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Electrical Energy Audit –An Experience in a Small Scale Textile Mill

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Abstract: Electrical Energy has become a one of the vital factor in deciding the total production cost and maintenance cost . Day by day, energy demand keeps rising in the industrial sectors because of this reason it is essential to reduce energy consumption for that energy conservation is must needed action. Energy Audit is the prime tool for finding the energy conservation oppourtunities. It helps us to make attempts to balance the total energy inputs with its use and serves to identify all the energy flow in a facility. Energy auditing will not only save money but it also improves the quality of electrical energy supply. Energy Conservation and Energy efficiency in industry has to be improved, this is the prime motive for Government of India. This paper shares the experiences of the authors on Electrical Energy Conservation Projects carried out in a Textile Industry situated in Tamilnadu State. We have used Load Manager for the observation of electrical datas during normal working load condition itself. These datas helps us to gain the electrical energy audting experience in the industry

Index Term: Energy; Electrical Energy Audit; Power quality analyzer; Textile industry ; Environmental improvement; Payback period.

I. INTRODUCTION

The industrial sector consume about one third of the total energy usage in the world. Since energy use in many sectors highly affects both the local and global environment, it is necessary to increase the awareness of energy efficiency usage within industries. Furthermore, seen from the industrial sectors, it is also important to reduce dependency on energy with unstable prices in order to obtain economic predictability[1-3,20]. Tamilnadu has the major Textile industrial units in india, which is consume a significant amount of energy. The estimated energy saving potential is 23% for textile industry. The textile industry plays a important role in the indian economy which contributes 4% of GDP and 35% of gross export earnings, also tamilnadu is the largest garment exporter in india, So India consumes more energy for their textile process. In major foreign policies, the importing materials from the other countries should be manufactured at particular energy efficient process. Due to unawareness of energy efficiency most of the energy is in wastage form or losses.

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The same study showed that around 36% of the energy input to the textile industry is lost on site (e.g. in boilers, motor system, etc)[17-19].Energy audit of an industry is a systematic procedure which aims to evaluate that existing energy consumption and also it is a method to evaluate the existing pattern of energy consumption, according to the BEE norms, we can compare the existing measurement with the standard one to find out the energy conservation opportunities in it, this will improve energy efficiency and reduce production cost[4-7]. Normally, an energy audit is carried out by certified energy auditors / certified energy manager . By conducting energy audit process in industry, employees begin considering energy as a manageable expense and try to conserve it in day-to-day action[8-12]. Energy does not depend only on voltage & current and time, its indirectly depends on various factors like frequency, power quality maintenance, temperature etc. In this paper, authors get experienced in the division of electrical energy audit, data observations, parameter analyses, determination of energy wastage and identifying ENCON oppourtunties available in the present industry [13-16].

II. DETAILS OF EXISTING CONDITIONS

A .Industry Model

A private sector contains more than 30000 spindles operation in the industry with proper blowroom, and major spinning, drawing sections, its consumes more than 3 lakhs kWh in a month during the year 2018-19

B.Electrical Maximum Demand

This textile industry has four separate Low-Tension service, which is receiving the power from TNEB(Tamil Nadu Electricity Board) under Tariff III B. The permitted MD is around 420 kW.

C. Electricity Consumption

Energy Consumption: 10,080 kWh/day
Electricity Bill / day: Rs 70,560

D. Electricity Tariff

The textile industry is situated in a Non-Metropolitan locality and LT Tariff III B is applicable at the following rates:
Energy (kWh) charges: Rs 7 / kWh

E. Machineries/Equipments Inventory

The factory manager provides the following machineries and equipments:

BR(Blow Room) -- 1 line RF(Ring frames) – 18 Cone and Cheese Winding machines -- 3

Sewing Thread machines

Cards, Preparatory machines, Draw frames, Combers, Lap formers, etc.

Diesel Generators: 1 × 500 KVA

III. SERVICE CONNECTIONS & DATA SURVEY

It has four Low tension (LT) service connections provided by Tamilnadu Electricity Board (TNEB).

i) SC 886 - Connected Load → 105 H.P + 4 KW
ii) SC 955 - Connected Load → 145 H.P + 3.83 KW
iii) SC 1029 - Connected Load → 147 H.P + 2 KW
iv) SC 1202 - Connected Load → 145 H.P + 3 KW

A.Service Connection I – SC 886 :

Under service connection I, the details provided by the Electricity Board in main distribution board is as follows:

S.C no	:	886
Total demand	:	84 kW
T.F	:	III B
Connected Load	:	105 HP + 4 KW
C.T ratio	:	200/5 A
Multiplication Factor	:	40
Date of S.C Provided	:	05/04/2004
Unit cost	:	Rs 7/Unit

B. Service Connection II – SC 955 :

Under service connection II, the details provided by the Electricity Board in main distribution board is as follows:

S.C no	:	955
Total demand	:	112.5 kW
T.F	:	III B
Connected Load	:	145 HP + 3.83 KW
Unit cost	:	Rs 7/Unit
C.T ratio	:	200/5 A
Class	:	0.5
Multiplication Factor	:	40
Date of S.C Provided	:	2/6/2003

C. Service Connection III – SC 1029 :

Under service connection III, the details provided by the Electricity Board in main distribution board is as follows:

S.C no	:	1029
Total demand	:	112.5 kW
T.F	:	III B
Connected Load	:	147 HP + 2 KW
Unit cost	:	Rs 7/Unit
C.T ratio	:	200/5 A
Multiplication Factor	:	40
Date of S.C Provided	:	10/5/2005

D. Service Connection IV – SC 1202:

Under service connection IV, the details provided by the Electricity Board in main distribution board is as follows:

S.C no	:	1202
Total demand	:	111.75 kW
T.F	:	III B
Multiplication Factor	:	40
Date of S.C Provided	:	13/11/2009
Unit cost	:	Rs 7/Unit
C.T ratio	:	200/5 A
Connected load	:	145 HP+3KW

Total Connected Loads in that textile industry are 388 KW (or) 518 HP

IV. IV. DETAILS OF ENERGY AUDITING

With the help of power analyzer, we can observe the existing conditions of capacitors and also found the various internal electrical parameter conditions of all individual machines. The existing capacitors connected in all the service machinery has some connectivity problems, because of that there is a mis operation of generation and absorption of reactive power in it. In order to identify that, we have to check the current drawn of every capacitor. From this checking, we found the existing condition of capacitors is as shown in table 1:

Table .1 Existing condition of capacitors

Service Connection	Total Existing Capacitors	Total kVAr installed	Failures of Capacitors
SC 886	20	72	12
SC 955	25	93	14
SC 1029	27	92	20
SC 1202	8	63	4

From this condition, we can easily identify the reactive power requirement oscillations. After this we can found the all parameters with the help of power analyzer. In this power analyzer, there is a two important connectivity which is connected with every machinery is as follows and shown in figure 1,

- **C.T** – Current Transformers – Connected around three wire supply system to motor point individually
- **P.T** – Potential Transformers – Connected in the 3 terminal of Motor supply

Fig.1. Data Analysis using Power Analyzer

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Table.2. Motor parameter Spreadsheets – Ring Frame motor

Model 8332	Serial	304037 1:1	
Trend	RF10M - Ring Frame Motor 10		
Date Started	Time Started	Date Ended	Time Ended
2/13/2013	9:08:45 AM	2/13/2013	9:11:00 AM

S.No	Urms	Hz	sum of phases	sum of phases	sum of phases	sum of phases	PF	PF	PF
	V	Hz	W	Wh	VAR	VA	Phase 1	Phase 2	Phase 3
1	414.5	50.84	7142.14	9.92	6532.3	9681.060791	0.749	0.745	0.717
2	414.2	50.82	7141.17	19.8	6527.4	9677.165283	0.75	0.746	0.718
3	414.2	50.79	7381.11	30.1	6567.1	9881.792236	0.758	0.754	0.727
4	414.3	50.8	7376.46	40.3	6561.1	9874.338135	0.758	0.754	0.727
5	414.3	50.86	7259.64	50.4	6546.9	9777.875977	0.754	0.75	0.723
6	414.5	50.87	7171.86	60.4	6536.8	9706.106689	0.751	0.746	0.718
7	414.2	50.82	7040.03	70.2	6506.6	9588.502197	0.746	0.742	0.714
8	414.3	50.78	7270.31	80.3	6554.2	9790.626465	0.754	0.75	0.723
9	414.5	50.85	7490.68	90.7	6588.1	9977.849121	0.762	0.758	0.731
10	414.4	50.83	7366.63	100.9	6568.7	9872.13208	0.758	0.754	0.726
11	414.1	50.83	7202.15	110.9	6524.2	9719.967041	0.753	0.748	0.721
12	414.6	50.82	7104.33	120.8	6528.2	9650.459961	0.748	0.744	0.716
13	414	50.82	7126.50	130.7	6516.8	9659.197754	0.749	0.746	0.718
14	414.3	50.83	7390.76	140.9	6574.9	9894.173096	0.758	0.755	0.728
15	414.3	50.79	7403.65	151.2	6568.6	9899.613037	0.759	0.755	0.728
16	414.3	50.82	7273.98	161.3	6554.4	9793.634033	0.754	0.75	0.723
17	414.4	50.82	7065.65	181.1	6528.6	9622.433105	0.747	0.742	0.714
18	414.3	50.82	7242.74	221.8	6547.7	9765.939697	0.754	0.749	0.721
19	414	50.82	7209.48	241.7	6529.8	9729.509766	0.753	0.749	0.72
20	414.5	50.8	7418.45	252.0	6582.6	9920.151855	0.759	0.755	0.728
21	414.2	50.78	7472.85	262.4	6587.6	9964.144775	0.761	0.757	0.73
22	414.2	50.83	7314.22	272.6	6556.0	9824.642822	0.756	0.752	0.725
Avg	**414.3**		**7266.58**	**127.3**	**6549.5**	**9785.060**	**0.754**	**0.750**	**0.723**

Table 2. show the motor internal parameter under various load conditions in the textile process. In this the reactive power needed by the machine is 6.6 kVAr. According to this reactive power demand the PF maintained in the range of 0.75 only . So we need to provide the required reactive power compensation through capacitor banks for maintaining good PF and reduces the power loss.

S.no	Energy Saving in kWh @ 0.85 Load factor / Month	EB Bill Saving in Rs / Year	Pay Back period In Months
1	2506	2,10,515	5

V. V. ELECTRICAL ENERGY CONSERVATION

After the completion of all the data's collection in all the service connection, we have to analyze all the requirement of reactive
power individually. According to that we make a design of suitable capacitors for all the machineries.

Total No of Capacitors installed : 113 No's
Total kVAr Installed : 253 kVAr

A. Service connection SC 886

-Energy Bill can be reduced up to 6%
-Energy savings is **8** % of **84** KW (i.e.) **6.72 KW** in this service due to Reactive power Compensation
- Individuals motor unbalanced current carry will be limited +/- 10 %
- Efficiency & the life span of the machines improved up to 3% & 10 years

Table 3. Energy Bill – Before Audit

S.no	Energy usage in kWh @ 0.85 Load factor / Month	EB Bill in Rs / Year	Investment For Audit Execution
1	38,556	3,238,704	78,000

Table 4. Energy Bill Saving – After Audit

S.no	Energy Saving in kWh @ 0.85 Load factor / Month	EB Bill Saving in Rs / Year	Pay Back period In Months
1	3084	2,59,096	4

In this service connection we attained the savings of 3084 units per month by the small investment of money with 4 month of payback period.

B. Service connection SC 995

-Energy Bill can be reduced up to 6%
-Energy savings is **6.5** % of **84** KW (i.e.) **5.46 KW** in this service due to Reactive power Compensation
- Individuals motor unbalanced current carry will be limited +/- 10 %
- Efficiency & the life span of the machines improved up to 3% & 10 year

Table 5. Energy Bill – Before Audit

.no	Energy usage in kWh @ 0.85 Load factor / Month	EB Bill in Rs / Year	Investment For Audit Execution
1	38,556	3,238,704	72,000

Table 6. Energy Bill Saving – After Audit

In this service connection we attained the savings of 2506 units per month by the small investment of money with 5 month of payback period.

C. Service connection SC 1029

-Energy Bill can be reduced up to 6%
-Energy savings is **9** % of **84** KW (i.e.) **7.56 KW** in this service due to Reactive power Compensation
- Individuals motor unbalanced current carry will be limited +/- 10 %
- Efficiency & the life span of the machines improved up to 3% & 10 years

Table 7. Energy Bill – Before Audit

S.no	Energy usage in kWh @ 0.85 Load factor / Month	EB Bill in Rs / Year	Investment For Audit Execution
1	38,556	3,238,704	78,000

Table 8. Energy Bill Saving – After Audit

S.no	Energy Saving in kWh @ 0.85 Load factor / Month	EB Bill Saving in Rs / Year	Pay Back period In Months
1	3470	2,91,483	3

In this service connection we attained the savings of 3470 units per month by the small investment of money with 3 month of payback period.

D. Service connection SC 1202

-Energy Bill can be reduced up to 6%

-Energy savings is **5** % of **70** KW (i.e.) **3.5 KW** in this service due to Reactive power Compensation

- Individuals motor unbalanced current carry will be limited +/- 10 %

- Efficiency & the life span of the machines improved up to 3% & 10 years

Table 9. Energy Bill – Before Audit

S.no	Energy usage in kWh @ 0.85 Load factor / Month	EB Bill in Rs / Year	Investment For Audit Execution
1	32,130	2,698,920	75,000

Table 10. Energy Bill Saving – After Audit

S.no	Energy Saving in kWh @ 0.85 Load factor / Month	EB Bill Saving in Rs / Year	Pay Back period In Months
1	1606	1,34,946	7

In this service connection we attained the savings of 1606 units per month by the small investment of money with 7 month of payback period.

VI. CONCLUSION

The industrial sector plays a major role in energy consumption. So, we are concentrating one of the higher consumption manufacturing company for the energy analysis. In this company electricity consumption takes the lead role compare to other energy sources. In this project, the energy conservation of textile industry was analysis and executed. The management of the textile industry attain the maximum production ith less energy cost, so they are raising their production rate per hours due to the savings attained and the saving is 7.23% on the electricity cost in a year. Also an improvement of power factor from 0.92 to 0.98 by installing the capacitor bank. According to the environmental benefits, we can reduce some production of SOx and NOx by attaining the electricity savings in the industry, also we suggest that the some portion of renewable energy sources should be consider for compensate above the base loads in future which helps furthur savings of cost with moderate ROI.

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