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Energy Conservation And Management using BEMS

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Abstract: **-- The worldwide and most common issue in today's world is energy conservation. Buildings are designed for both residential and commercial use. Generally larger the building area there is probably more people will be using which will increase the energy consumption. There are several ways to save energy by energy conservation techniques. In this paper, we have discussed the most efficient way to save energy in buildings by using Building Energy Management System (BEMS). This system uses a broader mix of energy source in which the major preference is given to the renewable domestic energy sources. To control the whole system it is proposed to use SCADA. By using BEMS it is expected that all major sources required in daily life are controlled efficiently and energy saving is done with the help of BEMS.**

Keywords: **– Energy, BEMS, SCADA, Renewable, Conservation.**

I. INTRODUCTION

Building energy management systems are computer-based control systems that control and monitor a building's mechanical and electrical equipements such as heating, ventilation, lighting, power systems etc. Sometimes called building management system (BMS), they connect the building services plant back to a central computer to allow control of on/off times, temperatures, humidity etc. Cables connect the plant through a series of hubs called outstation around the building back to a central superviser computer where building operators can control the building. Software provides control functions, monitoring, alarms, and allows the operators to optimize building performance. BEMS are critical component to managing energy demand particularly in large complex buildings and multi buildings sites. Analogue and digital input signals tell the BEMS what temperature, humidity etc. the building is running at. Inputs might also include whether equipment like pumps, fans and boilers are running or not. Analogue/digital outputs then sent signals from the central superviser PC to valves, pumps, fans etc. to control their settings or to switch things on and off, resulting in changes to comfort conditions. BEMS can be used to control almost anything and it is becoming increasingly used to control lighting and to monitor critical systems.

II. BUILDING MANAGEMENT SYSTEM

Not only the building management system controls all devices in the building but also completely protects the building against burglary, fire and gas leaks via security and safety systems. The proficiency of the BMS is directly linked to the quantity of energy consumed in the buildings and the comfort of the buildings' residents. The function of BMS is known and significant, since these systems can contribute to the continuous energy management and therefore the achievement of the possible energy and cost saving. BMS is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment by various systems. Such systems are ventilation, security and fire alarm system, lighting, energy management and intelligent control systems (Fig.1). They can be easily adapted to different needs due to their high flexibility. In addition, during the operation, changes and improvements can be perform to achieve better operation, reduce the expenses of energy and maintenance. In intelligent buildings, many functions, which were done habitually by residents, are performed by smart systems. This action makes economize in time and manpower. By using various interior and exterior sensors and also computer network, getting permanent and immediate data of temperature, pressure, humidity, air flow rate, oxygen and carbon dioxide are possible. With such facilities, the amount of energy consumption, fuel and electricity can be measured at any time. It can be useful for reducing energy consumption and energy conservation in building. BMS allows users to control each of subsystems individually. It also permits the integrated control of them. BMS installation is offered in the following modes; (1) the design is too complex or using the HVAC system, (2) the energy which is stored by BMS is proportional to investment cost. So far, most applications of BMS in central heating, air conditioning and firefighting systems were mentioned. Another application of BMS is central lighting. In this case, energy efficiency and thermal loads due to the lighting conditions should compare with an estimated price and optimal condition should be considered. Use energy efficient light bulbs and fluorescent lamps are proposed. Santos et al. (2013) considered a secondary function is to monitor the level of human generated CO2, mixing outside air with waste air to increase the amount of oxygen

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while also heat/cooling losses .Doukas et al. (2007) reported that BMS includes the following components; (1) indoor &outdoor sensors: they measure temperature, relative humidity, air quality, movement and luminance, (2) controllers: include switches, diaphragms, valves and actuators, (3) decision unit: areal time decision support unit includes interaction with the sensors, the incorporation of expert and intelligent system techniques, and communicates with the building's controllers and (4) database: it includes the database of the building energy characteristics and the knowledge database, where all essential information in recorded

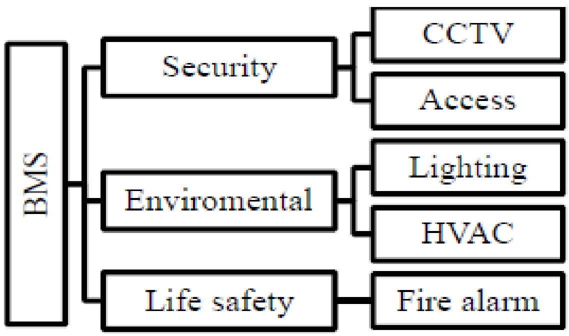

Fig.1 BMS task

Fig. 2 illustrates four major advantages of BMS which explained shortly in the following; (1) obtain more convincing for residents by doing rapidly task automatically, (2) create a favorable environment for residents, (3) efficient use of equipment and increase longevity, (4) playing an important role to prevent the intensification crisis condition (e.g. flooding, fire, and theft, by different warning), (5) provide controlling system with time schedule performance ability, (6) dramatic decline cost of maintenance and servicing, (7) no need for local contractor, (8) monitoring and controlling all areas via PC or Internet access and (9) prepare statistical and performance report from each device to more optimize them.

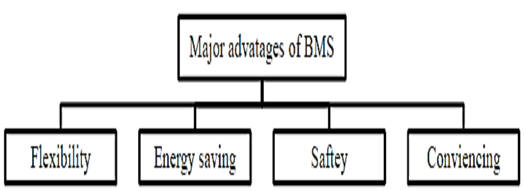

Fig.2 Advantages of implementation BEMS

III. POWER SUPPLY SYSTEM DESCRIPTION

The power supply system is composed by several independent units of decentralized production, concerning different sources of renewable energies (photovoltaic, wind and biomass). This system also contemplates one unity for energy storage. Fig. 1 presents the electric interconnection of the several system components. PETER facility is located in an area with a solar radiation between 1650 and 1750 kW h/m2/year, on a horizontal surface. Fig. 2 presents 1 year estimation of the photovoltaic produced energy with the panels facing south and with a 30———————————— angle with the horizontal base plan. The photovoltaic solar unity has 10 KWP of power, and it is composed by three different sets of PV-panel technology:

(i) 3.24 KWP from Mono-crystalline silicon panels with an exposure area of 23.6 m2; (ii) 3.50 KWP from Polycrystalline silicon panels with an exposure area of 24.4 m2 and (iii) 3.35 KWP from amorphous silicon panels with an exposure area of 53.8 m2. From the distribution of the wind speed (histogram of frequency and distribution of Weibull), presented in Fig. 3, one can obtain an average wind power flow available of 26.0 W/m2, for the PETER location.

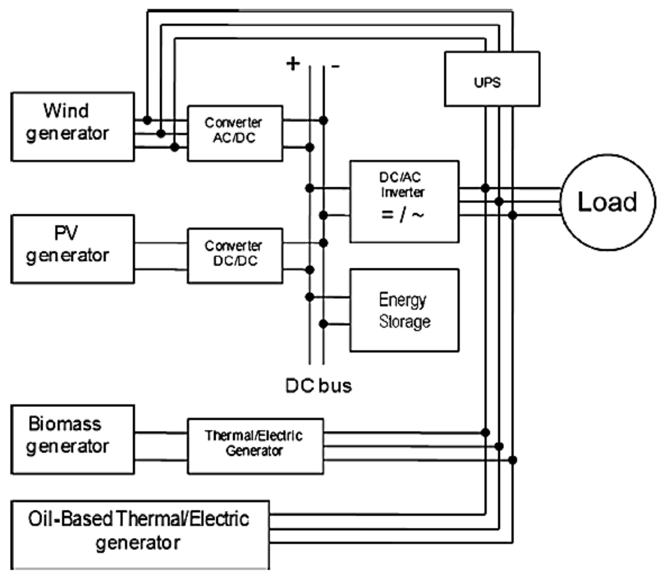

Fig.3 Electrical structure of the PETER power supply system

IV. RETURN ON INVESTMENT

The main objective for using BMS in the building is energy saving and energy efficiency. Both energy storage and return on investment are the result of this objective. Implementation costs of BMS seem to be high, but its installation will return the investment by means of energy saving. Some energy saving methods are explained via following examples; (1) in commercial buildings, the majority of the employers do not consider efficient usage of energy wisely. For instance, they do not turn ventilation or lighting systems off even when they leave the room for a long time whereas BMS automatically put systems on standby after a short time until someone enter the room, (2) the ventilation and lighting system are turned on at 7:00 in the morning in large scale commercial building while some staff are on vacation or mission or come to office with delay. Whereas BMS turn system on when employers use an attendance device on entrance door so it prevents waste of energy, (3)another issue that plays an important role in returning the investment is the optimal use of resources which increases the lifetime of the equipment. For instance, the workload is split among all members (e.g. circulation pumps) in mechanical systems by dividing operation time among all members, while it prevents permanent inactivity of some part that improves function and (4) in air handling, the desired temperature may be secured from the outside air, without having air handling activities. Although the outside air temperature is desirable, air handling will also continue to work and consume energy in the absence of management and control condition. Santosn et al. (2013) reported that systems connected to a BMS typically demonstrate 40% of a building's energy usage and if the lighting is included, this number obtains 70%. The BMS is a critical constituent to managing energy demand. An inappropriately configured BMS with control errors can easily raise the energy consumption of buildings in the region of 5% - 30%, in some situation even more.

V. METHODS FOR REDUCING ENERGY CONSUMPTION IN THE ABSENCE OF EMS

It is necessary to point out that EMS is not always beneficial. The main reason for using them is to save energy cost. Sometimes the cost of installation in a building with normal function is higher than the amount of financial savings from energy saving. Thereupon, an overall analysis of the costs and other factors (such as the type and function of building, size and dimensions of the building and the number of indoor control system) should be done before installation. In normal cases, regarding the following items, a significant amount of energy loss can be prevented:

Thermal Insulation. The insulation in walls, ceilings, and floors can reduce energy consumption up to 25%. It is recommended to ventilate the air under the floor if it is possible. Prevent natural ventilation. Prevent air penetration through doors, windows and other openings via special bands are recommended. Moreover heat or cold losing is prevented by decreasing window dimensions and increasing glazing windows. Sunlight control. The use of internal and external awnings and colored or reflex glass largely declines the effect of sunlight. Engine / pump type. Type of the engines or pumps that are considered for ventilation system should have reasonable price and other desirable properties such as silence and shortage of any vibration.

VI. REVIEW PERFORMANCE

The main advantage of a BEMS installation is the ease with which users can review the performance of controls and conveniently make adjustments. Other advantages include:

- close control of environmental conditions, providing better comfort for occupants;
- energy-saving control functions which will reduce energy bills (e.g.weather compensation);
- ability to log and archive data for energy management purposes;
- provision of rapid information on plant status (is it ON and working?);
- automatic generation of alarms to warn appropriate personnel of equipment failure or condition changes.
- identification of both planned and reactive maintenance requirements(e.g. systems can record the number of hours that motors have run, or identify filters on air supply systems which have become blocked); and
- ease of expansion to control other plant, spaces or buildings.

Once a BEMS has been installed and fully commissioned properly it can be used as a tool to optimize building performance. Even the best designed and commissioned control strategy is likely to evolve with the user's and the building's requirements. A well-trained BEMS operator can carry out regular reviews of BEMS settings to gradually reduce room set points, operating times and energy consumption without compromising comfort conditions. This fine-tuning of the building controls often requires one or two full heating seasons to reach optimum settings. But the process doesn't end there, as the building usage and requirements change then so will set points and times so this optimization is a continuous process as the building use changes.

This optimization process is particularly important where BEMS are controlling large multi-building sites and buildings spread across a wide area. The BEMS operator can keep a watchful eye on operations and energy use from afar without having to visit the buildings. This central BEMS bureau approach is highly cost effective and common in large estates and through FM providers.

As a result of this continuous optimization it is important to maintain records of all changes to the system during the lifetime of the building with good reasons as to why changes have been made. Too many buildings have high operating hours and set points that have been badly programmed many years ago often.

VII. CONCLUSION

A flexible, easy-to-use, networked BEMS is an important tool for the implementation and monitoring of energy conservation measures. Through its direct digital control capabilities, the

BEMS provides occupants of a facility with a comfortable, precisely-controlled environment.
The energy-saving opportunities available through a BEMS help address the needs for energy and environmental improvements—improvements that are clearly demanded by government organizations and the public alike. The features of TAC's BEMS demonstrate our commitment to remain at the forefront of technical innovation and to provide the "best of breed" BEMS systems and tools to maximize the energy savings capabilities of our customers systems

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