

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

no action
add
OK

Date: April 9, 1979

Project Title: Energy Conservation Study

Project No: A-2345

Project Director: L. R. Edens

Sponsor: Tattnall Memorial Hospital

Agreement Period: From 3/7/79 Until 5/7/79

Type Agreement: Std. Ind. Agree.

Amount: \$2,160

Reports Required: Final Technical Report

Sponsor Contact Person (s):

Technical Matters

Contractual Matters
(thru OCA)

Mr. John B. Wheatley, Jr.
Tattnall Memorial Hospital
Hwy. 121 South
Reidsville, Ga. 30453

Defense Priority Rating:

Assigned to: Technology & Development (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director-EES
Accounting Office
Procurement Office
Security Coordinator (OCA) ✓
Reports Coordinator (OCA)

Library, Technical Reports Section
EES Information Office
EES Reports & Procedures
Project File (OCA)
Project Code (GTRI)
Other _____

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT TERMINATION

Date: 8/7/79

Project Title: Energy Conservation Study

Project No: A-2345

Project Director: L. R. Edens

Sponsor: Tattnall Memorial Hospital

Effective Termination Date: 7/20/79

Clearance of Accounting Charges: 7/20/79

Grant/Contract Closeout Actions Remaining:

- Final Invoice and Closing Documents
- Final Fiscal Report
- Final Report of Inventions
- Govt. Property Inventory & Related Certificate
- Classified Material Certificate
- Other _____

Assigned to: EEL/IED (School/Laboratory)

COPIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director--EES
Accounting Office
Procurement Office
Security Coordinator (OCA)
Reports Coordinator (OCA)✓

Library, Technical Reports Section
EES Information Office
Project File (OCA)
Project Code (GTRI)
Other _____

Have you checked, to the best of your ability, the contents of this document and title page? Imperfect volumes delay return of binding. Thanks.

B 29

BOUND BY THE NATIONAL LIBRARY BINDERY CO. OF GA.

AN ENERGY CONSERVATION STUDY
FOR TATTNALL MEMORIAL HOSPITAL
REIDSVILLE, GEORGIA

Prepared for the
Tattnall County Memorial Hospital

by
Larry R. Edens
Project Director and Research Engineer

Savannah Area Office
Engineering Extension Laboratory
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
July 1979

Table of Contents

	<u>Page</u>
INTRODUCTION	1
Background	1
Purpose	1
Approach and Methodology	1
SURVEY OF EXISTING CONDITIONS	3
Energy Audit	3
Status of Current Energy Conservation Program	4
IDENTIFICATION AND EVALUATION OF ENERGY CONSERVING OPPORTUNITIES	5
General	5
Heating, Ventilation, and Air Conditioning Systems	5
Lighting Systems	7
Water Heating	8
Electrical Demand Control	10
Heat Loss/Gain Control	12
THE ESTABLISHMENT OF AN ENERGY MANAGEMENT PROGRAM	13
Organization	13
Establishment of Goals	14
Monitoring, Evaluation, and Reporting	14
Periodic Program Review and Revision	15
CONCLUSIONS AND RECOMMENDATIONS	17
APPENDICES	19
A. Table 1. Summary of Electrical Power Consumption and Demand 1976-1979	23
Table 2. Electrical Energy Costs and Rates	24
Table 3. Water Consumption for Latest 12-month Period	25
Table 4. Estimated Power Consumption for Lighting	26
B. Exhibit I. Canoochee Electric Membership Corporation Schedule B. Commercial and Industrial	29
Exhibit II. Computer Analysis of Demand Control Opportunities	31

INTRODUCTION

Background

The Tattnall Memorial Hospital is a 40-bed facility located in Reidsville, Georgia and operated under the direction of the Tattnall County Hospital Authority. Construction of the Hospital was started in late 1972 and operation began in March 1974. A recent study by the U. S. Department of Health, Education, and Welfare indicated that more than 90 percent of the nation's hospitals constructed or designed before 1975 were largely energy inefficient. When Tattnall Memorial Hospital was constructed, the present level of awareness of the need for energy conservation and cost control had not developed. The spiraling cost of energy has made it a major expense of providing health care in hospital facilities and administrators of even the newest hospitals are seeking ways to reduce energy consumption and costs.

Current annual expenditures for energy at Tattnall Memorial total approximately \$60,000. The Hospital Administrative Services data, published by the American Hospital Association, show that the energy cost on a square-foot basis at Tattnall Memorial is approximately twice the state average for hospitals of comparable size, and almost 2.5 times the national average. Because of these unfavorable comparisons and steadily rising energy costs, the Hospital Administrator contracted Georgia Tech's Industrial Extension Division to perform an Energy Conservation Study for the facility in March 1979.

Purpose

The purpose of this project was to conduct an energy conservation study for Tattnall Memorial Hospital to define operational changes and cost effective modifications to the facility which could be implemented by the hospital management to reduce energy usage and costs. Guidelines for organizing, implementing, and monitoring an energy management program were developed as part of the project.

Approach and Methodology

Previous studies have indicated that hospital energy consumption occurs in the general ranges shown for the areas listed below.

<u>System</u>	<u>Percent of Total Energy Use</u>
Environmental Control	40-65%
Lighting and Wall Receptacles	10-20%
Laundry	8-15%
Food Service	5-10%
Medical Equipment	3-5%
Sterilization and Incineration	2-3%

With the exception of the laundry operation, which is not applicable to Tattnell Memorial, the study effort was initially directed to the above systems in proportion to energy consumption. As the study progressed, the effort was concentrated on the evaluation of energy conserving opportunities which appeared to offer the greatest potential savings. The methodology used in this study is based on widely-accepted and established engineering and economic practices. The Georgia Tech staff maintained a close working relationship with the Hospital Administrator throughout the project.

The study was divided into five major tasks as outlined below.

- Task I: A detailed review of all energy consumption data and present energy related operating procedures and policies.
- Task II: A survey of all energy using equipment and systems and preliminary identification of energy conserving opportunities.
- Task III: An evaluation of identified energy conserving opportunities to determine the practicality and feasibility of each.
- Task IV: Development of guidelines for establishing and implementing an energy conservation program.
- Task V: The presentation of conclusions and recommendations in a final project report.

It was not within the scope of this project to prepare complete design and engineering plans for new or modified equipment but only to perform preliminary technical and economic analyses to be able to inform the administration of areas where more in-depth professional engineering work is advisable.

SURVEY OF EXISTING CONDITIONS

Energy Audit

Essentially, all the energy consumed by Tattnall Memorial Hospital is in the form of electrical power. The only identified exception is the insignificant amount of LP Gas used by the pathological incinerator. Electrical power consumption and monthly demand (highest consumption for a 30-minute period) data for the period from January 1976 through May 1979 are shown in Appendix A, Table 1. At the present time, the Canoochee Electric Membership Corporation charges for electrical power on a usage schedule plus a power cost adjustment. No charges are made based on demand, however, the demand measurements are recorded. The energy usage data are summarized below:

ELECTRICAL ENERGY CONSUMPTION

<u>Year</u>	<u>KWH</u>	<u>Change From Previous Period</u>
1976	1,330,400	+06.9%
1977	1,456,800	+09.5%
1978	1,500,200	+03.0%
1979 (5 mos.)	721,000	+13.7% (5 mos.)

Electrical energy costs for the period January-May of 1979 are presented in Appendix A, Table 2. The effective rate increased from 3.75¢/KWH in January 1979 to 4.20¢/KWH in May. During the same period of 1978, the effective rate averaged 3.54¢/KWH. The hospital's electrical power costs for the first five months of 1979 were 26.4% higher than the same period in 1978. This increase resulted from a 13.7% increase in consumption and an 11.0% increase in price of electricity. If the current trends in consumption and prices continue, the hospital's energy costs for 1979 will approach \$70,000.

Since an energy management program has no control over the electrical power rates, this study is directed primarily towards the reduction of energy consumption and not energy costs, per se. As energy prices rise, any reduction in consumption will result in greater dollar savings.

Although water is not an energy source, its consumption is indirectly associated with energy conservation, since a significant amount is heated. Water

consumption data for the last 12-month period are presented in Appendix A, Table 3. The Hospital consumes slightly less than 3 million gallons per year for which it pays less than \$3,000 at present rates.

A survey of the Hospital equipment, along with limited electrical consumption measurements made during the study, provided the basis for the following estimated consumption factors for various energy-using systems:

<u>System</u>	<u>Percent of Total Energy Use</u>
Environmental Control (HVAC)	60-70%
Lighting	15-18%
Food Service	5-7%
Water Heating	4-7%
Miscellaneous Equipment	6-9%

All electrical power used by the Hospital is measured by a single meter, which makes it difficult to determine the actual consumption of individual systems. However, the above data are considered adequate for the preliminary evaluations made by this study.

Tattnall Memorial Hospital has an unusually high amount of 120/240 volt usage for its 277/480 volt, 3-phase supply. Transformer losses for reducing the supply voltage generally average 3-5%. It is not economically practical to correct this problem related to the design of the electrical distribution system. Ideally the separate air conditioning units and some lighting should be on 277 volt service.

Status of Current Energy Conservation Program

The Administrator of Tattnall Memorial Hospital has recognized the need for a management program to control energy consumption and costs. Recent actions have been taken to reduce lighting, heating, and air conditioning loads. However, at present no standard procedure has been established for identifying, evaluating, and implementing energy conservation measures as a continuous process. Energy consumption data have been analyzed only on a limited basis and no formal organization has been established to assume responsibility for an energy conservation program which would provide for the training and motivation of all employees.

IDENTIFICATION AND EVALUATION OF ENERGY CONSERVING OPPORTUNITIES

General

This study included the preliminary evaluation of a large number of potential energy-saving ideas. Those which were found to be economically feasible are presented in the following sections of this report and are referred to as Energy Conserving Opportunities (ECOs). The ECOs range from no-cost changes in operating or maintenance procedures, which yield immediate savings, to large capital investments for installation of equipment, which may require a payback period of several years.

The feasibility of using an alternate energy source is not an Energy Conserving Opportunity but an opportunity to save energy dollars. From a cost standpoint the Hospital is at a disadvantage because of its all-electric operation. Because of environmental factors and low price, natural gas is the Hospital's most practical alternative to electricity as an energy supply. Water and space heating with pipeline natural gas presently costs only 25-30% of the cost of using electricity. CEMC is currently charging \$1.10-\$1.25 per therm (100,000 BTUs) of energy delivered to the Hospital. Natural gas energy can be delivered to large pipeline customers for about \$0.25-\$0.30 per therm. Adjusted for an 80% efficiency for natural gas equipment versus 95% efficiency for electrical units, the comparison for net heating cost per therm becomes approximately \$1.15-\$1.30 for electricity versus \$0.30-\$0.40 for natural gas. The feasibility of using natural gas for space and water heating is discussed in later sections of the report.

Heating, Ventilation, and Air Conditioning Systems

The Hospital has a complex system of environmental control equipment which consists of the following: (a) two large A/C chiller units which provide chilled water to four zone air handling units; (b) two electric strip heater sections and eighteen duct heaters in the zone systems; (c) twenty-four individual room HAC units; (d) two kitchen A/C units; (e) a separate lobby HAC unit; (f) nineteen air exhaust fan units; and (g) all associated instruments and controls. Two of the zone systems use 100% fresh air make-up to meet hospital regulations. Regulations also specify many other requirements related to temperature settings and ventilation.

Because of the complexity of the Hospital's environmental control system, the best approach to energy conservation appears to be through trial and error methods. Changes should be made to the system which would be energy conserving. If the results of the changes are acceptable in regard to regulations and patient and employee comfort, the new conditions should become standard operating procedures. When conditions are reached which are not acceptable, the system should be returned to the most energy-conserving condition which was acceptable.

The operating parameters listed below should be optimized by trial and error procedures.

1. Raise summer and lower winter thermostat settings where allowed by regulations
2. Reduce exhaust air volume by turning off selected fans
3. Eliminate reheating when A/C units are in operation
4. Eliminate heating and air conditioning in corridors
5. Cycle chiller operations when only one unit can meet requirements
6. Reduce chilled water system to lowest adequate temperature

Energy-conserving practices by employees can produce greater savings in the HVAC system than in any other energy-using system. Environmental control equipment in unused areas must be turned off or operated at the most energy-conserving level which is acceptable. Thermostat settings must remain at energy-conserving levels determined to be adequate. The maintenance engineer should schedule regular cleaning of air filters, fans, air cooled coils, and water-cooled tubes to ensure optimum operating efficiency.

It is estimated that the HVAC systems of the Hospital are consuming almost one million KWH per year at a present cost of about \$40,000. No practical equipment modifications were identified which could significantly reduce this cost. However, optimization of the use of the equipment and energy-saving actions by employees could probably reduce the energy consumed by 10 percent.

Because of the high capital investment required to modify existing environmental control equipment, it was quickly determined that the use of natural gas as an alternate energy source for space heating was not feasible. Such a conversion was not practical because of the requirements for zone systems and the large number of existing individual HAC units.

Lighting Systems

Interior lighting consists of approximately 777 fluorescent lamps and 177 incandescent lamps which together use an estimated 225,300 KWH/yr., or about 15% of the Hospital's total power usage. Exterior lighting consists of 19 Mercury vapor lamps which use about 16,600 KWH/yr., or about 1% of the total. An analysis of the energy requirements for lighting is shown in Appendix A, Table 4.

Lighting levels were measured throughout the building during the study and typical illumination data are shown below:

TYPICAL HOSPITAL LIGHTING LEVELS

<u>Location</u>	<u>Average Illumination (Foot Candles)</u>	<u>Recommended Level (Foot Candles)</u>
Administrator's Office	100	70-100
Patient Rooms	20	20-30
Cafeteria	80	40
Hallways (100% of Lamps)	75	10-20
(25% of Lamps)	15	10-20
Operating Room Entrance Hall	230	70
Recovery Room Entrance Hall	150	70
OB Room Entrance Area	130	70
Supply Room	80	40

The use of recently developed low-wattage fluorescent lamps can reduce energy consumption by about 15% (34 watts vs. 40 watts, and 25 watts vs. 30 watts) with less than a 10% reduction in illumination. Lighting levels in the Hospital could be reduced by 10% and, generally, still be above recommended levels. It is estimated that this change would save 30,000 KWH or \$1,200 annually when relamping is completed. The price differential in the lamps (which have the same average life) will cost the Hospital approximately \$100 annually based on an average lamp life of four years. Hospital purchase orders indicate that 144, 40-watt fluorescent lamps were purchased in 1978 at an average cost of \$4.69 each. Recent prices quoted by Westinghouse (Savannah) were \$2.13 for 40-watt lamps and \$4.55 for 30-watt lamps. Low-wattage lamps listed at \$2.55 and \$5.45 respectively.

Westinghouse gives a 50% discount with purchases of 10 cases (240 lamps) and over. Substantial savings could be realized by placing larger orders through the manufacturer's distribution system.

Even with the use of lower wattage lamps, there are several areas in the Hospital where the illumination would greatly exceed the recommended levels. Removal of some lamps could be used to reduce the lighting levels in the cafeteria, supply storage room, and various halls and entrance areas. Ballasts should be taken out when lamps are permanently removed because they generally consume about 15% of the power required for the lamps. The use of only 25% of the hall lighting should be required. It is estimated that the reduction of interior lighting levels could save approximately 7,500 KWH (\$300) annually.

The Hospital's exterior lighting is considered more than adequate for security and safety needs. It is recommended that exterior lighting be reduced from 19 to about 10 lamps. The elimination of nine lamps would result in an annual savings of about 8,000 KWH or \$320. Approximately the first year's savings would be used to remove the lamps and ballasts. Although total replacement by 150-watt, high pressure, sodium lamps offered satisfactory annual savings, the costs of initial replacement of lamps and ballasts were prohibitive. An evaluation showed that there was no cost advantage for the Hospital to use the CEMC Schedule SYE for Mercury vapor security lights.

The ECOs presented above would reduce the total power for lighting by an estimated 45,500 KWH annually (\$1,820). This represents a reduction of almost 19% of the current lighting power consumption. Greater savings could be realized through employee training and motivation to turn off lights when an area is not being used.

Water Heating

Hot water is heated in two electric units, each with a storage capacity of 380 gallons and a maximum power usage of 99 KW. They operate on 440 volt, 3-phase service. During the study, the controllers were set to maintain water temperature at 130° F. Due to the arrangement of the units, the cold supply water is heated by one unit with the second unit operating only to maintain the temperature of the stored water. Electrical meters were installed on both units to determine the power consumed. During a seven-day period in June, the system used 1,210 KWH for an annual projected use of about 63,000 KWH, or 4.2% of the

Hospital's total power consumption. A lower than normal occupancy rate (51%) and warm weather conditions during the test period caused this consumption estimate to be conservative. On an annual basis, water heating probably consumes nearer to 5-6% of the total power usage, or in the range of 75,000-90,000 KWH.

Water heating generally offers the most feasible opportunity to convert from electrical energy to natural gas. Such conversions have recently been made at several motels and restaurants in the Savannah area, with reportedly excellent paybacks.

The existing water heaters have a recovery rate of 405 gal/hr., each, at a rise of 100° F. Two gas-fired water heaters with 540 gal/hr. (rise of 100° F) recovery rate, each, could be installed for approximately \$5,000. The gas heaters would have only 120 gallons of storage each, but the existing electric heaters could be used for storage and emergency use. A space approximately 4' x 8' would be needed for the installation.

The current cost of an estimated 80,000 KWH water heater operation is about \$3,200/yr., (\$.04/KWH) for electricity versus a projected natural gas cost (based on 80% efficiency) of about \$950 (\$.28/therm). The saving of energy costs estimated from the use of gas water heaters is \$2,250 annually. This provides an attractive payback period of 2.2 years. However, an additional cost may be incurred from the gas supplier for connecting the Hospital to the existing pipe line several hundred feet north along Georgia Highway 121. The connection charges must be established through negotiations between the Hospital and the supplier, using projected consumption rates. Even with a substantial connection charge, this conversion may be feasible.

Water heater energy consumption showed that the demand rose rapidly to a plateau between 6-9 a.m. and remained steady until it reached a high peak between 5 and 7 p.m. Energy usage was very low between 8 p.m. and 6 a.m. The peak load between 5-7 p.m. was about 99 KW. The water heater operation should be considered in a peak shaving study, if a demand-based schedule is adopted.

Electric Demand Control

The Canoochee Electric Membership Corporation charges the Hospital for electric power based on their Schedule B for commercial and industrial customers

(refer to Appendix B, Exhibit I), which consists of a usage rate schedule plus a power cost adjustment charge. (At present the power cost adjustment charge accounts for 55-60% of the total effective rate, which recently has averaged about \$0.04/KWH.) Although the CEMC does not include a demand charge in its rate schedule for commercial and industrial customers, it does pay a wholesale rate which is based on a demand charge on power purchased from the Oglethorpe Electric Membership Corporation. The OEMC purchases 80% of the power it distributes from the Georgia Power Company.

Officials of CEMC informed the study team during interviews in March and June 1979 that the Corporation would probably begin using a commercial and industrial rate based on a demand charge within the next twelve months. The CEMC has been measuring and recording 30-minute demands for several years for evaluation purposes. Although there is no information available on the type of demand schedule the CEMC may develop, it will probably be similar to that used by Georgia Power Company.

In order to evaluate roughly the savings which could be realized with the installation of a demand control (peak shaving) system, the Hospital's electric power usage and demand information for the calendar year 1978 was processed by a computer at Georgia Tech's Engineering Experiment Station in Atlanta to determine the following.

1. Total 1978 power costs with demand billing if served by Georgia Power Company
2. Total 1978 power costs with demand billing if served by Georgia Power Company with 10% peak shaving
3. Total 1978 power costs with demand billing if served by Georgia Power Company with 20% peak shaving

The computer printout sheets are attached to this report as Appendix B, Exhibit II. A summary of the results is shown below:

TATTNALL HOSPITAL ELECTRIC POWER COSTS - 1978

<u>Basis of Calculation</u>	<u>1978 Power Cost</u>	<u>Savings by Peak Shaving on Demand</u>
Actual Power Costs from CEMC	\$56,228	-
Computed Power Costs on Georgia Power Company Demand Rate Schedule	\$48,061	-
Computed Power Costs on Georgia Power Company Demand Rate Schedule with 10% Peak Shaving	\$46,178	\$1,883
Computed Power Costs on Georgia Power Company Demand Rate Schedule with 20% Peak Shaving	\$44,239	\$3,822

The Georgia Power Company billing demand is determined as the highest of (1) 60% of the highest actual demand occurring in a winter month in the previous 11-month period, (2) 95% of the highest actual demand occurring during a summer month during the previous 11-month period, or (3) the highest demand in the current month. For Tattnell Memorial Hospital the billing demand in recent years would have been determined by current or previous July demand. An analysis of the Hospital's power load shows that the most practical method of obtaining 10% or 20% peak shaving during the high demand periods of July is to reduce air conditioning usage. This could be accomplished by operating only one chiller unit during the peak shaving period. A detailed engineering study would be required to estimate the effect of this procedure on the temperature levels inside the Hospital. Another possibility is to reduce hot water heating.

Although the analysis is hypothetical, it does provide estimates of savings from peak shaving which may be used in preliminary payback calculations for demand control systems. For example, a demand control system costing \$15,000 would offer simple payback periods of 8.0 years with 10% shaving and 3.9 years with 20% shaving.

It should be noted that a 10% peak shaving reduced the annual power costs by 3.9% and 20% shaving reduced the costs by 7.9%. Any proposed demand control systems claiming savings greater than this range should be carefully evaluated.

Tattnell Memorial Hospital does not have a severe peak load problem. It is probable that conversion to a demand-based rate schedule would reduce the Hospital's power costs.

Heat Loss/Gain Control

Although limited opportunities for efficiency improvements were identified for the operation of the environmental control systems, several opportunities were evaluated to reduce the requirements on the systems by minimizing heat gain and loss. The modifications required to implement these improvements do not directly involve the HVAC equipment.

The overhead insulation of the building consists of the roofing material, a 2 1/2-inch poured concrete deck, 1-inch of rigid insulation, and the suspended ceiling. The total overhead R Factor is estimated as 6-7. By increasing the overhead insulation to R-20, the energy cost saving is estimated at \$1,800 for winter heating and \$1,300 for summer cooling. To determine the payback, actual quotes for adding insulation equal to R-13 should be received from contractors and divided by the total projected savings of \$3,100/yr. An accurate estimate of the cost could not be made due to the large labor requirements and the various methods of adding the insulation. It is recommended that the insulation not be blown on top of the suspended ceiling but be added by either (1) spraying cellulose on the bottom of the concrete base or (2) adding rigid foam under the roofing when it is replaced.

The installation of Koolshade Solar Screens on the windows of the building was found to be not economically practical, even on the southwest exposure only. Insulated draperies (white backing) are recommended for interior window covering. The use of the draperies could be optimized by training employees to open and close them to take advantage of heat gain and loss conditions.

The roof should be completely covered with white gravel to reduce its surface temperature. On a sunny day with 95° F air temperature, a white roof may be as much as 50° F cooler than a black roof (140° F versus 190° F). This greatly reduces heat gain through the building's roof during peak air conditioning periods.

THE ESTABLISHMENT OF AN ENERGY MANAGEMENT PROGRAM

Organization

A successful Hospital Energy Management Program is based upon a strong commitment from top management and the involvement and cooperation of all employees. The establishment of an Energy Management Committee provides the organization needed to coordinate the efforts of employees whose functions are valuable to the monitoring and implementation of the Energy Management Program. The Energy Management Committee operates under the leadership of an Energy Coordinator. If the Hospital Administrator chooses not to fill this position himself, he should designate the Assistant Administrator or another senior staff member to serve in this role.

The success of the energy-saving effort will be proportional to the dedication and commitment of the Energy Coordinator and his committee. The functions of the various members of an Energy Management Committee for the typical organization are described below:

Energy Management Committee

Energy Coordinator - Supervise overall committee activities, train and assign responsibilities to other members, establish goals, evaluate and report results, review and revise overall program.

Maintenance Engineer - Monitor energy using system, implement equipment modifications and changes in operating procedures, maintain facilities for efficient operation.

Accountant/Bookkeeper - Collect and analyze historical and current energy consumption data, maintain energy reporting systems.

Shift Monitor - Monitor adherence to energy conservation procedures and policies, promote cooperation from all employees, forward suggestions to the committee.

The assignment of Shift Monitors may be made on an annual basis to involve other employees in the program. If a Shift Monitor or other committee member is not properly performing his duties because of lack of interest, motivation, or commitment, he should be replaced by another individual.

Establishment of Goals

An overall energy conservation goal must be established by the top administration and the Energy Management Committee. The goal should be specific, attainable, and consistent with other administrative policies and regulations, e.g., a reduction of 10 percent in electrical consumption within the first year of the energy management program. This goal must be based upon a list of specific program objectives. The objectives can include the establishment of low-cost operational and maintenance changes which would result in practically instantaneous savings. The amount of savings from each objective should be estimated. Longer range objectives should be established which require capital investments. The priority and timing of these objectives must be determined by top management because they must be involved in budget planning and preparation. The energy savings from objectives of this type would probably be realized during subsequent years of the program.

Monitoring, Evaluation, and Reporting

The monitoring and evaluation of the program should be a continuous process performed by the Energy Management Committee. Shift Monitors along with other committee members should continuously check the performances of employees to ensure that established operating standards are being followed. The Maintenance Engineer should monitor the implementation of equipment modification and maintenance procedures. All members should periodically report their findings to the full committee for evaluation. Continuous monitoring efforts will improve the performance and motivation of all employees and demonstrate the commitment of top management to the program.

The Accountant or Bookkeeper should prepare energy consumption data on a monthly basis to submit to the committee for evaluation of program results. The committee should determine from these data if the overall goal is being achieved. Current month data should be compared to the data from the corresponding month of the previous year to minimize the effect of weather conditions which cause monthly variations. Deviations from expected results should be analyzed to determine probable causes. Unusual weather conditions, hospital occupancy rates, or equipment modifications and additions should be considered when evaluating the deviation from expected consumption.

Consumption data for water should also be monitored and evaluated on a monthly basis. Although it is not an energy source, water is related to energy consumption because a significant portion is heated.

The results of the program and its success or failure to meet the established goal should be reported monthly to all employees. It is suggested that a display chart be posted to indicate the current year's consumption by month compared to the previous year. The chart should clearly show the goal for the current year. All reports and charts should use energy units (KWH) and not costs because changes in energy prices are beyond the control of the management program. If hospital expansions are made, the chart should be modified to indicate consumption on a basis of KWH/square foot of space for comparing to the previous year's data.

Periodic Program Review and Revision

An annual program review should be made by top management and the Energy Management Committee to eliminate or modify unattainable objectives and establish new ones. A revised goal should be set to avoid complacency or stagnation of the program if previous goals have been achieved. The program must have successive refinements to remain a continuous process which produces favorable results.

CONCLUSIONS AND RECOMMENDATIONS

The potential for energy savings at Tattnall Memorial Hospital is limited by its all electric operation and the complexity and segmentation of its HVAC systems. However, with a strong Energy Management Program, the Hospital should be able to reduce energy consumption by 10-15% and develop a long-range strategy for minimizing energy costs. The following recommendations are made based upon the findings of this study:

1. Establish a continuing Energy Management Program under guidelines similar to those outlined in this report.
2. Set realistic goals for energy conservation which can be achieved through the implementation of ECOs and the motivation and training of all employees.
3. Develop energy-related criteria for evaluating the efficiency of facility expansions and equipment modifications or additions.

APPENDICES

Appendix A

Table 1

TATNALL MEMORIAL HOSPITAL
SUMMARY OF ELECTRICAL POWER CONSUMPTION AND DEMAND 1976-1979

	1976		1977		1978		1979	
	<u>KWH</u>	<u>30-Minute Demand (KW)</u>	<u>KWH</u>	<u>30-Minute Demand (KW)</u>	<u>KWH</u>	<u>30-Minute Demand (KW)</u>	<u>KWH</u>	<u>30-Minute Demand (KW)</u>
January	151,800	340	170,000	414	158,400	362	162,200	N/A
February	115,400	216	153,000	370	149,800	356	136,800	N/A
March	87,000	228	71,600	296	124,000	358	140,200	N/A
April	79,400	210	118,600	230	107,200	268	156,800	N/A
May	92,400	210	127,800	216	94,600	222	125,000	N/A
June	93,600	208	109,200	228	142,600	250		
July	124,000	230	139,800	252	142,600	280		
August	114,200	230	132,000	234	129,400	256		
September	102,400	244	134,200	234	126,800	262		
October	118,600	212	108,400	232	107,000	240		
November	121,800	292	88,800	268	93,000	202		
December	<u>129,800</u>	340	<u>103,400</u>	332	<u>124,800</u>	318		
	1,330,400 (Total)	247 (Avg.)	1,456,800 (Total)	276 (Avg.)	1,500,200 (Total)	281 (Avg.)	721,000 (5 mos.)	N/A
% Change From Previous Year	(+6.9%)	(-1.2%)	(+9.5%)	(+11.7%)	(+3.0%)	(+1.8%)	(+13.7%)	N/A
Avg. Hospital Occupancy Rate (Not Including Nursery)		-		59%		63%		77%

Table 2

TATTNALL MEMORIAL HOSPITAL
ELECTRICAL ENERGY COSTS AND RATES

<u>1979</u>	<u>Consumption (KWH)</u>	<u>Cost (\$)</u>	<u>Rate (\$/KWH)</u>
January	162,200	\$ 6,081	\$0.0375
February	136,800	5,136	0.0375
March	140,200	5,403	0.0385
April	156,800	6,491	0.0414
May	<u>125,000</u>	<u>5,247</u>	0.0420
Total	721,000	\$28,358	\$0.0393 (Avg.)
Jan.-May 1978	634,000	\$22,438	\$0.0354 (Avg.)
% Change (Jan.-May 1979 vs. Jan.-May 1978)	+13.7%	+26.4%	+11.0%

Table 3
 TATTNALL MEMORIAL HOSPITAL
 WATER CONSUMPTION FOR LATEST 12-MONTH PERIOD

<u>Year - Month</u>	<u>Total Gallons Used</u>
1978 - June	290,390
July	269,440
August	185,520
September	278,220
October	250,800
November	300,970
December	241,680
1979 - January	289,850
February	217,040
March	192,650
April	168,410
May	<u>171,390</u>
Total 12-Month Usage	2,856,360

Average Effective Rate for Jan.-May 1979: \$0.99/1000 gallons

Table 4
TATNALL MEMORIAL HOSPITAL
ESTIMATED POWER CONSUMPTION FOR LIGHTING

<u>Type Lamp</u>	<u>Number</u>	<u>Total Wattage</u>	<u>Estimated Percent Usage</u>	<u>Estimated Power Used KWH/Yr.</u>
Fluorescent - 40 watt	638	25,520	70%	156,400
Fluorescent - 30 watt	139	4,170	80%	29,200
Incandescent	177	22,650	20%	<u>39,700</u>
			Interior Total:	225,300
Mercury Vapor - 250 watt (Exterior)	19	4,750	40%	<u>16,600</u>
			Total Estimate:	241,900

Estimated Percent of Total Electrical Power Used for Lighting:
(Based on consumption for calendar year 1978)

$$\text{Interior: } \frac{225,300}{1,500,200} = 15.0\%$$

$$\text{Exterior: } \frac{16,600}{1,500,200} = 1.1\%$$

$$\text{Total Lighting: } 16.1\%$$

Appendix B

SCHEDULE B

Commercial and Industrial

APPLICABILITY

Applicable to all commercial and industrial consumers subject to the established rules and regulations of the cooperative.

CHARACTER OF SERVICE

Single-phase and Three-phase, 60 cycles, at available secondary voltages.

MONTHLY RATE

First 40	kwh	@	9.5¢	per kwh
Next 60	kwh	@	9.5¢	per kwh
Next 400	kwh	@	5.0¢	per kwh
Next 2000	kwh	@	3.0¢	per kwh
Over 2500	kwh	@	1.7¢	per kwh

MINIMUM MONTHLY CHARGE

The minimum monthly charge shall be \$3.80. Minimum monthly charge in excess of 3 KVA will be \$1.00 per KVA of installed capacity.

POWER COST ADJUSTMENT CHARGE

The above rates shall be increased or decreased by 0.1 mill per kilowatt-hour for each 0.1 mill or major fraction thereof by which seller's total average purchased power cost per kilowatthour sold for the ~~preceding~~ *CURRENT* twelve months exceeds or is less than ~~11.6~~ *11.4* mills per kilowatthour.

TAX PROVISION

Any taxes apportioned to the cooperative by any legal entity shall be passed on to the consumer on a pro rata basis as may be applicable.

TERMS OF PAYMENT

The above charges are net, payable by the first of the month. Bills not paid by the 20th will be disconnected, subject to a \$10.00 reconnecting charge during regular working hours, \$15.00 for other hours.

Source: Canoochee Electric Membership Corporation. Service Rules and Regulations. September 1974.

Exhibit II
Computer Analysis of Demand Control Opportunities

ELECTRICITY USAGE ANALYSIS
 FOR TATTNALL COUNTY HOSPITAL
 IN COOPERATION WITH THE TECHNOLOGY DEVELOPMENT LAB
 GEORGIA TECH ENGINEERING EXPERIMENT STATION
 ATLANTA, GEORGIA 30332

INPUT DATA

BILLING PERIOD	ACTUAL DEMAND	BILLING DEMAND	CONSUMPTION	FUEL ADJUSTMENT	LOAD FACTOR
JANUARY, 1978	362	239	158400	.003	.59
FEBRUARY, 1978	356	239	149800	.003	.63
MARCH, 1978	358	239	124000	.003	.47
APRIL, 1978	268	239	107200	.003	.56
MAY, 1978	222	239	94600	.003	.57
JUNE, 1978	250	250	142600	.003	.79
JULY, 1978	280	280	142600	.003	.68
AUGUST, 1978	256	266	129400	.003	.68
SEPTEMBER, 1978	262	266	126800	.003	.67
OCTOBER, 1978	240	266	107000	.003	.60
NOVEMBER, 1978	202	266	93000	.003	.64
DECEMBER, 1978	318	266	124800	.003	.53

LOCAL TAX IS \$.03

PROJECTED ELECTRICITY COST

BILLING PERIOD	BILLING AMOUNT
JANUARY	4551.57
FEBRUARY	4409.85
MARCH	3984.66
APRIL	3707.80
MAY	3476.39
JUNE	4291.19
JULY	4385.92
AUGUST	4073.65
SEPTEMBER	4030.81
OCTOBER	3704.50
NOVEMBER	3446.73
DECEMBER	3997.85
TOTAL	\$ 48060.91

PROJECTED COST WITH 10% PEAK SHAVING

BILLING PERIOD	ACTUAL DEMAND	BILLING DEMAND	LOAD FACTOR	COST
JANUARY	362	239	.59	4371.60
FEBRUARY	356	239	.63	4229.87
MARCH	358	239	.47	3804.68
APRIL	268	239	.56	3527.82
MAY	222	239	.57	3318.28
JUNE	250	250	.79	4182.93
JULY	251	251	.76	4196.47
AUGUST	251	251	.69	3978.93
SEPTEMBER	251	251	.70	3936.08
OCTOBER	240	239	.60	3524.52
NOVEMBER	202	239	.64	3288.61
DECEMBER	318	239	.53	3817.87
TOTAL				\$ 46177.66

PROJECTED SAVINGS DUE TO 10% PEAK SHAVING IS \$ 1883.25

PROJECTED COST WITH 20% PEAK SHAVING

BILLING PERIOD	ACTUAL DEMAND	BILLING DEMAND	LOAD FACTOR	COST
JANUARY	362	217	.59	4221.39
FEBRUARY	356	217	.63	4079.66
MARCH	358	217	.47	3654.48
APRIL	268	217	.56	3377.61
MAY	222	217	.57	3169.97
JUNE	223	223	.88	4007.02
JULY	223	223	.86	4007.02
AUGUST	223	223	.78	3789.48
SEPTEMBER	223	223	.79	3746.63
OCTOBER	240	217	.60	3374.32
NOVEMBER	202	217	.64	3143.60
DECEMBER	318	217	.53	3667.66
TOTAL				\$ 44238.83

PROJECTED SAVINGS DUE TO 20% PEAK SHAVING IS \$ 3822.08