed in each zone. The space temperatures were 69.5°F for the book stack area and 73°F for the back area near the loading dock.

Recommended Energy Measures

1. Optimize the differential pressure schedule for the ChW loop.
2. Optimize the operating time periods of the hot water system and optimize differential pressure reset schedule.
3. Reset cold deck temperature setpoints.

PE Building (gym, and offices)

Building Information

It is a 1-story building with an area of 29,500 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. The hot water pump (7.5 hp) has a variable speed drive (VFD) and was running at 66% speed. The setpoint for the HW loop was 15 psi. An auto control valve is on the HW line. The supply and return HW temperatures were 140°F and 138°F. The ChW pump (20 hp) was running at 18% speed. The actual DP was about 40 psi for the ChW building loop. The measured ChW supply temperature was 43.9°F, and the EMCS reading was 37°F.

A total of four AHUs serve the building. Two single duct constant volume AHUs (AHU-2 & 3) serve the gym area. It was found that the fan motor was running and the belt was off for AHU-2. The HVAC operator replaced the belt within 15 minutes after it was discovered. The cold deck temperature was 55.8°F for AHU-3. The space temperature of the gym was about 72°F with one AHU running. Two single duct VAV units with box reheat (AHU-1 & 4) serve the locker rooms, several offices, lobby, and other sports rooms. The fans were running at 66% and 87% speed and the discharge temperatures were 53.2°F and 62°F for two VAV units. The static pressure setpoint was 1.59"H_2O for AHU-1. The outside air (OA) intake was over 50% for AHU-4. There were no motion sensors installed for the lecture room. The temperature in the large lecture room was about 68°F. Currently, the systems have a shut down schedule from 11:00 p.m. to 6:00 a.m. or 7:00 a.m. for most of the week. However, it was found that the system was back on line before 7:00 a.m. based on a check of the Landis control system. The shut down measures need to be verified.

Recommended Energy Measures

1. Optimize the differential pressure setpoints and balance the ChW loop.

2. Optimize operating time schedule of the hot water system and reset differential pressure setpoint.
3. Reset cold deck temperature setpoints.
4. Optimize the static pressure reset schedule.
5. Adjust the room temperature setpoint for the gym area.
6. Optimize OA intake following ASHRAE standard for AHU-4.
7. Optimize systems operating time periods based on the occupancy schedules.
8. Calibrate or replace the ChW supply temperature sensor.

Classroom Laboratory Building (classrooms, labs, and offices)

Building Information
It is a 2-story building with an area of 40,628 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. The hot water pump was manually shut off. The supply and return HW temperatures were 140°F and 126°F, respectively. The ChW pump (7.5 hp) was equipped with VFD and running at 44% speed. The actual DP was about 40 psi for the ChW building loop.

A total of four AHUs serve the building. Two multi-zone units AHUs (AHU-1 & 2) serve the classrooms, offices and some laboratories. The cold deck temperatures were 54°F to 57°F for two units. The hot deck temperature was 80°F for AHU-1 with a mixed air temperature of 73°F. There is no manual balancing damper for the multi-zone units. Two thermostats were found to control the room temperature for a middle size empty classroom. The setpoints were 55°F for one box and 80°F for the other. The two boxes were fighting each other. One thermostat controls most of the hallway and one diffuser in the classroom. If this thermostat can be moved to the hallway, the fighting problem will be resolved. AHU-3 serves the auditorium. AHU-4 serves the administration office area with a space temperature of 74°F. Currently, the systems have a shut down schedule from 9pm and 10pm to 7:30 am for most of the week. However, it was found that the system was back on line before 7:30 am based on the results from the Landis control system. That shut down measures need to be verified. The make-up unit was off-line.

Recommended Energy Measures
1. Optimize the differential pressure setpoints and balance the ChW loop.
2. Optimize operating time schedule of the hot water system and reset differential pressure setpoint.
3. Reset cold deck and hot deck setpoints.
4. Move the thermostat in the classroom to the hallway.
5. Optimize the operating time periods based on the occupancy schedules.
6. Fix the make-up air unit.

Kirkham Hall (labs., and offices)

Building Information
It is a 2-story building with an area of 19,448 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. The hot water pump (1.5 hp) and the ChW pump (3 hp) were on during the visit.

Three multi-zone units and one single duct constant volume AHU serve the building. The cold deck temperatures were 52°F, 54°F and 62°F for three different multi-zone units. The space temperatures of the labs varied from 70°F to 75°F. All the outside air dampers were closed.

An outside door was open on the east side of the second floor permitting the outside air to enter the rooms. This resulted in condensation on the floor and presented a hazardous walking condition with very slick floors. The south side rooms were about 75°F but the north side rooms were about 69°F. An air balance problem for this unit (AHU-5) was discovered during the visit.

Currently, the systems have a shut down schedule from 9:00 p.m. & midnight to about 7:30 a.m. for most of the week. However, it was found that the system was back on line before 7:00 a.m. based on the results from the Landis control system. Also, condensation on the exterior window was found in the morning. It appears that the units were left on at night. That shut down measures need to be verified.

Recommended Energy Measures

1. Optimize the operating time periods for the hot water system.
2. Reset cold deck and hot deck setpoints.
3. Balance the air for unit-5 and solve the condensation problems.
4. Optimize the systems online time periods based on the occupancy schedules.

Engineering Laboratory (labs, and offices)

Building Information
It is a 1-story building with an area of 13,290 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop.

Two single duct constant volume AHUs serve the building. It was found that the space temperature of the whole building except for the unconditioned machine shop area was about 64°F to 66°F. All the thermostat setpoints were about 63°F to 66°F. Less than 5 people were in the building at the time of visit. According to the working staff, the room

was cold in the summer and hot in the winter. Humidistats used to the control the coil had a setpoint of 20%. This setpoint may override the cooling coil control.

Currently, the systems have a shut down schedule from 10:00 p.m. to 7:00 a.m. for most of the week. However, it was found that the system was back on line before 7:00 a.m. based on the results from the Landis control system. That shut down measures need to be verified.

Recommended Energy Measures

1. Reset the room thermostat and humidistat setpoints.
2. Check humidistat control logic and solve the comfort problems in both the summer and in the winter.
3. Optimize the system operating time periods based on the occupancy schedules.

A-B dorm (residential rooms)

Building Information

It is a combination of two and three story buildings with an area of 54,287 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. One of two hot water pumps was on. One of two ChW pumps was running at 50% speed.

A total of three single duct VAV AHUs with reheat serve the building. There may be another unit which serves the common lobby areas, but it was not found during the trip. The VFDs were bypassed for AHU-1 and 3. The cold deck temperatures were 54°F to 61°F for different AHUs. The static pressure setpoints were 1.5"H_2O for all three AHUs. The outside air (OA) dampers were 100% open for all AHUs.

The mixed air temperature was about 90°F. This may be due to a very high outside air intake or due to the return air from the laundry rooms. This problem should be investigated. Also, at the building chase, near the chilled water pipes entrance, there was a lot of cool air flowing out of the building. The unit serving the common area was off line. The common area temperature was about 85°F on the second floor, much too high for normal comfort.

Recommended Energy Measures

1. Optimize the differential pressure setpoints and balance the ChW loop.
2. Optimize operating time schedule of the hot water system and reset differential pressure setpoint.
3. Reset cold deck setpoints.
4. Optimize the static pressure reset schedule.
5. Optimize OA intake following ASHRAE standard for AHUs.
6. Solve the problems of cool air flowing out and hot air coming in.

7. Fix the off-line unit for the common area.
8. Fix the VFD bypass problem.

Mary Moody Northern Student Building (cafe, bookstore, classrooms and offices)

Building Information
It is a 1-story building with an area of 18,068 sq-ft. The HVAC systems are controlled by a Landis DDC system.

The building receives chilled water and hot water from the chilled water loop and the hot water loop. Both hot water pumps were off. The ChW pump was running at 64% speed. The actual DP was over 30 psi for the ChW building loop.

A total of three AHUs serve the building. One multi-zone AHU-1 serves the common area, small classrooms, some offices and the café area. The cold deck temperature was 56°F. The OA intake was about 70% for the unit. One single duct constant volume unit serves the kitchen area with the cold deck of 54°F. AHU-3 serves bookstore with a space temperature of 68°F for the book area and 64°F for the loading dock space. The discharge air was heated by a terminal coil to satisfy the room temperature setpoint. The humidity alarm was on due to the lower room temperature. The systems have a shut down schedule from 10:00 p.m. and 11:30 p.m. to 5:00 a.m. for most of the week. However, condensation was found on the exterior window at 7:00 a.m. This suggests that the systems were left on all night. The shut down measures need to be verified.

Recommended Energy Measures
1. Optimize the differential pressure setpoints and balance the ChW loop.
2. Optimize operating time schedule of the hot water system and reset differential pressure setpoint.
3. Reset cold deck setpoints.
4. Adjust the room temperature setpoints for the bookstore area.
5. Optimize OA intake following ASHRAE standard for AHU-1.
6. Optimize the systems online time periods based on the occupancy schedules for AHU-1 and 2.

Ft. Crockett Building (labs. and offices)

Building Information
It is a 3-story building with an area of 77,312 sq-ft. The HVAC systems are controlled by a pneumatic system. This building is used for marine laboratory research and is located in a separate location away from the main campus.

Two small water-cooled chillers provide chilled water to the building. One 2.8 MMBtu/hr hot water boiler provides hot water to the building. One of two hot water pumps was on. Two chilled water pumps serve the two chillers and pump water to the building.

More than eight small AHUs serve the building. Most of the AHUs are single duct coupled control units controlled by a thermostat. Five AHUs in the attic and two AHUs on the 3rd floor were measured. The basement is not conditioned.

Recommended Energy Measures

1. Optimize the system operating time periods based on the occupancy schedule for each AHU.

Bayou Building (classrooms, offices, labs)

Building Information

It is a 2-story building with an area of 8,241 sq-ft. The HVAC systems are controlled by a pneumatic system. This building is a TEEX facility used for marine safety and training.

A total of 3 rooftop units and 3 other split units on the ground serve the building. No gas is supplied to the building. Reheat is from electric resistance heating devices for the building. At the time of visit, one rooftop had cycled off. The systems have a nighttime setback controlled by a thermostat. When the setback is programmed in the thermostat, the temperature swing will be larger than the comfort control mode. The setback mode can be overridden by pushing the button on the thermostat during normally unoccupied periods.

Recommended Energy Measures

1. Implement setback based on the occupancy schedules for all the units if possible.

Summary of Central Plant Information and Recommended Energy Measures

Plant Information (the main campus):

Two 250 ton and one 500 ton water-cooled chillers are located in the central plant and provide chilled water (ChW) to a loop for the campus. Three constant volume ChW loop pumps are located in the central plant. There is a blending station for this ChW loop in the plant. Two cooling towers are equipped with two variable volume fans. According to the design sequence, the chiller lead/lag sequence and the chilled water supply temperature reset schedule based on OA temperature have been implemented. However, it was found that the chiller was manually set on or off and the chilled water supply temperature was set to 42°F. Originally, the bypass valve is used to ensure the minimum chilled water flow through each online chiller. The minimum chilled water flow for each chiller is 540 gpm for the 250-ton chiller and 850 gpm for the 500-ton chiller. Based on the site EMCS meter, the chilled water flow was over 1000 gpm for chiller 3 (500 ton). However, it was found that the isolation valve for chiller 1 (250 ton) was open and there was chilled water flow through this chiller even though the differential temperature for the loop was about 8°F. According to the operator, they were trying to push some chilled water flow through another chiller to reduce chilled water flow through chiller No.3 due to the flow meter limitation. But, this reduced the chiller efficiency for the chiller and also increased the chilled water supply temperature by 3°F to 4°F to the loop.

Two 150-hp boilers and one 300-hp boiler are located in the central plant and provide the hot water to the campus loop. Two constant volume HW pumps and a blending station for the HW loop are located in the plant. It was found that one boiler was online during the visit. The boiler is only used for heating according to the operator.

The HVAC systems are controlled by the Landis Insight 600 DDC system. The Landis personnel maintain the control system as needed.

Recommended Energy Measures

1. Optimize the chiller operation.
2. Optimize chilled water supply temperature setpoint.
3. Enable the bypass control to ensure the minimum chilled water flow for each online chiller.
4. Fix the chilled water meter flow limitation problem or ignore this issue.
5. Optimize the hot water system operation.

Electricity Deregulation Metering Options

Option 1: Buy the 15-minute time interval utility data from HL&P if can be purchased at a reasonable price, for the main campus. If Ft. Crockett is going to be retained by TAMU, 15-minute interval data could also be obtained from HL&P to aggregate with the rest of the main campus. The TEEX Bayou building is too small to install a pulse initiator and record 15-minute interval data, but the ESL could install temporary metering for a few typical weeks to get an hourly load profile which could then be estimated throughout the year based on monthly utility bills. For the electric utility deregulation program, it could be in the best interest of both TEEX and Ft. Crockett, if their load could continue to be tied to TAMU at Galveston.

Option 2: Reinstall the ESL metering and poll the electrical data from College Station. We previously monitored TAMU-Galveston when the load was paid off. The ESL still has historical whole campus electrical data for the main campus.

Utility Bill Summary

TAMUG	Main campus						
	Electricity				Natural Gas		
Month	Energy -kwh	Energy Cost $	Demand-kVA	Demand Cost $	Gas-MCF	Gas Cost $	Total cost
Jan-98	608,880	32,430			2,759	7,940	40,370
Feb-98	822,360	37,430			2,852	8,857	46,287
Mar-98	650,640	33,408			2,921	10,654	44,062
Apr-98	848,760	38,048			2,373	7,778	45,826
May-98	846,240	38,976			1,817	6,268	45,244
Jun-98	990,600	44,185			1,054	3,207	47,392
Jul-98	890,160	39,938			879	2,964	42,902
Aug-98	1,050,840	45,450			1,104	3,489	48,939
Sep-98	1,157,400	53,694	2,483		1,544	3,764	57,458
Oct-98	1,102,920	48,769	2022		1,576	4,496	53,265
Nov-98	817,080	41,737	1870		3,051	9,027	50,764
Dec-98	805,560	41,458	1661		2,563	7,753	49,211
Sub-total	**10,591,440**	**495,523**	**2483**		**24,493**	**76,197**	**571,720**
Jan-99	656,040	37,801	1608		2,652	6,986	44,787
Feb-99	747,960	40,049			2,800	6,815	46,864
RE/HL&P: Reliant Energy/ Houston Lighting and Power							
SUC: Southern Union Company							
Demand charge may be included in the energy costs							