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Energy Audit of a Food Industry

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Abstract: *The Energy Audit would give a positive orientation for implementing the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Energy Audit is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame. This thesis deals with the identification of nature of losses in industry that manufacturers food products. The energy accounting with the use of measuring instruments like lux-meter, power and harmonic analyzer etc. helps to record and analyze data of energy usage. With the help of this data, energy wastage and losses are calculated and recommendations are given to reduce these losses and improve savings. Lastly, to deal with the issues of power quality, power quality assessment is done at PCC.*

Keywords: *Energy audit, Point of common coupling, Power harmonic analyzer, ILER.*

I. Introduction

Energy audit process is a planned and organized approach to identify energy wastage in a facility, finding how this wastage can be removed at a reasonable cost within a suitable time limit. Energy audit is widely used in all the areas like industries small scale or large scale, commercial buildings, institutes etc. Energy auditing of a premises can vary from a short walkthrough of the area to a detailed analysis. Energy audit not only serves to identify energy use among the various services and to identify opportunities for energy conservation but it is also first step in establishing an energy management program. The audit will produce the data on which such a program is based. Such kind of study must reveal to the owner or management team the options available for reducing energy waste, the costs involved, and the benefits achievable from implementing those energy-conserving opportunities (ECOs). A “Detailed Energy Audit" is a type of audit which is most comprehensive type of energy audit. This includes the use of instruments to measure the energy use of whole building and energy systems within the building. An audit aims at analyzing and identifying possible energy saving measures, which can be implemented in a factory. This will help the factory to reduce their monthly electrical energy consumption thus reducing the cost of production

In the energy audit the first is the Lighting audit, which is performed during the premises assessment process which includes a visit to the premises in order to identify areas for the Energy Conservation process. The second one is the harmonics analysis. Harmonics reflect the distortion of the wave form and pollute the quality of the power which leads to increased transformer heating and transmission losses. Harmonics can be defined as periodic, steady-state distortion of voltage or may be current waveform in a power system. These distortions are injected by devices which have non-linear relationship between current and voltage. Poor power quality due to harmonic distortion has come up as a serious issue. The effects of harmonics can often be serious, computer systems may fail to operate properly, capacitor banks, such as those used for power factor correction, can become overload and fail, and the interference may occur on communication lines.

II. Lighting Based Audit

The first and important part of lighting based energy audit is the input data collection. Although industry contains bulk load like motors, compressors, etc. 10% of the total load is of lighting and out of this 2-4% of the energy consumption can be reduced by installing efficient fixtures. Secondly, proper illumination at the working place is much important for the safety of the employees working in the plant, keeping all these points the lighting based energy audit has been conducted in production office and engineering workshop. Before conducting lighting based energy audit some terminologies and definitions should be known and there must be a process flowchart through which it becomes easier to understand the steps to be performed during energy audit. Two areas have been considered as case A(Process Hall) and B(workshop). Cases are further divided into three categories as:

1. With only day light is on
2. With day light as well as Luminaries on

3. With Luminaries only at night time.

For all the three cases mentioned above ILER is calculated.
Installed Load Efficacy Ratio = Lux per watt square meter / Target Lux

Table 1: ILER calculated for three categories of both cases

Case A	**Installed Load Efficacy Ratio**	**Case B**	**Installed Load Efficacy Ratio**
A1	0.3	B1	.48
A2	0.78	B2	1.2
A3	0.71	B3	.78

Table 2: ILER as recommended by BEE

ILER	Assessment
0.75 or above	Satisfactory to good
0.51 to 0.74	Review suggested
0.5 or less	Urgent action required

Table 3: Results for both cases

Cases	**Suggestion**	**Cases**	**Suggestion**
A1	Poor illuminance level	B1	Poor illuminance level
A2	Good lighting condition	B2	Good lighting condition
A3	Action required for better lluminance	B3	Good lighting condition

Case A: Though ILER for this case is satisfactory, it was found that mounting height was approximate 8 meters of the fixture therefore illuminance can be increased or improved further by reducing the mounting height. Also MV lamps can be replaced by more efficient fixtures such as Metal Halide or LED panels.
Case B: In workshop, the mounting height was also nearly 4.5 meters, the illuminance level measured was not found good in case B1. Main reason behind poor illuminance level was the mounting height and no proper utilization of day light, fixtures are not clean. This requires additional installation of the lamps therefore the cost as well as wastage of energy increased. For improvement in illuminance level & increasing the savings, avoid such problem by decreasing the mounting height and keep the fixtures clean, therefore get better illuminance level.

III. Harmonic Analysis

Harmonic analysis at point of common coupling (PCC) is very important as harmonic currents produced by non-linear loads are injected back into power distribution systems through the point of common coupling (PCC). With the help of Power and Harmonic Analyzer, total harmonic distortions (THD) are recorded at Point of Common Coupling (PCC).The industrial consumer falls in the category in which maximum allowed THD is 4%.

Table 4: Thd V and I measured at PCC

		Voltage- Thd V	**Current – Thd I**
33kv side	R	1.9	3.017
	Y	2.1	4.6
	B	2.1	4.7

Table 5: Current Distortion Limit of IEEE-519-1992 Standard

Isc/IL	**<11**	**11 ≤ h<17**	**17 ≤ h<23**	**23 ≤ h<35**	**35 ≥h**	**TDD**
<20	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

IV. Conclusion

From the survey it was found that, illuminance level is poor, in few areas. This dissertation implemented the concept of energy audit for the calculation of lighting parameters manually. This dissertation implemented the concept of lighting methodology that calculated the lighting parameters like ILER, energy wastage, etc manually. Power Quality Assessment was done at Point of common Coupling (PCC) of the industry. The harmonic components at Point of common Coupling (PCC) were measured, recorded and analyzed with the help of harmonic analyzer. With the help of measured data, total harmonic distortion (THD%) and total harmonic distortion (TDD%) were calculated. From the calculated THD% and TDD%, it was found to be within permissible limit.

V. Future Scope

The energy audit conducted at food industry was done. The tedious manual calculations can be done simply with the help of development of software programme.

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