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Effective Energy Audit in a Rice Mill through PSCAD

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Abstract

The fundamental goal of energy management is to reduce the power demand in an effective manner and to provide services with the least cost and environmental effect. A careful day to day monitoring of specific energy consumption can help in saving wastage of energy and fossil fuels. India is third largest country in production of electricity in the world but still it's lagging in meeting the power demand. Considering the present power scenario initiative taken to save power and generate own power through energy management and energy audit. The detailed energy audit is conducted in the industry, which will produce quality of rice. Data were observed in a detailed manner for each and every machine. The observed data were analyzed and the necessary recommendations are suggested. The suggested recommendations are implemented in PSCAD and analyses were done. Output was compared with the existing system. Along with this, recommendation for agro based waste utilization to generate energy in rice mill .This is an innovative concept imposed in rice mill.

Keywords: Energy Audit, Energy Management, Lightings, Motors Efficiency, Agro Based Waste,

1. Introduction

Energy efficiency is a key challenge for building sustainable societies. Due to growing populations, increasing incomes and the industrialization of developing countries, the world primary energy consumption is expected to increase annually by 1.6%. This scenario raises issues related to the increasing scarcity of natural resources, the accelerating pollution of the environment, and the looming threat of global climate change. The world scenario of electrical generation and demand in the society is increasing day by the day and due to this the demand is not matched the generation. In India the co2 emission and electrical demand is increasing and due to this, it is not able to

match the demand in an effective manner .The total installed capacity of TNEB is 20103MW which include of all, State government, Central government, Independent power producer and renewable power generation. To meet the ever increasing energy demand, TNEB has proposed a number of next generation projects to be constructed. But all of these programs concentrate on generation of power and not more on savings of energy. From our opinion rather than generating, one should think about saving energy. The energy consumption can be effectively done by energy audit. The energy audit will provide potential money returns the probable energy and thus the cost saving after implementation. Worldwide research work on energy audit and management is presented through eminent researchers. Audit activities in general order include, identification, evaluation, analysis preparation of report Studies. This work by Malkiat [1] shows the execution resulted that energy auditing and conservation can save India Rs1800Crore / year equivalent to installation of 5250 MW. Manoj[2] and team conduct the energy auditing by calculating the rated and actual efficiency of the motors. The total capital cost net saving of the different rewound motors and the payback period of two years. Nangare [3] and team members recommended Co- generation plant for the beneficial to enhancement in electricity generation through energy audit. Kulkarni [4] suggested their glass reinforced plastic fans to save mechanical power up to a 2% of rated KW hour.

To support the initiative to reduce demand and create awareness to the general public Dr. M.G.R Educational & Research Institute, Chennai has taken initiative in the year 2014 called. 'MGR Vision 10 MW' under the leadership of Dr. L Ramesh to save 10 MW in 10 years. The contributed research works under the pilot project-1 were published in Scopus publications [5-9] and the reports are published by the Research Forum **GREEN9** (Energy Efficiency Research Group). This work is the pilot study-2 of MGR Vision 10 MW, to conduct the detailed energy audit in the industry, where the output product is rice. In this study the suitable recommendation for savings of energy is recommended for implementation in rice mill. The proposed output through PSCAD is referred to the industry for live recommendation.

2. Data Collection

Energy audit was conducted in Murali Rice Mill, a rice mill situated in red hills at Chennai. It's basically a produces rice from paddy and also it's having unit of dal mill. Daily tons of rice are produced and exported to markets. The motor used are 38% 2HP Motor for the production of rice. This complete unit was run by 440v transformer connected from line. The collected data's are presented below in the respective table.

3.1 Lighting and Fan Load: This rice mill section consists of tube-lights, CFL, motor & Air Conditioners. The table given below is stating about the units per month consumption with respect to each section of rice mill. The total units per month for each section are given below.

Table 3.1 light and fan load data collection

(UNITS/MONTH)	BOILER	RICE MILL	DAL MILL	PACKING AREA	MAIN OFFICE
TUBE LIGHT	55.5	132.84	88.56	44.28	22.14
CFL	10.71	229.5	206.4	-	22.95
EXHAUST FAN	321.3	-	805.68	402.84	-
CEILING FAN, Desk, AC	-	900	-	-	126
TOTAL(UNITS/MONTHS)	387.51	1262.34	1100.64	447.12	171.09

So with above tables we can conclude that total bill for whole rice mill industry other than motor load is around 20,212 Rs/ month.

3.2 Motors Data Collection: In rice mill there are total 11 motors which are responsible for processing of paddy to rice conversion. Each motor is of 3 phase induction type motor. Total seven types of motors are there which are stone separator, thickness grader, silk master, black mover, black rice storage & white rice storage. The collected data of each motor along with its specification is tabulated below.

Table 3.2 Comparison of real and rated data of motors

	MILLTECH SEPARATOR (PARAMETERS)		SHELLER N1 (PARAMETERS)		THICKNESS GRADER (PARAMETERS)		SILK MASTER (PARAMETERS)		BLACK REMOVER PORTION (PARAMETERS)		BLACK RICE STORAGE (PARAMETERS)		WHITE RICE STORAGE (PARAMETERS)	
	REAL	RATED	REAL	RATED	REAL	RATED	REAL	RATED	REAL	RATED	REAL	RATED	REAL	RATED
CURRENT (I)	3.1	3.4	6.5	4.8	3.0	3.4	4.6	3.4	3.0	3.4	3.4	3.6	3.3	3.6
VOLTAGE (v)	393	440	393	440	393	440	393	440	393	440	393	440	393	440
SPEED (s)	900	1360	1150	1475	1100	1460	950	1460	1175	1460	1100	1475	1100	1475
CAPACITY (HP)	1.5	1.5	3	3	2	2	2	2	2	2	1.75	1.75	1.75	1.75
KILO WATT(KW)	1.01	1.12	2.10	2.23	1.31	1.49	1.35	1.49	1.30	1.49	1.28	1.30	1.27	1.30

According to above tabular column, pie chart is prepared for total power consumption of the motors throughout the rice mill. Refer the pie chart it was found that 2 hp motors are being used heavily and for longer time.

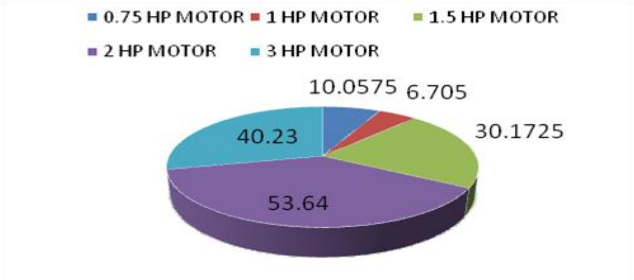

Fig 3.1 Power Consumption by Different Motors in units per month

3.3 Existing Layout of Rice Mill: The picture shows the existing layout of the rice mill which consist of 11 motors and lighting system which consist of tube lights & CFLs. All motors are synchronous induction motors. This single line diagram having two types of load sections that is motors section and lighting sections respectively. The layout starts with the transformer connection. Then there is a main bar through which four sections are connected which are rice mill 1, rice mill 2, and dal mill and office sections. In rice mill1 section there is two further subdivisions one is tube light and CFL sections and another one is motors section. Similarly in rice mill 2 also. In dal mill two further subdivision are there light load and motor load sections. In the last section that is office section there is there are tube light and fan sections along with computers also.

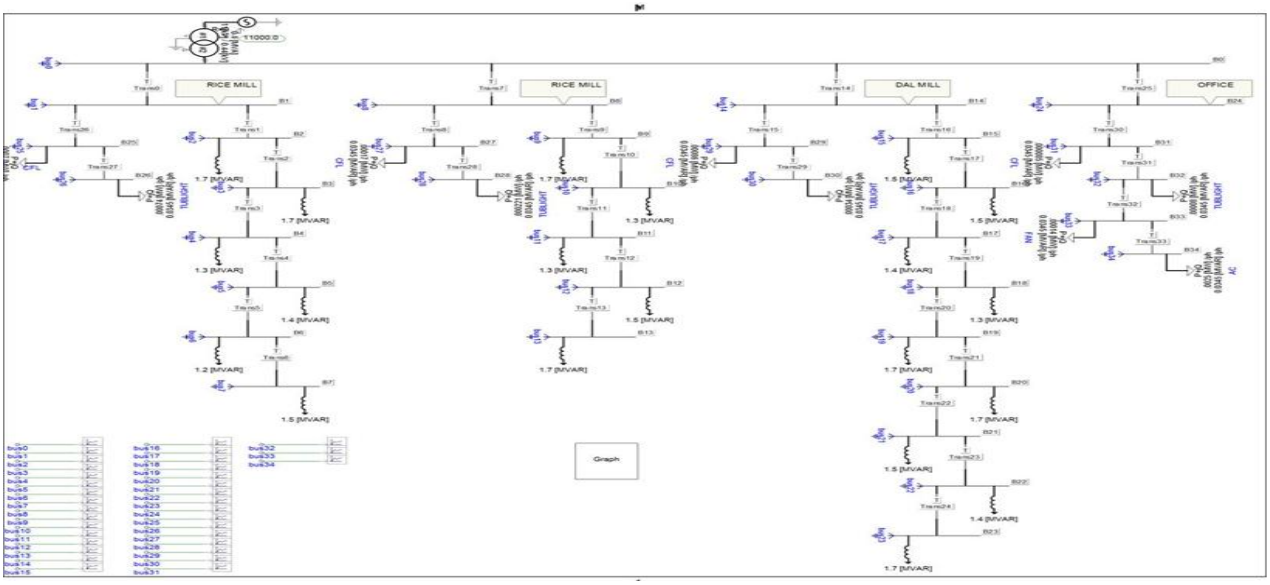

Fig 3.2 Existing Lay Out of Rice Mill in PSCAD

Agro Based Waste Data Collection

According to collected data we come to know that totally there is 11,923 kg of paddy is given as an input to the process and around 65% of rice is given out i.e. 7,750 kg. Then remaining 25% is husk i.e. 2,823 kg of husk is produced along with this 8% bran and 2% dust is produce which means 953Kg bran and 238 kg of dust respectively. All these items are producing at a rate of kg/day.

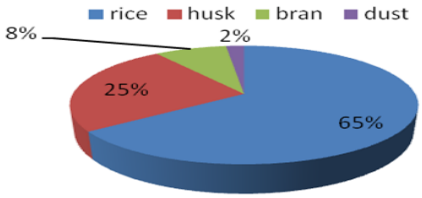

Fig 3.3 percentage Wise products from Paddy

4. Recommendation

In the figure 4.7 the new proposed SLD is shown, here complete lighting sections is converted to solar panel and 3 motors of 3 hp are converted to 2 hp motors and in backup power is taken from TNEB if solar issues are there. All the suggested recommendations are implemented in the proposed layout.

4.1 Proposed SLD with implementation: Refer figure 4.9 which states pre and post audit current for lighting. This graphical representation tells the reduction in the consumption by the lighting and motor after installation of solar panel along with LED. There is a huge reduction which is shown by the blue line .this output is simulation output by the PSCAD.

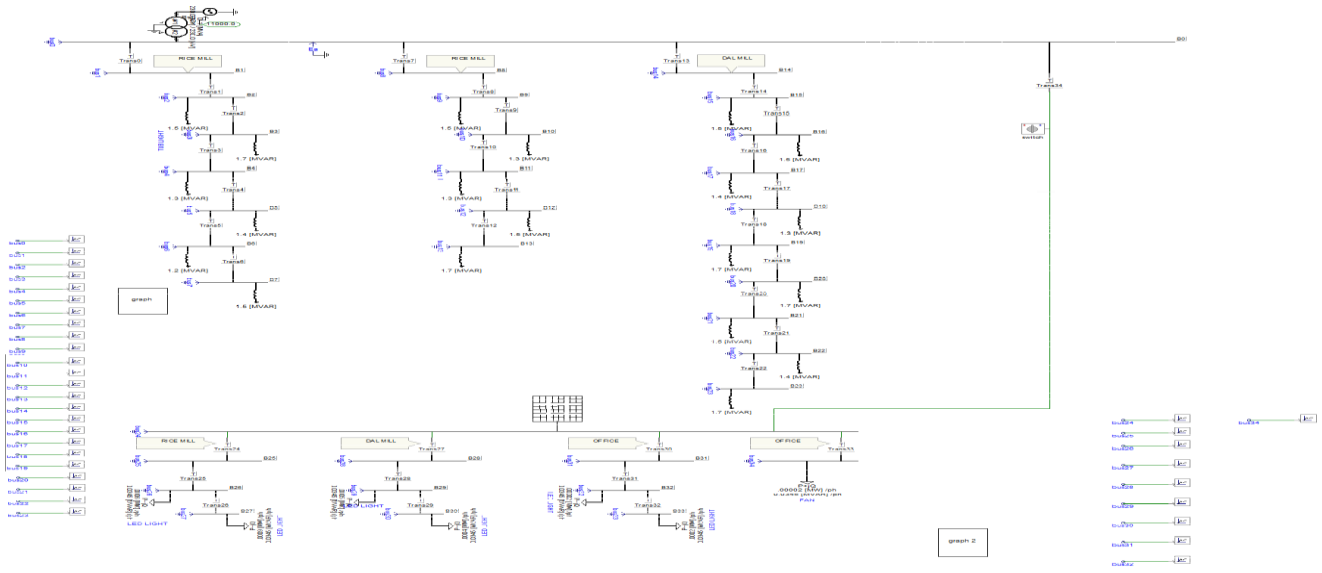

Fig 4.1 proposed SLD for rice mill

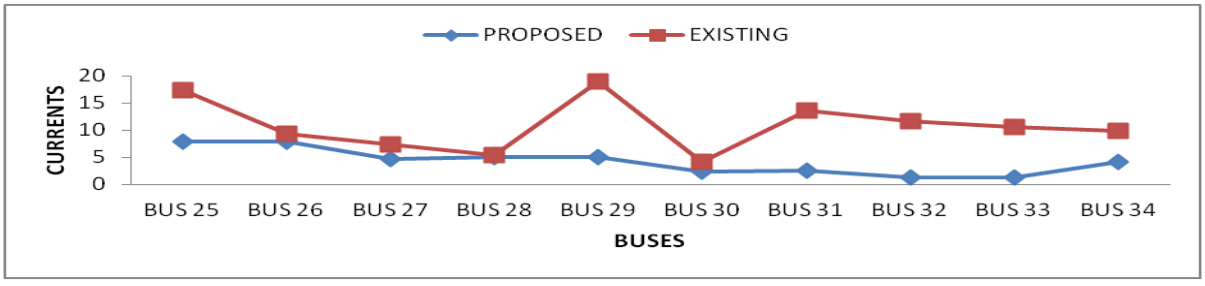

Fig 4.1 Output Simulation & Comparison for Lighting

4.2 Lighting Recommendation:

Recommendation with minimum and medium investment - Use of transparent glass roof will give you maximum sun light in dark area where they are using light lamp in noon time it will save 50% of light consumption. As already tube lights and CFLs are being used in rice mill and after analyzing the lighting condition it is recommended to install the 28 watts dc LED in the rice mill having lumens 2600. For tube lights it is recommended to replace one tube light with one LED as they both are having same lumen but tube light is of 41 watts and LED is of only 28 watts. The savings comparison is shown by the graphical representation in the graph given below.

Table 4.1 Proposed Lighting & Savings

	Proposed Number Of LEDs	Watts	Units/Day	Cost/Months	Savings(Rs/Months)
Rice Mill	32	28	8.06	1450	723
Boiler	33	28	8.31	1495	792
Dal Mill	26	28	6.55	1179	592
Packing Area	4	28	1.08	195	7
Main Office	2	28	0.50	100	173
Total Savings					**2350**

Recommendation With Maximum Investment - With respect to recommendation we are recommending to have 97 LEDs and according to calculation 2.7 kw /hour is the requirement by the LED considering that requirement we are installing 3 solar panel of 1kw each. With the installation of solar panel we are saving almost 52000 per annum and installation cost is around 3 lacs along with this the payback period is round 5.6 years.

4.3 Motors Section Recommendation

Variable Frequency Drive - Many fixed-speed motor load applications that are supplied direct from AC line power can save energy when they are operated at variable speed by means of VFD. Such energy cost savings are especially pronounced in variable-torque centrifugal fan and pump applications .

Table 4.2 Savings & Payback Period by Variable Frequency Driver

Motor Type (HP)	Current Power Consumption (Units)	Proposed Power Consumption	Savings (Units)	Savings %	Money Saving /Annum	Payback Period (Years)	Installation Cost(Rs)
3	7128	4990	2138	28-30	12828	2	25838
2	4834	3384	1450	28-30	8700	2.6	22941
1	2417	1692	725	28-30	4350	4	18433

Buck Booster - In industry we face line losses. In order to compensate these losses we go for voltage booster in industry this voltage booster will compensate with voltage losses and will give you stabilized power system. 440 is rated voltage and existing is 390 volts so lagging with 50 volts. After implementation 7% savings is achieved with power factor improvement to 0.99 and annual savings is 30,000 with 1.5 year as payback period.

Maximum Investment - With respect to the analysis done the recommendation suggested to install total three motors which are brand new star rated motors the specification of the motors are tabulated below . All the three motors are 3 hp motors only. All those three motors are having 60% efficiency and installation of the motors will increase it to 80% efficiency and per day 3hp of power will be saved by new installation. There is reduction current consumption by the motors in rice mill after installation of new motors and 400 units saved.

4.4 Agro Based Waste Recommendation

After bagasse, rice husks are probably the largest mill-generated source of biomass available for energy use. As large quantities of rice husks are normally available at the rice mills. Here it was found that mill is having heavy potential of generating their own money from the waste generated by the mill throughout the day. The simple recommendation is to consult with regarding agro industry and sells their waste to that industry and can earn huge amount of money as a savings. Rice oil , rice bran gaba rice dust all are having heavy potential to be used as an edible items and can also be used as filler and insulators in a construction of buildings also. It is concluded that this can be good source of income. These come in medium investment category. The author suggested to install Pillets Machine. The pelletization equipment is applicable to materials which is difficult to mold and bond, such as rice husk, sunflower seed husk and peanut shell, branch, trunk, wood rind, crop straw, rubber, cement, ash and other chemical materials which can be converted to a high calorie bio fuels. Now, we are going with the installation of machine capacity of the 80kg/hr and machine will run 9 hrs per day and pellets rate is around 2Rs/kg and annual income is around 5,18,400 whereas installation cost is around 3,3600 so, payback period is around 7 months only .

Total Saving Graph per Annum

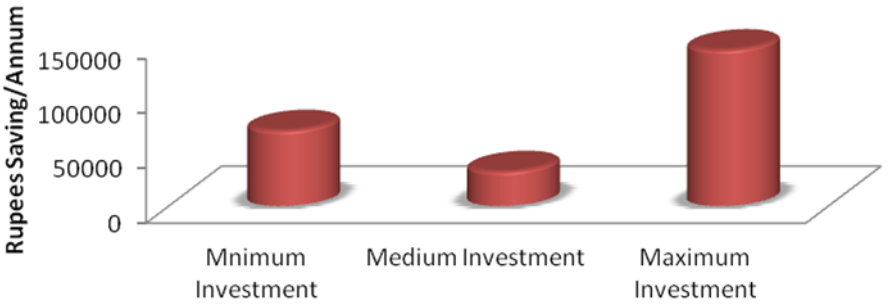

Fig 4.2 Rupees saved Per Annum

Conclusions

Energy audit is a powerful tool to achieve interesting energy savings. The reduction of energy costs is a key to improve companies' competitiveness. Detailed energy audit was conducted in a rice mill which has many conclusions. The expected lightings saving almost 28,200/-per annum. For motors savings will be around 37,440/- per annum after implementation of recommended suggestion .If lubrication is used savings will be around 12% in a machine and if variable frequency driver is installed then saving will be around 28% to 30%. If soft starter is installed then 5% saving will be there in motors. Utilization of agro based waste can, give additional income to the rice mill which is around 5, 18,400/-.The conclusion states that recommendation suggested and if implemented then there can be maximum savings as per the analysis done for particular places. This work will surely reduce the power generation and consumption gap in an efficient manner. This work will sort out the power cut issues also which is prime issue now days.

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