HOSPITAL ENERGY AUDIT

GEORGETOWN PUBLIC HOSPITAL, GUYANA

IMPROVING HEALTH FACILITY INFRASTRUCTURE

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EPP-I-00-03-00008-00, TASK ORDER 07

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1. EXECUTIVE SUMMARY

The purpose of this report is to identify cost effective Energy Management Opportunities (EMOs) and assist in their implementation. The Association of Energy Engineers (AEE) was contracted by Tetra Tech under USAID IHFI GUYANA Contract No. EPP-I-00-03-00008-00, to perform an Energy Audit and Training Program for the Georgetown Public Hospital, in Guyana, South America. In pursuance of that objective the AEE/Spectrum Engineering and Training Team analyzed furnished data and was on site from April 24, 2012 thru May 4, 2012 to survey and gather data for this analysis and report of the Georgetown Public Hospital facility in Georgetown, Guyana.

The objective of this Energy Audit and Assessment is to evaluate the existing systems in the facility which consume the most energy and, therefore, have the greatest contribution to the energy bills. This analysis reviewed installed equipment as well as operation and maintenance practices at the facility. The key objective is to identify Energy Management Opportunities (EMOs) and evaluate new technologies that improve efficiency and can reduce overall operating costs. The analysis consisted of an on-site survey of the facility, followed by a technical evaluation of various applicable measures using the data gathered during the site visit. The following steps were conducted to prepare the survey:

- Conduct an Investment-Grade survey of the facility to obtain equipment nameplate data and observe the building's operation.
- Deployment of various Energy Audit Instruments including Metering, Power Quality analysis and recording devices, Combustion Analyzer, Light Meters, Temperature Measuring Devices, RMS Electrical Meters, etc.
- Discuss system operating characteristics and usage profiles with building occupants and operators, and
- Review equipment manufacturer data.

Subjective factors used to determine the overall energy performance of the building include:

- Comfort of the building occupants,
- Mechanical equipment operating safety, and
- Evaluation of current equipment maintenance practices.

The 450 bed Georgetown Public Hospital presently spends about $360,468,843 per annum for the 5,680,483 kWh of Electricity consumed as well as another $54,960,100 burning 278,125 liters of diesel fuel oil. Thus the total cost of energy spend is approximately $415,000,000. This is the largest hospital in the country providing no-cost care to the citizens and is comprised of multiple clinics covering most common medical conditions along with advanced care needs through the Surgery Suites and Intensive Care units.

This Investment Grade Energy Audit has identified thirteen Energy Management Opportunities applicable to the Georgetown Public Hospital facility.

The energy and cost savings will result in an estimated reduction of 957,227 kWh or about 17% of the electrical use and a reduction in fuel oil consumption of approximately 27,191 Liters or about 10%, with total identified cost savings of $60,303,600 GYD ($301,518 USD) per year.

At a total estimated installed cost of $103,918,800 GYD ($519,594 USD) these projects have a combined payback period of about 1.7 years. Table #1, ECO Matrix, summarizes the energy savings, cost savings, and implementation costs for each of the recommended projects.

Additional projects which could not be completely quantified or require further investigation are discussed at the end of this report. .

The following Table summarizes the findings and recommendations applicable to the facility. The table lists the ECO, electric kWh savings, diesel fuel savings, the annual cost savings from implementing the ECO's, the capital cost requirements, along with the simple payback period.

Table 1: ECO-Matrix

ECO DESCRIPTION	Annual Electric Demand Savings	Annual Electric Energy Savings kWh	Annual Electric Cost Savings $GYD	Annual Diesel Savings Liters/yr.	Annual Diesel Savings ($GYD/yr.)	Total Annual Cost Savings ($GYD/yr.)	Rough Order of Magnitude (ROM) First Cost $GYD	Simple Payback (Years)
Energy Awareness - Energy Team / Campaign		113,610	$6,110,200	5598	$1,099,200	$7,209,400	$4,000,000	0.30
Program A/C Controls - Split Systems		33,865	$1,916,800			$1,916,800		Instant
RCx Main Building - HVAC re-commissioning		180,900	$10,239,000			$10,239,000	$6,655,200	0.60
Install T-8 Lighting - All Bldgs - See details #4	47.29	300,543	$17,928,000			$17,943,800	$19,311,200	1.10
Install Variable Frequency Drive on Surgery AHU		22,363	$1,266,000			$1,266,000	$1,500,000	1.20
Install Web-based Thermostat Controls - Split Systems		56,959	$3,206,800			$3,206,800	$5,200,000	1.60
Install Lighting Controls		24,480	$1,385,600			$1,385,600	$2,720,000	2.00
Reduce System Steam Leaks		-		2699	$530,000	$530,000	$1,060,000	2.00
Improve System Steam Condensate Return		-		5398	$1,060,000	$1,060,000	$3,180,000	3.00
Install BMS on Main Building HVAC		180,900	$10,239,000			$10,239,000	$34,000,000	3.30
Install O^2 Trim Burner Conrols (2 boilers)*		3,189	$180,400	5398	$1,060,000	$1,240,400	$4,240,000	3.40
Install LED Lighting - Exterior / Laundry/ Misc	9.97	43,607	$2,673,000			$2,220,400	$10,292,400	4.60
Install Boiler Stack Economizers		-	$0	13495	$2,650,000	$2,650,000	$16,000,000	6.00
TOTAL	**57.26**	**957,227**	**$54,964,400**	**27191**	**$5,339,200**	**$60,303,600**	**$103,918,800**	**1.72**

*Installation of O_2 trim for boilers was not included in the Totals. We have suggested that the Boiler Economizers are a better long term investment despite the higher investment.

RECOMMENDATIONS

Based on the finding of the energy audit work performed we offer the following suggestions for implementation of the ECO's in TABLE #1.

Immediately seek funding and approval to implement the following ECO's as PHASE I:

- ECO #1 – Energy Team – Energy Awareness Program
- ECO #2 – Program the existing controls on the split system Air Conditioners
- ECO #4 – Install T-8 Lighting throughout
- ECO #5 – Install Variable Frequency Drive on Surgery air handler
- ECO # 7 – Install lighting controls
- ECO #12 – Install exterior LED lighting

The approximate cost to implement the above ECO's is $37,823,600 with anticipated achievable annual cost savings in the amount of $69,765,600 and a resultant simple payback of less than one year.

After successful completion of the ECO's in PHASE I, we recommend the implementation of some of the other ECO's as PHASE II as follows:

- ECO #3 – Re-commission Main Building HVAC
- ECO #8 – Reduce System Steam Leaks
- ECO # 9 – Improve Steam System Condensate Return
- ECO #13 – Install Boiler Stack Economizers

The second phase of the energy improvements will require and investment of $26,895,200 which is projected to return $14,533,000 each year for a simple payback of a little over two years.
Following the suggested phasing will allow the operators to become familiar with the concepts and be more comfortable with the more complex undertakings in Phase 2.

2. ENERGY AUDIT TRAINING PROGRAM

One of the main objectives of conducting the investment grade energy audit was to allow participants to engage directly in the data collection process by means of working with the audit team. Among the knowledgeable group of audit participants were the following individuals:

Name	**Organization**	**Title**
Carlyle Benjamin	University of Guyana	Professor - Technologist
Kamal Haricharan	GPH	Maintenance Planner
Brian Constantine	Tetra Tech	Energy Engineer
Leon De Souza	Guyana Energy Agency	Energy Engineer
Edward Peters	GPH	Manager – O&M
Kevon Grimmond	University of Guyana	Electrical Engineering Student
Ronald Rowe	GPH	Industrial Electrician

Over the course of seven days the participants accompanied the members of the Energy Audit Team to a wide variety of tasks. Some of the trainees accompanied our team Electrical Engineer to discover the procedures needed to assess the electrical power quality of the hospital. Fluke Power analysis meters were installed to record the incoming voltages and waveforms of the electricity furnished by the utility. Graphs and recordings were obtained and used to illustrate the various phases, the maintained voltage levels, the real time power consumption, power factors, harmonic distortion, etc. During the Georgetown Hospital Energy Audit and Training Workshop, the above individuals received extensive training with the use of a Fluke 434 Electrical Power Quality Analyzer. The individuals were involved in the selection of the two main transformers and their corresponding generators to obtain power data logging information.

The team was exposed to the identification of the three phase buss bars required to gather information on the load requirements logged as kVA and kW demand for the facility. With the

use of the Fluke power quality analyzers they were able to witness the selection of buss bars for voltage sensing and current transformer (CT) placement to obtain the demand information along with the power factor and harmonic distortion levels.

The team further witnessed the instruction to obtain this information utilizing the Automatic Transfer Switches allowing the capture of the backup generator loading profiles when the generators were engaged. Each team member was exposed to the real time logging capability of these meters. Each team member was further instructed on the use of protective gear such as, electrical mats, shoes, gloves, face-shields, hard hats, etc.

The same data was obtained when the standby generators were brought on line due to intermittent failures of the electrical grid system. The installation procedures for the Current Transformers providing input to the Fluke Power Meters were carefully explained and demonstrated several times. The installation of these "CT's" can result in serious injury or death if not done properly, so the emphasis was placed on the important safety aspects of the procedure. Students were shown how to be sure the power was isolated off using common VOM Meters before installing the CT's to prevent accidents.

The display screens and graphs obtained during this electrical data gathering training was used to illustrate the issues and waste of energy that can occur when power quality issues are discovered. Particular emphasis was placed on the "droop" of voltages with the needed ongoing explanations of the consequences on the electric motor loads.

The Standby Generators were also monitored and it was discovered that they were insufficiently sized to maintain voltage levels when operating. Again, graphs obtained by the metering were used to train the participants as to what to be aware of. In the main Clinic Building the participants were exposed to several control cabinets containing various relays, switches, fuses, and operating controls. The use of handheld meters was demonstrated to show which of the control systems were working as designed and which needed remedial work.

Figure 1: Control Panel at Georgetown Hospital

The team was trained and exposed to the use of Fluke voltage sensing probes to find live circuits. Also the team was trained in the use of Fluke clamp on amp meters to identify motor loads in each phase of three phase motor windings.

A control cabinet exercise was conducted to assist the team in the reading of control circuit diagrams to troubleshoot and identify motor starting contactors for easy three phase amp readings at the contactor instead of at the motor. This data was used to compute horsepower delivered by the motors

A further exercise was conducted with the team to utilize another brand of analyzer on a third location. However, the supplied analyzer was determined to be inoperable. The team was able to successfully identify the three phase circuits to properly obtain the demand data.

Training was provided to teach the participants how to assess the meaning and operation of the indicator lamps as well as confirming the actual operating factors of the equipment.

Figure 2: Training participants at Georgetown Hospital

Various training team members were shown the proper use of portable Data Loggers manufactured by HOBO. The data loggers utilized included functions for lighting analysis, temperature trending and recording, and motor operation run times. As a method of additional training reinforcement, one of the lighting data loggers was installed in the training room of the Cara Lodge where the ensuing two day training workshop was conducted. The data from this data logger was downloaded to a computer and displayed during the workshop training to reinforce the students understanding of the application and capabilities of portable data loggers.

A complete lighting survey of all Hospital Facilities was conducted by the students and energy audit team members. The forms furnished for use allowed for the capture of the quantity of lighting fixtures, the wattage of the ballasts and lamps, the identification of various types of outdoor fixtures as well as incandescent lamps located throughout the facility. This data was then used as the basis of the recommended lighting improvements.

Students were exposed to the operation and maintenance issues that result in energy waste by examining the air handling and chilled water systems located on the main Clinic Building and servicing the Operating Theaters. Attention was given to common energy wasting items such as missing pipe and duct insulation, failed air handling door gaskets, the consequences of dirty heat

transfer surfaces, and the relative ventilation typical code requirements of these applications. A review of the operating controls was included as discussed previously in the electrical discussion above.

The students were included in the assessment of the Boiler House operations, including the use of a computerized Bacharach Combustion Analyzers to determine the relative waste heat going through the boiler flue exhaust stacks. Demonstrated was the ability to adjust the air/fuel damper on the boilers to reduce the excess oxygen and improved combustion efficiency as fully explained in other portions of this report.

The energy audit team pointed out various energy savings opportunities in the overall steam and condensate system, including the issues of poor condensate return, failed condensate return pumping systems, excess boiler blowdown, steam trap maintenance and missing pipe insulation as well as steam leaks that contribute to energy waste in these systems.

The field training exercise was conducted in such a manner as to provide hands-on capabilities for the students to use during future energy audits. Emphasis on "where to look" and understanding what would be typically encountered during an energy audit were considered essential learning goals. Understanding how the various systems are designed to operate and comparing theory with the field conditions is a valuable learning tool that was heavily emphasized.

During the workshop a team in excess of 40 people, that included Electrical inspectors, Consultants, Electrical Engineers, Auditors, Managers, OSHO, Power Company Personnel, Lecturers, Educators, etc. were exposed to the power quality concepts and their practical use to examine power usage and demand to improve overall hospital efficiency.

3. GEORGETOWN PUBLIC HOSPITAL

The population of Guyana is 771,057 and Georgetown, the capital city is approximately 250,000. The Georgetown Public Hospital receives approximately 171,110 patients per year (469 per day). Guyana Public Hospital (6°48'59" N, 58° 09'23"W) is the largest hospital in Georgetown. The hospital currently operates at a capacity 450 beds. The fairly new Ambulatory Care and Diagnostic Center is well equipped and houses a new Accident and Emergency Department. There is a 4-suite Operating Room and a 2-suite minor surgery room. There is also an 8-bed Intensive Care Unit (ICU) with state-of-the-art equipment.

The facility comprises of a North and South campus consisting of multiple buildings (list of buildings in the appendix) which totals 253,537 sqft. It is estimated that only 29% or 73,347 sqft is air conditioned space. This is located in the main hospital building, clinics, surgery, intensive care areas and offices located around the site. A layout of the hospital is on the next page. Details of equipment identified and operational measurements are in the appendix of the report.

Georgetown Public Hospital is one the largest hospitals in the country, with around 450 patient beds. The hospital consumes about half million units of electricity per month and at an average unit cost of more than $61.05 GYD (US$ 0.30)/kWh, the monthly expenditure on electricity alone is in the order of $30,525,000 GYD (US$150,000). In addition, the facility requires over 20,000 liters of diesel oil for its four standby DG sets and use by the facility Boilers. Air-conditioning accounts for the major electrical load for the facility. It has two water chillers, 28 mini-split and 38 window air-conditioning units and 11 packaged units. The facility uses process steam supplied from the three boilers. The hospital also has four diesel generating sets to provide emergency backup electricity, which operated an average of 35 hours in the last year. The electricity distribution system for the hospital is currently undergoing an upgrade. The GPL is converting the electricity distribution frequency from 50 Hz to 60 Hz to reduce the distribution losses and was scheduled to be completed by December 2011, but is still in process as of this writing.

Table 2: Electricity Supply and Major Loads

Electricity Supply and Major Loads for the Georgetown Public Hospital	
Electricity Generation and Supply:	
Electricity and Fuel supply	Electricity - national grid (GPL); Diesel: bulk supply
Average monthly diesel consumption (KL)	20,700 liters (boilers and diesel generators)
Average monthly diesel cost ($)	$4,222,800 GY dollars
Manufacturer and nameplate capacity of each standby power diesel generator	Caterpillar Diesel set 2 of 400kVA each
	EG Wilson Diesel set 1 at 330kVA and 1 at 268kVA
Average monthly run time of diesel generators	Approximate run time – 3 h/month
Major Loads:	
Window units and capacity	38 window units @ 1.5 tons
Mini-split units and capacity	28 split units @ 3 tons each
Packaged units	11 packaged units @ 54,000 BTU each
Water chillers and capacity	2 York chillers @ 75 tons each
Steam boiler and capacity	3 Superior Boilers @ 80hp each
Pumps	4 pumps @ 300 gpm
Laundry equipment	3 industrial size washing machines

Table 3: Monthly Energy Data for GPH

Meter	kWh (Energy)	kW (Demand)	Monthly Cost (GY$)	GY$/kWh	US$/kWh)
IT0001119	9079	38	765,695	84	0.42
IT0000431	109490	296	6,965,982	64	0.32
IT0001518	265540	666			-
IT0001460	37152	125	2,465,650	66	0.33
IT0002191	68340	226	4,505,952	66	0.33

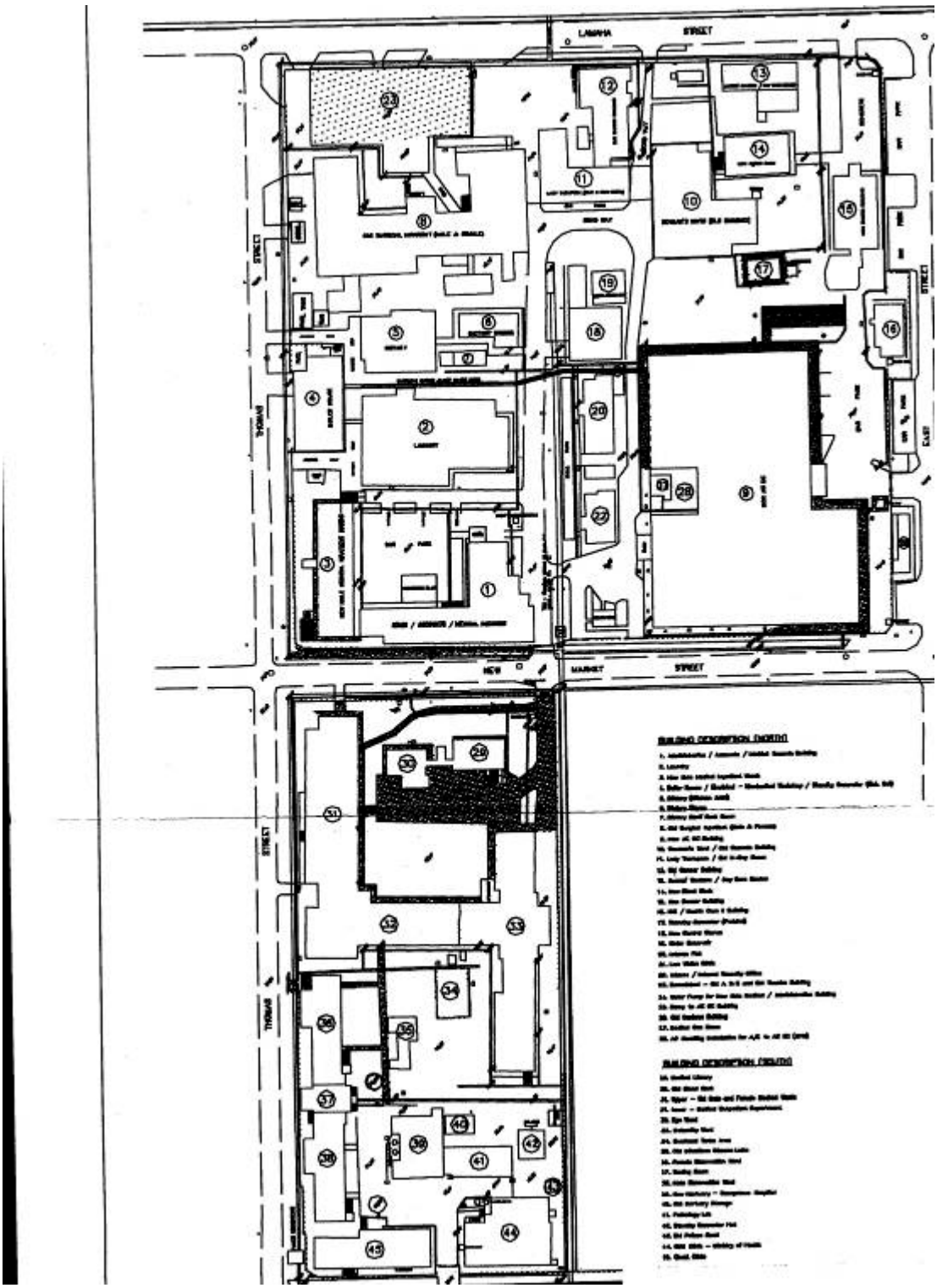


Figure 3: Hospital Layout

3.1 UTILITY INFORMATION

This section of the report details the energy consumption history of the Georgetown Public Hospital facility in Georgetown, Guyana. Based on 2011 data, Utility costs are divided as follows; electricity 85% and diesel 15%.

Table 4: Annual Utility Expenditures

Georgetown Public Hospital Utility Costs 2011 -GYD	
Electricity	$305,508,743
Diesel	$54,960,100
Total	**$360,468,843**

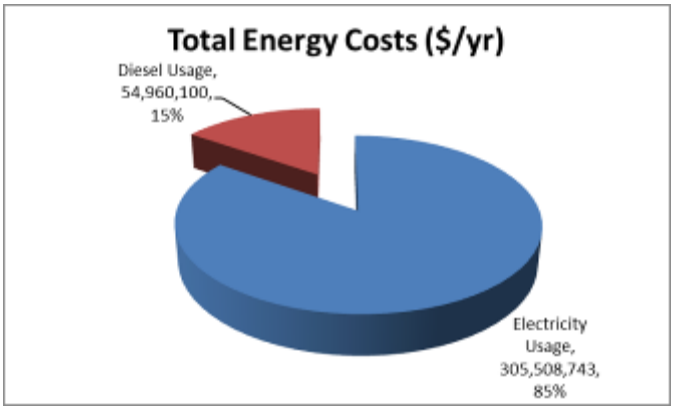


Figure 4: Annual Energy Costs

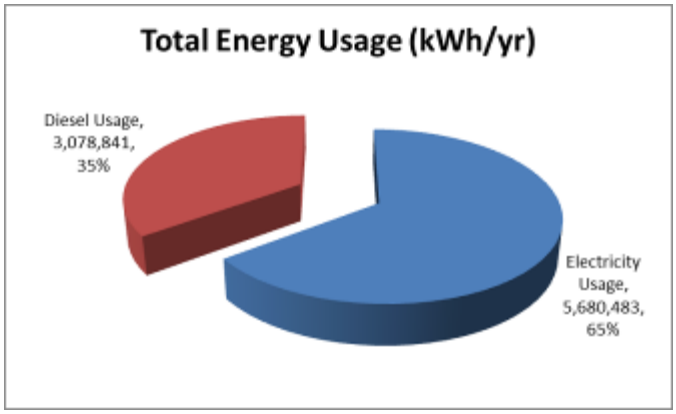


Figure 5: Annual Energy Usage

3.2 ELECTRICITY USAGE AND COSTS

The Georgetown Public Hospital processes over 21 electricity accounts. Of these only six accounts cover the actual hospital site, the remaining small accounts are for various rental facilities and building outside the site. A summary of the six main electric accounts is presented below:

Table 5: Monthly Electricity Data

	Electric Demand (kW)	Total Energy Usage (kWh)	Total Cost ($ GY)
January-11	1,042	470,240	30,072,200
February-11	1,007	441,804	28,369,400
March-11	1,116	439,443	28,525,000
April-11	1,206	491,756	31,473,600
May-11	1,211	478,417	30,734,000
June-11	2,688**	432,401	30,650,420*
July-11	1,105	462,945	29,543,000
August-11	1,391	502,806	32,557,000
September-11	1,271	498,638	32,046,000
October-11	1,276	494,274	30,650,420*
November-11	1,243	499,781	33,039,200
December-11	1,215	467,977	30,144,800
Totals		**5,680,483 kWh**	**$305,508,800**

Note: $0 cost months due to billing credit

*Average Monthly consumption for the 10 months of actual bills received.

**Billing discrepancy

Based on the 2011 billing information, it is estimated that the Georgetown Public Hospital facility energy usage is approximately 5,680,483 kWh per year which represents an annual electric cost of $305,508,800 GYD. The estimated cost for energy was determined after accounting for standard monthly charges; individual block rate charges etc. and assumed to be $56 per kWh and $193 per kW for the purposes of calculating cost savings in this report.

The following chart represents the site's energy usage verses Cooling Degree Day (CDD) information. Cooling Degree Days are a relative measure of how much air conditioning would be used at that weather condition. Thus, the greater the number of degree days, the greater the use and consequent consumption of electricity for air conditioning needs. This shows that energy usage for the site shows some correlation with the weather data. We would expect such an outcome due largely to the site's large base electric load each month, since essential utilities are always in use without regards weather or occupancy.

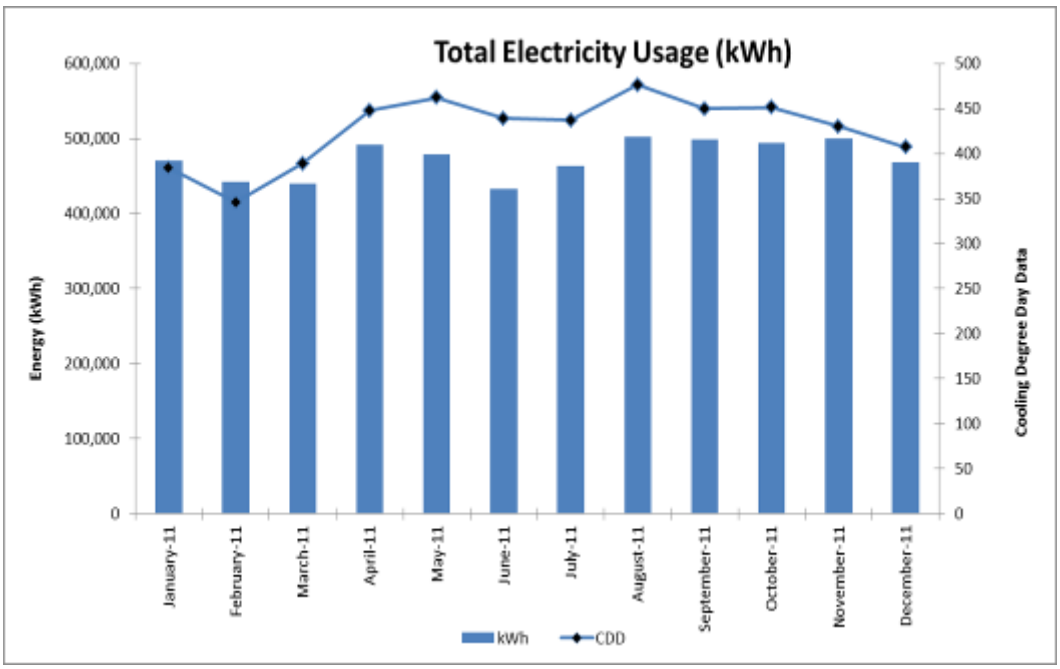


Figure 6: Consumption vs. Degree Days

Georgetown Public Hospital does not seem to present a strong correlation in terms of cooling degree day data for use in attempting to track and predict the site's electricity usage. The most probable reason for this is simply the fact that only about 30% of the facility is actually air conditioned. We would expect a stronger correlation to the weather data Cooling Degree Days if the facility was completely air conditioned since the foregoing graph seems to indicate the logic of the assumption.

3.3 ELECTRICAL USE BY CATEGORY

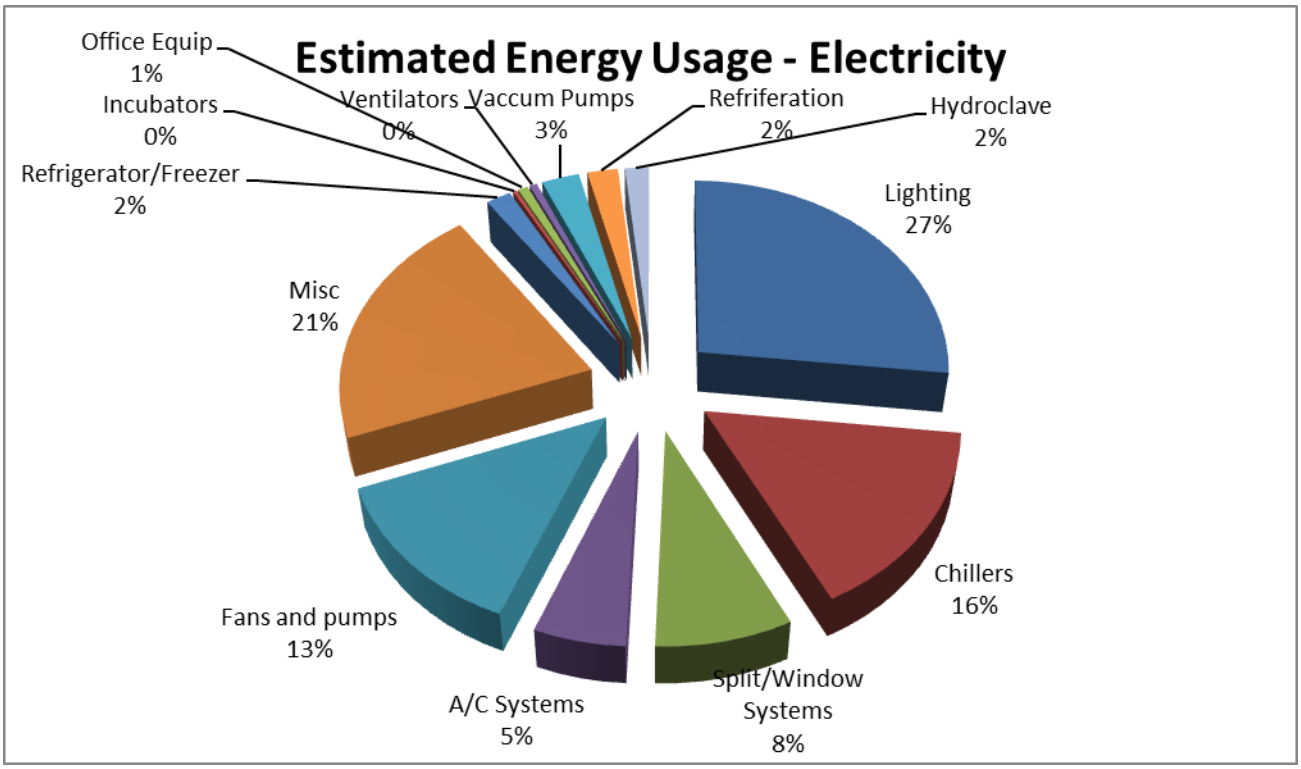


Figure 7: Electricity Use by Type

This graph illustrates how energy is used at the site. It is possible that the lighting and AC systems operate for longer periods than estimated based on conversations with members of staff. Additional analysis of building usage and operations will help to identify further the individual energy uses in the miscellaneous section.

3.4 DIESEL USAGE AND COSTS

The following represents the diesel usage for the Georgetown Public Hospital facility in Georgetown, Guyana for 2011.

Table 6: Monthly Diesel Fuel Use

Period	Usage Liters	Cost ($ GY)
January-11	8,990	1,658,920
February-11	35,672	6,647,010
March-11	18,251	3,604,546
April-11	19,974	3,944,960
May-11	19,732	3,897,060
June-11	28,568	5,823,900
July-11	20,700	4,088,250
August-11	20,913	4,130,384
September-11	26,505	5,234,804
October-11	25,476	5,394,904
November-11	25,744	5,084,362
December-11	27,600	5,451,000
	278,125	**54,960,100**

Based on the recent billing information, it is estimated that the Georgetown Public Hospital facility energy usage is approximately 278,125 liters per year. The average cost for energy was assumed to be $198 per liter for the purposes of this report which represents an annual diesel cost of $54,960,100.

The consumption of the diesel fuel is not metered into either the boilers or the standby generators, although it is recommended that the hospital implement such sub-metering as soon as possible to assist in distributing costs. Additionally, diesel fuel is purchased randomly when the onsite storage tank appears to be drawing down. Fuel is delivered in 6,900 liter loads as that is the capacity of the delivery vehicle.

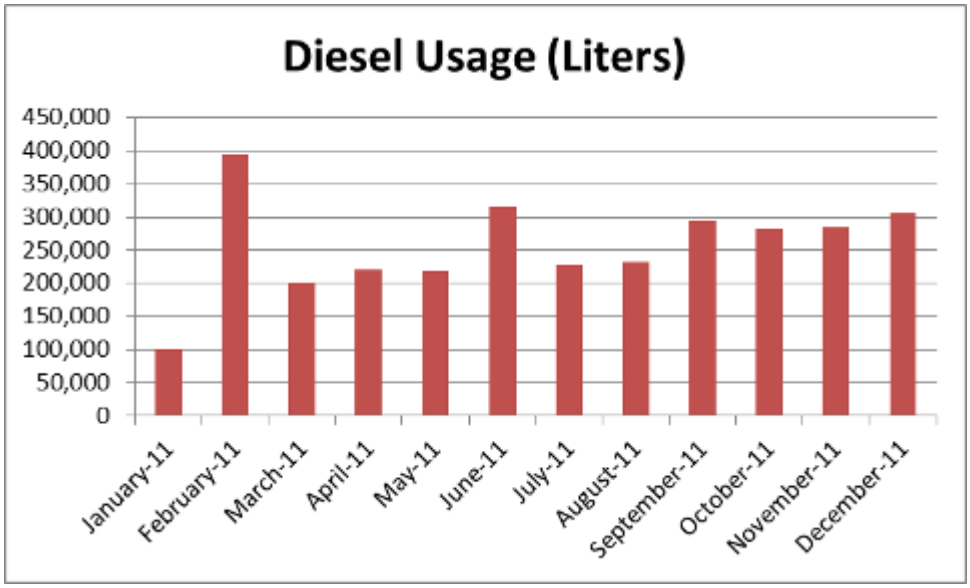


Figure 8: Monthly Diesel Purchases

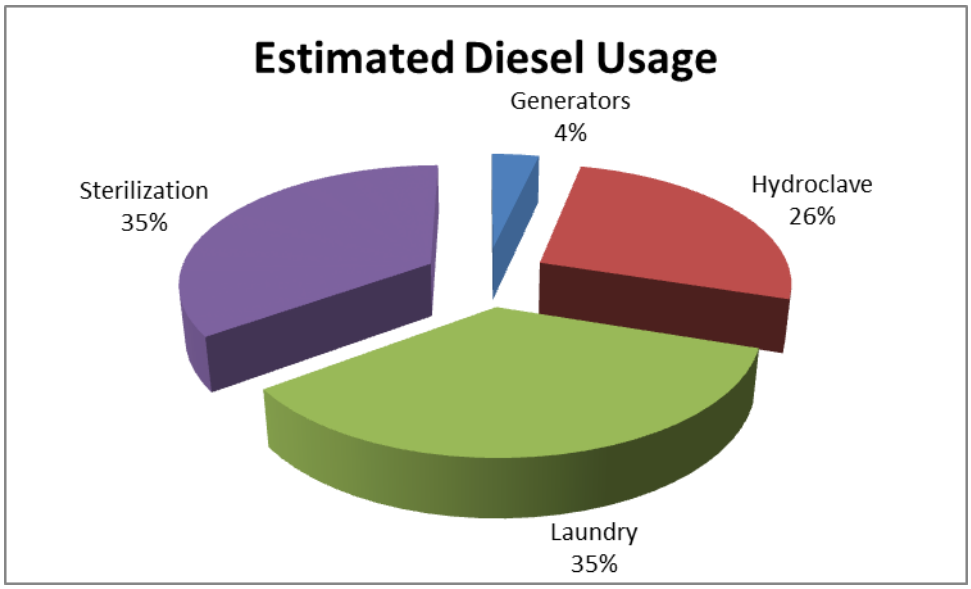


Figure 9: Diesel Use by Type

3.5 STANDBY GENERATORS OPERATION

Based on generator logs taken off the generators themselves and matched to handwritten logs kept by the onsite operators,, the number of hours of operation for the generators have been identified and summarized below. Operating times each year range from 35 hours per year, up to several days, particularly in 2009. Total operating hours for the latest full year, 2011 was only 35 hours.

Table 7: Annual Generator Operating Hours

Year	Generator Operating Hours per year
2007	48
2008	37
2009	130
2010	55
2011	35

3.6 WATER USAGE AND COSTS

Table 8: Water Bills 2009

Prd	Voucher#	Vendor Name	Description	Amount
2	4600462	Guyana Water Inc.	Charges for 2009	6,750,000.00
4	4601122	Guyana Water Inc.	Charges for 2009	7,000,000.00
10	4604261	Guyana Water Inc.	water charges 2009	5,109,534.00
12	4605027	Guyana Water Inc.	Water charge @ 171 Rupa place	78,658.00
12	4605194	Guyana Water Inc.	Doctor flat @ East Street	19,800.00
Grand Total				**18,957,992.00**

Table 9: Water Bills 2010

Prd	Voucher#	Vendor Name	Description	Amount
1	4600168	Guyana Water Inc.	CHARGES FOR 2010	5,000,000.00
4	4601332	Guyana Water Inc.	CHARGES FOR 2010	7,500,000.00
7	4602527	Guyana Water Inc.	PAYMENT ON ACCOUNT 2010	6,250,000.00
10	4603583	Guyana Water Inc.	CHARGES FOR 2010	6,250,000.00
Grand Total				**25,000,000.00**

Table 10: Water Bills 2011

Prd	Voucher#	Vendor Name	Description	Amount
1	4600166	Guyana Water Inc.	CHARGES FOR 2011	8,000,000.00
4	4601376	Guyana Water Inc.	WATER CHARGES 2011	7,000,000.00
7	4602625	Guyana Water Inc.	WATER CHARGES FOR 2011	7,000,000.00
10	4604214	Guyana Water Inc.	WATER CHARGES FOR 2011	6,000,000.00
Grand Total				**28,000,000.00**

Water charges for 2010 and 2011 are assessed based on random estimated consumption. While opportunities may exist for Water Conservation ECO's, absent consumption information is it impossible to assign valid estimates of savings.

3.7 ENERGY CARBON FOOTPRINT

The calculated environmental impact for Georgetown Public Hospital's energy usage represents 12,053,800 lbs. of CO2 per year. Implementation of the recommendations of this report will have a positive impact on the environment and is estimated to reduce Georgetown Public Hospital's Carbon Footprint or CO_2 emissions by at least 1,654,425 lbs. of CO_2 per year or 14% based on your energy carbon footprint.

Table 11: Annual Carbon Emissions

	Carbon Emissions (lbs. CO2 per year)
Electricity Usage *	7816345
Diesel Usage **	4237455
Total CO_2 Emissions	**12,053,800**

*Source generation efficiency over grid to Hospital is assumed to be 35% which is the approximate grid losses in the USA and results in the need to offset additional CO2.
**Diesel Fuel is site use in the boilers and generators and calculated as such.

3.8 BENCHMARK INFORMATION

Building Site Energy Use Intensity (EUI)

This metric is the sum of the total site energy use (kWh/yr.) per unit of gross building area (ft^2). This metric is one of the most commonly used whole-building performance metrics, because the data required are usually easy to obtain from utility bills.

This metric has been used to benchmark Georgetown Public Hospital relative to peer buildings. The peer group is a sub set of buildings that have similar characteristics in terms of climate zone, and occupancy hours. We used data from hospitals in Florida (http://www.energystar.gov) and Jamaica (TetraTech Energy Audits) for comparison purposes in this report.

Based on the analysis below, Georgetown Public Hospital appears to operate a fairly energy efficient site, based on a kWh/ft^2 basis (EUI). This is supported by our review of the sites HVAC systems, controls, O&M practices and also a review of after-hours operations. Although a significant amount of control is performed manually, after-hour's walk-through by security staff turning off lights etc., has resulted in a low energy usage index (EUI) at the site. However it must be noted that the other comparative facilities have more air conditioned space and this results in Georgetown Public Hospital operating with a lower apparent EUI.

Table 12: Comparative EUI Index

	kWh/yr	**kWh/bed**	**kWh per sqft**	**Cost $ Guyana**	**Cost per bed $ Guyana**
Electricity Usage	5,680,483	12,623	22	305,508,743	678,908
Diesel Usage	3,078,841	6,842	12	54,960,100	122,134
Total	**8,759,325**	**19,465**	**35**	**360,468,843**	**801,042**
Number of Beds	450				
kWh per bed	19,465				
Cost per bed	801,042	$ Guyana			
Total Est. Sqft	253,537				
kWh per sqft	**34.55**	**for Georgetown Hospital**			
kWh per sqft	42.50	For Miami, FL - new hospitals			
kWh per sqft	39.00	For Jamaica			

3.9 OPERATIONS AND MAINTENANCE RECOMMENDATIONS

Based on the site visit and conversations with members of staff, it would appear that the site has a system of maintenance practices and procedures in place. We noticed that the sites preventative maintenance procedures could be improved. Maintenance appeared to be performed as equipment failed or as a problem was identified. We recommend a detailed review of maintenance procedures by the Energy Team to determine whether further maintenance procedures can be put in place to reduce energy and operating costs. Improving maintenance procedures has been shown to reduce energy and operating costs which can often help justify increased manpower to implement the new maintenance programs.

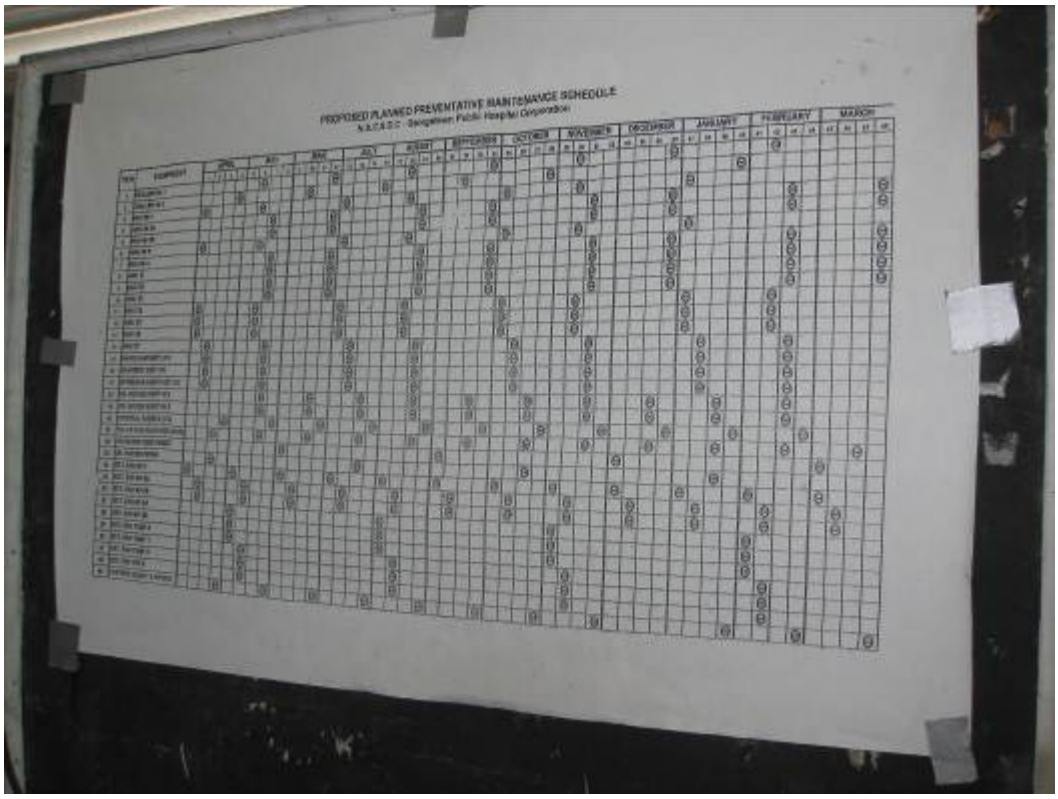


Figure 10: Current Calendar-based Maintenance Schedule for Main Clinic and Surgery Building

Much of the HVAC maintenance is performed by way of a subcontracted air conditioning maintenance operation. Our team observed the presence of a Television up in the Mechanical Maintenance penthouse over the Main Clinic Building. This TV was always switched on as we visited and surveyed the building which would seem to indicate that the maintenance technician, a sub-contractor, likely had free time that could be put to work improving general

maintenance practices. It is our recommendation that this television be removed immediately and permanently.

The following outlines the benefits of different maintenance programs.

1) **Reactive Maintenance -** Repair of service equipment when it is broken or in need of repair. This approach is appropriate for non-critical, non-expensive components.

2) **Preventive Maintenance** – Repair or service is performed at a predetermined time interval (i.e. Every 3 months, every 30,000 hours, etc.). This is the consistent performance of a manufacturer's recommended tasks.
   - Reduces maintenance costs
   - Ensures stability of customer's business processes by reducing unplanned downtime
   - Core of a strategic approach to service

3) **Predictive Maintenance** – Adds the component of diagnosis of equipment symptoms to the element of preventive maintenance's scope.
   - Vibration analysis and other technologies
   - Maximizes equipment efficiency and life
   - Provides a higher level of equipment uptime assurance

4) **Proactive Maintenance** – Utilizes predictive services to determine the root cause of equipment problems.
   - Use technology and information
   - Treat the root cause of the problem, not just the symptom
   - [Eliminate costly recurring problems]
   - [Achieve the highest] level of equipment uptime assurance
   - Combine with preventive and predictive for the maximum impact

The purpose of this section is to describe cost effective operations and maintenance (O&M) measures identified during the survey. The recommended O&M measures listed below are based on information gained from the detailed survey of the facility, discussions with the building's occupants, maintenance and a review of the energy systems. The engineer has made recommendations based on this survey of the existing facility. While every effort has been made to gain as much information as possible, it is impossible to determine every O&M measure. The facility's staff and Energy Team are encouraged to continue to search for other possible O&M measures.

General Recommendations:

HVAC
(Currently subcontracted – ensure that contracted PM is performed)

1. Lock thermostats
2. Clean radiators and air registers
3. Check operation of automatic controls
4. Program/set indoor temperature setpoints (see ECM #2)

VENTILATION
(Currently subcontracted – ensure that contracted PM is performed)

1. Inspect operation of outdoor air dampers
2. Check mechanical operation (fans, motors, dampers)
3. Improve filter maintenance
4. Maintain positive interior pressure

INFILTRATION

1. Check/Repair door and window caulking
2. Check/Repair door and window weather-stripping
3. Check/Repair wall and roof insulation

UTILITY PLANT DISTRIBUTION SYSTEMS

1. Monitor boiler makeup water
2. Operate minimum number of boilers
3. Isolate off line boilers
4. Repair boiler, tank, and pipe insulation
5. Subcontract : Annual boiler efficiency and combustion tuning
6. Check operation of steam traps
7. Repair all leaks

DOMESTIC WATER SYSTEMS

1. Check/Repair leaks
2. Raise chilled water temperature settings on water fountains
3. Repair insulation on pipes and storage tanks

LIGHTING

1. Maximize use of daylight
2. Clean lamps and fixtures
3. Improve reflectance of surfaces
4. Utilize task lighting
5. Use photocells

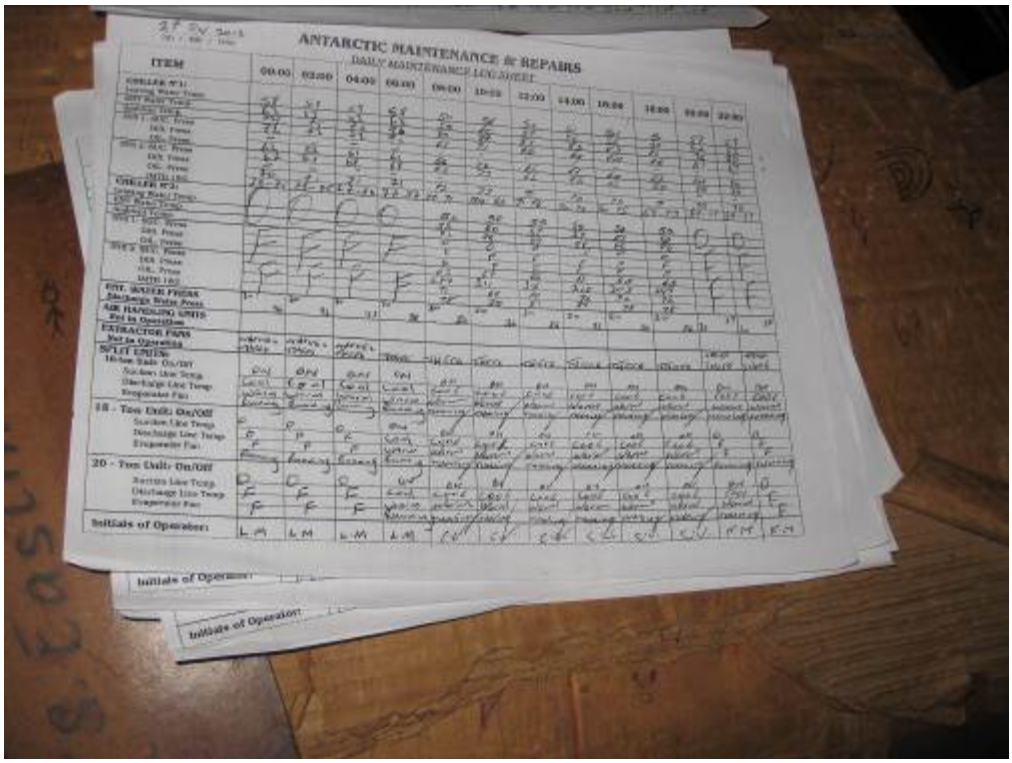


Figure 11: Current HVAC Maintenance Logs - Typical

4. ENERGY MANAGEMENT RECOMMENDATIONS

General

The recommendations on the following pages represent our best engineering judgment as to the EMOs that are technically and economically viable for the facility. The EMOs discussed on the following pages include:

Proposed Energy Management Opportunities

In addition to the information presented in this section, the Appendix of this report contains the assumptions and engineering calculations to support each recommended EMO.

- Energy Management
  Energy Team
  Energy Awareness Campaign
- Program AC controls - Split Systems
- Retro Commissioning - Main Building HVAC
- Install T-8 Lighting All buildings
- Install VSD on Surgery AHU
- Install Web-Based Thermostat controls - Split Systems
- Install Lighting Controls
- Reduce Steam System Leaks
- Improve Steam System Condensate Return
- Install BMS on Main Building HVAC
- Install O2 Trim Burner Controls (two Boilers)
- Install LED Lighting - Exterior Fixtures/Laundry/Miscellaneous
- Install Boiler Exhaust Stack Economizers (two Boilers)

Additional Energy Management Projects

4.1 ECO #1 - ENERGY AWARENESS

Energy Team

Potential energy savings will be highlighted through the creation of a formal framework, increasing awareness and improved monitoring of the areas and levels of energy consumption. Without a formal energy management structure in place, Georgetown Public Hospital will not have specific energy goals. Also, any energy management projects that are implemented will not be tracked effectively. We recommend that Georgetown Public Hospital develop an Energy Team with the following approach and strategy.

Energy Policy

Georgetown Public Hospital has a Corporate Energy Policy and specific goals for Energy and Carbon Management. The Energy Team should tailor the Energy policy to the Georgetown, Guyana site to provide specific direction and goals. We recommend the following actions:

Construct an action plan and strategy

Once a formal site energy policy has been adopted, Georgetown Public Hospital should consider the construction of a formal action plan and strategy for achieving further energy savings. The results from this audit should be used as the basis of an action plan starting with the projects listed on page 5 of this report.

The action plan should be regularly updated with actions required through both management and technical measures. The recommendations made in this report should be used as the basis of the action plan and as a platform for further investigation.

Form an Energy Team

We recommend forming an Energy Team. This New Energy Team would direct Energy projects and Energy Management efforts at the site. The purpose of the Energy Team, whose members

should be from individual areas/departments, should be to identify opportunities to reduce energy consumption and monitor progress to date.

The minutes of the meetings should be logged including any action either completed or required. In its formative stages, the first main target should be to produce an action plan of all measures that have historically and are currently being considered for implementation that will reduce energy consumption.

Conduct regular reviews

The new Energy Team should carry out regular reviews and progress and key energy projects at the facility. Monitoring the site's energy demand and usage should form an integral part of this review.

Energy usage should also be reviewed in all new projects. Project specifications should be reviewed to ensure that energy efficient equipment is specified.

The results of the reviews should be incorporated into the action plan to ensure that energy saving measures are implemented. The action plan should be regularly updated as the reviews are conducted and the results of the improved monitoring and targeting incorporated to identify achievements to date.

Improve Energy Awareness

We recommend that the Energy Team implement an Energy Awareness Program to reduce energy and operating costs.

The level of awareness of energy conservation among all the staff should therefore be improved to ensure that energy conservation measures are implemented. This can be achieved through education, training, and regular energy awareness campaigns. Members of staff will then soon appreciate how minor changes in their daily routines can help reduce energy use and costs.

By creating an energy culture and improving everyone's knowledge about energy use, then any deviation from normal consumption patterns can be quickly identified, which will allow corrective actions to be taken promptly.

Awareness training does not need to be overly technical, but simply related to 'good housekeeping' measures over which members of staff have direct control. For example, staff could switch off lighting in empty areas, check thermostat controls to ensure they are correctly set and report on energy issues and areas of concern to relevant authorities.

Publicize energy efficiency actions and achievements

Actions taken by the Energy Team to reduce energy consumption should be published via existing notice boards and an internal Website to assist in improving the levels of energy awareness.

Monitoring and Targeting (M&T)

The Georgetown Public Hospital facility has a number of electric and diesel accounts for the entire site and there are a number of electric meters located around the site. We recommend that Georgetown Public Hospital consider installing metering that will allow for real time energy usage monitoring for each main building (such as the main hospital building) and significant operations within the buildings. This is recommended as part of the BMS project, later in the report.

The purpose of monitoring and targeting (M&T) is to relate your energy consumption data to the weather and/or other measures (such as occupancy) in such a way that you get a better understanding of how energy is being used. In particular, it will help identify if there are signs of avoidable waste or other opportunities to reduce consumption. Once meters have been installed, Georgetown Public Hospital will be able to track energy usage, benchmark buildings, and individual operations at the site.

For now we recommend that the Energy Team track and monitor billing information as part of an M&T program. Logging the individual billed energy consumption and demand in a spreadsheet format that can easily be reviewed should be a long-term goal.

Once an M&T program has been set up, its routine operation should be neither time-consuming nor complex. An M&T program will provide essential underpinning for your energy management activities:

1. Detect avoidable energy waste that might otherwise remain hidden. This is waste that occurs at random because of poor control, unexpected equipment faults or human error, and which can usually be put right quickly and cheaply (or, indeed, at no cost). Intercepting and rectifying such problems should more than cover the cost of operating the M&T program.

2. Quantify the savings achieved by any and all of your energy projects and campaigns in a manner that accounts fully for variations in weather, levels of production activity, and other external factors. Many users cite this as the most valuable result of M&T.

3. Identify fruitful lines of investigation for energy surveys. Rather than starting a survey with no clear agenda, you can go prepared with specific questions to ask, prompted by observed erratic or unexpected patterns of consumption.

4. Provide feedback for staff awareness, improve budget setting, and undertake benchmarking.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analysis are provided in the Appendix of the report. Implementation costs are based on time and effort required by members of Georgetown Public Hospital staff. Additional

costs may be required for training and staff training materials, etc. It is important to budget time for energy management and to acknowledge that this effort has a cost to the facility. The savings associated by implementing energy management procedures at Georgetown Public hospital could justify a dedicated full time Energy Manager position to ensure that the procedures are put in place and maintain the program year to year.

We also recommend that a detailed review of existing energy management practices and procedures be performed to help identify strengths and weaknesses - so that the Energy Team knows which areas that the Team needs to prioritize.

Table 13: ECO #1 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	113,610	6,110,200	5,598	1,099,200	7,209,400	4,000,000	0.3

4.2 ECO #2 - PROGRAM AC CONTROLS – SPLIT SYSTEMS

Split system AC usage is estimated to represent approximately 8% of your electricity usage. We recommended that GPH considers programing existing thermostat controls with operating schedules and recommended temperature setpoints to reduce energy and operating costs.

The area thermostat is currently manually controlled and maintained by each occupant. By programming the existing thermostats, and setting temperatures back during night and weekend unoccupied periods to approximately 85°F energy consumption can be greatly reduced.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analyses are provided in the Appendix of the report.

Table 14: ECO #2 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	33,865	1,916,800	0	0	1,916,800	0	Immediate

Figure 12: Typical Split AC with Remote

4.3 ECO #3 - RETRO-COMMISSIONING – MAIN BUILDING HVAC

We recommend that the Georgetown Public Hospital contract with a specialized Engineering Company to "re-commissioning" or "retro-commissioning" the Main Building HVAC systems. Re-commissioning is a tuning-up of the HVAC systems by running tests and making calibrations and adjustments. Re-commissioning includes diagnosis, troubleshooting, making adjustments and minor repairs, and identifying bigger repairs that are needed. This is performed by an engineer and can include working with a test and balance Company. We do not recommend that Georgetown Public Hospital perform this task "in-house".

Commissioning of new buildings has become standard operating procedure for many building owners. Re-commissioning is becoming widely recognized as a valuable tool for improving the energy efficiency and operational effectiveness of existing buildings. This is necessary because most buildings have never gone through any type of commissioning or quality assurance process and are therefore performing well below their potential. The systems that need to be addressed are the central chiller system, packaged HVAC systems and individual A/C units.

Even if building staff have been able to work most of the "bugs" out of the building systems, they are often forced to solve problems under severe time constraints and without the benefit of proper documentation. Addressing problems this way results in "quick and dirty" solutions that lead to other costly building problems. For example, Texas A&M University has re-commissioned over 70 buildings since 1996 and reports a typical energy reduction of 15 to 30% and sometimes as much as 40 percent.

Not only does re-commissioning identify problems that occurred at construction, but it also identifies and solves problems that have developed during the building's life. This can be particularly true when buildings have undergone remodeling or, as most buildings have experienced rapid growth in personal computers and other energy-using, heat-producing, electronic devices.

We recommend that Georgetown Public Hospital consider re-commissioning. Priorities would be the chilled water system and air handling systems, etc. as these are likely to have the greatest opportunity for improvement. Simple paybacks rarely exceeded 4 years and are often two years or less. (Source: Portland Energy Conservation, Inc., A Practical Guide for Commissioning Existing Buildings). By focusing just on the Main Building HVAC system of the Georgetown Public Hospital the cost benefit is increased and should result in a low project payback.

Typical issues identified through the re-commissioning process:

- Sensors defective or out of calibration
- Equipment failures
- BMS not working properly
- Incorrect set points and operating schedules
- Outside air deficiency or overage
- Simultaneous heating and cooling
- Envelope problems

Figure 13: Excessive Boiler Blowdown from Maintenance Issues with Feedwater System

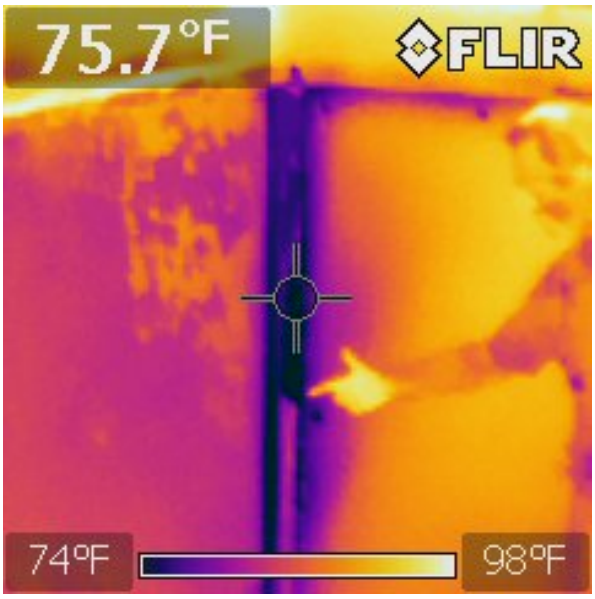


Figure 14: Thermograph of leaking AHU gasket:

Figure 14 shows a FLIR Thermograph of Surgery Air Handling Unit missing gaskets on access doors, causing severe leakage of conditioned air out on the roof. Significant wasted energy is the end result of lack of maintenance and commissioning.

Figure 15: Photo of leaking AHU. Photograph of air handling unit shown in above thermograph.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analyses are provided in the Appendix of the report.

Table 15: ECO#3 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	180,900	10,239,000	0	0	10,239,000	6,655,200	0.6

4.4 ECO #4 - INSTALL T-8 LIGHTING

Georgetown Public Hospital has performed some lighting improvement projects to date; the new building has been installed with a T-8 lighting system. However, our on-site survey indicates that a majority of the site's remaining lighting systems are old T-12 fluorescent lamps and magnetic ballasts.

While a detailed lighting survey of the sites building was performed by the Energy Audit team, it is likely that due to access issues and/or unfamiliarity with the site and its buildings, that the light count should be verified. The lighting audit should also address improvement in controls.

This EMO recommends replacing the existing T-12 fluorescent lighting system throughout the site with a T-8 fluorescent lighting system. The cost of T-8 lamps and electronic ballasts has fallen over the years making T-8 fluorescent fixtures the standard in new construction.

A T-8 fluorescent lighting system is a viable option for anyone considering replacing both lamps and ballasts. Standard fluorescent lamps are designated T-12 (12 being the diameter of the lamps in eighths of an inch). A T-12 lamp is therefore 1-1/2 inches in diameter. More efficient, smaller diameter lamps (1 inch diameter) are available and are designated T-8 lamps. Commercial names for these lamps are "Octron" by Sylvania, "Trimline" by General Electric, and "Octolume" by North American Phillips.

T-8 lamps require less energy to operate (typically 32-Watts instead of the 40-Watts for four-foot lamps installed at the hospital) and have better lumen maintenance than standard T-12 lamps. The T-8 lamps also provide better color rendition than standard T-12 lamps.

Table 16: Fluorescent lamp and ballast performance for standard fixtures.

No. lamps –type	Ballast type	Ballast factor	Fixture lumens	Lumens per watt	Fixture watts
4–F40T12	Std	0.88	9,126	47.53	192
4–F32T8	Elec	0.87	8,926	78.30	114
2–F40T12	Std	0.94	4,874	50.77	96
2–F32T8	Elec	1.29	6,618	118.18	56

Standard magnetic ballasts control current to the lamps. Solid state electronic ballasts operate in a similar manner to magnetic ballasts, but at a much higher frequency. The higher frequency results in a more efficient transfer of input power to the lamps, less energy dissipation and elimination of light decay during each cycle. Some electronic ballasts also have dimming capability. It is likely that lamps recommended for replacement by this measure contain mercury and the ballasts contain PCBs in their insulating oil. Their disposal may be subject to laws and regulations in Guyana. We recommend that the Hospital, and/or its contractors engaged to implement this recommendation, follow appropriate guidelines.

Summary

The following summarizes the energy and economic impact of replacing the existing T-12 fluorescent lighting system with a T-8 fluorescent lighting system.

Table 17: ECO #4 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
47.29	300,543	17,928,000	0	0	17,928,000	19,311,200	1.1

The following summarizes the energy and economic impact of replacing the existing T-12 fluorescent lighting system with a T-8 fluorescent lighting system, building by building, at the site.

Table 18: Lighting Retrofit Summary

Building	Sqft	Demand Savings kW	Energy Savings kWh/yr	Energy Cost Savings $/yr	Project Cost $	Project Payback yrs.
ACDC	83,189	27.86	189,032	$56,162	$51,736	0.9
Mortuary	4,290	0.65	5,668	$1,662	$1,910	1.2
Male Medical	12,774	2.48	21,742	$6,376	$6,476	1.0
Laundry	10,591	0.19	855	$261	$340	1.3
Dietary Stores	1,388	0.17	168	$67	$508	7.7
Kitchen	4,911	1.53	6,899	$2,109	$2,907	1.4
Facility Mgmt.	6,176	2.21	7,721	$2,418	$6,100	2.5
Admin Building	12,251	4.64	16,247	$5,088	$9,986	2.0
Boiler Room/workshops	5,095	0.93	4,176	$1,277	$1,869	1.5
Path Lab	3,314	1.18	5,310	$1,624	$2,631	1.6
Maternity Build	26,273	4.27	37,361	$10,956	$9,212	0.8
Library/Infectious Diseases	5,385	1.19	5,364	$1,640	$2,880	1.8
Total		**47.29**	**300,543**	**$89,640**	**$96,556**	**1.1**

4.5 ECO #5 - INSTAL VSD CONTROLS ON SURGERY AHU

Georgetown Public Hospital is familiar with variable speed motor controls and has installed them on the new domestic water pumping system at the site. While most of the hospital's air handling units (AHU) that can be turned off, are turned off at the end of the day and at weekends, the hospital's surgery air handling system operates 24 hours per day, 7 days per week. Elective surgeries are performed during the day, from 8am to 5pm, and emergency surgery's as required. This means that the surgery AHU operates all the time. We recommended that the hospital consider retrofitting variable speed drive controls to the surgery AHU system to allow the system to be operated at lower speed/volume during night and weekends to reduce energy and operating costs. When emergencies occur and surgeries are required outside normal hours, the system can easily be returned to normal operation. Installing VSD on fans allows for the speed of the fan to match the demand requirements of the system to take advantage of the Centrifugal Fan Laws. Fans installed with VSD's typically obey the "cube law" for horsepower (HP) energy reduction, i.e.

100% flow = 100% kW

80% flow = 51% kW (i.e. 0.8 x 0.8 x0.8)

50% flow = 12.5% kW (i.e. 0.5 x 0.5 x 0.5)

VSD control will improve control of the fans; reduce energy and costs along with reduced maintenance costs.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analysis for each application are provided in the Appendix of the report.

Table 19: ECO #5 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	22,363	1,266,000	0	0	1,266,000	1,500,000	1.2

4.6 ECO #6 - INSTALL WEB-BASED THERMOSTAT CONTROLS FOR SPLIT SYSTEMS

Split system energy usage is estimated to represent 8% of the hospital electric usage. We have recommended programming of the existing thermostat controls as a low cost or no cost option. However we also recommend considering installing alternative thermostat controls to reduce energy and operating costs.

There are new technologies available where the thermostat can be remotely monitored and controlled via the internet (high speed internet not required). This may be a lower cost option for the hospital than these thermostat controls to a building management System (BMS) which may be cost prohibitive. Several manufacturers make "Internet Managed Thermostats" and an example is provided in the back of this report. A regular "name brand" programmable thermostat costs around $100 to $200 each, the Internet Thermostat cost in the $300 to $500 range.

Much of the savings associated with this recommendation can be performed using the existing thermostat controls and through the Energy Awareness program, etc. However, having remote monitoring and control access ensures that the savings are fully achieved.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analysis for each application are provided in the Appendix of the report.

Table 20: ECO #6 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	56,659	3,206,800	0	0	3,206,000	5,200,000	1.6

4.7 ECO #7 - INSTALL LIGHTING CONTROLS

This EMO recommends installing occupancy sensors to control existing lighting systems in the offices, conference, break rooms and waiting rooms, etc. throughout the site. Installing lighting controls is one of the most effective means of decreasing facility operating expenses. When lights are left on unnecessarily, energy costs increase. For instance, a toilet may be occupied only fifty percent of the day, but the lights stay on continuously.

A variety of different lighting controls can be installed in all facilities to insure that lights are operated only when they are needed. Occupancy sensors provide control of lighting fixtures in response to the absence or presence of occupants. They are ideal in areas where lighting or exhaust fans are often left on, such as in toilets, break rooms, offices etc. The two primary types of occupancy sensors used in commercial applications are infrared and ultrasonic sensors.

Passive infrared occupancy sensors detect heat rays emitted from the human body, as well as changes in heat that are caused by movement. These devices are typically not affected by airflow from heating, ventilating and air conditioning (HVAC) systems or other extraneous movements. The sensors can detect motion in a 180-degree arc, and will keep lights on as long as the space is occupied. Passive infrared sensors are suitable for areas such as offices.

Ultrasonic occupancy sensors use a Doppler effect (like radar) to detect motion within a defined coverage area. Unlike infrared sensors, these devices can see over and around objects such as partitions, shelving, and stalls. This characteristic makes them suitable for restrooms.

We recommend contacting a lighting contractor/supplier for lighting control options and pricing before proceeding.

Summary

The following summarizes the estimated energy and economic impact of installing occupancy sensor lighting controls throughout the site. We recommend that you get a contractor to recommend lighting control options for the site to reduce energy and operating costs. Details of the analyses are provided in the Appendix of the report.

Table 21: ECO #7 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	24,480	1,385,600	0	0	1,385,600	2,720,000	2.0

4.8 ECO #8 - REDUCE STEAM SYSTEM LEAKS

This Energy Management Opportunity (EMO) is concerned with the energy savings potential for locating and repairing steam leaks, and steam trap maintenance. Leaks in the steam distribution system waste steam and energy and increase fuel consumption. What is not always apparent is that even a small leak can cost a considerable amount of money annually. We observed a large number of steam leaks at the site. Piping and trap leaks were observed in the boiler plant room and leaks were observed at traps located near the main building. The main condensate return system for the clinic building was inoperative and venting steam. A significant amount of the leaks for this plant will be located outside the boiler room, which may or may not be accessible.

When a trap fails to function properly, steam blows through the trap, resulting in a loss of useable energy, problems with condensate return to the boiler, and failure of steam heated equipment to function properly. We recommend completing a full steam trap survey and repairing or replacing all leaking traps in your facility and performing maintenance on a regular basis. We estimate energy savings up to 2% could be achieved, more if leaks throughout the plant can be fixed.

In the Appendix of this report, a copy of the Department of Energy's Steam assessment tool for Georgetown Public Hospital to review and assess the efficiency of the steam system. Georgetown Public Hospital is encouraged to fill out all the information required so that you can quantify existing practices against standard operating procedures to determine if the operation of the steam system can be improved. An electronic copy of the assessment can be obtained at: http://www1.eere.energy.gov/industry/

The chart on the next page is useful in reinforcing the impact of steam leaks.

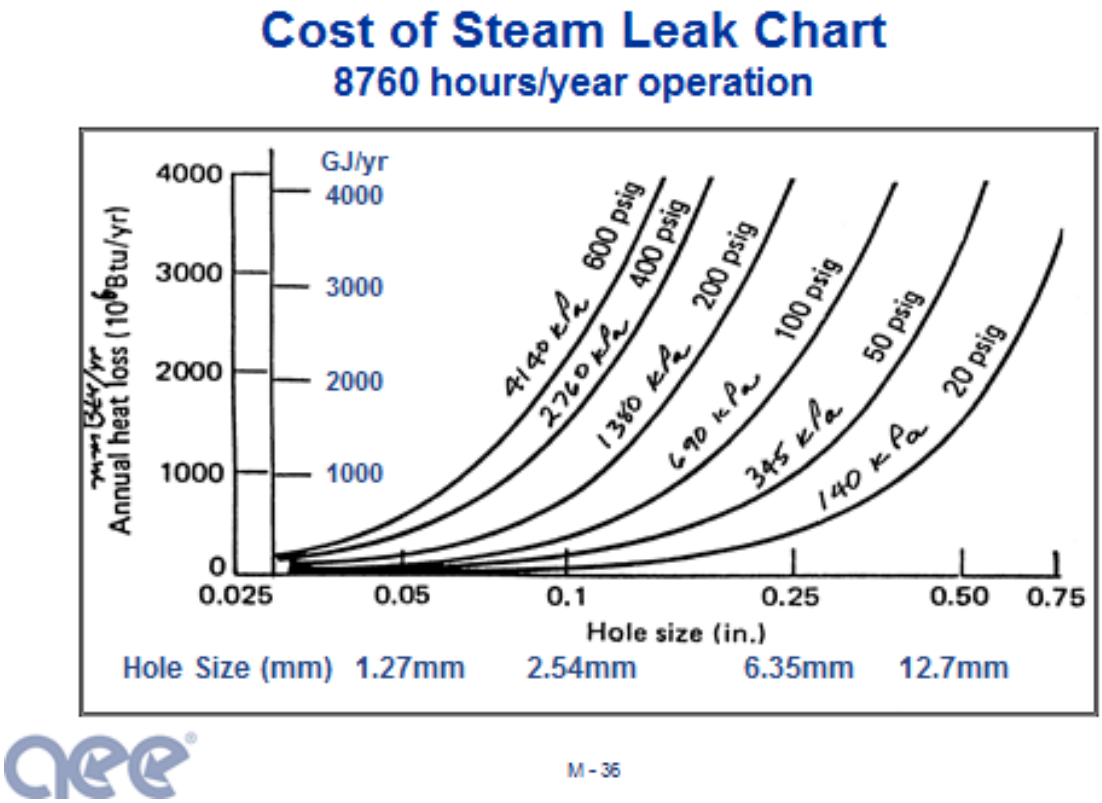


Figure 16: Steam Leak Chart

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Implementation costs are budgetary subject to a more detailed evaluation of steam leak issues. Details of the analyses are provided in the Appendix of the report.

Table 22: ECO #8 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	0	0	2,669	530,000	530.000	1,060,000	2.0

4.9 ECO #9 - IMPROVE STEAM SYSTEM CONDENSATE RETURN

Condensate return levels, based on conversations during the site visit, are low. The Laundry and Hydroclave Medical Waste Shredder applications do require a significant amount of steam, some of which is used directly. However, significant quantities of condensate are clearly lost down the facilities drains. No information on the amount of condensate that could or is being returned to the boiler plant was gathered during the visit but savings of 2% to 5% are typical in systems with very poor levels of condensate return.

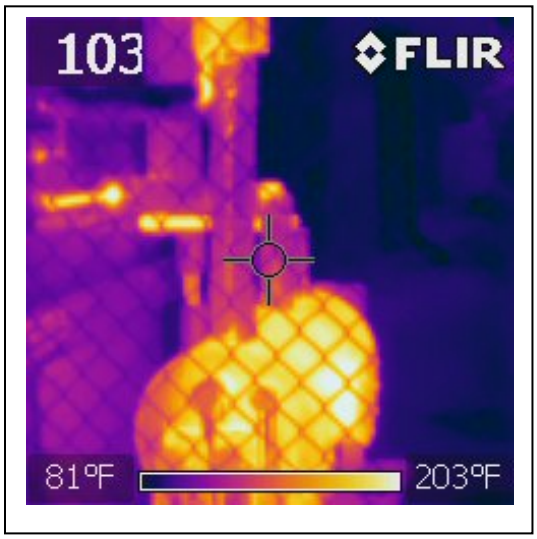


Figure 17: Inoperative Condensate Return System from Clinic: Thermograph of Condensate return station (left), Photograph of Condensate return station (right)

Most of the work to increase the amount of condensate return to the boiler system would have to be performed in the facility and a detailed survey of the steam distribution will be required to identify the condensate return problems. We have estimated that if more condensate could be returned to the plant, the hospital could save up to approximately 3% of the energy cost of the system.

Figure 18: Inoperative Condensate Return system for the Hydroclave Medical Waste Shredder.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Implementation costs are budgetary subject to a more detailed evaluation of the condensate problems. Details of the analysis for each application are provided in the Appendix of the report.

Table 23: ECO #9 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr)	Annual Electric Cost Savings ($/yr)	Annual Diesel Savings (Liters/yr)	Annual Diesel Savings ($/yr)	Total Annual Cost Savings ($/yr)	Capital Cost ($)	Simple Payback (Years)
0.00	0	0	5,398	1,060,000	1,060,000	3,180,000	3.0

4.10 ECO #10 - INSTALL BMS ON MAIN BUILDING HVAC

The main building HVAC controls at the Georgetown Public Hospital are no longer operating and all systems, with the exception of the Satchwell temperature controls, appear to be manually controlled by maintenance staff. Based on maintenance logs, the systems are operated based on occupancy and a time schedule. However, the reliance on members of staff to operate this equipment efficiently means that equipment could be operating unnecessarily for many hours and some equipment may never be turned off.

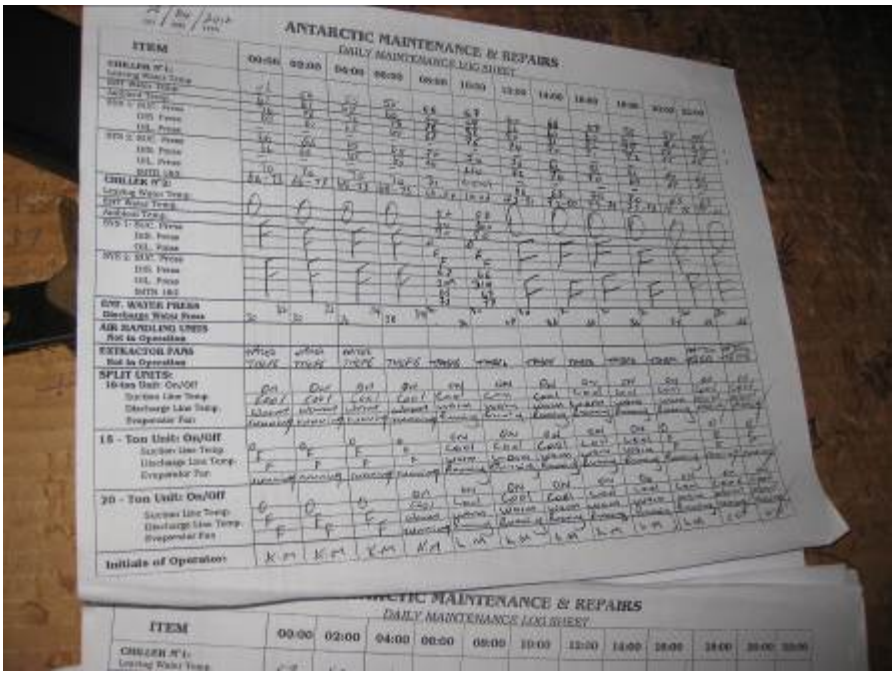


Figure 19: Maintenance Log

We recommend that the Georgetown Public Hospital consider the installation of a building Management System (BMS) to operate the HVAC system for the main hospital building. This should include the chillers, air handling systems, DX systems, along with temperature control.

Georgetown Public Hospital due to the number of building and operations would benefit from a building management system (BMS) that would monitor and control these main energy using systems. Installing submeters monitored by the BMS for electricity and steam usage throughout

the site would enhance the M&T recommendations outlined in the Energy Management section earlier in this report.

Installation costs can be quite high for BMS systems which are based typically on the number of points of control. It is important to identify the minimum number of points of controlled but still provide enough monitoring and control capacity to be effective. It is not considered to be cost effective to install the split system and window AC units found across the site to the BMS.

Due to the high capital cost, it is unlikely that the BMS could be solely justified by energy savings alone. A BMS provides maintenance with useful information about major systems on the site and can reduce overall operating costs. It is important that maintenance staff is well trained on the system and its operation so that the Georgetown Public Hospital can take full advantage of both the energy and operational cost savings from the large investment of the BMS system.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analyses are provided in the Appendix of the report.

Table 24: ECO #10 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr.)	Annual Electric Cost Savings ($/yr.)	Annual Diesel Savings (kWh/yr.)	Annual Diesel Savings ($/yr.)	Total Annual Cost Savings ($/yr.)	Capital Cost ($)	Simple Payback (Years)
0.00	180,900	10,239,000	0	0	10,239,000	34,000,000	3.3

4.11 ECO #11 - INSTALL O2 TRIM BURNER CONTROLS

The boilers at Georgetown Public Hospital do not have a means to optimally control the relative percentage of excess air required for combustion at different firing rates and conditions. A linkage based control of the combustion airflow and diesel flow requires the flow rate to be set at one particular operating point and one particular burner setting. That point is necessarily the flow rate required at 100% firing of the boiler so that under all conditions the minimum amount of excess air is provided. As combustion air is decreased the amount of excess air is reduced but not in the same proportion as the combustion air such that at low firing rates more excess air is required on a percentage basis than is actually required. The fuel valve and combustion air damper are linked together to modulate as the load modulates. By design the combustion airflow is modulated at a different rate than the fuel valve so that there is always more excess air provided than is required. More fuel is required to heat the unneeded excess combustion air. The excess oxygen at low fire can be 10% to 15%, which relates to 5% to 10% stack losses.

Figure 20: Adjusting air/fuel mixture

We performed a combustion test analysis of each of the two boilers operating at the time of the visit, boiler #1 and boiler #3. Both boilers tested at high, low and estimated operating range of around 60% (valve position) showed excess oxygen values between 89 to 250%. A minor adjustment to the linkage of both boilers would reduce the excess air content to around 45% increasing boiler efficiency from 76% to 82%.

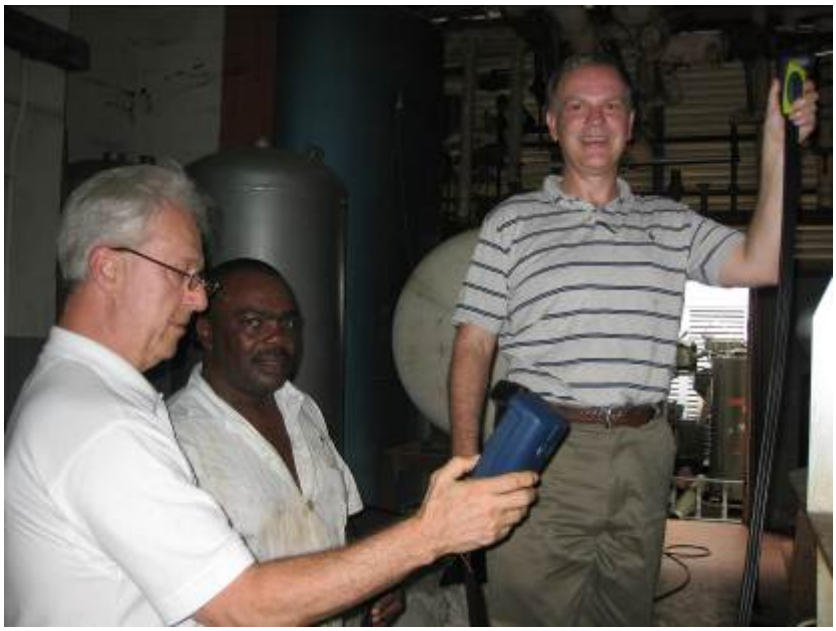


Figure 21: Use of Combustion Analyzer

The installation of oxygen trim control(s) will allow fine-tuning of the combustion airflow control damper with respect to fuel valve modulation. The fine-tuning will be accomplished based on an input signal from an O2 and/or CO sensors in the exhaust stack. The excess air will be limited to the quantity required for safe operation of the boiler over its entire operating range such that the percent of oxygen in the combustion exhaust stack is controlled to 2% (assuming diesel is the fuel). We estimate that energy savings up to 2% could be achieved.

This EMO also recommends installing an adjustable (ASD) or variable speed drive (VSD) on the existing 2 horsepower combustion blowers. The VSD can convert a single speed motor to variable speed with no modification to the motor itself. This can be an efficient way to convert, for example, constant volume systems into variable volume systems that can adjust to the load of

the system. VSD's are readily available for motors from 1 hp to 300 hp and are easily installed directly into the power line leading to the motor, replacing the existing motor starter.

The VSD operates on a simple principle. The rotational speed of an AC induction motor depends on the number of poles in the stator and the frequency of the applied AC power. Although the number of poles in an induction motor cannot be altered easily, variable speed can be achieved through a variation in frequency. The VSD rectifies standard 60 cycle AC line power to DC, and then synthesizes a variable frequency AC output. Motors connected to VSD provide variable speed mechanical output with high efficiency. These devices are capable of up to a 9:1 speed reduction ratio (11 percent of full speed), and a 3:1 speed increase (300 percent of full speed). We estimate that savings of up to 40% of the energy used to operate the motor could be achieved.

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. Details of the analyses are provided in the Appendix of the report.

Table 25: ECO #11 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr.)	Annual Electric Cost Savings ($/yr.)	Annual Diesel Savings (Liters/yr.)	Annual Diesel Savings ($/yr.)	Total Annual Cost Savings ($/yr.)	Capital Cost ($)	Simple Payback (Years)
0.00	3,189	180,400	5,398	1,060,000	1,240,400	4,240,000	3.4

4.12 ECO #12 - INSTALL LED LIGHTING

Georgetown Public Hospital has a small number of 250-watt metal halide fixtures in the Laundry and Boiler room. The exterior lights are estimated to be primarily 175-Watt Mercury Vapor (MV) fixtures. We have investigated the options for the hospital in reducing energy usage for lighting and found that newly available LED lighting fixtures are becoming a viable option.

Several manufacturers make 88-Watt LED fixtures that can be used in place of 250-Watt Metal Halide and Mercury Vapor fixtures. The typical costs for these fixtures in the past have been well over $1,000 each resulting in very long project paybacks. Fixtures are now available below $600 resulting in project payback within a reasonable range.

Figure 22: Mercury vapor exterior light fixture nearing failure. Note the "green" tint.

We recommend reviewing the light output (lumens) of the proposed LED fixtures to ensure that it provides equivalent light output to the existing Metal Halide and Mercury Vapor fixtures and that the light quality or color is acceptable. Many of these existing fixtures were in need of

refurbishment and/or replacement which only helps to justify the switch to new LED type. These newer lighting technologies may also reduce maintenance costs as the LED lamps will last significantly longer than the existing fixtures.

Table 26: Luminaire Efficiency - sample data from the EERE website.

	Metal Halide	**LED**
System Watts	208	153
Initial Lamp Lumens	11,700	N/A
Downward Efficiency	81%	100%
Downward Lumens	9,477	10,200
Luminaire Efficiency	**46 Lumens/Watt**	**67 Lumens/Watt**

We identified only a small number of incandescent lamps around the site; these were typically 40-Watt lamps. LED or compact fluorescent replacements are recommended for these lamps to further reduce energy and operating costs

Summary

The following summarizes the estimated energy and economic impact of LED lighting throughout the site. We recommend that you get a contractor(s) to recommend fixtures and lighting control options for the site to reduce energy, operating costs and take advantage of the available rebates. Details of the analyses are provided in the Appendix of the report.

Table 27: ECO #12 Summary

Annual Electric Demand Savings (kW)	**Annual Electric Energy Savings (kWh/yr.)**	**Annual Electric Cost Savings ($/yr.)**	**Annual Diesel Savings (Liters/yr.)**	**Annual Diesel Savings ($/yr.)**	**Non-Energy Savings ($/yr.) (*)**	**Total Annual Cost Savings ($/yr.)**	**Capital Cost ($)**	**Simple Payback (Years)**
9.97	43,607	2,673,000	0	0	-46,900	2,220,400	10,292,400	4.6

(*) Negative due to life cycle costs, the high costs of LED fixture results in a small negative life cycle cost.

4.13 ECO #13 - INSTALL BOILER EXHAUST STACK HEAT RECOVERY

The boilers at the Georgetown Public Hospital provide steam to the Laundry, Hyroclave and for generating hot water all year round. A diesel (or any other type of fuel) direct fired steam boiler converts the chemical energy of the fuel into heat energy in a combustion process and transfers the heat to water converting the water to its vapor phase (steam). The efficiency of a direct fired boiler is equal to the amount of heat contained in the fuel source minus the boiler radiation losses and the losses of heat through the elevated temperature flue gases all measured in BTU/hr. Radiation losses normally account for 1% to 3% of the fuel input flow rate at full load conditions.

Flue gas losses can be accounted for as unburned fuel and elevated temperature combustion by-products. The larger of these two losses is the elevated temperature flue gases leaving the boiler. The total amount of the losses from the high temperature flue gases can range from 15% to 70% of the fuel input heat. The only way to reduce these loses is to recover more heat from the combustion by-products. Heat can generally be recovered to preheat the air used in the combustion process or heat the boiler feed water. Boiler feed water heaters, usually termed economizers, are normally more cost effective than air preheaters. Based on the combustion analysis performed on-site, we conservatively estimate that up to 5% of the energy can be recovered from the boilers by installing new exhaust stack economizers.

Figure 23: Stack Economizer

Figure 24: Domestic Hot Water Tanks

Figure 25: Boiler Feed-water System

Summary

A summary of the estimated energy and cost savings for this recommendation is presented below. The project economics are based on two boilers (to reduce project costs and project simple payback) being installed with economizers to ensure that at least one of the two boilers operating is recovering heat. Details of the analyses are provided in the Appendix of the report.

Table 28: ECO #13 Summary

Annual Electric Demand Savings (kW)	Annual Electric Energy Savings (kWh/yr.)	Annual Electric Cost Savings ($/yr.)	Annual Diesel Savings (Liters/yr.)	Annual Diesel Savings ($/yr.)	Total Annual Cost Savings ($/yr.)	Capital Cost ($)	Simple Payback (Years)
0.00	0	0	13,495	2,650,000	2,650,000	16,000,000	6.0

5. ADDITIONAL ENERGY MANAGEMENT OPPORTUNITIES

5.1 STEAM AND CHILLED WATER PIPE INSULATION

We recommend a rolling preventative maintenance program to inspect and repair/replace piping insulation throughout the site as needed. This project was highlighted early in our discussions as an energy project; however, based on thermal imaging around the site, we found that the piping insulation performance better than the visual condition. Some valves, steam traps etc. were un-insulated and there were various areas with missing insulation. A preventative maintenance program to insulate and repair insulation will reduce energy and operating costs.

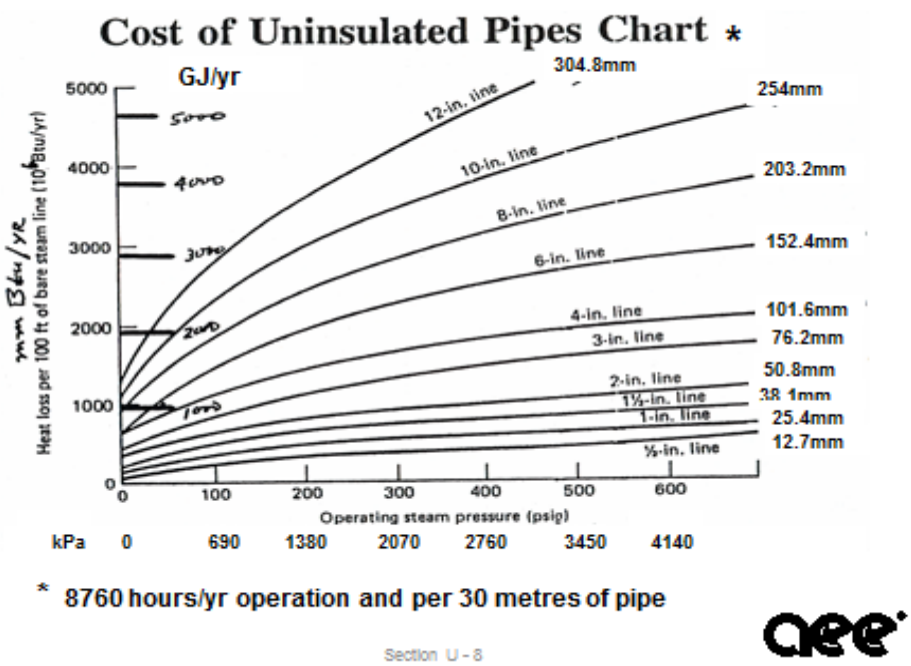


Figure 26: Heat loss thru un-insulated pipes

5.2 INSTALL ENERGY EFFICIENT MOTORS - BURNOUT

It is recommended that Georgetown Public Hospital purchase and installs only high efficiency motors when replacing existing motors that fail. Electric motors function as energy converters changing electrical energy to mechanical energy and are one of the most efficient means of energy conversion known. Although some losses do occur in the conversion process, the majority of the

electrical energy delivered to the electric motor is converted to mechanical energy and delivered to the load. Electric motors are typically 80.0% to 97.5% efficient with the losses showing up as heat.

Energy efficient electric motors are generally 1.0% to 8.0% more efficient than standard efficiency electric motors. Standard efficiency motors typically incur yearly operating costs of 10 to 20 times purchase price, compared to 8 to 12 times purchase price for premium-efficiency motors. Energy efficient electric motors achieve efficiency gains by using heavier gauge copper for windings, increasing the cross sectional area of the windings, increasing the length and quantity of iron used in the motor core, tighter tolerance air gap between rotor and stator to reduce magnetic flux losses, using smaller cooling fans due to reduce winding losses and improving the motor manufacturing process. The increases in efficiency will result in lower operating costs and longer life due to the reduction in heat generated by the losses.

5.3 COGGED V-BELTS

Georgetown Public Hospital uses a mix of standard and cogged v-belts in their belt drive applications. We recommend installing only cogged v-belts to reduce energy and operating costs. Replacing standard v-belts with cogged v-belts can reduce drive losses due to the higher drive efficiency of cogged v-belts. Although cogged v-belts are approximately 25 percent more costly than standard v-belts, the additional cost is offset by the longer life expectancy of cogged belts; therefore, the incremental implementation cost is effectively zero. Cogged v-belts are more efficient than solid v-belts because of their notched profile, which allows the belt to flex more easily around the pulley. This application results in reduced energy absorption by the belt and consequently less heat buildup and improved drive efficiency. It is reasonable to assume that drive efficiency will increase from 94 percent for standard belts to 96 percent for cogged belts. This increase in efficiency provides essentially the same level of energy savings as the use of energy-efficient motors, at a fraction of the cost.

6. POWER RELATED ISSUES AND RECOMMENDATIONS

Georgetown Hospital personnel requested the monitoring of two of their most heavily loaded transformers. One had a 750 kVA capacity and the other was a 500 kVA capacity. Each will be replaced shortly as upgrades to the electrical distribution system are in progress.

To further support their electrical needs, Georgetown Hospital has four diesel generating sets to provide emergency backup electricity.

The electrical distribution system is currently undergoing an upgrade and GPL is converting the electrical distribution frequency from 50 Hz to 60 Hz to reduce the distribution losses.

Two new transformers are in place and will upgrade the 750 kVA to 1500 kVA and a 500 kVA to 750 kVA

Figure 27: New Transformers

Electrical load data was taken over a five day period that included three weekdays and a weekend load profile.

Below are the results of the kVA demand on the 750 kVA transformer. The average kVA load on this transformer ranged from 400 to 650 kVA indicating a relatively loaded device which is operating within its design upper limits.

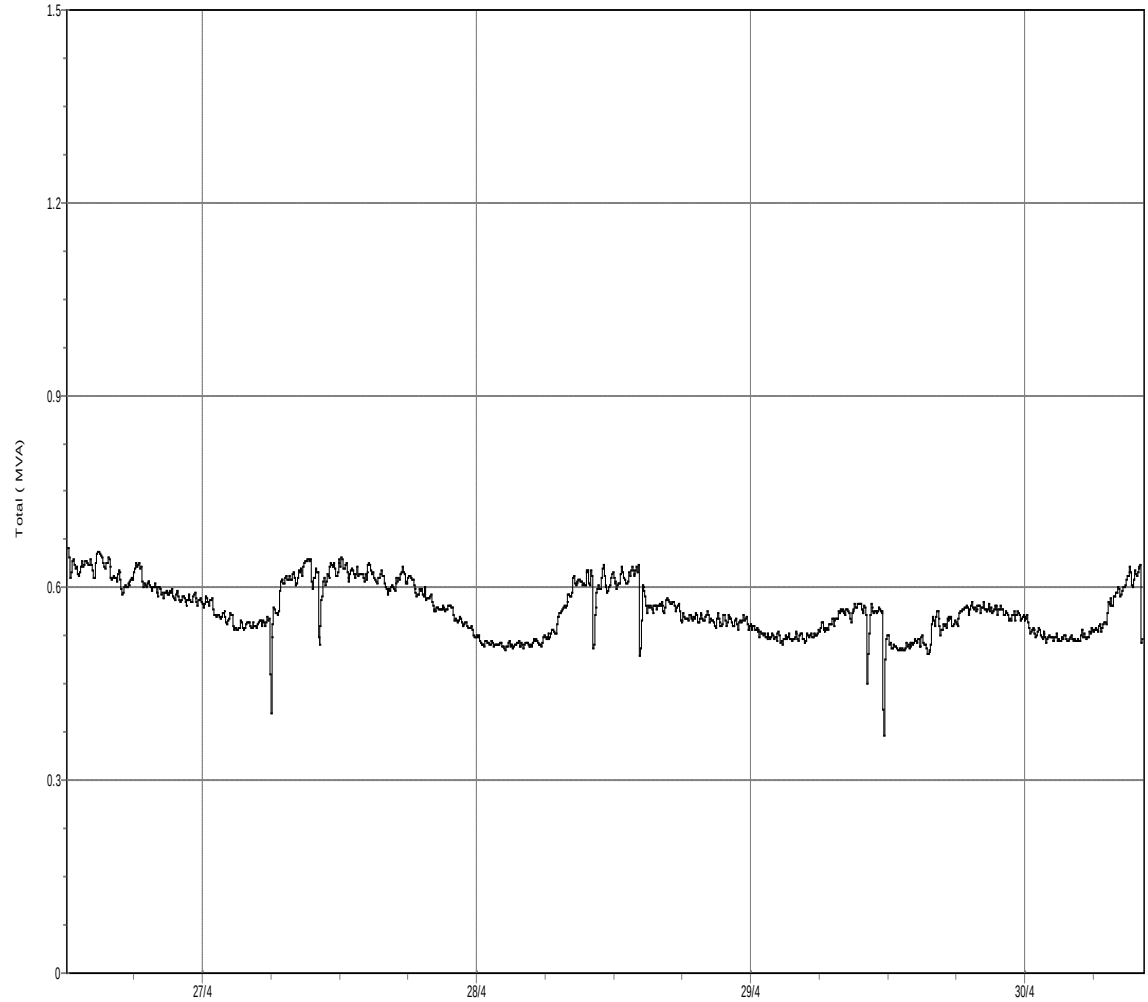
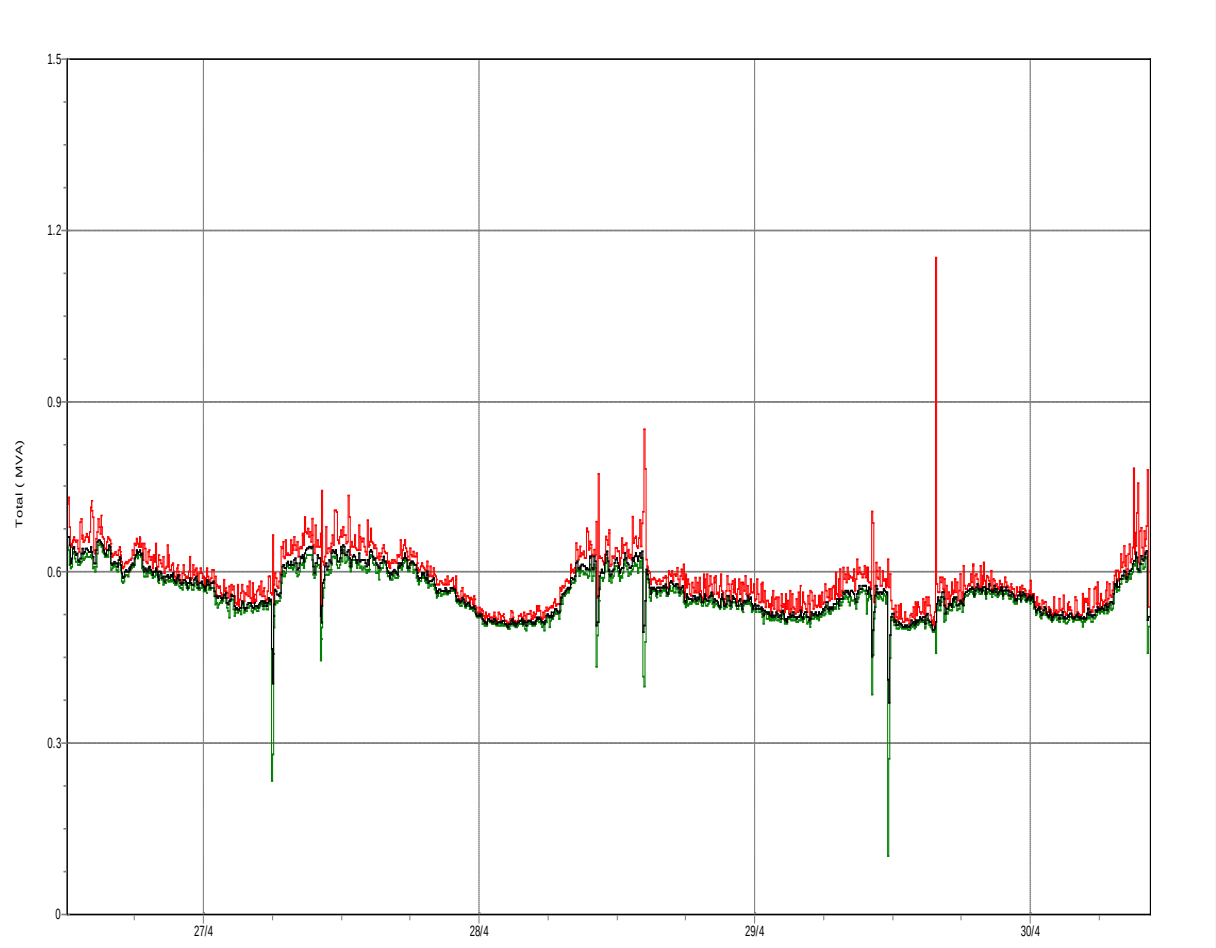


Figure 28: Demand load on 750 kVA Transformer

Adding the minimum and maximum power data recordings below to the same graph, this 750 kVA transformer on occasion is exceeding its capacity.

Maximum (Red) and minimum (Green) kVA's are superimposed over the Average (Black).



4/27/12 4/28/12 4/29/12 4/30/12

Figure 29: 750 kVA loads – Min – max – average

The electrical load data was taken at the Automatic transfer switch (ATS) so the generator load could be captured concurrently when an outage occurred.

Figure 30: Fluke Power Meter installation

The L1, L2, and L3 voltage load profile of the 750 kVA transformer is shown below. The average line to neutral voltage was roughly 241 to 243 volts that represents a phase to phase voltage of 417 to 421. This is at a 5% low voltage limit on a 440 volt system.

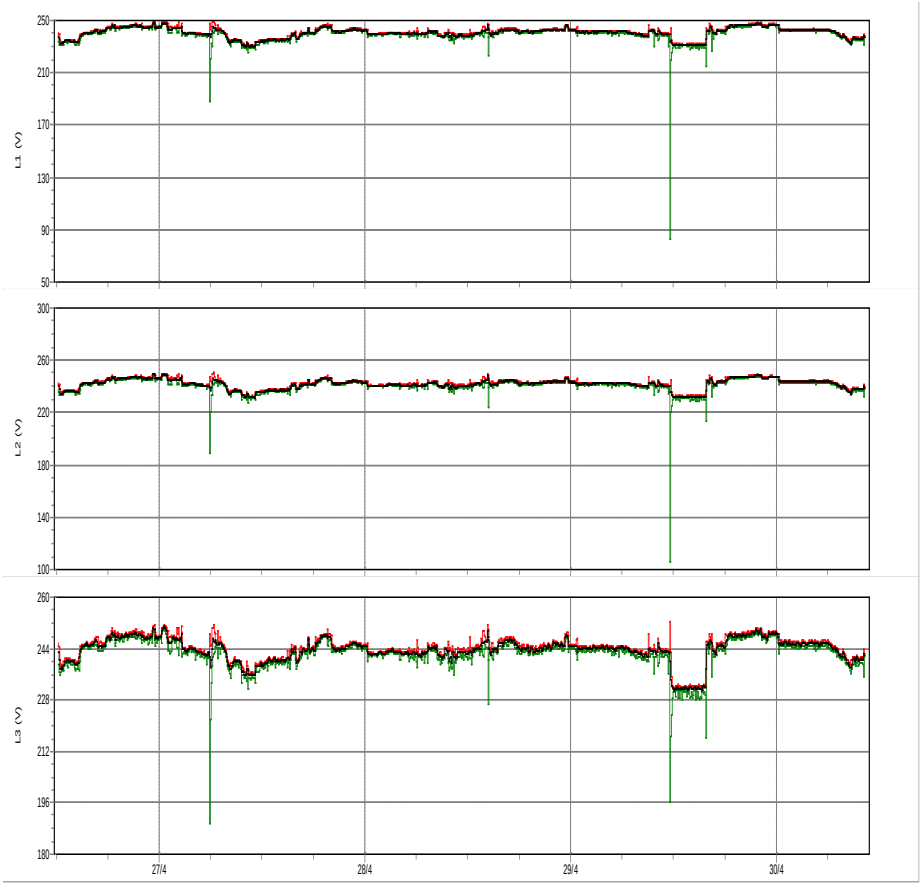


Figure 31: Voltage variation of Phases

The consequence of the voltage being under limits is that all loads will pull more amperage to compensate for the condition. This causes excess heat in all the conductors and the motor windings significantly reducing motor life.

Motor life is severely affected by low voltage. Notice the significant drop in voltage when the generators were employed near the second last day of recording shown in the graph below. The phase voltage dropped to 231 volts line to neutral or 400 volts phase to phase. This is unacceptable. The generators cannot maintain the required 440 volt limits.

The average power factor is shown below and ranges from .73 to .81. Significant improvement can be made here to increase the power factor to .95. This will unload the kVA demand on the transformers to allow for additional kW load and will improve the overall system voltage.

Since the transition to the new transformers was not complete at the time of the energy audit the opportunity must be re-assessed when the conversion to 60 Hz power is completed.

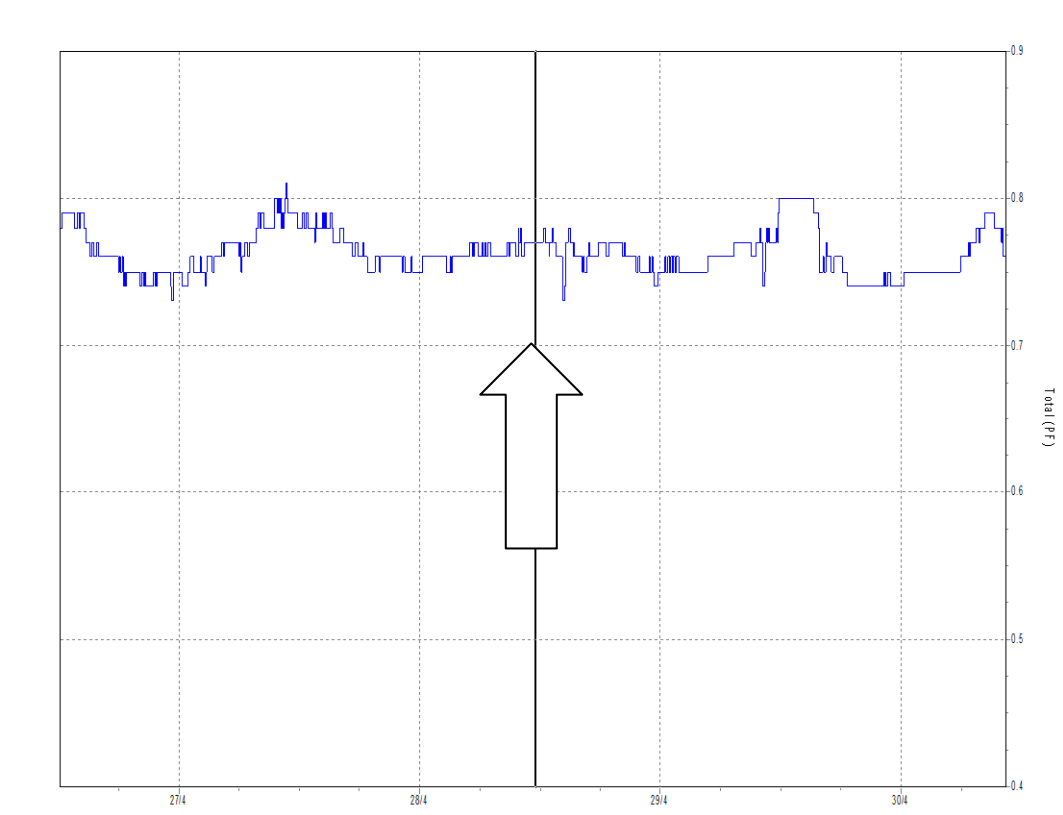


Figure 32: Voltage drop from generator operation

The 750 kVA transformer at the maintenance shop location had a total harmonic voltage distortion was less than 1% of the fundamental waveform. Additional voltage harmonic content was very low for the third, fifth and 7th harmonic.

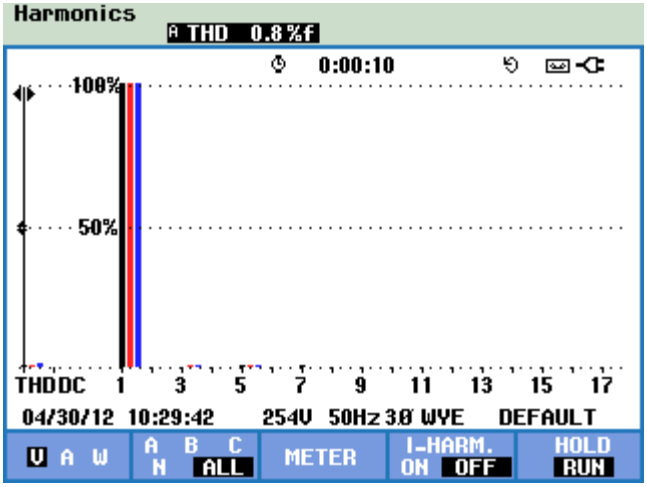


Figure 33: Harmonic Voltage Distortion 750 kVA Transformer

The 750 kVA transformer at maintenance shop had a total harmonic current distortion of 3%. This is well within acceptable limits. Other current harmonic levels were also very low and acceptable.

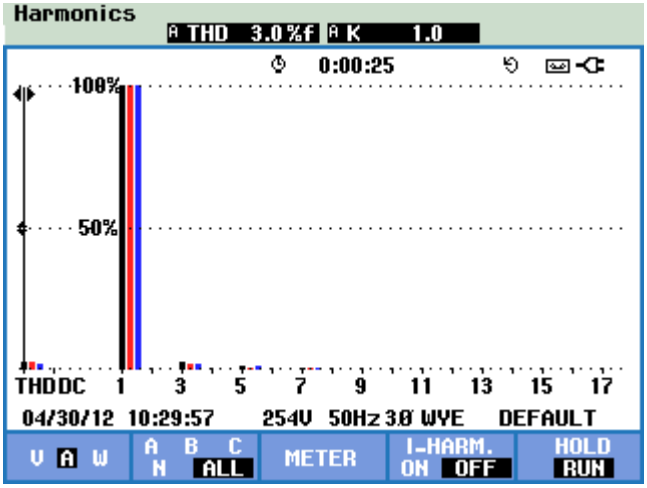


Figure 34: Total Harmonic Distortion 750 kVA Transformer

The 500 kVA Transformer Distribution at 240 Volts 3 Phase had the following electrical characteristics.

Figure 35: 500 kVA Transformer

Below are the results of the kVA demand. During the week the average load is 170 to 200 kVA and on the weekends the load is flat at 100 kVA. This transformer has plenty of capacity.

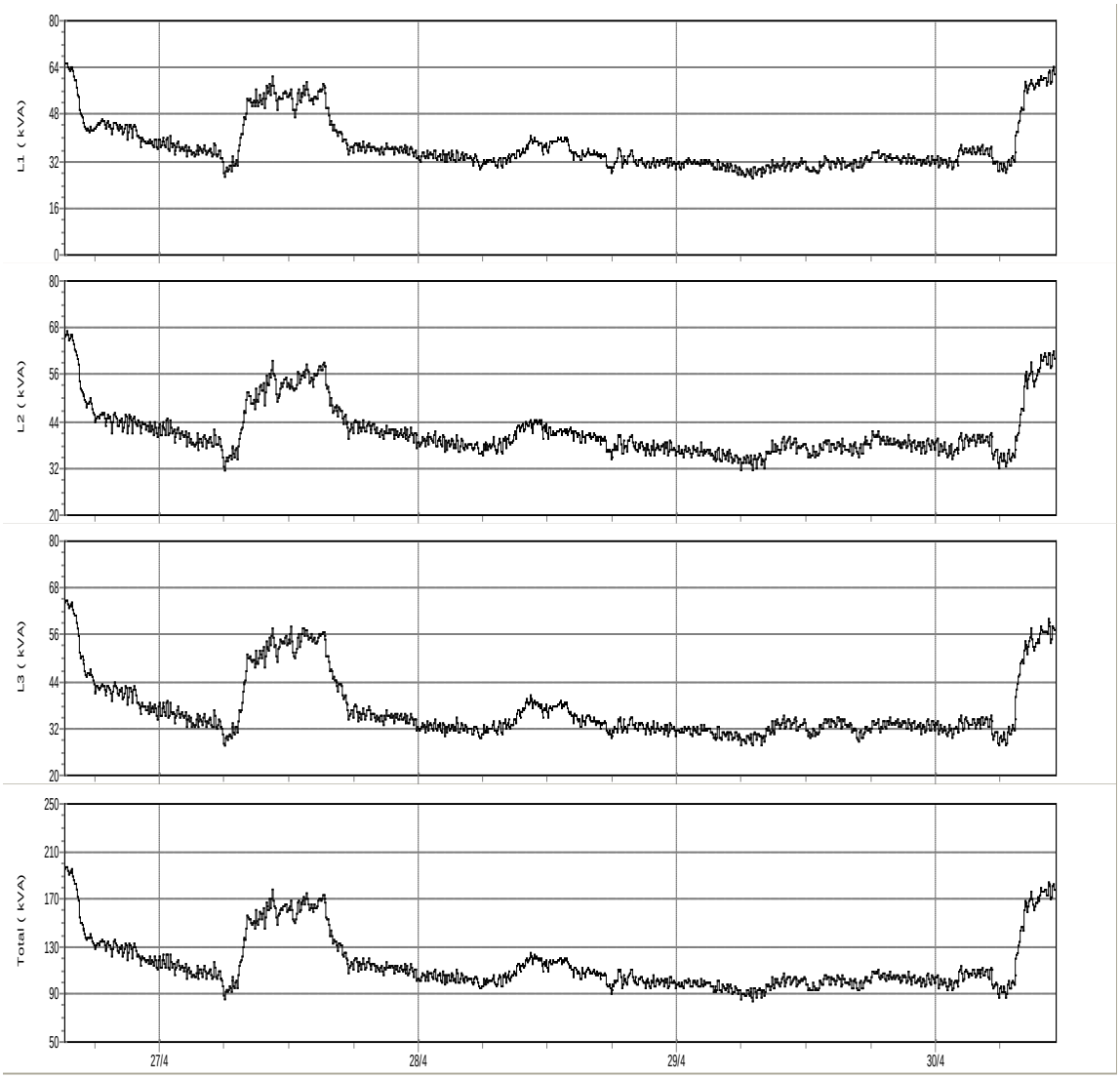


Figure 36: kVA Demand on 500 kVA Transformer

The electrical load data was also taken at the ATS for this transformer. Given the minimum and maximum loads on this transformer, as shown below, it is operating within its limits.

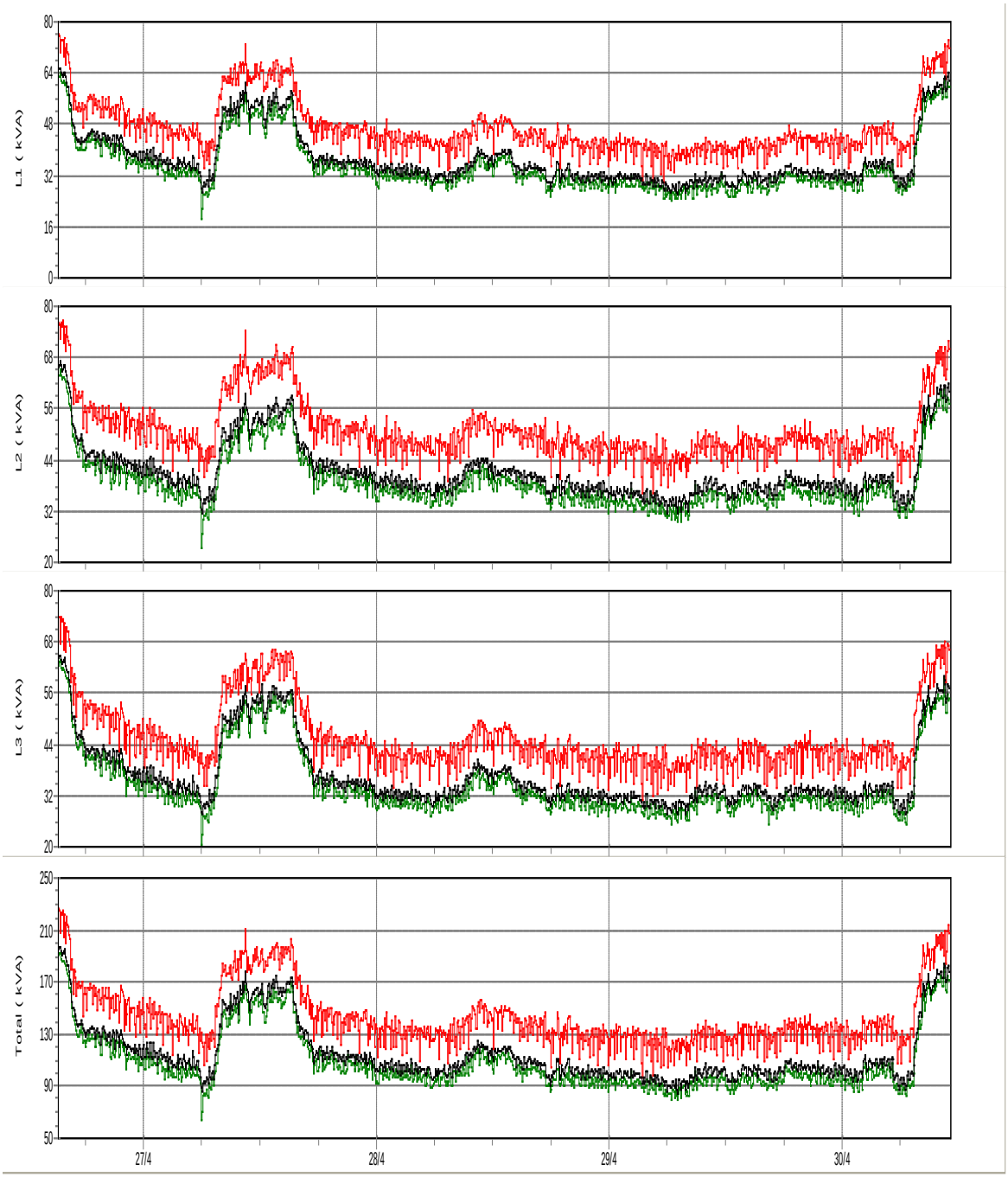


Figure 37: Maximum – Minimum – Average Loads 500 kVA Transformer

The L1, L2, and L3 voltage load profile of the 500 kVA transformer is shown below. The average line to neutral voltage was roughly 113 to 122 volts that represents a phase to phase voltage of 195 to 211. The majority of the time this transformer maintained a 120 volt average. This generator did a much better job of maintaining system voltage when employed. See near the

second last day of recording compared to the 750 kVA transformer. The average phase voltage only dropped a few volts.

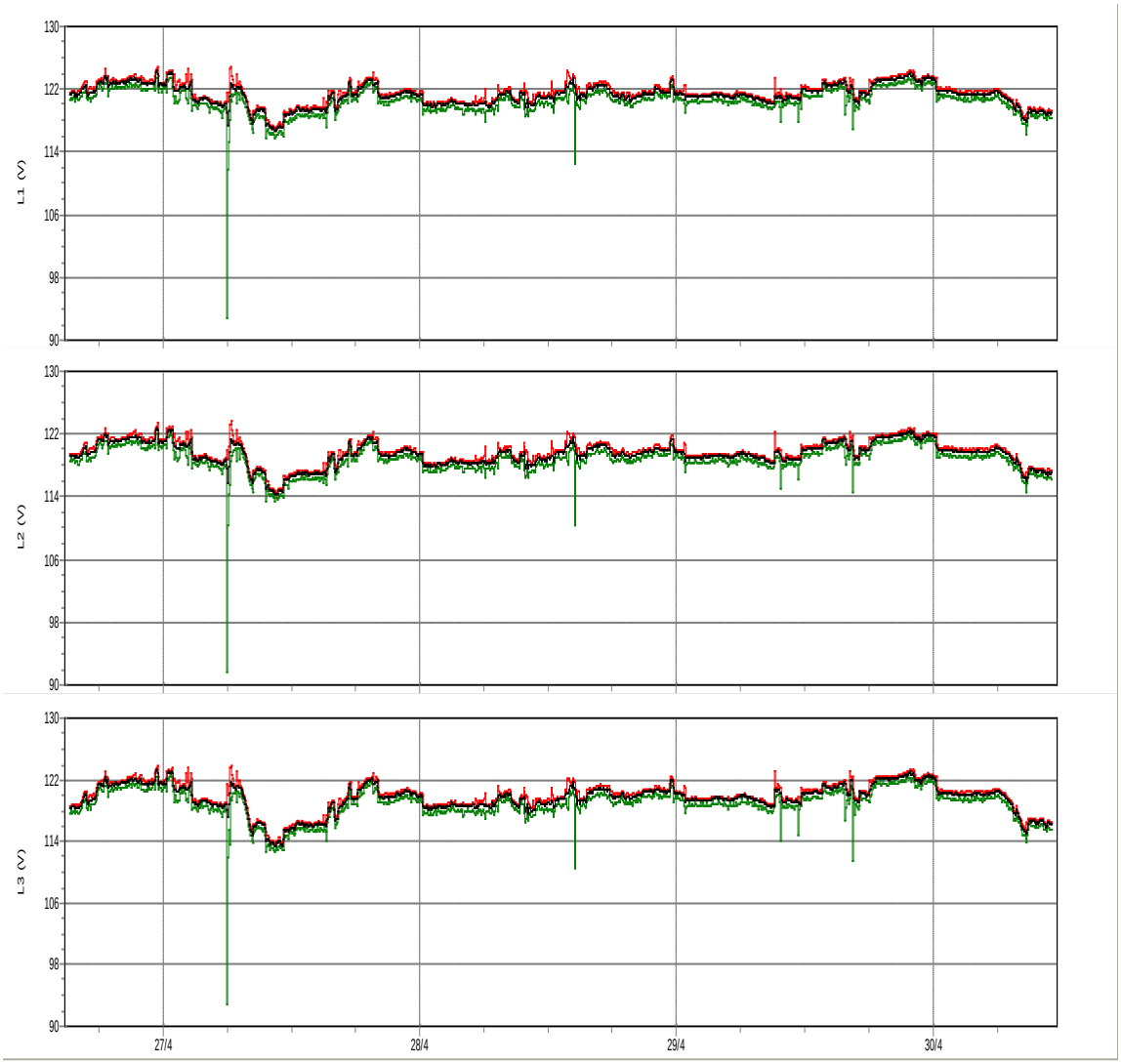


Figure 38: Phase voltages of 500 kVA transformer

The average power factor is shown below and ranges from .71 to .83. Significant improvement can be made here to improve the power factor to .95. This will unload the kVA demand on the transformers to allow for additional kW load and will improve the voltage.

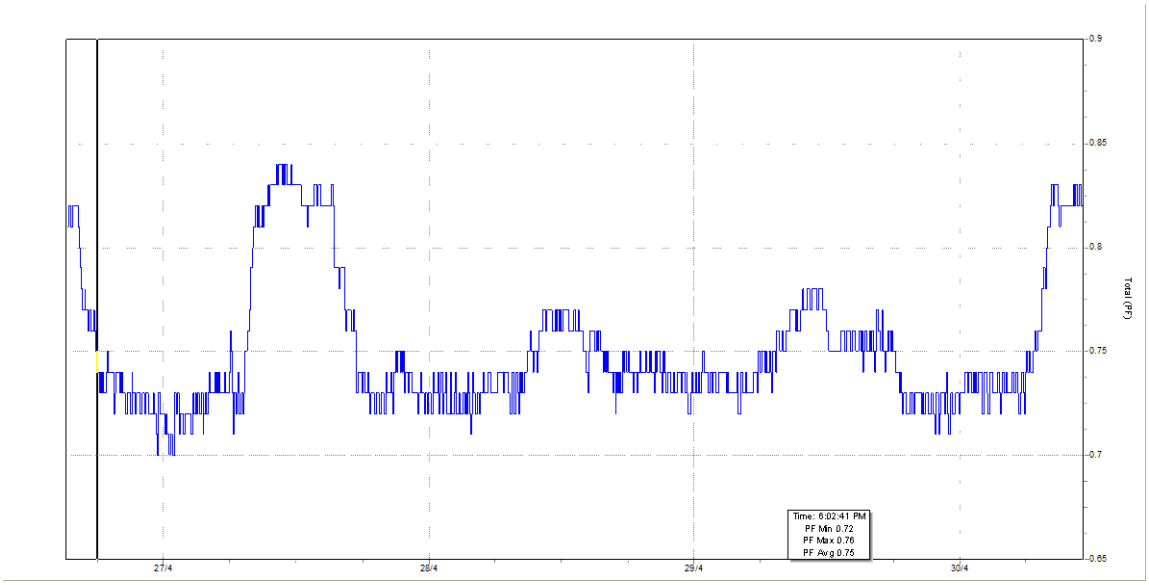


Figure 39: **Power Factor of the 500 kVA Transformer**

The 500 kVA transformer had a total harmonic voltage distortion less than 1% of the fundamental waveform. Additional voltage harmonic content was very low for the third, fifth and 7th harmonic.

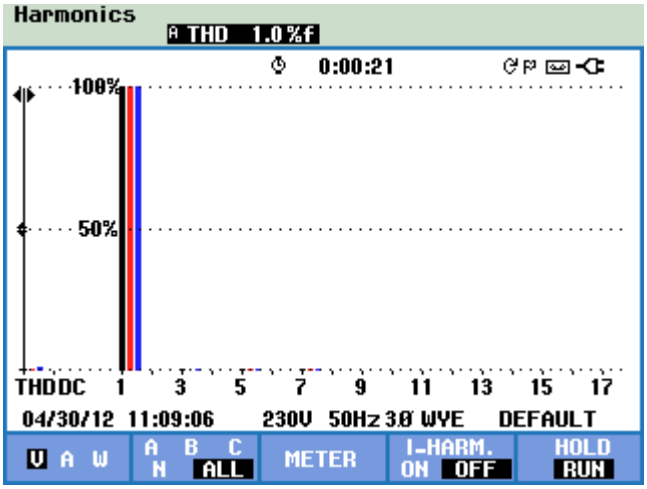


Figure 40: Harmonic Waveform Distortion of 500 KVA transformer

The 500 kVA transformer had a total harmonic current distortion of less than 2.5% of the fundamental waveform. Additional current harmonic content was very low for the third, fifth and 7th harmonic.

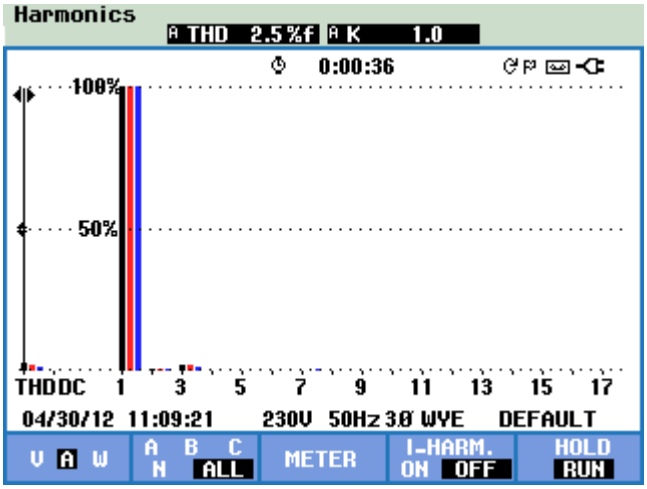


Figure 41: Total Harmonic Distortion of 500 kVA Transformer

6.1 OBSERVATIONS & RECOMMENDATIONS

The Georgetown hospital is upgrading from a 750 kVA transformer from a 440 volt 50 hertz secondary to a 1500 kVA 480/277 60 hertz secondary style transformer. This is going to be a very good upgrade. However, as motors need to be replaced, sourcing should be changed to specify 480 volt 60 cycle high efficiency motors.

There seems to be some confusion on the old 500 kVA new 750 kVA transformer. Typically the secondary on transformers used for 3 phase loads and 120 volt control power is specified with a 208/120 volt secondary. Most data received listed the voltage with a 240 volt secondary.

The generator set located at the maintenance shop near the boiler room individually rated at 415 volts and 633 amps; however, below is L1 volts and L1 amps that show an output near 750 amps at 405 volts. The generators were not able to make their specified voltage at the ATS. In the future this will continue to significantly reduce motor life while running on backup power.

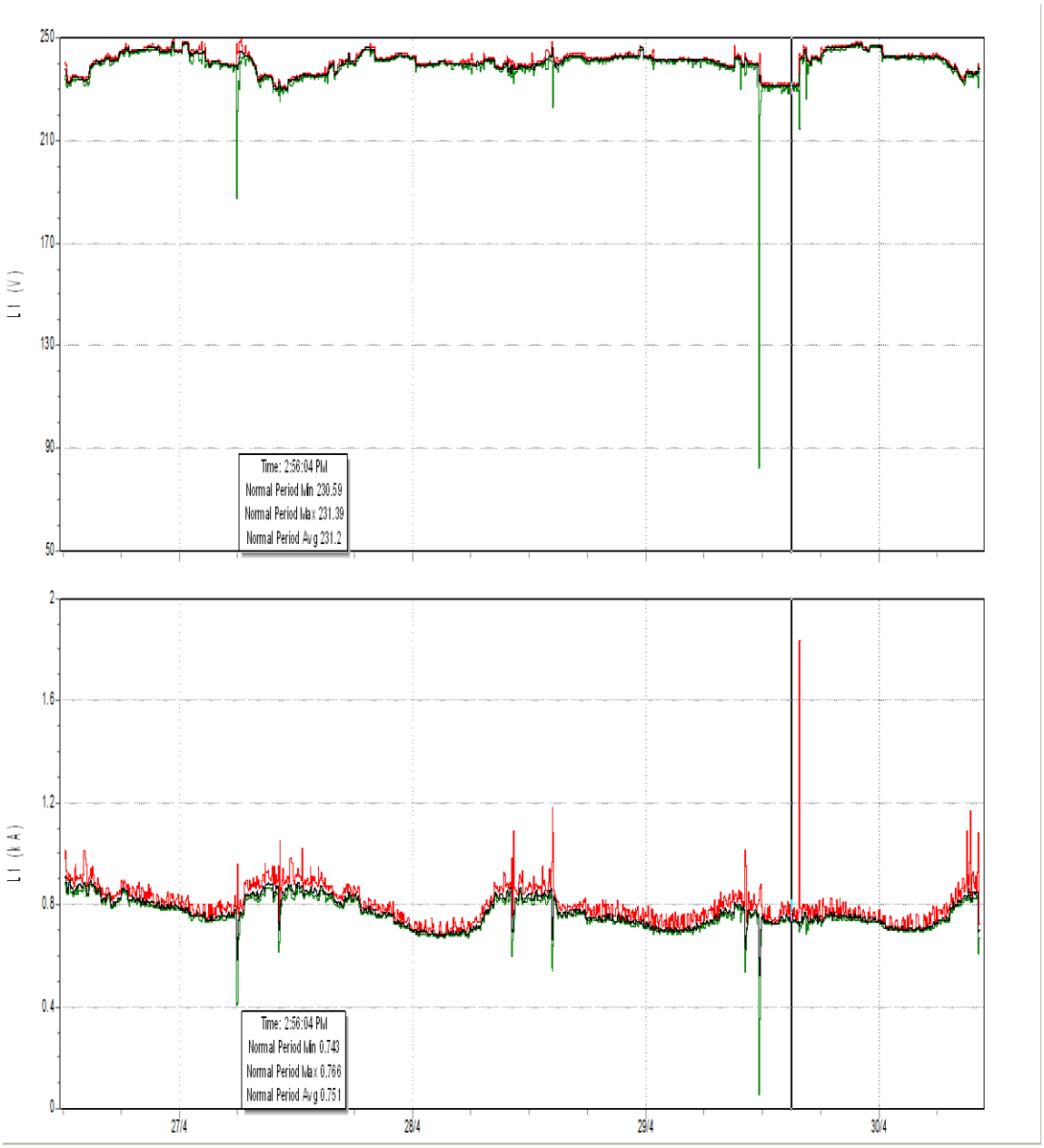


Figure 42: Performance characteristics of Generators

As the transition to the new electrical grid distribution system from 440 volts to 480 volts is completed, the capacity and ratings of the existing generator sets will need to be carefully reviewed.

- **Data suggests that the existing generators will not be capable of providing the needed voltage and may need to be replaced.**

As we covered the hospital, we did point out some life safety issues related to the wire distribution and termination techniques.

Power factor is poor throughout both distribution systems monitored. The poor power factor requires that the power company deliver more kVA to the hospital.

- **The kVA demand and line current can significantly be reduced and the distribution system voltage can be improved to increase the power factor to a minimum of 0.95.**

Since the revisions to the electrical system were not completed at the time of our energy audit we cannot reliably offer beneficial calculations that will be useful.

- **It is essential to the ongoing operation of the hospital and particularly the backup generators that all factors be re-examined when the new electrical service is completed.**

APPENDIX A: ENGINEERING CALCULATIONS

ECO #1 - ENERGY MANAGEMENT

Energy Team and improving Energy Awareness									
			Diesel Savi	Diesel Cost	Elect Savings	Elect Cost	**Total Cost Savings**		
Savings for energy team			kWh/yr.	$/yr.	kWh/yr.	$/yr.	**$/yr.**	$/yr. (US)	
Installing an Energy Team - Improving Energy Awareness and M&T									
Estimate 2 to 5 percent									
Est.	2.00%	Savings	61,577	$ 5,496	113,610	$ 30,551	**$ 7,209,377**	$36,047	
Cost of Energy Team							**$ 4,000,000**	**$20,000**	
Payback							**0.6**	**Years**	
			35,628		220,630		256,258	CO2	

HVAC UNITS – INVENTORY

Size of Unit (tons)	No of Split Type	Tons	EER	No. of Window Type	Split Window tons		Total Tons
0.75	**4**	**3**	**7**	**1**	0.75		3.75
1.0	**12**	**12**	**7 to 10**	**4**	4		16
1.5	**9**	**13.5**	**7 to 10**	**14**	21		34.5
2.0	**13**	**26**	**7 to 10**	**4**	8		34
3.0	**14**	**42**	**7 to 10**		0		42
	52			23			130.25

Size of Unit (Ton)	No	EER	Est. EER	DX Units tons
4.5	11	10 to 12	8 to 10	49.5
7.5	1	10 to 12	8 to 10	7.5
10	1	10 to 12	8 to 10	10
15	1	10 to 12	8 to 10	15
20	1	10 to 12	8 to 10	20
			Total	102

Other		COP - est.	COP design
Chillers	2x 75 Tons	4.5 to 5.0	6
AHU's	12		
Extractor Fans	9		

Number of BMS Point	on/off	76
	temp	30
	Misc.	14
	Total	**120**

HVAC Measured Data

Volts	**432**					
pf	**0.8**					
EFF	**0.95**					
	kW				**Est.**	
	Phase A	**Phase B**	**Phase C**	**Line To Line average**	**hp np**	**HP load @.pf and EFF.**
Chiller #1						
Motor 1	116	110	107	111.00		84.51
Motor 2	145	134	139	139.33		106.09
pumps	21.6	22.9	21.4	21.97		16.73
Chiller #2						
Motor 1	128	137	138	134.33		102.28
Motor 2	138	146	145	143.00		108.88
pumps						
						418.48
AHU#1 Theater & CCSU	12.4	14.2	14.3	13.63	15	10.38
AHU 2B x-ray						
AHU2A x-ray						
AHU Room1	1.99	2.17	2.15	2.10	3	1.60
AHU Room2	2.32	2.72	2.51	2.52	3	1.92
AHU	2.4	2.53	2.5	2.48	3	1.89

Room3						
AHU Room4	2.2	2.2	2.5	2.30	3	1.75
AHU Room5	1.7	1.8	1.9	1.80	1.5	1.37
AHU Room6	2.4	2.2	2.3	2.30	3	1.75
Extractor Fans on rm. 4,5,6						
EF2-8	9.6	10.3	10.2	10.03	10	7.64
TGE-1	1.4	1.4	1.4	1.40	3	1.07
EF2-B	10.5	11	11.1	10.87	10	8.27
Other Extractor Fans						
EFT6E2						
EF4A	2.4	2.7	2.5	2.53	3	1.93
EF4B	4.5	4.5	4.6	4.53	10	3.45
EF1	5	4.7	4.7	4.80	10	3.65
EFTE5	1.2	1.2	1.2	1.20	3	0.91
					Fan Total	**47.58**
Pumps						**Pump Data**
Chiller					25	n/a
Water					25	n/a

HVAC Calculations (Note: all calculations in $US and converted to $GY in the main body of the report)

ECO # 2 Program AC Controls split system Units								**Assumptions**			
Estimated A/C usage			455,875	kWh Per Year				Operating hours	3500	Hours per year	
								Save	1	hour per day	
Setting Temperatures and HVAC Systems Operating Parameter									260	Hours per year	
		Savings	kWh/yr.	Cost Savings/yr.	Cost	Payback	CO2	**Total Savings**	**7%**	**Savings**	
Assumptions											
Cooling Savings		7%	33,865	9,584	0	0.0	65765.8				
(CTG002 HVAC Control Technology guide states up to 15% savings for commercial/industrial facilities for new/improved controls)											

ECO #6 Install Web-based Thermostat Controls - Split Systems								**Assumptions**			
Estimated A/C usage			455,875	kWh Per Year				Operating hours	3500	Hours per year	
Number of units			52					Save	1	hour per day	
Cost per unit			500	installed					260	Hours per year	
		Savings	kWh/yr.	Cost Savings/yr.	Cost	Payback	CO2		7%		
								Improved temp Control			
Assumptions								1 degC = 5%	5%		
Cooling Savings		12%	56,659	16,034	26,000	1.6	110031.3	**Total Savings**	**12%**		
(CTG002 HVAC Control Technology guide states up to 15% savings for commercial/industrial facilities for new/improved controls)											

ECO #10 Install BMS System for main building HVAC								**Assumptions - BMS**			
Estimated A/C usage			1,206,000	kWh Per Year				Improved temperature control			5%
								Scheduling operating hours for AHU's/Chillers/DX			10%
Setting Temperatures and HVAC Systems Operating Parameter								Maintenance Savings			TBD
		Savings	kWh/yr.	Cost Savings/yr.	Cost	Payback	CO2	**Total Savings**			**15%**
								Cost ($1k per point)	120	# Points	$120,000
Assumptions								Computer/software			$50,000
Cooling Savings		15%	180,900	51,195	170,000	3.3	351307.8	**Total Cost**			**$170,000**
(CTG002 HVAC Control Technology guide states up to 15% savings for commercial/industrial facilities for new/improved controls)											

ECO #3 Retro commissioning Main Building HVAC									**Assumptions**	
Elect	1,206,000	kWh/yr.			Elect	**Total Cost Savings**			Rebalance systems	
Building	33,276	Sqft			kWh/yr.	**$/yr.**			Ensure correct operation of all mechanical systems	
Only Recommission HVAC area of the building										
Est.	15.00%	Savings			180,900	**$51,195**			**Total Savings**	**15%**
Cost of Retro commissioning			**$1.0**	**per sqft**		**$33,276**			Texas A&M University has re-commissioned over	
Payback						**0.6**	**Years**		70 buildings since 1996 and reports a typical energy	
						351,308	CO2		reduction of 15 to 30% percent.	

LIGHTING

Lighting Count by Building and type

					2ft T-12			4ft T-12				2ft T-8			4ft T-8				Exterior
Building	**Sqft**	**Hours**	**Inc**	**CFL**	**1 Lamp**	**2 lamp**	**3 lamp**	**1 Lamp**	**2 lamp**	**3 Lamp**	**4 lamp**	**1 Lamp**	**2 lamp**	**4 lamp**	**1 Lamp**	**2 lamp**	**4 lamp**	**MH**	**MH**
ACDC	83,189	8,760		6			50	91	240	33	34								
		3,500			38			6	261										
Mortuary	4,290	8,760	1					29	1										
Male Medical	12,774	8,760			41			25	31										
Laundry	10,591	4,500							5									19	
Dietary Stores	1,388	1,000						8											
Kitchen	4,911	4,500			3			1	39										
Facility Mgmt	6,176	3,500			4			76	15										
Admin Building	12,251	3,500			22			26	102										
Boiler Room/worksho	5,095	4,500						8	20									15	
Path Lab	3,314	4,500						20	20										
Maternity Build	26,273	8,760	6	3	9			45	85										
Library/Inf Desies	5,385	4,500			5			20	19										
New Building	72,500	7,860		48								298			600				
Chest Building	5,400	3,500		15				15	12	5									
Total	**253,537**		**7**	**72**	**122**	**0**	**50**	**370**	**850**	**38**	**34**	**298**	**0**	**0**	**600**	**0**	**0**	**34**	**20**

Energy Efficient T-8 Lighting Systems- ACDC Building

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
ACDC	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	8,760	1.00		0	0.0	0	0.00	
ACDC	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	8,760	1.00		0	0.0	0	0.00	
ACDC	50	8	3F20T12/2EFF	3	20,000	2	60,000	81	4.05	1.00	8,760	1.00	35,478	0	0.0	0	0.00	
ACDC	91	8	1F40T12/1STD	1	20,000	1	45,000	52	4.73	1.00	8,760	1.00	41,452	0	0.0	0	0.00	
ACDC	240	8	2F40T12/1STD	2	20,000	1	45,000	96	23.04	1.00	8,760	1.00	201,830	0	0.0	0	0.00	
ACDC	33	8	3F40T12/2STD	3	20,000	2	45,000	148	4.88	1.00	8,760	1.00	42,784	0	0.0	0	0.00	
ACDC	34	8	4F40T12/2STD	4	20,000	2	45,000	192	6.53	1.00	8,760	1.00	57,185	0	0.0	0	0.00	
ACDC	38	8	1F20T12/1STD	1	20,000	1	60,000	34	1.29	1.00	3,500	1.00	4,522	0	0.0	0	0.00	
ACDC			2F20T12/1STD	2	20,000	1	60,000	52		1.00	3,500	1.00		0	0.0	0	0.00	
ACDC			3F20T12/2EFF	3	20,000	2	60,000	81		1.00	3,500	1.00		0	0.0	0	0.00	
ACDC	6	8	1F40T12/1STD	1	20,000	1	45,000	52	0.31	1.00	3,500	1.00	1,092	0	0.0	0	0.00	
ACDC	262	8	2F40T12/1STD	2	20,000	1	45,000	96	25.15	1.00	3,500	1.00	88,032	0	0.0	0	0.00	
ACDC			3F40T12/2STD	3	20,000	2	45,000	148		1.00	3,500	1.00		0	0.0	0	0.00	
ACDC			4F40T12/2STD	4	20,000	2	45,000	192		1.00	3,500	1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	754								69.99				472,376					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00	8,760	1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00	8,760	1.00			
ACDC	50	8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47	2.35	1.00	8,760	1.00	20,586	$10,404	$6,037
ACDC	91	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	2.82	1.00	8,760	1.00	24,712	$12,156	$7,247
ACDC	240	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	13.92	1.00	8,760	1.00	121,939	$59,186	$35,758
ACDC	33	8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90	2.97	1.00	8,760	1.00	26,017	$12,546	$7,629
ACDC	34	8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111	3.77	1.00	8,760	1.00	33,060	$16,769	$9,695
ACDC	38	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.91	1.00	3,500	1.00	3,192	$1,416	$1,000
			2F17T8/1EL	2	36,000	1	75,000	$49.70		33		1.00	3,500	1.00			
			3F17T8/1EL	3	36,000	1	75,000	$53.90		47		1.00	3,500	1.00			
ACDC	6	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.19	1.00	3,500	1.00	651	$342	$204
ACDC	262	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	15.20	1.00	3,500	1.00	53,186	$27,568	$16,655
			3F32T8/1EL	3	36,000	1	75,000	$53.90		90		1.00	3,500	1.00			
			4F32T8/1EL	4	36,000	1	75,000	$58.10		111		1.00	3,500	1.00			
TOTALS:	754										42.13				283,344	$140,387	$84,225

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
ACDC	1.70	14,892	$4,367	$64	$39	0	$0	0	$0	$4,470	$2,695	$840	$258.00	$3,793	0.8
ACDC	1.91	16,740	$4,909	($76)	$30	0	$0	0	$0	$4,863	$4,141	$1,401	$236.74	$5,779	1.2
ACDC	9.12	79,891	$23,428	($113)	$93	0	$0	0	$0	$23,407	$11,928	$3,696	$706.92	$16,331	0.7
ACDC	1.91	16,767	$4,917	$71	$36	0	$0	0	$0	$5,024	$1,779	$508	$183.05	$2,470	0.5
ACDC	2.75	24,125	$7,075	$85	$39	0	$0	0	$0	$7,199	$1,975	$571	$200.29	$2,747	0.4
ACDC	0.38	1,330	$416	($19)	$2	0	$0	0	$0	$400	$1,729	$585	$93.96	$2,408	6.0
													$0.00		
													$0.00		
ACDC	0.13	441	$138	($2)	$1	0	$0	0	$0	$137	$273	$92	$15.61	$381	2.8
ACDC	9.96	34,846	$10,912	($49)	$40	0	$0	0	$0	$10,903	$13,021	$4,035	$771.72	$17,828	1.6
													$0.00		
													$0.00		
TOTALS:	27.86	189,032	$56,162	($38)	$280	0	$0	0	$0	$56,403	$37,541	$11,729	$2,466	$51,736	0.9

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$56,162	per year	$11,232,404	per year
Non-energy Savings	$241	per year	$48,276	per year
Total Savings	$56,403	per year	$11,280,680	per year
Measure Cost:	$51,736		$10,347,297	
Simple Payback:	0.9	Years		
Demand Reduction:	27.86	kW		
Energy Savings:	189,032	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Mortuary

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Mortuary	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Mortuary	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Mortuary	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Mortuary	29	8	1F40T12/1STD	1	20,000	1	45,000	52	1.51	1.00	8,760	1.00	13,210	0	0.0	0	0.00	
Mortuary	1	8	2F40T12/1STD	2	20,000	1	45,000	96	0.10	1.00	8,760	1.00	841	0	0.0	0	0.00	
Mortuary	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Mortuary	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	30								1.60				14,051					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Mortuary	29	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.90	1.00	8,760	1.00	7,875	$3,874	$2,309
Mortuary	1	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	0.06	1.00	8,760	1.00	508	$247	$149
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	30										0.96				8,383	$4,120	$2,458

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
													$0.00		
Mortuary	0.61	5,335	$1,564	($24)	$10	0	$0	0	$0	$1,550	$1,320	$447	$75.44	$1,842	1.2
Mortuary	0.04	333	$98	($0)	$0	0	$0	0	$0	$98	$50	$15	$2.95	$68	0.7
													$0.00		
													$0.00		
TOTALS:	0.65	5,668	$1,662	($25)	$10	0	$0	0	$0	$1,647	$1,369	$462	$78	$1,910	1.2

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$1,662	per year	$332,408	per year
Non-energy Savings	($15)	per year	-$2,930	per year
Total Savings	$1,647	per year	$329,478	per year
Measure Cost:	$1,910		$381,918	
Simple Payback:	1.2	Years		
Demand Reduction:	0.65	kW		
Energy Savings:	5,668	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Male Medical

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Male Medical	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Male Medical	41	8	2F20T12/1STD	2	20,000	1	60,000	52	2.13	1.00	8,760	1.00	18,676	0	0.0	0	0.00	
Male Medical	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Male Medical	25	8	1F40T12/1STD	1	20,000	1	45,000	52	1.30	1.00	8,760	1.00	11,388	0	0.0	0	0.00	
Male Medical	31	8	2F40T12/1STD	2	20,000	1	45,000	96	2.98	1.00	8,760	1.00	26,070	0	0.0	0	0.00	
Male Medical	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Male Medical	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	97								6.41				56,134					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
Male Medical	41	8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33	1.35	1.00	8,760	1.00	11,852	$5,477	$3,476
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Male Medical	25	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.78	1.00	8,760	1.00	6,789	$3,339	$1,991
Male Medical	31	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	1.80	1.00	8,760	1.00	15,750	$7,645	$4,619
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	97										3.93				34,392	$16,461	$10,085

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
Male Medical	0.78	6,824	$2,001	($37)	$2	0	$0	0	$0	$1,966	$2,038	$631	$110.19	$2,779	1.4
													$0.00		
Male Medical	0.53	4,599	$1,349	($21)	$8	0	$0	0	$0	$1,336	$1,138	$385	$65.04	$1,588	1.2
Male Medical	1.18	10,319	$3,026	($15)	$12	0	$0	0	$0	$3,023	$1,541	$477	$91.31	$2,109	0.7
													$0.00		
													$0.00		
TOTALS:	2.48	21,742	$6,376	($72)	$22	0	$0	0	$0	$6,325	$4,716	$1,494	$267	$6,476	1.0

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$6,376	per year	$1,275,172	per year
Non-energy Savings	($50)	per year	-$10,076	per year
Total Savings	$6,325	per year	$1,265,096	per year
Measure Cost:	$6,476		$1,295,247	
Simple Payback:	1.0	Years		
Demand Reduction:	2.48	kW		
Energy Savings:	21,742	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Laundry

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Laundry	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Laundry	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Laundry	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Laundry	0	8	1F40T12/1STD	1	20,000	1	45,000	52		1.00	0	1.00		0	0.0	0	0.00	
Laundry	5	8	2F40T12/1STD	2	20,000	1	45,000	96	0.48	1.00	4,500	1.00	2,160	0	0.0	0	0.00	
Laundry	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Laundry	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	5								0.48				2,160					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
		8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31		1.00		1.00			
Laundry	5	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	0.29	1.00	4,500	1.00	1,305	$660	$399
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	5										0.29				1,305	$660	$399

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
													$0.00		
													$0.00		
Laundry	0.19	855	$261	($1)	$1	0	$0	0	$0	$261	$249	$77	$14.73	$340	1.3
													$0.00		
													$0.00		
TOTALS:	0.19	855	$261	($1)	$1	0	$0	0	$0	$261	$249	$77	$15	$340	1.3

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$261	per year	$52,290	per year
Non-energy Savings	($0)	per year	-$43	per year
Total Savings	$261	per year	$52,246	per year
Measure Cost:	$340		$68,046	
Simple Payback:	1.3	Years		
Demand Reduction:	0.19	kW		
Energy Savings:	855	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Dietary Stores

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	
Prop. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	Measure Life: 15 Years
Cost of heating fuel:	$0.00000 per Gallon		

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Dietary Stores	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Dietary Stores	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Dietary Stores	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Dietary Stores	8	8	1F40T12/1STD	1	20,000	1	45,000	52	0.42	1.00	1,000	1.00	416	0	0.0	0	0.00	
Dietary Stores	0	8	2F40T12/1STD	2	20,000	1	45,000	96		1.00	0	1.00		0	0.0	0	0.00	
Dietary Stores	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Dietary Stores	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	8								0.42				416					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Dietary Stores	8	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.25	1.00	1,000	1.00	248	$165	$98
		8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58		1.00		1.00			
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	8										0.25				248	$165	$98

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
													$0.00		
Dietary Stores	0.17	168	$67	($1)	$0	0	$0	0	$0	$66	$364	$123	$20.81	$508	7.7
													$0.00		
													$0.00		
													$0.00		
TOTALS:	0.17	168	$67	($1)	$0	0	$0	0	$0	$66	$364	$123	$21	$508	7.7

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$67	per year	$13,307	per year
Non-energy Savings	($0)	per year	-$92	per year
Total Savings	$66	per year	$13,215	per year
Measure Cost:	$508		$101,602	
Simple Payback:	7.7	Years		
Demand Reduction:	0.17	kW		
Energy Savings:	168	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Kitchen

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	
Prop. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	Measure Life: 15 Years
Cost of heating fuel:	$0.00000 per Gallon		

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Kitchen	3	8	1F20T12/1STD	1	20,000	1	60,000	34	0.10	1.00	4,500	1.00	459	0	0.0	0	0.00	
Kitchen	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Kitchen	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Kitchen	1	8	1F40T12/1STD	1	20,000	1	45,000	52	0.05	1.00	4,500	1.00	234	0	0.0	0	0.00	
Kitchen	39	8	2F40T12/1STD	2	20,000	1	45,000	96	3.74	1.00	4,500	1.00	16,848	0	0.0	0	0.00	
Kitchen	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Kitchen	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	43								3.90				17,541					

	PROPOSED							Implementation Cost										
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
Kitchen	3	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.07	1.00	4,500	1.00	324	$140	$99
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Kitchen	1	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.03	1.00	4,500	1.00	140	$72	$43
Kitchen	39	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	2.26	1.00	4,500	1.00	10,179	$5,152	$3,113
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	43										2.37				10,643	$5,364	$3,254

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
Kitchen	0.03	135	$41	($2)	$0	0	$0	0	$0	$40	$137	$46	$7.42	$190	4.8
													$0.00		
													$0.00		
Kitchen	0.02	95	$29	($0)	$0	0	$0	0	$0	$29	$46	$15	$2.60	$64	2.2
Kitchen	1.48	6,669	$2,039	($9)	$8	0	$0	0	$0	$2,038	$1,938	$601	$114.87	$2,654	1.3
													$0.00		
													$0.00		
TOTALS:	1.53	6,899	$2,109	($12)	$8	0	$0	0	$0	$2,106	$2,120	$662	$125	$2,907	1.4

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$2,109	per year	$421,894	per year
Non-energy Savings	($4)	per year	-$730	per year
Total Savings	$2,106	per year	$421,164	per year
Measure Cost:	$2,907		$581,479	
Simple Payback:	1.4	Years		
Demand Reduction:	1.53	kW		
Energy Savings:	6,899	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Facility Mgmt

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Facility Mgmt	4	8	1F20T12/1STD	1	20,000	1	60,000	34	0.14	1.00	3,500	1.00	476	0	0.0	0	0.00	
Facility Mgmt	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Facility Mgmt	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Facility Mgmt	76	8	1F40T12/1STD	1	20,000	1	45,000	52	3.95	1.00	3,500	1.00	13,832	0	0.0	0	0.00	
Facility Mgmt	15	8	2F40T12/1STD	2	20,000	1	45,000	96	1.44	1.00	3,500	1.00	5,040	0	0.0	0	0.00	
Facility Mgmt	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Facility Mgmt	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	95								5.53				19,348					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
Facility Mgmt	4	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.10	1.00	3,500	1.00	336	$149	$105
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Facility Mgmt	76	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	2.36	1.00	3,500	1.00	8,246	$4,332	$2,582
Facility Mgmt	15	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	0.87	1.00	3,500	1.00	3,045	$1,578	$954
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	95										3.32				11,627	$6,059	$3,641

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
Facility Mgmt	0.04	140	$44	($2)	$0	0	$0	0	$0	$42	$182	$62	$9.89	$253	6.0
													$0.00		
													$0.00		
Facility Mgmt	1.60	5,586	$1,749	($25)	$10	0	$0	0	$0	$1,734	$3,458	$1,170	$197.71	$4,826	2.8
Facility Mgmt	0.57	1,995	$625	($3)	$2	0	$0	0	$0	$624	$746	$231	$44.18	$1,021	1.6
													$0.00		
													$0.00		
TOTALS:	2.21	7,721	$2,418	($30)	$13	0	$0	0	$0	$2,400	$4,386	$1,463	$252	$6,100	2.5

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$2,418	per year	$483,573	per year
Non-energy Savings	($18)	per year	-$3,503	per year
Total Savings	$2,400	per year	$480,070	per year
Measure Cost:	$6,100		########	
Simple Payback:	2.5	Years		
Demand Reduction:	2.21	kW		
Energy Savings:	7,721	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Admin Build

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	
Prop. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	Measure Life: 15 Years
Cost of heating fuel:	$0.00000 per Gallon		

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Admin Build	22	8	1F20T12/1STD	1	20,000	1	60,000	34	0.75	1.00	3,500	1.00	2,618	0	0.0	0	0.00	
Admin Build	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Admin Build	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Admin Build	26	8	1F40T12/1STD	1	20,000	1	45,000	52	1.35	1.00	3,500	1.00	4,732	0	0.0	0	0.00	
Admin Build	102	8	2F40T12/1STD	2	20,000	1	45,000	96	9.79	1.00	3,500	1.00	34,272	0	0.0	0	0.00	
Admin Build	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Admin Build	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	150								11.89				41,622					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
Admin Build	22	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.53	1.00	3,500	1.00	1,848	$820	$579
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Admin Build	26	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.81	1.00	3,500	1.00	2,821	$1,482	$883
Admin Build	102	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	5.92	1.00	3,500	1.00	20,706	$10,732	$6,484
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	150										7.25				25,375	$13,034	$7,946

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
Admin Build	0.22	770	$241	($11)	$1	0	$0	0	$0	$231	$1,001	$339	$54.40	$1,394	6.0
													$0.00		
													$0.00		
Admin Build	0.55	1,911	$598	($9)	$3	0	$0	0	$0	$593	$1,183	$400	$67.64	$1,651	2.8
Admin Build	3.88	13,566	$4,248	($19)	$16	0	$0	0	$0	$4,245	$5,069	$1,571	$300.44	$6,941	1.6
													$0.00		
													$0.00		
TOTALS:	4.64	16,247	$5,088	($39)	$21	0	$0	0	$0	$5,069	$7,253	$2,310	$422	$9,986	2.0

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$5,088	per year	$1,017,564	per year
Non-energy Savings	($18)	per year	-$3,666	per year
Total Savings	$5,069	per year	$1,013,897	per year
Measure Cost:	$9,986		$1,997,175	
Simple Payback:	2.0	Years		
Demand Reduction:	4.64	kW		
Energy Savings:	16,247	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Boiler Rm

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Boiler Rm	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Boiler Rm	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Boiler Rm	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Boiler Rm	8	8	1F40T12/1STD	1	20,000	1	45,000	52	0.42	1.00	4,500	1.00	1,872	0	0.0	0	0.00	
Boiler Rm	20	8	2F40T12/1STD	2	20,000	1	45,000	96	1.92	1.00	4,500	1.00	8,640	0	0.0	0	0.00	
Boiler Rm	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Boiler Rm	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	28								2.34				10,512					

	PROPOSED							Implementation Cost										
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Boiler Rm	8	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.25	1.00	4,500	1.00	1,116	$572	$341
Boiler Rm	20	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	1.16	1.00	4,500	1.00	5,220	$2,642	$1,596
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	28										1.41				6,336	$3,214	$1,937

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
													$0.00		
Boiler Rm	0.17	756	$231	($3)	$1	0	$0	0	$0	$229	$364	$123	$20.81	$508	2.2
Boiler Rm	0.76	3,420	$1,046	($5)	$4	0	$0	0	$0	$1,045	$994	$308	$58.91	$1,361	1.3
													$0.00		
													$0.00		
TOTALS:	0.93	4,176	$1,277	($8)	$5	0	$0	0	$0	$1,274	$1,358	$431	$80	$1,869	1.5

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$1,277	per year	$255,393	per year
Non-energy Savings	($3)	per year	-$587	per year
Total Savings	$1,274	per year	$254,806	per year
Measure Cost:	$1,869		$373,784	
Simple Payback:	1.5	Years		
Demand Reduction:	0.93	kW		
Energy Savings:	4,176	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Path Lab

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000	per kW
Cost of heating fuel:	$0.00000	per Gallon		

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Path Lab	0	8	1F20T12/1STD	1	20,000	1	60,000	34		1.00	0	1.00		0	0.0	0	0.00	
Path Lab	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Path Lab	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Path Lab	20	8	1F40T12/1STD	1	20,000	1	45,000	52	1.04	1.00	4,500	1.00	4,680	0	0.0	0	0.00	
Path Lab	20	8	2F40T12/1STD	2	20,000	1	45,000	96	1.92	1.00	4,500	1.00	8,640	0	0.0	0	0.00	
Path Lab	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00		1.00		0	0.0	0	0.00	
Path Lab	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00		1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	40								2.96				13,320					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
		8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24		1.00		1.00			
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Path Lab	20	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.62	1.00	4,500	1.00	2,790	$1,431	$853
Path Lab	20	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	1.16	1.00	4,500	1.00	5,220	$2,642	$1,596
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	40										1.78				8,010	$4,073	$2,449

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
													$0.00		
													$0.00		
													$0.00		
Path Lab	0.42	1,890	$578	($9)	$3	0	$0	0	$0	$573	$910	$308	$52.03	$1,270	2.2
Path Lab	0.76	3,420	$1,046	($5)	$4	0	$0	0	$0	$1,045	$994	$308	$58.91	$1,361	1.3
													$0.00		
													$0.00		
TOTALS:	1.18	5,310	$1,624	($13)	$7	0	$0	0	$0	$1,618	$1,904	$616	$111	$2,631	1.6

CALCULATION FORMULAS:

LIGHTING SAVINGS:

Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:

$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):

Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:

Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$1,624	per year	$324,745	per year
Non-energy Savings	($6)	per year	-$1,206	per year
Total Savings	$1,618	per year	$323,539	per year
Measure Cost:	$2,631		$526,188	
Simple Payback:	1.6	Years		
Demand Reduction:	1.18	kW		
Energy Savings:	5,310	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Maternaty Build

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	
Prop. Cost per energy unit	$0.28000 per kWh	$9.67000 per kW	Measure Life: 15 Years
Cost of heating fuel:	$0.00000 per Gallon		

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Mat Build	9	8	1F20T12/1STD	1	20,000	1	60,000	34	0.31	1.00	8,760	1.00	2,681	0	0.0	0	0.00	
Mat Build	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	8,760			0	0.0	0	0.00	
Mat Build	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	8,760	1.00		0	0.0	0	0.00	
Mat Build	45	8	1F40T12/1STD	1	20,000	1	45,000	52	2.34	1.00	8,760	1.00	20,498	0	0.0	0	0.00	
Mat Build	85	8	2F40T12/1STD	2	20,000	1	45,000	96	8.16	1.00	8,760	1.00	71,482	0	0.0	0	0.00	
Mat Build	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00	8,760	1.00		0	0.0	0	0.00	
Mat Build	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00	8,760	1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	139								10.81				94,661					

	PROPOSED							Implementation Cost										
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
Mat Build	9	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.22	1.00	8,760	1.00	1,892	$786	$555
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00	8,760				
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00	8,760	1.00			
Mat Build	45	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	1.40	1.00	8,760	1.00	12,220	$6,011	$3,584
Mat Build	85	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	4.93	1.00	8,760	1.00	43,187	$20,962	$12,664
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00	8,760	1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00	8,760	1.00			
TOTALS:	139										6.54				57,299	$27,759	$16,803

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
Mat Build	0.09	788	$231	($11)	$1	0	$0	0	$0	$221	$410	$139	$22.25	$570	2.6
													$0.00		
													$0.00		
Mat Build	0.95	8,278	$2,428	($37)	$15	0	$0	0	$0	$2,405	$2,048	$693	$117.07	$2,858	1.2
Mat Build	3.23	28,295	$8,297	($40)	$33	0	$0	0	$0	$8,290	$4,225	$1,309	$250.37	$5,784	0.7
													$0.00		
													$0.00		
TOTALS:	4.27	37,361	$10,956	($89)	$49	0	$0	0	$0	$10,916	$6,682	$2,141	$390	$9,212	0.8

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$10,956	per year	$2,191,221	per year
Non-energy Savings	($40)	per year	-$7,939	per year
Total Savings	$10,916	per year	$2,183,282	per year
Measure Cost:	$9,212		$1,842,358	
Simple Payback:	0.8	Years		
Demand Reduction:	4.27	kW		
Energy Savings:	37,361	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

Energy Efficient T-8 Lighting Systems- Library/Inf Diseases

Georgetown Hospital
Load factor assumes 100% of the fixtures operating

Exist. Cost per energy unit	$0.28000	per kWh	$9.67000 per kW
Prop. Cost per energy unit	$0.28000	per kWh	$9.67000 per kW
Cost of heating fuel:	$0.00000	per Gallon	

Measure Life: 15 Years

	EXISTING													HVAC DATA				
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Avg Watts/ Fixt	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Weeks of A/C	A/C EER	Weeks of Heat	Heat Eff.	Notes
Lib/Inf Diseases	5	8	1F20T12/1STD	1	20,000	1	60,000	34	0.17	1.00	4,500	1.00	765	0	0.0	0	0.00	
Lib/Inf Diseases	0	8	2F20T12/1STD	2	20,000	1	60,000	52		1.00	0			0	0.0	0	0.00	
Lib/Inf Diseases	0	8	3F20T12/2EFF	3	20,000	2	60,000	81		1.00	0	1.00		0	0.0	0	0.00	
Lib/Inf Diseases	20	8	1F40T12/1STD	1	20,000	1	45,000	52	1.04	1.00	4,500	1.00	4,680	0	0.0	0	0.00	
Lib/Inf Diseases	19	8	2F40T12/1STD	2	20,000	1	45,000	96	1.82	1.00	4,500	1.00	8,208	0	0.0	0	0.00	
Lib/Inf Diseases	0	8	3F40T12/2STD	3	20,000	2	45,000	148		1.00	0	1.00		0	0.0	0	0.00	
Lib/Inf Diseases	0	8	4F40T12/2STD	4	20,000	2	45,000	192		1.00	0	1.00		0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
														0	0.0	0	0.00	
TOTALS:	44								3.03				13,653					

	PROPOSED							Implementation Cost									
AREA	# of Fixt's	Mounting Height	Fixture Type	# of Lamps per Fix	Lamp Life (Hours)	# of Ballasts per Fix	Ballast Life (Hours)	Materials $/Fixt. w/ Tax	Labor $/Fixt Non-Union	Average Watts/ Fixture	Total kW	Load Factor	Scheduled Hours Per year	Usage Factor	kWh per year	Exist. Cost per year	Prop. Cost per year
Lib/Inf Diseases	5	8	1F17T8/1EL	1	36,000	1	75,000	$45.50	$15.40	24	0.12	1.00	4,500	1.00	540	$234	$165
		8	2F17T8/1EL	2	36,000	1	75,000	$49.70	$15.40	33		1.00					
		8	3F17T8/1EL	3	36,000	1	75,000	$53.90	$16.80	47		1.00		1.00			
Lib/Inf Diseases	20	8	1F32T8/1EL	1	36,000	1	75,000	$45.50	$15.40	31	0.62	1.00	4,500	1.00	2,790	$1,431	$853
Lib/Inf Diseases	19	8	2F32T8/1EL	2	36,000	1	75,000	$49.70	$15.40	58	1.10	1.00	4,500	1.00	4,959	$2,510	$1,516
		8	3F32T8/1EL	3	36,000	1	75,000	$53.90	$15.40	90		1.00		1.00			
		8	4F32T8/1EL	4	36,000	1	75,000	$58.10	$16.80	111		1.00		1.00			
TOTALS:	44										1.84				8,289	$4,175	$2,535

	LIGHTING SAVINGS			MAINT. SAVED		EFFECT ON A/C		EFFECT ON HEAT		Total	IMPLEMENTATION COST				
AREA	kW Red'n	kWh per year	Cost Savings per year	Mat'l $ per year	Labor $ per year	kWh Savings per year	Cost Savings per year	Gallon Savings per year	Cost Savings per year	Cost Savings per year	Total Mat'l Cost	Total Labor Cost	Total Disposal Cost	Total Cost	SIMPLE PAYBACK (Years)
Lib/Inf Diseases	0.05	225	$69	($3)	$0	0	$0	0	$0	$66	$228	$77	$12.36	$317	4.8
													$0.00		
													$0.00		
Lib/Inf Diseases	0.42	1,890	$578	($9)	$3	0	$0	0	$0	$573	$910	$308	$52.03	$1,270	2.2
Lib/Inf Diseases	0.72	3,249	$994	($5)	$4	0	$0	0	$0	$993	$944	$293	$55.96	$1,293	1.3
													$0.00		
													$0.00		
TOTALS:	1.19	5,364	$1,640	($16)	$8	0	$0	0	$0	$1,631	$2,082	$678	$120	$2,880	1.8

CALCULATION FORMULAS:

LIGHTING SAVINGS:
Peak kW Reduction = Present kW - Proposed kW
kWh per year Savings = Present kWh - Proposed kWh
$ per year Savings = (kWh Savings x $ per kWh)+
(kW Reduction x months per year x $ per kW)

MAINTENANCE SAVINGS:
$ per year Savings = Present $ per year - Proposed $ per year
Lamp $ per year = # Lamps x $ per Lamp x Hours use / Lamp life
Bal'st $ per year = # Bal'st x $ per Bal'st x Hours use / Bal'st life

EFFECT ON AC (air conditioning):
Percent season = (Weeks of AC) / 52
kWh Savings = % season x 3,413 x 0.7 x kWh Saved / (EER x 1,000)

EFFECT ON HEATING:
Percent season = (Weeks of Heating) / 52
Fuel Savings = % season x 3,413 x 0.7 x kWh Saved / (THV x eff.)
where: THV = Fuel Thermal Value

Cost Summary:	$ US		$ Guyana	
Energy Savings	$1,640	per year	$328,048	per year
Non-energy Savings	($9)	per year	-$1,762	per year
Total Savings	$1,631	per year	$326,286	per year
Measure Cost:	$2,880		$575,951	
Simple Payback:	1.8	Years		
Demand Reduction:	1.19	kW		
Energy Savings:	5,364	kWh per year		
	0	Gallons per year		

HOW TO READ FIXTURE TYPE CODES:
FORMAT: number of lamps - lamp type - lamp wattage code - fluorescent lamp type / number of ballasts - ballast type
where: Lamp types: F=fluorescent; CF=compact fluorescent; I=incandescent; MV=mercury vapor; MH=metal halide; HPS=high pressure sodium
Lamp wattage code: First number is the typical lamp designation; ES=energy saving lamp; HO=high output; VHO=very high output
Fluorescent lamp types: T12=1.5 inch diameter tube; T8=1 inch diameter tube; TT=twin tube
Ballast types: STD=standard magnetic ballast; EFF=energy efficient magnetic ballast; EL=electronic ballast
example: 2F40EST12/1STD = two, 34 Watt fluorescent lamps (T12, or 1.5 inch diameter) with one standard magnetic ballast
Note: a 34 Watt lamp is the energy saving version of the 40 Watt lamp.

STEAM SYSTEM

Steam System Improvements					$17.85	per kWh Diesel					
			Fuel Usage	**2,968,999.40**	**$52,999,319.79**						
	Typical Savings	Est. Savings		kWh/yr.	Cost Savings	Cost Savings ($US)	Project Cost	Project Cost ($US)	Typical Payback	Est. Payback	CO2
Operations and Maintenance											
Reduce leaks	1 to 2%	1.00%		29,690	$529,993	$2,650	$4,000,000	$5,300	1 to 3 yrs	2.0	17178.63
Improve Cond Return	1 to 3%	2.00%		59,380	$1,059,986	$5,300	$4,000,000	$15,900	1 to 3 yrs	3.0	34357.26
Capital Projects (installation on two of the three boilers)											
O2 Trim	1 to 2%	2.00%		59,380	$1,059,986	$5,300	$4,000,000	$20,000			34357.26
VFD burner Control				3,189	$180,478	$902	$240,000	$1,200			6192.376
Total				62,569	$1,240,465	$6,202	$4,240,000	$21,200	2 to 3 yrs	3.4	40549.64
Stack economizer	5 to 10%	5.00%		148,450	$2,649,966	$13,250	$16,000,000	$80,000	3 to 5 yrs	6.0	85893.15
Source: Optimizing energy savings opportunities in Steam Boiler systems - Energy Engineering Vol 109, No. 2 2012											

APPENDIX B: BENCHMARKING SHEETS

Information from Department of Energy Website http://www1.eere.energy.gov/industry/

SUMMARY RESULTS		
SCOPING TOOL QUESTIONS	POSSIBLE SCORE	YOUR SCORE
1. STEAM SYSTEM PROFILING		
STEAM COSTS		
SC1: Measure Fuel Cost To Generate Steam	10	
SC2: Trend Fuel Cost To Generate Steam	10	
STEAM/PRODUCT BENCHMARKS		
BM1: Measure Steam/Product Benchmarks	10	
BM2: Trend Steam/Product Benchmarks	10	
STEAM SYSTEM MEASUREMENTS		
MS1: Measure/Record Steam System Critical Energy Parameters	30	
MS2: Intensity Of Measuring Steam Flows	20	
STEAM SYSTEM PROFILING SCORE	90	
2. STEAM SYSTEM OPERATING PRACTICES		
STEAM TRAP MAINTENANCE		
ST1: Steam Trap Maintenance Practices	40	
WATER TREATMENT PROGRAM		
WT1: Water Treatment - Ensuring Function	10	
WT2: Cleaning Boiler Fireside/Waterside Deposits	10	
WT3: Measuring Boiler TDS, Top/Bottom Blowdown Rates	10	
SYSTEM INSULATION		
IN1: Insulation - Boiler Plant	10	
IN2: Insulation - Distribution/End Use/Recovery	20	
STEAM LEAKS		
LK1: Steam Leaks - Severity	10	
WATER HAMMER		
WH1: Water Hammer - How Often	10	
MAINTAINING EFFECTIVE STEAM SYSTEM OPERATIONS		
MN1: Inspecting Important Steam Plant Equipment	20	
STEAM SYSTEM OPERATING PRACTICES SCORE	140	
3. BOILER PLANT OPERATING PRACTICES		
BOILER EFFICIENCY		
BE1: Measuring Boiler Efficiency - How Often	10	
BE2: Flue Diesel Temperature, O2, CO Measurement	15	
BE3: Controlling Boiler Excess Air	10	
HEAT RECOVERY EQUIPMENT		
HR1: Boiler Heat Recovery Equipment	15	
GENERATING DRY STEAM		
DS1: Checking Boiler Steam Quality	10	
GENERAL BOILER OPERATION		
GB1: Automatic Boiler Blowdown Control	5	
GB2: Frequency Of Boiler High/Low Level Alarms	10	
GB3: Frequency Of Boiler Steam Pressure Fluctuations	5	
BOILER PLANT OPERATING PRACTICES SCORE	80	
4. STEAM DISTRIBUTION, END USE, RECOVERY OPERATING PRACTICES		
MINIMIZE STEAM FLOW THROUGH PRVs		
PR1: Options For Reducing Steam Pressure	10	
RECOVER AND UTILIZE AVAILABLE CONDENSATE		
CR1: Recovering And Utilizing Available Condensate	10	
USE HIGH-PRESSURE CONDENSATE TO MAKE LOW-PRESSURE STEAM		

FS1: Recovering And Utilizing Available Flash Steam	**10**
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES SCORE	**30**

SUMMARY OF STEAM SCOPING TOOL RESULTS

	POSSIBLE SCORE	YOUR SCORE
STEAM SYSTEM PROFILING	**90**	
STEAM SYSTEM OPERATING PRACTICES	**140**	
BOILER PLANT OPERATING PRACTICES	**80**	
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES	**30**	
TOTAL SCOPING TOOL QUESTIONAIRE SCORE	**340**	
TOTAL SCOPING TOOL QUESTIONAIRE SCORE (%)		
Date That You Completed This Questionnaire		

STEAM SYSTEM PROFILING

STEAM COSTS

What To Do Identify what it costs at your facility to produce steam (in units of Cost/1000 lbs), and use this as a benchmark for evaluating opportunities for improving your steam operations. Start with determining what your fuel costs are to make steam, then add other costs associated with your operations (chemical costs, labor, etc).

Why Important Understanding the cost to make steam can be an eye-opener - producing steam is not free! Any opportunity that reduces the amount of steam generated saves money, so understanding the cost to make steam is a key step to being able to quantify improvement opportunities.

	ACTIONS	SCORE	YOUR SCORE
Do you monitor your Fuel Cost To Generate Steam - in terms of (Cost) / (1000 lbs. of steam produced)?	yes	10	
	no	0	0
How often do you calculate and trend your Fuel Cost To Generate Steam?	at least quarterly	10	
	at least yearly	5	
	less than yearly	0	0

STEAM/PRODUCT BENCHMARKS

What To Do Identify how much steam it takes to make your key products. Then track this benchmark: a) with what other facilities in your company do; b) with what other similar plants in your industry do; and c) with how this benchmark varies in your operations over time.

Why Important The bottom line of your operation is how cost effectively you make your products, and steam use has an impact on your productivity. Steam/product benchmarking is an excellent way to monitor productivity and how steam improvements translate to improved productivity.

	ACTIONS	SCORE	YOUR SCORE
Do you Measure your Steam/Product Benchmark - in terms of (lbs. of steam needed) / (unit of product produced)?	yes	10	
	no	0	
How often do you Measure and Trend your Steam/Product Benchmark - in terms of (lbs. of steam needed) / (unit of product produced)?	at least quarterly	10	
	at least yearly	5	
	less than yearly	0	

STEAM SYSTEM MEASUREMENTS

What To Do Identify key steam operational parameters that you should monitor and ensure that you are adequately measuring them.

Why Important You Can't Manage What You Don't Measure! Measurement of key steam system parameters assists you in monitoring your system, diagnosing potential system problems, and ensuring that system improvements continue to provide benefits to your operations.

	ACTIONS	SCORE	YOUR SCORE
Do you measure and record Critical Energy Parameters for your Steam System?			
Steam Production Rate (to obtain total steam production)	yes	10	
Fuel Flow Rate (to obtain total fuel consumption)	yes	6	
Feed water Flow Rate	yes	6	
Makeup Water Flow Rate	yes	4	
Blowdown Flow Rate	yes	2	

Chemical Input Flow Rate	yes	2	
	no to all of above	0	
How intensely do you meter your steam flows? - CHOOSE ONE OF FIVE ANSWERS	by major user/equip	20	
	by process unit	10	
	by area or building	5	
	by plant as a whole (i.e., total boiler output)	2	
	not at all	0	

STEAM SYSTEM OPERATING PRACTICES

STEAM TRAP MAINTENANCE

What To Do Implement a comprehensive program to correctly select, test, and maintain your steam traps.

Why Important Steam traps play three important functions: a) prevent steam from escaping from the system before the heat is utilized; b) remove condensate from the system; and c) vent no condensable steam. Poor steam trap selection, testing, and maintenance can result in many system problems including water hammer, ineffective process heat transfer, steam leakage, and system corrosion. An effective steam trap selection and maintenance program is often an excellent investment with paybacks of less than half a year.

Does Your System Steam Trap Maintenance Program Include The Following Activities?	ACTIONS	SCORE	YOUR SCORE
Proper Trap Selection For Application	yes	10	
At Least Annual Testing Of All Traps	yes	10	
Maintaining A Steam Trap Database	yes	10	
Repairing/Replacing Defective Traps	yes	10	
	none of the above	0	

WATER TREATMENT PROGRAM

What To Do Implement and maintain an effective Water Treatment Program in your steam system.

Why Important An effective steam system Water Treatment Program: a) reduces the potential for waterside fouling problems in your boilers; b) is critical to minimizing boiler blow down and the resulting energy losses; c) can reduce the generation of wet steam; and d) greatly reduces the potential for corrosion problems throughout your steam system. Most effective water treatment programs include both mechanical (filtration, softening, and deaeration) and chemical treatment. Problems in this area can lead to significant plant productivity issues related to equipment failure and downtime - be sure to consult with a chemical treatment specialist on an ongoing basis.

	ACTIONS	SCORE	YOUR SCORE
How often do you ensure that your Water Chemical Treatment System is functioning properly?	at least daily	10	
	at least weekly	5	
	less than weekly	0	
How often do you NEED to clean Fireside or Waterside deposits in your Boiler?	every 5-10 years	10	
	every 1-5 years	5	
	once/year or more	0	

How often do you measure Conductivity (or Total Dissolved Solids [TDS]) in your Boiler and determine what your Steam and Mud Drum Blowdown Rate (or Top and Bottom Boiler Blowdown Rate) should be?	continuous, or at least once/shift	10	
	once/day	5	
	once/week or less	0	

SYSTEM INSULATION

What To Do Ensure that the appropriate major components of your steam system are well insulated. Determine the economic insulation thickness for your system components, and perform system insulation reviews to identify exposed surfaces that should be insulated and/or unrestored or damaged insulation.

Why Important Effective insulation - on piping, valves, fittings, and vessels - serves many important purposes. Insulation keeps steam energy within the system to be effectively used by processes, it can reduce temperature fluctuations in the system, it can reduce space conditioning requirements, and it can reduce the potential for personnel burns.

	ACTIONS	SCORE	YOUR SCORE
Is your Boiler Plant equipment and piping system insulation (refractory, piping, valves, flanges, vessels, etc.) maintained and in good condition?	insulation excellent	10	
	insulation good, but can be improved	7	
	insulation inadequate	0	
Is your Steam Distribution, End Use, and Condensate Recovery equipment insulation (piping, valves, flanges, heat exchangers, etc.) maintained and in good condition?	insulation excellent	20	
	insulation good, but can be improved	14	
	insulation inadequate	0	

STEAM LEAKS

What To Do Identify and quickly repair steam leaks in your steam system.

Why Important Steam leaks can result from failures associated with such things as improper piping design, corrosion problems, and joint and valve seal failures. In high-pressure industrial steam systems, energy costs associated with steam leaks can be substantial. Identifying and repairing steam leaks is essential to properly balancing your steam system.

	ACTIONS	SCORE	YOUR SCORE
How would you characterize Steam Leaks in your Steam System?	none	10	
	minor	8	
	moderate	3	
	numerous	0	

WATER HAMMER

What To Do Detect and quickly eliminate Water Hammer in your steam system.

Why Important Water Hammer is a serious concern - it can lead to failure and rupture of piping and valves, and in many cases significant personnel injury due to contact with steam and condensate. There are two main types of water hammer: one caused by accumulation of condensate in steam distribution piping and transport of this condensate by high-velocity steam; and the other caused by a pressure pulse resulting from steam collapse (rapid condensation) in condensate return lines and heat exchange equipment. Water Hammer in your steam system always says FIX ME!!

YOUR

	ACTIONS	SCORE	SCORE
How often do you detect noticeable Water Hammer in your Steam and Condensate Recovery System?	less than once a month	10	
	monthly or weekly	5	
	daily or hourly	0	

MAINTAINING EFFECTIVE STEAM SYSTEM OPERATIONS

What To Do Establish and carry out a comprehensive steam system maintenance program.

Why Important Effective steam system operating practices and improvements can provide benefits to your steam operations year after year - IF you have an effective system maintenance program in place. Major areas of maintenance that will provide year-after-year benefits to your operations include: a) steam traps; b) boiler performance; c) water treatment; d) turbines, piping, heat exchangers, pumps, motors, and valves; and e) system insulation.

	ACTIONS	SCORE	YOUR SCORE
Do you periodically - at least once a year - inspect the following important Steam Plant Operational Equipment?			
Boiler Plant Equipment - boiler, deaerator, feed water tank, chemical treatment equipment, blow down equipment, economizer, combustion air preheater, insulation, etc.?	yes	5	
Distribution System Equipment - piping (including design), steam traps (types, sizes, locations), air vents, valves, pressure reducing stations, insulation, etc.?	yes	5	
End Use System Equipment - turbines, piping (including design), heat exchangers, coils, jacketed kettles, steam traps (types, sizes, locations), air vents, vacuum breakers, pressure reducing valves, insulation, etc.?	yes	5	
Recovery System Equipment - piping (including design), valves, fittings, flash tanks, condensate pumps, condensate meters, insulation, etc.?	yes	5	
	no to all of above	0	

BOILER PLANT OPERATING PRACTICES

BOILER EFFICIENCY

What To Do Measure, trend, and look for opportunities to improve the efficiency of your boilers.

Why Important One of the key boiler plant functions is to generate steam at the highest possible efficiency. Major sources of boiler efficiency losses include: a) combustion and flue diesel energy losses [typically the largest]; b) blow down losses; and c) refractory insulation losses. It is important to measure and trend boiler efficiency, flue diesel temperature, flue diesel oxygen content, and flue diesel carbon monoxide content on a regular basis. Measurement and control of excess oxygen is critical to minimizing boiler combustion energy losses. Trending flue diesel temperature can provide indications of other potential boiler problems, such as waterside or fireside fouling problems.

	ACTIONS	SCORE	YOUR SCORE
How often do you measure your overall Boiler Efficiency - [(heat absorbed to create steam) / (energy input from fuel)]?	at least quarterly	10	
	at least yearly	5	
	less than yearly	0	

Do you measure the following parameters as a function of boiler load and ambient temperature?

Flue diesel temperature	yes	5	
Flue diesel Oxygen content	yes	5	
Flue diesel CO content	yes	5	
	no to all of above	0	

How do you control Excess Air in your Boiler to maximize Boiler Efficiency?	automatically	10	
	manually	5	
	not at all	0	

HEAT RECOVERY EQUIPMENT

What To Do Evaluate installation of Heat Recovery Equipment on your Boiler Plant.

Why Important In some boilers, high flue diesel temperatures and high continuous blow down rates can provide opportunities for installation of heat recovery equipment. Feed water economizers and combustion air preheaters can, under appropriate conditions, be installed to extract excess flue diesel energy and effectively increase the boiler efficiency. Blowdown heat recovery equipment can also, for some systems, be installed to extract otherwise lost heat from the blow down system. For either potential opportunity, an economic analysis is needed to determine the feasibility of the opportunity, and the equipment should be designed and installed by qualified professionals.

	ACTIONS	SCORE	YOUR SCORE
Do you have any of the following Heat Recovery Equipment installed on your Boilers?			
Feed water Economizer and/or Combustion Air Preheater	yes	10	
Blowdown Heat Recovery	yes	5	
	no to all of above	0	

GENERATING DRY STEAM

What To Do Ensure that you generate high-quality dry steam in your boiler plant.

Why Important Steam of 100% quality contains no liquid water; wet steam contains liquid droplets. Generating wet steam in your boiler can cause many system problems, including: a) inefficient process heat transfer; b) equipment failure by water hammer; c) equipment failure by corrosion and erosion; and d) steam trap failure by overloading. Some typical causes for creation of wet steam and boiler carryover are: a) wide swings in boiler water level; b) reduced operating pressure; c) boiler overload; and d) poor boiler total dissolved solids (TDS) control. A critical step to ensuring generation of high-quality steam is to measure the quality of steam leaving your boiler; this is typically done using steam calorimeters.

	ACTIONS	SCORE	YOUR SCORE
How often do you check the Quality of Steam that is output from your Boiler to the Distribution System, and ensure that you are generating Dry Steam?	at least quarterly	10	
	at least yearly	5	
	less than yearly	0	

GENERAL BOILER OPERATION

What To Do Ensure that your boilers perform their functions without large fluctuations in operating conditions.

Why Important How you control boiler operation can effect many elements of the steam system - including the operating life of the boiler, the quality of steam produced, and the effectiveness of steam use throughout your production operations.

	ACTIONS	SCORE	YOUR SCORE
Do you have an operational automatic blow down controller on your Boiler?	yes	5	
	no	0	

What is the frequency of High Level Alarms (possibly indicating boiler undersized) or Low Level Alarms (possibly indicating boiler oversized) for your Boiler?	less than 1/month 1-5 per month more than 5/month	10 5 0	
How often do you experience steam pressure fluctuations of greater than 10% of your Boiler Operating Pressure?	less than 1/month 1-5 per month more than 5/month	5 3 0	

STEAM DISTRIBUTION, END USE, RECOVERY - OPERATING PRACTICES

OPTIONS FOR REDUCING STEAM PRESSURE - MINIMIZE STEAM FLOW THROUGH PRVs

What To Do Investigate potential to use backpressure turbines in parallel with pressure reducing valves in your steam system.

Why Important In many steam systems, pressure reducing valves (PRVs) are used to provide steam at pressures lower than generated from the boiler. A potential opportunity for improving a steam system is to minimize the flow of steam through PRVs. One opportunity for doing this is to install backpressure turbines in parallel with PRVs in your steam system; in this way you can provide the low-pressure steam required and generate electricity or shaft power that can be utilized. A detailed economic analysis must be performed to evaluate this type of opportunity.

	ACTIONS	SCORE	YOUR SCORE
How do you reduce steam pressure in your steam system?	steam generated at required pressure, or PRVs appropriately applied	10	
	backpressure turbines used in parallel with PRVs	10	
	boiler control used to reduce pressure	5	
	excess steam vented and/or used inefficiently	0	

RECOVER AND UTILIZE AVAILABLE CONDENSATE

What To Do Determine how much of your available condensate you recover and utilize.

Why Important Returning a substantial portion of your condensate to your boiler can have both energy and chemical treatment benefits: a) condensate is hotter than makeup water, so less energy is required to convert condensate to steam; and b) condensate requires significantly less chemical treatment than makeup water, so there may be savings in chemical treatment costs associated with returning condensate. Returning as much condensate as possible also can help to reduce boiler blow down (because fewer impurities are resident in condensate), and so minimize blow down energy losses.

	ACTIONS	SCORE	YOUR SCORE
How much of your available Condensate do you recover and utilize?	greater than 80%	10	
	40% to 80%	6	
	20% to 40%	3	
	less than 20%	0	

USE HIGH-PRESSURE CONDENSATE TO MAKE LOW-PRESSURE STEAM

What To Do Investigate opportunity to utilize high-pressure condensate to produce useable low-pressure steam.

Why Important An opportunity for utilizing high-pressure condensate is to allow it to pass through a flash tank and utilize the flash steam in low-pressure steam applications. The remainder of the condensate, now at lower pressure and temperature, can then be sent back to the boiler for use in producing steam.

	ACTIONS	SCORE	YOUR SCORE
How much of your available Flash Steam do you recover and utilize?	greater than 80%, or flash steam unavailable	10	
	40% to 80%	6	
	20% to 40%	3	
	less than 20%	0	

APPENDIX C: EQUIPMENT LIST

Biomedical Equipment

X-Ray

Equipment	Model#	Serial#	Tag#
Portable X-Ray Machine	46-270954G2	81740032-048	515140052
Portable X-Ray Machine	2275938-10	1019213WK6	
Ultra Sound	428335U4	5171610	5151400049
Processor	AGFA CE16284	A-000044	515140080
X-Ray Machine	AL01F/05892919	2900	515140052
Processor	20287	20287	801140002

Biochemistry

Equipment	Model#	Serial#	Tag#
Centrifuge		229426	503140241
Centrifuge		229336	503140230
Chemwell # 2		2910-2538	503120132
Chemwell # 1		2910-2389	503120134
Chemwell # 3		2910-2895	503120133
Easylyte Plus Analyzer # 2		28079BMKC	503120127
Easylyte Plus Analyzer # 3		43160CNKC	503140004
Lab Special Mixer		11121076	503130002
Balance	XP-3000		503140221
Bio-Rad		D56F054313	

Compatibility

Equipment	Model#	Serial#	Tag#
Quick Thaw Plasma System		970613	503140236
Triple Beam Scale			503140220
ID Centrifuge S II		8618-23-035	503140232
MTS Incubator		225571257	503140233
Medlite Centrifuge		4580646	503140234
Freezer			503140235
Freezer			
Freezer			
Incubator		967301	503140231
Freezer	ISOTEMP		503140219
Fridge (Blood Fridge)			503140239

Thermo Electron Cryoprecipitate Freezer			503140183
Incubator			503140238

Urology

Equipment	Model#	Serial#	Tag#
Rotator		07990360	503140212
Clinitek 50			1 28 024
Incubator	1500E	04065404	503140003
Micromaster		12708-0021039	503140181

Hematology

Equipment	Model#	Serial#	Tag#
Microscope		94203	1/28/03601
Lab Line Rotator		1690125	503140206
Centrifuge		0912372	503140226
Centrifuge		0911304	503140227
Hotplate		61101121	503140205
Slide Dryer		8L740-5	503140208
Microscope		JL06921-5	506140127
Rotator	SM-100		503130002
Microscope		JL06885	503140052
Microscope		2625518	503120126
Analyzer		AL51182	503140224
Microscope		12706-0024-041	

Microbiology

Equipment	Model#	Serial#	Tag#
Centrifuge			503140243
Incubator			503140244
Microscope			503140242
Microscope			503140178
Microscope			503140198
Biosafety Cabinet			503140187
Hotplate			503160147
Hotplate			503160146
Balance			503140245
Balance			503140001
Magnetstir			503140140
Autoclave			503140251

Incubator	470	0304-1929	503140185
Incubator	1500E	0201004	503140002

Ward E

Equipment	Serial#	Model#
Blood Pressure Apparatus	SW8550	Stand By
	SW8358	Stand By
	065533	WABaumCo
Laryngoscope (with 3 blades)	Nil	Nil
Electric Suction Apparatus	No 1F8.048	YX940D
Examination Lamp	Nil	Nil
	GPHC # 606140091	Nil
Oxygen Regulator	D10042	AMVRX
	B01210	Ohmeda
Flowmeter Double	D03298/D03299	Ohmeda
	D03296/D03297	Ohmeda
Glucose Meter	103A0050E7B	On Call Plus

Post Natal

Equipment	Serial#	Model#
Laryngoscope	Nil	Nil
Regulator	0620416Y	Ohmeda
	06204179	Ohmeda
Suction	Nil	YX940D
Examination Lamp	Nil	Nil
Examination Lamp	Nil	Nil
Blood Pressure Apparatus	SX0023	Stand By
	0667437	Labtron

Department: Pre-Natal

Equipment	Serial#	Model/ Product #	Tag#
Fetal Monitor	3650016250	Ml3508	-
Fetal Monitor	3121001878	M1350A	-
Examination Lamp	-	-	606140092
Examination Lamp	-	-	606140088
Oxygen Regulator	6700-1240-900	OHMEDA	-
Oxygen Regulator	Dl0555	Amvex	-
Flow Meter (Double)	K03683/K03682	OHMEDA	-
BP Apparatus	SW9565	Standby	-
BP Apparatus	SX0031	Standby	-
BP Apparatus	065531	Wabaum Co	-

Glucose Meter	103A006FAE1	On Call Plus	-

Department : Labor Room

Equipment	Serial#	Model#	Tag#
Warmer	TF02052	PM78-1	-
Warner	GP04680	PM-78-1	-
Warmer	PH28087	PM-78-1	-
Electric Suction Apparatus	IT10.200	YX932D	-
Electric Suction Apparatus	IT4.050	YX940D	

Department: CS Room

Equipment	Serial#	Model#	Tag#
Flow Meter (Double)	B01227 *I* B01228	OHMEDA	-
BP Apparatus	SX0159	Standby	-
Examination Lamp	-	-	605140283
Glucose Meter	103A006F303	On Call Plus	-
Oxygen Regulator	D10979	Amvex	-

Department – NNU

Equipment	Brand	Model	Serial#	Asset#
Phototherapy Unit	Olympic Bililite	-	26977	-
Phototherapy Unit	Olympic Bililite	-	23276	-
Phototherapy Unit	David	ZHZ-90	4206I205073	62II400I2
Phototherapy Unit	David	ZHZ	4026I205072	62Il400II
Phototherapy Unit	Neo Blue	Led Phototherapy	22666	621140070
Phototherapy Unit	Neo Blue	Led Phototherapy	2271I	621I40066
Phototherapy Unit	Neo Blue	Led Phototherapy	22709	621I40062
Phototherapy Unit	Neo Blue	Led Phototherapy	22670	62II40068
Phototherapy Unit	Neo Blue	Led Phototherapy	22710	621140069
Incubator	Drager	C2p5-I	NGOl073	62I140064
Incubator	Drager	C2p5-I	Mu21125	62I140063
Incubator	Drager	C2p5-1	MU21I23	62II40065
Incubator	Omega	GIRAFFE	HDHG54275	-
Incubator	Omega	GIRAFFE	HDHG54274	-
Incubator	Omega	GIRAFFE	HDHG54270	-
Incubator	Omega	GIRAFFE	HDHG54272	-
Suction	SHAF	YX932D	-	-
(5) Examination	-	-	-	-
(2) o 2 Regulator	-	-	-	-
(8) o 2 Flow meter	-	-	-	-

Equipment	Serial#	Model	Tag#
Suction	20011017014	0405	614140008
Scale	-	DECTECTE	600140002
BP Apparatus	SW8525	STANDBY	617140127
Flow Meter (Single)	K02372	OHMEDA	301150069
Flow Meter (Single)	K02370	OHMEDA	301150068

Department : Male Surgical

Flow Meter (Single)	K02360	OHMEDA	301150039
Flow Meter (Single)	K02346	OHMEDA	3000115005
Flow Meter (Single)	K02551	OHMEDA	301150046
Flow Meter (Single)	K02365	OHMEDA	-
Flow Meter (Single)	K02347	OHMEDA	301150042
Flow Meter (Single)	K02350	OHMEDA	301150049
Oxygen Regulator	510998	AMVEX	-
Laranscope	-	MAC 1-4	-

Equipment	Serial#	Model	Tag#
Flow Meter (Single)	K20367	OHMEDA	302150032
Flow Meter (Single)	K02344	OHMEDA	301150023
Flow Meter (Single)	K02375	OHMEDA	301150045
Flow Meter (Single)	K02369	OHMEDA	301150037
Flow Meter (Single)	K02352	OHMEDA	301150054
Flow Meter (Single)	K02365	OHMEDA	301150033
Flow Meter (Single)	K02348	OHMEDA	321150065
Flow Meter (Single)	K02343	OHMEDA	-301150058
Glose Meter	10340050E65	On Call Plus	-
Laranscope	-	2Mrc-2,2Mk3	-
Suction	N-10480	3040	618140009

Department : Male Medical

Equipment	Serial#	Model	Tag#
Suction	20040323007	405	61140024
Suction	J-95B	4040	-
BP Apparatus	SW6991	STANDBY	-
BP Apparatus	JV5078	STANDBY	-
BP Apparatus	TYM060MS	LUMISCOPE	-
Flow Meter (Double)	F01715/F01714	OHMEDA	-
Flow Meter (Double)	F01719/F01718	OHMEDA	-

Flow Meter (Double)	C22583/C22582	OHMEDA	-
Flow Meter (Double)	F01725/F01724	OHMEDA	-
Flow Meter (Double)	FO1727/FO1726	OHMEDA	-
Flow Meter (Double)	FO1721/FO1720	OHMEDA	-
Flow Meter (Single)	K02350	OHMEDA	-
Glucose Meter	1034006FB64	On Call Plus	-
Laranscope	-	MAC-RT3	611130001
Scale	-	-	611140023

Intensive Care Unit

Equipment	Serial#	Model#	GPHC#
Ventilator	173371	SV900-C	Nil
Ventilator (110-240V 47-63Hz)	KA601943	15336	Nil
Ventilator (110-240V 47-63Hz)	KC003120	15020	Nil
Ventilator (115V 60Hz)	8645228	PB 7200 Series	604140186
Ventilator (110-240V 50-60Hz)	Nil	PB740	604140187
Ventilator (115V 60Hz)	Nil	PB 7200 Series	
Infant Ventilator (240V 50Hz)	Nil	SC-Y200	604140020
Infant Ventilator (240V 50Hz)	Nil	SC-Y200	604140019
Monitors:			
	CK00022771	UP-6000	508120003
(100-250V)	0000023812	UP-6000	
	DD00023570	UP-6000	
(115-220V)	Nil	HP	604120174
(115-220V)	Nil	HP	501120248
(115-220V)	Nil	HP	604120177
Blood Pressure Apparatus	SW8590	Stand By	604140181
Oxygen Regulator	Nil	Ohmeda	Nil
Oxygen Regulator	El0196	AMVEX	Nil
Examination Lamp (120V 60Hz)	Nil	Portable Lumimare	Nil
ECG	US10812083	Page Writer Touch	Nil
Defibrillator	20601A06180	HP-43100A	Nil

Main Operating Theatre

Roo		
Equipment	**Serial#**	**Model#**
Anesthetic Ventilator	AMXM01552	7100
Patient Monitor	6267389	GE
Suction Apparatus	27300016	5713916
Suction	Nil	YX930D
Blood Warmer	6F9447004	Nil
Laparoscopic Apparatus:		
Monitor	2019939	Sony PVM-201V2MOU
Color Video Printer	12752	Sony UP-51MO
Endoscope	AH55271	26430520
Endoscope Trican SL	KF614699	20222120
Patient Monitor	CL00022813	UP-6000
Suction	20010929005	Gomo 3040
Laparoscopic:		
Monitor	2011588	
C-Arm	F2506128	GE Ever View 7500
Room 3		
Anesthetic Ventilator	AMFYOOI08	Excell 410 ISO
Patient Monitor	62208380	62000 Welch Allyn
Patient Monitor	041242-033	CAMS 11
Electrosurgical Machine	Nil	Excell 250
Blood Warmer	6F9447007	Grant
Suction Apparatus	27300020	Oxylitre 5713916
Room 4		
Anesthetic Ventilator	AMXN00116	Ohmeda 7100
Patient Monitor	6494423	GE
Suction Apparatus	Nil	YX9300
Suction	27300017	Oxylitre 5713916
Electrosurgical	0908G2313JUJ	EB03
Blood Warmer	6F9447005	Grant
Room 5		
Infant Warmer	HCAX01388	Ohmeda 3300
Anesthetic	AMFYY00102	Grant BWl
Ventilator		

Department: HDU

Department: Female Surgical

Department: Female Medical

Equipment	Serial#	Model	Tag#
Suction	20010929008	3040	-
BP Apparatus	3W7069	Standby	602140190
BP Apparatus	5W7049	Standby	614140014
BP Apparatus	5W17013	Standby	617140109
BP Apparatus	5W7037	Standby	-
Oxygen Regulator	-	Ohmeda	-
Oxygen Regulator	07408chw	Ohmeda	-
Oxygen Regulator	07903cln	Ohmeda	-
Oxygen Regulator	-	Ohmeda	-

Department: ENT

Equipment	Serial#	Model#	Tag#
Suction	J-3532	3020	-
Suction	LA701399719	Record 500	-
Oxygen Regulator	07106NY2	OHMEDA	-
Microscope	-	CARL ZE155	-
Microscope	-	CARL ZE155	-

Department: Pediatrics

Equipment	Serial#	Model#	Tag#
Flow Meter (Double)	K03625/K03674	OHMEDA	-
Flow Meter (Double)	K03685/K03684	OHMEDA	-
Flow Meter (Double)	K03705/K03704	OHMEDA	-
Flow Meter (Single)	B01196	OHMEDA	-
Flow Meter (Single)	K02373	OHMEDA	-
High Suction Control	021107198	OXYLITRE	-

High Suction Control	11551	OXYLITRE	-
High Suction Control	11546	OXYLITRE	-
High Suction Control	1723013	OXYLITRE	-
High Suction Control	11557	OXYLITRE	-
High Suction Control	1723015	OXYLITRE	-
High Suction Control	1018008	OXYLITRE	-
High Suction Control	11549	OXYLITRE	-
BP Apparatus	SW17258	STANDBY	505140009
BP Apparatus	-	STANDBY	505140012
BP Apparatus	SW7237	STANDBY	505140011
BP Apparatus	SW7232	STANDBY	505140010
Oxygen Regulator	06204178	OHMEDA	301180102
Glucose Meter	10340050E31	On Call Plus	-
Laranscope	-	o 2 MAC-2,MAC-1	-
Scale	-	Detecto	-
Monitor	93029690	5014	-
Monitor	1031OEK00073	PC9000	505140013
Suction	-	Devi!B155	-
Suction	-	SSV-2	505140015
Nebulizer	D3487102	5650D	505140017
Nebulizer	D3097384	5650D	-
Nebulizer	-	5652D	-
Defibrillator	0004815	LIFEPAK7	-
Examination Lamp	-	Portable Luminaire	505140021
Examination Lamp	-	Portable Luminaire	505140020
Infant Scale	-	-	505140003
Electrical Scale	2595800176	-	-

Equipment	Serial#	Model#	Tag#
Blood Warmer	-	Grant	60412017 l
High Suction Control	GFHX28665	OHMEDA	-
High Suction Control	GFHX25661	OHMEDA	-
High Suction Control	GFHX28673	OHMEDA	-
High Suction Control	GFHX28587	OHMEDA	-
High Suction Control	GFHX28663	OHMEDA	-
High Suction Control	GFHX28676	OHMEDA	-
High Suction Control	GFHX28671	OHMEDA	-
Flow Meter (Single)	X38079	OHMEDA	-
Flow Meter (Single)	X38071	OHMEDA	-
Flow Meter (Single)	X38032	OHMEDA	-
Flow Meter (Single)	X38077	OHMEDA	-
Flow Meter (Single)	-	OHMEDA	-
Flow Meter (Single)	-	OHMEDA	-
Flow Meter (Single)	L7740	OHMEDA	-
Infusion Pump	55869	Stigma 8000 Plus	-
Infusion Pump	62831	Stigma 8000 Plus	-
Infusion Pump	63583	Stigma 8000 Plus	-
Infusion Pump	54835	Stigma 8000 Plus	-
Infusion Pump	70976	Stigma 8000 Plus	-
Infusion Pump	-	Stigma 8000 Plus	-
Infusion Pump	64490	Stigma 8000 Plus	-
Infusion Pump	70974	Stigma 8000 Plus	-
Infusion Pump	64517	Stigma 8000 Plus	-
Infusion Pump	49381	Stigma 8000 Plus	-
Infusion Pump	-	Stigma 8000 Plus	-
Infusion Pump	-	MedFusion 3010a	-
Infant Incubator	11071201001	YP-90A	621140024
Infant Incubator	11071201003	YP-930	-

Equipment	Model#	Serial#	Tag#
Portable X-Ray Machine	46-270954G2	81740032-048	515140052
Portable X-Ray Machine	2275938-10	1019213WK6	
Ultra Sound	428335U4	5171610	5151400049
Processor	AGFA CE16284	A-000044	515140080
X-Ray Machine	AL01F/05892919	2900	515140052
Processor	20287	20287	801140002

Stand Suction	27300018	Oxylitre
	20010929002	Gomo 3040
Electrosurgical	L3I65602-10	Vally Lab 55E2L
Suction Apparatus	20010929006	Gomo 3040
Patient Monitor	62204689	Welch Allyn 62000
Anesthetic Ventilator	AMFY00106	Excell 410 ISO
Patient Monitor	62204688	Welch Allyn
Operating Microscope	Nil	Scan Optics 505800
Auto Clave	Nil	Tuttnumer 1730M
Voltage Regulator		Pyra
Recovery Room		
Blood Pressure Apparatus	1642	Lohneir
Pulse Oximeter	Pb-12691 031	
Syringe Pump	0900263	Angel AJ-5803
Patient Monitor	J0700EFOO168	UP-6000
Blood Pressure Apparatus	1643	Lohmeir 13606
Patient Monitor	62209134	Welch Allyn 62000
Defibrillator	099116927	Zoll
Infant Warmer	YG17286	Air Shields Pm78-1
Patient Monitor	62204693	Welch Allyn 62000
Blood Pressure Apparatus	1646	B606
Anesthetic	AMXN00469	Datex 7100
Patient Monitor	6518333	GE Healthcare
Suction Apparatus	1484090	Oxylitre
Electrosurgical	Nil	Excell ISO

O2 Regulator	06204164	OHMEDA
O2 Regulator	05co3LED	OHMEDA
O2 Regulator	E10494	AMYEX
Flow meter (Single)	K03C78/K03679	OHMEDA
Flow Meter (Double)	K03691/K03690	OHMEDA
High Suction Control	11554	oxylitre
High Suction Control	10181016	oxylitre
High Suction Control	11555	oxylitre
High Suction Control	11545	oxylitre
High Suction Control	11547	oxylitre
High Suction Control	021107197	oxylitre
Monitor	OD00023810	Up-6000
Monitor		Cams 11
Examination lamp		Portable Luminare
Defibrillator	3304404389	M1722A
Laranscope		Mil-4,MAC-4
Scale		Detecto

Equipment	Serial#	Model	Tag#
BP Apparatus	SW7015	Standby	618140012
BP Apparatus	SW5148	Standby	618140010
Suction	J-3519	3020	619140018
Oxygen Regulator	-	Western Medical	-
Oxygen Regulator	05003664	OHMEDA	301150095
Glucose Meter	103A006Fc59	On Call Plus	-
Examination Lamp	-	UL Portable Luminaire	-
Laranscope	-	-	-
Laranscope	MAC-1	-	-
Laranscope	MAC-1	-	-
Laranscope	MAC-2	-	-
Laranscope	MAC-3	-	-

APPENDIX D: DISCLAIMER

While recommendations in this report have been reviewed for technical accuracy and are believed to be correct, Spectrum Energy Concepts, Inc. is not liable if projected savings or economics are not actually achieved. The recommendations are based on an analysis of conditions observed at the time of the survey, information provided by the Customer and costs based on Spectrum Energy Concepts, Inc.'s experience on similar projects. Estimated savings are computed on the basis of research by government agencies, product literature and engineering groups. Actual savings will depend on many factors, including measures implemented, seasonal weather variations, fuel price, and specific energy use practices of the facility occupants and workers. Performance guidelines provided in the report are for informational purposes only -- and are not to be construed as a design document.

Spectrum Energy Concepts, Inc. will not benefit in any way from your decision to select a particular contractor or vendor to supply or install the materials recommended in this survey. Equipment quotes contained in this report may be based on industry estimating procedures, rule of thumb, or provided by specific contractors or vendors. The quotes represent the best judgment of the auditors for implementation of the recommended action. You are encouraged to ask for the opinion of your firm's usual contractor or suppliers.

Disturbance, removal, or replacement of building material, insulation system, high intensity discharge and fluorescent lamps, lamp ballast's, power factor correction capacitors, starting and running capacitors of motors, and potentially other components may contain asbestos, mercury, or PCBs requiring handling and disposal in accordance with applicable laws and regulations for your facility. Spectrum Energy Concepts, Inc. may be able to assist the customer in providing information applicable to specific concerns; however, the customer has responsibility to ensure that he or his contractors follow such guidelines in the implementation of the recommendations of this report.