

Energy Conservation in Lerdsin Hospital

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Abstract

Hospitals have been one of the biggest energy consumers in the category of commercial buildings. The cost of energy had rapidly increased to 80.95 percent in 2005 since the opening of the new building “Karnchanapisek” in 2003. Investigation for the reason of energy consumption and its countermeasures were necessary. The report presented how to reduce electrical energy consumption in the hospital by monitoring electrical use and investigated simple conservation methods. There were five buildings in the hospital. Karnchanapisek building accounted for approximately 50 percent of the total floor space. Three sets of data logger, the Energy Management System (EMS) were installed to monitor total and site specific electricity consumptions in each building. Among air conditioning, lighting, elevator and other systems, chiller unit for air conditioning in the new building was the largest electricity consumption item. Demonstration test run for energy conservation of chiller units was performed in March 2005 by increasing the chilled water leaving temperature, decreasing the cooling water temperature and minimizing the number of operating pumps. Results of the monitoring showed that cost ratio of electricity, fuel oil and liquefied petroleum gas against total energy cost were 87 percent, 12 percent, and 1 percent respectively. The new building consumed more than 50 percent of the total electricity in the hospital. In the running test, a maximum 28 percent of electricity consumption by chiller units could be conserved. Cost saving of more than 1,000,000 baht / year was reportedly achieved. The test process for energy conservation described in this study is simple and quite cost effective.

Key words: energy conservation, air condition, chiller units

According to “Thailand Energy Situation” report published by Department of Alternative Energy Development and Efficiency (DEDE), energy consumption by residential and commercial sector in year 2005

accounted for 17 percent in the last four years^(1,2). In the energy crisis that crude oil price has risen sharply, it is encouraged to reduce energy consumption in order to minimize the country’s financial burden. Also

UN Framework Convention on Climate Change has announced that further reduction of CO₂ emission should be required in order to sustain well - balanced global environment.

Hospitals have been one of the biggest energy consumption in the category of commercial buildings. Before 2003, Lerdsin Hospital considerably consumed energy for air conditioning, lighting, elevator and other systems and its electricity bill of the Hospital has rapidly increased in the last few years after the completion of the new building (Kanchanapisek) in 2003. The energy cost has climbed from 16.5 million baht/year in 2003 to 19.33 million baht/year in 2004 (17.11% increase) (Figure 1). Although countermeasures for energy consumption are required, there are scanty reports concerning hospital's energy conservation⁽³⁻⁶⁾ particularly in Thailand.

The purposes of the study were to monitor electrical consumption and to investigate how to reduce electric energy use in the hospital buildings.

Methodology

Monitoring and reporting electrical consumption of its air conditioning system

Of the 5 buildings of Lerdsin Hospital, the new building floor space accounted for approximately 50 percent of the total space of the hospital (Figure 2). The new building consisted of 3 sets of 300 ton chiller. The water type chiller consisted of chiller, chiller wa-

ter pump, cooling water pump and cooling tower. The new building, the highest electricity consumption, is classified legally as a "designated buildings" according to the Energy Conservation Promotion Act (the ENCON Act)⁽⁷⁾.

To measure the energy consumption of the hospital, one set of data logger was installed to monitor total and also several main electricity consumption items of the new building. Other two sets of data logger with 0.05% error were used for collecting electricity consumption data of other buildings.

In order to prove the effect of energy conservation of chiller system which consisted of the cost of energy, electrical consumption and its reduction of chiller unit, following tests were performed in March 2005.

1) The chilled water leaving temperature increased from 44°F (6.7°C) to 50°F (10°C)⁽⁸⁻¹¹⁾.

2) The cooling water temperature decreased by adding one more set of cooling tower into operation⁽⁸⁾.

3) The number of operating pump was reduced by stopping one of the sets of chiller water pumps⁽¹¹⁾.

Test was done during April to August 2005. Total electricity consumption (kWh/month) were categorized into very hot season (April-May, 2 months), cold season (November-February, 4 months) and other months March, June July, August, September, October (6 months). Expected cost saving in baht/M was calculated using unit price of 2.793 baht/kWh and the

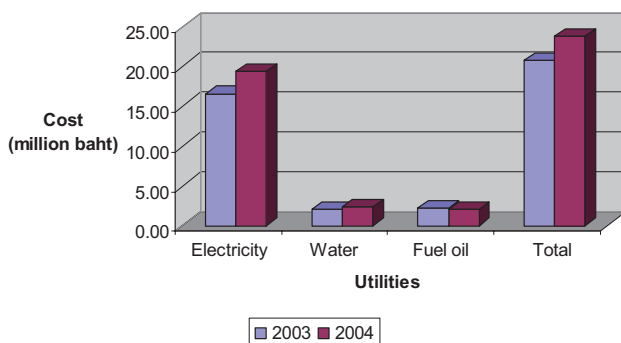


Fig. 1 Cost of energy consumption in Lerdsin Hospital

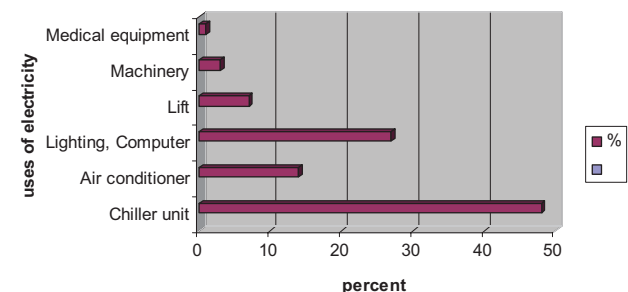


Fig. 2 Uses of electricity at the new building

percentage of expected energy saving in each period. Expected total cost saving in baht/year was the sum of baht saving in each period of time.

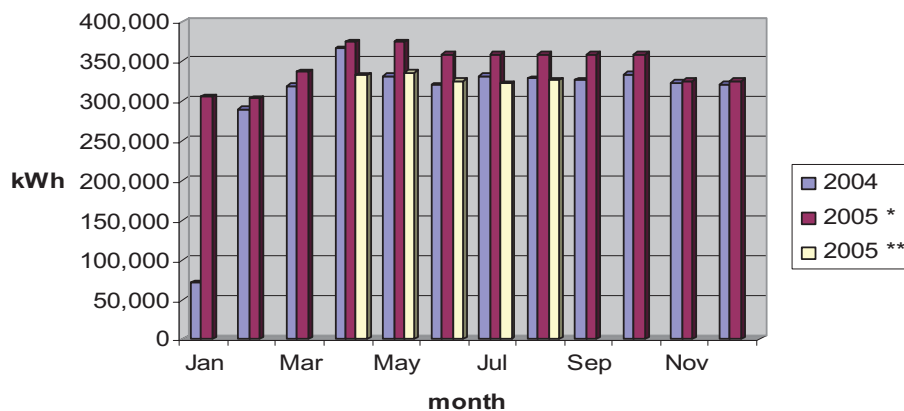
Results

Results of the monitoring showed that cost ratio of electrical, fuel oil and LPG to total energy cost accounted for 87,12 and 1 percent respectively. The new

building consumed more than 50 percent of total electricity consumption in the hospital with chiller units 48 percent (Table 1) and air conditioning 14 percent (Figure 2)⁽¹¹⁾.

Results of each test showed that energy conservation was 20 percent for chillers, 2 percent for cooling towers and 20 percent chiller water pumps. Maximum 28 percent of energy used for chiller units could

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 (baht)	72,000	290,000	319,000	366,000	332,000	320,000	332,000	328,000	326,000	334,000	323,000	321,000
2005 * (baht)	305,000	304,000	337,000	375,000	375,000	359,000	359,000	359,000	359,000	359,000	325,000	325,000
2005 ** (baht)				333,000	336,000	325,000	322,000	327,000				



*In case of no energy saving **Energy saving

Fig. 3 Electricity consumption / month of the new building before and after running test

Table 1 Expected cost saving by actual operation of chiller unit

Description	Very hot season (Apr-May)	Cold season (Nov-Feb)	Other months
Original electricity consumption *1 (kWh/m)	375,000	325,000	359,000
Chiller unit electricity consumption *2 (%)	48	41	47
Expected energy saving *3 (%)	28	28	28
Expected energy saving (kWh/m)	50,400	37,300	47,200
Expected cost saving *4 (baht/m)	140,800	104,200	131,800

Total cost saving (1 year from April 2005 to March 2006) : (140,800 X 2) + (104,200 X 4) + (131,800 X 6) = 1,489,200 baht /year

Remarks : *1. : Assumed from data of 2004 and calculated energy saving by chiller unit, for the case of no energy saving operation of chiller unit.

*2. : Proportion of chiller unit electricity consumption against total electricity consumption.

*3. : Estimate taking into consideration that chiller compressor operated at the range of less than 42%.

*4. : Calculated by using electricity unit price of 2.793 baht/kWh.

be reduced (Table 1) with cost saving of 1,489,200 baht/year achieved by this process. Before and after monthly electricity consumption of the new building was shown in Figure 3.

Discussion

Monitoring of energy consumption by using the data logger is important to know present status and also to find the countermeasures. Energy conservation can be obtained by tuning the operating condition of chiller units and minimizing the number of chiller water pumps. When 1°F of the chilled water leaving temperature is increased, 3 percent reduction of electricity consumption will be expected⁽⁹⁾. It was found that decreasing 1°C of cooling water making 2 percent energy saving⁽⁸⁾. By running the above tests, maximum total energy conservation is 28 percent for the chiller units.

The current report may be the first attempt to report the result of the hospital's energy conservation in Thailand. One of the most effective countermeasures for air condition system is to keep room temperature properly^(13,14). Target room temperature should be 26°C or higher according to recommendation by Thai government^(5,6,15).

Due to the set up of water temperature to AHU, the hospital using central air conditioning system can be proceeded without any effect. Staff should be aware of the appropriate control of air conditioning system and room temperature which have effective impact on energy conservation. It is expected and hoped that every one including staffs, patients and their relatives will have cooperative mind and consensus for further total energy conservation.

Hospitals in the Kingdom should establish the energy conservation guideline for the purpose of effective planning and implementation of energy conservation.

Acknowledgement

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บทคัดย่อ การประหยัดพลังงานในโรงพยาบาลเลิดสิน กรมการแพทย์

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โรงพยาบาลเป็นสถานที่ซึ่งมีการใช้พลังงานมากที่สุดแหล่งหนึ่งในกลุ่มอาคารพาณิชย์ ในปีที่ผ่านมา โรงพยาบาลเลิดสินมีการใช้พลังงานเพิ่มมากขึ้น โดยเฉพาะพลังงานไฟฟ้า อันเนื่องจากการเปิดใช้อาคารใหม่ ดังนั้นบทความนี้เป็นการประเมินการใช้พลังงานไฟฟ้าและกำหนดแนวทางการลดการใช้พลังงานไฟฟ้าในโรงพยาบาลเลิดสินซึ่งประกอบด้วย 5 อาคารและอาคารกาญจนาภิเษก ซึ่งเป็นอาคารใหม่ที่มีพื้นที่ร้อยละ 50 ของพื้นที่โรงพยาบาลทั้งหมด โดยได้ติดตั้งระบบการจัดการพลังงานเพื่อตรวจวัดการใช้พลังงานไฟฟ้าในแต่ละตึกและซิลเลอร์สำหรับเครื่องปรับอากาศในอาคารกาญจนาภิเษกซึ่งเป็นหน่วยพลังงานไฟฟ้าที่ใหญ่ที่สุดของโรงพยาบาล การกำหนดมาตรการอนุรักษ์พลังงานมีดังนี้ ลดการใช้พลังงานไฟฟ้าและเพิ่มอุณหภูมิของซิลลิวเตอร์ลดอุณหภูมิของคูลลิ่งวอเตอร์ และลดจำนวนเครื่องสูบน้ำที่ทำงาน เมื่อดำเนินการตามมาตรการดังกล่าวพบว่าสามารถลดการใช้ไฟฟ้าจากระบบปรับอากาศได้ ซึ่งเป็นค่าใช้จ่ายหลักได้มากกว่าร้อยละ 18 หรือมูลค่าการประหยัดค่าไฟฟ้าได้มากกว่า 1 ล้านบาทต่อปี โครงการนี้เป็นโครงการที่ไม่ต้องลงทุนแต่อย่างใด แต่สามารถให้ผลประหยัดที่สูง เนื่องจากอาคารโรงพยาบาลเป็นอาคารที่ต้องมีการทำงานตลอด 24 ชั่วโมง

คำสำคัญ: การอนุรักษ์พลังงาน, เครื่องปรับอากาศ, หน่วยซิลเลอร์