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An Investigation of Standby Power Losses

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Abstract—*Standby power is the power drawn by electrical devices when they are in the idle condition. Standby power consumption may be a result of a combination of poor power supply design, memory retention function, internal clocks, LED/LCD displays, battery charging and remote control capability. Main sources of standby power are electronic devices which draw current continuously. An investigation was done to find out the various sources of standby power in various laboratories distributed over five floors of a technical educational establishment. It consisted of appliance survey, which used bottom-up estimate method to measure the standby power, and a questionnaire to gather various data like appliance operational behavior and user awareness. A power analyzer was used to measure the various electrical parameters in the normal operating, standby and soft-switch-off modes. Survey results were analyzed to obtain appliance penetration rate, standby time and electricity consumption of various devices. Some of the methods used to reduce standby power losses were studied. The data obtained from the investigation will be further used to design and implement a device to minimize standby power losses.*

Keywords: *Standby power, power saving*

1. INTRODUCTION

Standby power refers to the electric power consumed by electrical or electronic devices while they are in standby mode.The typical standby power per appliance is low (typically from less than 1 to 25 W). When multiplied by the large number of appliances in houses and in commercial buildings, standby losses represent a significant fraction of total electricity consumption throughout the world. According to International Energy Agency about 5-10% of a residential home's annual electricity consumption and 1% of global carbon dioxide emissions are due to standby power [1].

Standby mode is also known as soft-switch-off mode. Standby power is consumed by internal or external power supplies, remote control, text or light displays, and circuits energized when the device is plugged in, even when switched off. It occurs because devices which are switched off on the electronic interface may be drawing power from the main power supply.

In the past, standby power was not a big issue for users, electricity providers, manufacturers and government regulators.In the first decade of the 21st century, awareness of the issue grew and it became an important consideration for all parties. Up to the middle of the decade, standby power was often several watts or even tens of watts per appliance. By 2010, regulations were introduced in most of the developed countries restricting standby power of devices sold to one watt [1]. Although a certain degree of awareness has been created in the developed nations, there is very less to no realization of the importance of standby power.

The aim of this paper is to study the various sources of standby power in various laboratories distributed over five floors of a technical educational establishment. The following objectives were set up and defined for the course of the study:

- To conduct a survey in all the laboratories to determine the most commonly found electrical appliances with standby powers and the penetration levels of these appliances, to establish appliance use times and the level of consumer awareness on appliance standby power.
- To carry out a case study on the power consumption of various electrical and electronic devices. For this purpose a power analyzer is used to measure the various electrical parameters like voltage, current, power and harmonics in appliance operating modes namely ON, soft- switch-off and sleep modes.

Section II of this paper deals with the two methods which are commonly used to determine standby power losses. The appliance survey conducted in various laboratories is discussed in Section III and the appliance power measurements are detailed in Section IV. An attempt to discuss about the various methods used to mitigate standby power losses is given in Section V and conclusions made are given in Section VI.

2. METHODS TO DETERMINE STANDYBY POWER LOSSES

There are many statistical and analytical methods available, which can be used to find and estimate the amount of standby power that is consumed by various electrical and electronic devices. The commonly used methods are:

2.1 Bottom-up Estimation

This method is used to estimate average standby power consumption per home. The individual basic elements of a system are specified in detail and are then linked together to form larger subsystems. These subsystems then in turn are linked in many levels, until a complete top-level system is formed. When applied to the purpose of finding the amount of standby power consumed by the devices, this approach starts with detailing the power ratings and consumption of the individual elements of a system. The data thus obtained is extrapolated to find the standby power consumed by the larger system that is made up of these smaller units [2]. This method is accurate for common appliances. In our study we have used this method is used to estimate standby power consumption.

2.2 Whole-House Measurements

In this method the total standby power for each establishment is calculated by summing the individual appliance measurements. This measurement is verified by comparing with the electricity use recorded by the power meter for approximately eight minutes while all appliances are either off or in standby mode [2]. Whole-house measurements provide variation of standby power consumption in individual homes.

3. LABORATORY APPLIANCE SURVEY

A survey was conducted in various laboratories of the establishment. A questionnaire was used to collect the information regarding appliance data, ownership, use times, operational behaviour and consumer awareness. Analysis of the survey is summarized below:

3.1 Appliance Ownership

Every lab in the establishment was surveyed to make an inventory of all the electrical and electronic devices in them. The collected data was then tabulated to reflect the results of the survey. It was found each laboratory had appliances like air conditioners, personal computers and their supporting devices such as UPS and stabilizers and printers.

3.2 Appliance Penetration Rates

Appliance penetration rate is the incidence of occurrence of an appliance within a given laboratory. Appliance penetration rates exceeded 1 since there was more than one of each appliance per laboratory. It can be calculated using Equation.1 [3]. Results on penetration rates of fifteen laboratories of the establishment are given in Figure.1. and Figure.2.

$$\text{Penetration rate} = \frac{\text{Number of consumers for a typical appliance}}{\text{Total consumers}} \quad (1)$$

From the figures it is concluded that personal computers have the maximum penetration in the laboratories.

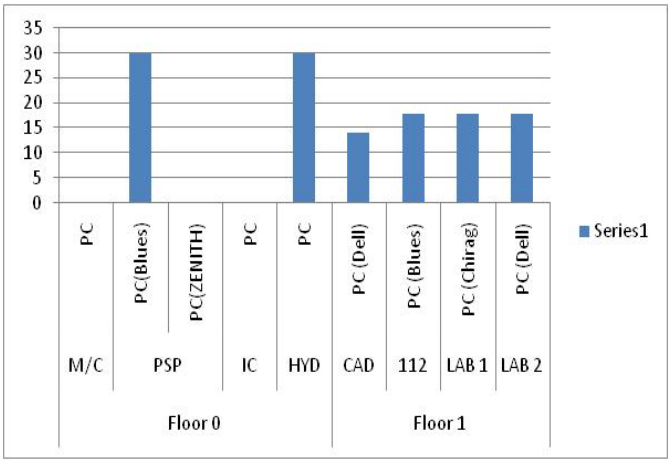

Fig. 4: Appliance Penetration Rate for laboratories on the ground and first floors

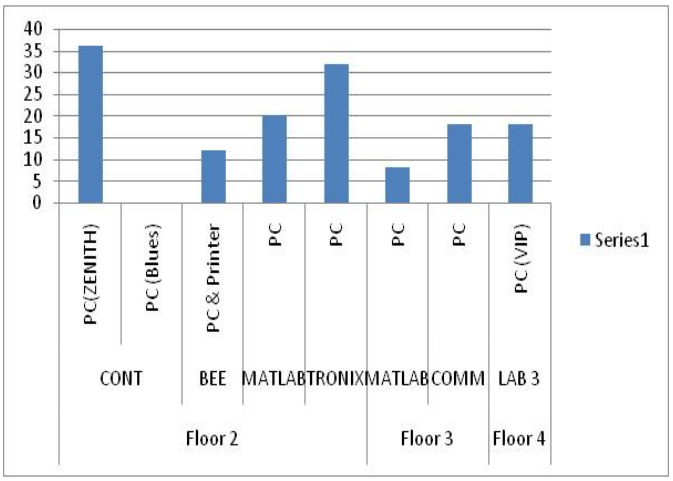

Fig. 5: Appliance Penetration Rate for laboratories on the second, third and fourth floors

3.3 Appliance Usage

The purpose of this survey was to find the devices that are operated with the help of remote controls. The other objective of this part of the survey was to make note of the average life span of the devices along with the current ages of the devices in use. The most important contributors, as revealed from this part of the survey were found to be the air conditioning systems employed in the computer labs, as they remained switched on for almost the entire day, and switched off only with the "soft off", i.e. with the remote control.

3.4 Appliance Use Times

The purpose of this survey was to make a note of the amount of time for which the electrical/electronic devices are used on weekdays, weekends and holidays. This was necessary to understand the overall usage of all the devices and to calculate the weekly standby power consumption that they contribute. This part of the survey revealed that the devices are used most during the weekdays. The devices are switched on for almost six-eight hours on every weekday and when they are switched off, it is only via the "soft off." The average weekly usage can be represented as shown in the Figure.3.The data obtained from the three surveys was analyzed to determine which devices were the ones that contribute the most to standby power. The largest contributors were found to be computers and their supporting devices such as UPS and stabilizers. Thus, for the remainder of the project we decided to focus of the standby consumption of personal computer systems.

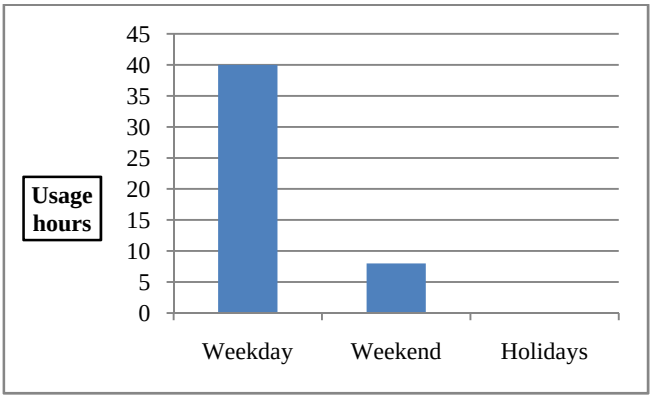

Fig. 3: Appliance Usage Time

3.5 Awareness

This part of the survey was aimed at gauging the degree to which the people who are in charge of the various laboratories in the establishment are aware of the existence of standby power. Figure.4 shows the percentage of the population who are aware about standby power losses.

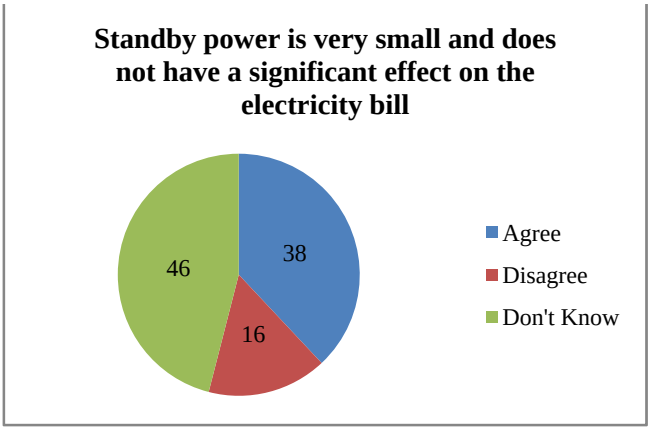

Fig. 4: Consumer Awareness

4. APPLIANCE STANDBY POWER MEASUREMENT AND ANALYSIS

The next task was to select, from the overall inventory of devices, the ones that contribute to standby power. It was observed that, electrical/electronic devices that employ some kind of display device, such as output screens, consume maximum standby power. In most cases personal computers consumed maximum standby power.

A device known as a power analyzer was used for measurement of electrical parameters such as voltage, current, active power, reactive power, apparent power and harmonics of the devices that are sources of standby power. A power analyzer is shown in Figure.5. The measurements are tabulated in Table.1. It is seen that power drawn in the soft switch-off mode is around 20% as that of ON mode for personal computers.

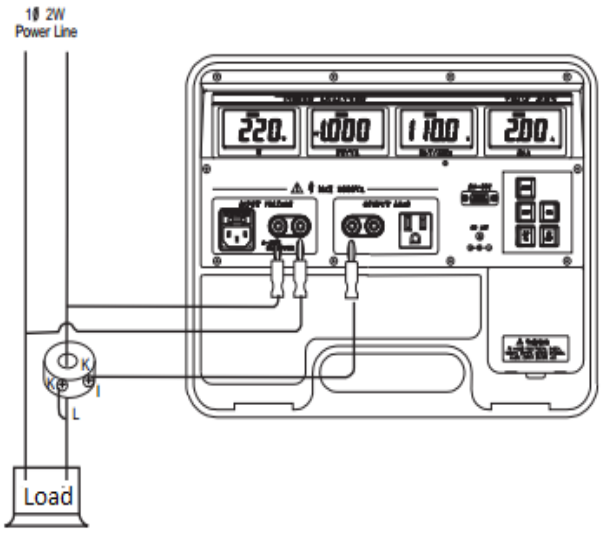

Fig. 5: Power Analyzer [4]

TABLE 1: APPLIANCE STANDBY POWER MEASUREMENTS

Mode	Voltage (V)	Current (A)	Total P (KW)	Total S (KVA)	Total Q (KVAR)
BLUES PC					
Sleep Mode	235.4	0.492	0.079	0.114	0.083
Switched On	235.2	0.665	0.105	0.155	0.115
Shutdown	236.9	0.184	0.026	0.042	0.034
PRINTER					
Switched On	237.9	0.047	0.002	0.01	-0.01
ZENITH PC					
Sleep Mode	236	0.101	0.011	0.022	-0.02
Switched On	235.6	0.52	0.082	0.121	0.09
Shutdown	235.3	0.095	0.011	0.021	0.019

5. SOLUTIONS TO MITIGATE STANDBY POWER

With the advances in technology and reducing prices of electronic devices use of electrical products are increasing throughout the world. One of the largest energy saving efforts is to reduce standby power in electronic devices. Some of the activities that could reduce standby power losses are described below:

1. Unplugging the appliances that are not in use. This should not involve devices which are opted to be in the sleep mode. For example a personal computer connected to a network should not be unplugged since it causes communication problem with peripheral devices or with the network manager.
2. Replace the old and inefficient appliances by energy efficient products. These devices have many power saving features such as:
    - Efficient low voltage transformers
    - Power switch at the high voltage side
    - Smart recharge circuits in rechargeable appliances
3. Policies and standards can be adopted by government and other stakeholders to favour more efficient appliances.
4. Standby controllers that can be placed between the socket and appliance plug can be used. A combination of a controller with multiple sockets is viable option to mitigate standby power losses. For example a television can be plugged in the master socket with a DVD and a music system in the multiple sockets. When the television consumes lesser power than a specified value, the television is switched off together with all the peripheral devices.

6. CONCLUSION

Energy is the most important natural resource. The demand for energy is increasing all over the world. In this paper, instead of increasing the generation from various sources of energy, an attempt to improve the efficiency of the existing system from the consumer side is studied. This paper focuses on saving energy lost by electronic devices in stand-by mode. And thus to conserve energy by increasing consumer awareness on their energy usage and reducing standby loads in their premises.

An extensive laboratory survey was conducted as an effort to study the effects of standby power losses in an educational institution. Various appliances that consume standby power in their soft-switch-off mode were identified. The power analyzer provided direct measurements of all the necessary parameters which showed that the standby power makes a highly significant contribution to the overall power consumption. Also the survey revealed a general lack of awareness among the consumers in the establishment.

It was concluded from the study that on a yearly basis the amount of standby consumption contribute to significant share in electricity bill for the consumers. Methods should be adapted by each consumer to mitigate these losses so as to improve the energy efficiency and reduce the electricity bill. Thus we can reduce the global carbon dioxide emissions also.

REFERENCES

[1] A.K.Meier, W.Huber and Rosen K, “Reducing leaking electricity to 1W,” ACEEE Summer Study on Efficiency in Buildings, August 1998.
[2] A.K.Meier, “A world wide review of standby power use in homes,” Efficient Use of Energy and Reduction of its Environmental Impact, Osaka, February 2002.
[3] Parmal Singh Solanki,” An investigation of standby energy losses in residential sector: Solution and Policies”, International Journal of Energy and Enviornment, Vol.4, Issue 1, 2013.
http://www.mecoinst.com/poweranalyzer.