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Scope of Energy Consumption & Energy Conservation in Indian auto part manufacturing Industry

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Abstract

Energy is crucial to human sustenance and development. Due to the increase in the Demand of energy and deficiency in power generation, day by day the gap between demand and supply of electric energy is widening. Bridging this gap from the supply side is very difficult and expensive proposition. Also limited energy resources, scarcity of capital and high interest costs for the addition of new generation capacity is leading to the increased cost of electrical energy in India. The only viable way to handle this crisis, apart from capacity addition, is the efficient use of available energy, which is possible only by continuously monitoring and controlling the use of electrical energy. Hence energy management program is a systematic and scientific process to identify the potential for improvements in energy efficiency, to recommend the ways with or without financial investment, to achieve estimated saving energy and energy cost. It is estimated that Industrial energy use in developing countries constitutes about 45-50 % of the total commercial energy consumption. Much of this energy is converted from imported oil, the price of which has increased tremendously so much so that most of developing countries spent more than 50 % of their foreign exchange earnings. Not with standing these fiscal constraints, developing countries need to expand its industrial base like us if it has to generate the resources to improve the quality of life of its people. The expansion of industrial base does require additional energy inputs which become more & more difficult in the present scenario. In this competitive world, cost competitiveness is very essential for survival of every individual have to save the energy so is equal to the generate energy. To establish any work / motive or task, energy in one or other form is an essential component. Thus the need to conserve energy, particularly in industry and commerce is strongly felt as the energy cost takes up substantial share in the overall cost structure of the operation. Hence it calls MANAGEMENT OF ENERGY or in other words MANAGEMENT OF RESOURCES or ENERGY CONSERVATION.

Keywords: Indian auto part industry, energy consumption, Energy Conservation, load consumption paten study

Introduction

In today's power scenario, India is facing a major power crunch. Due to demand and supply imbalance, transmission and distribution losses go on increasing, grid frequency decreased as well as plant load factor decreases. Fluctuation in state grid frequency is harmful to plant equipments. Due to peak demand, strain on power generation and utilization equipment increases which result into increases in energy cost.

The industrial sector is the major energy consuming sector in India and uses about 50% of the total commercial energy available in the country. The main reason for higher specific energy consumption in Indian industries are obsolete technology , lower capacity, utilization , causal metering and monitoring of energy consumption , lower automation , raw material quality and poor handling ,operating and maintenance practices.

So monitoring industrial energy utilization on continuous basis and relating it to the production is the first step of energy conservation programme.

Even a 5% saving in electricity will prevent the need to install power plants of a few thousand MW. With this regards the government of India is formulating mandatory the “Energy Audit and energy conservation regulations”. Considerable energy saving is possible through proper choice of equipments, and their effective use & involvement of conservation measures:

“The Strategy and optimizing energy, using system and procedures so as to reduce energy requirements per unit of output while holding constant or reducing total costs of producing the output from these systems**”**

Poor management practices along with the declining labor productivity and operating efficiency of manufacturing processes over the years lowered the profitability of many of these plants significantly, resulting in a slowdown of industrial activities. The pursuance of policies that encouraged import-substituting industrialization and the pessimism of planners about exports offered no market incentive for these firms to improve their performance over the long run With the gradual integration of the domestic markets with the global economy and growing concerns about the environmental implications of the industrial activities, there is now increasing pressure on domestic industry to improve its performance. The energy shortages coupled with increasing energy prices being witnessed in various states in India is forcing the industries now to look at ways and means for reducing their energy consumption and adopting technologies that result in lowering their energy intensity.(table 1)

II Importance of study of Energy consumption & Energy conservation:

1. As per electricity Act 2001 Energy Audit Needed.
2. As per demand in industrial sector we are not supplying electricity to fill demand gap.
3. Wastage of electricity in commercial sectors as well in residential sector can be conserved.
4. Indian industries are not adapting the new technology.
5. in this way increasing bill in economical & social manner.

Salient Features of the Energy Conservation ACT 2001:

An Act to provide for efficient use of energy and its conservation and for matters connected therewith or incidental there to:

- Specify energy consumption standards for notified equipment and appliances;
- Direct mandatory display of label on notified equipment and appliances;
- Prohibit manufacture, sale, purchase and import of notified equipment and appliances not conforming to energy consumption standards;
- notify energy intensive industries, other establishments, and commercial buildings as designated consumers;
- establish and prescribe energy consumption norms and standards for designated consumers;
- prescribe energy conservation building codes for efficient use of energy and its conservation in new commercial buildings having a connected load of 500 kW or a contract demand of 600 kVA and above

III. Type of Energy Audit

The type of Energy Audit to be performed depends on:

- Function and type of industry
- Depth to which final audit is needed, and
- Potential and magnitude of cost reduction desired

Thus Energy Audit can be classified into the following two types.

I) Preliminary Audit

ii) Detailed Audit

a) Phase I - Pre Audit Phase
b) Phase II - Audit Phase
c) Phase III - Post Audit Phase

IV Significance Objectives of Study Energy consumption in Auto manufacturing Industry:

Selection of one industry. Identify particular industry & understand their system power consumption pattern. Gathered the information of their consumption. Identify their available sources & technology for full fill the requirement products is radiators, intercoolers, erg coolers, heater core etc. Types of energy they are consuming mainly electricity, oil, LPG gas etc. Electric power consumption layouts and power load flow of industry (table 2,3)

The Company's Product Range Includes:

- RADIATORS
- INTERCOOLERS
- HEATER CORES
- CONDENSERS
- EGR COOLERS
- OIL COOLERS

It is manufacturer of the auto component and deal with high power consumption. :

- Tube mill
- Press (C type, H type)
- Fin forming
- Degreasing
- Core assembly
- Brazing oven (Two continuous brazing furnaces)
- Tank clinching
- Intercooler welding lines

Above shown is basic oneline diagam of the industy and below in this papper using ETAP had a load folw analsiss of the system done. (Table 5,6)

Here above shown in graph C & chart D shows the load demand and consumption pattern of the particular auto part manufacturing unit. This unit mainly draw the power from state electricity board and when some failure occurred the time depend on own diesel generator set for power demand. Here below shows the table E which shows the potential conservation area and its solution how can we saved the energy by implementing various steps of Energy Management & Conservation

FDV : applying batter planning for operation which made by co-ordination with production line saving of 2% energy can be achieve

NEW BRAZING & OLD BRAZING: its works on IGBT Based control system so using harmonic filter and controlled coordination with production line so when production is closed that time conveyer can be utilized and better thermal insulation needed some of the insulation is damaged which replaced by glass woolen and new thermoplastic insulation this can be help to save almost 3% of the energy consumption in new brazing and around 5% in old brazing. (Temp. difference of 15^0c can be saved 0.5% energy in brazing)

I/C WELDING: welding machine operate by unskilled worker which not operative proper method as well as current section is wrong some time High capacity Material & proper current setting microcontroller can be ended to save 15% energy.

Administration / plant office building: light adopter can be replaced by same ratting by CFL or LED is saved 25-30 % of energy w.r.t. traditional light, A.C. set to $22\text{-}23^0$c which cause continues working of A.C. so, planning A.C. to $24\text{-}26^0$c is ended around 4% of saving in energy.

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Cleaning Plant: Reuse of water and proper planning of washing the parts can be saved almost 8% of energy

Engineering section: compressor and other drill machine used closed loop controlled system with VFD system helps to save 4-6% of energy

HLT- Tube mill: today traditional tube mill used to bending the tubes and brass part to modify the system such way that used sensors and compressor pressure so saving of 15% can be achieved.

The cost of the implementing above system has some cost and the cost can be payback in the return in terms of saving unit the in year the chart shown below shows typical saving payback chart.

V Example:

An industrial plant is operating at 400 KW and maximum demand of 520 KVA. The facility has a power contract based KVA demand charges, which shall reduce as the power factor is improved. The demand charges rates have been fixed @ Rs 150.00 per month per KVA. Determine the savings possible by improving the power factor along with the payback period of putting any investment on power factor correction.

Solution

The KVA demand can be reduced if the power factor is raised. Often 95% is a good economical power factor when the demand charges are based on KVA charges.

i) The Present Power Factor = KW/KVA = 400/520 = 77%

ii) Present demand charge = 520 x 150 = 78000

iii) Assuming that we target the new power factor to 95%. This would reduce the present 520 KVA demand down to 421KVA. Calculation as follows:

Reduced KVA = KW/modified power factor = 400/0.95 = 421KVA

iv) Modified demand charge = 421 x 150 = 63150

v) Probable Savings =78000-63150= 14850

vi) KVAR required increasing power factor from 0.77 to 0.95

The multiplying factor = 0.5 (from the capacitor estimation table above)

Therefore KVAR required = 0.5 x 400 = 200 KVAR

vii) Capacitor Investment

Cost of 200 KVAR of capacitors (on a 480 volt system, installed capacitor cost is approx 750/KVAR)

200 KVAR x 750 = 150000

viii) Payback Period (Figure 4)

Monthly savings on demand charge = 14850

Investment on capacitors = 150000

Simple Payback = First cost/ savings = 150000 / 14850= approx 10 months. The savings shall continue thereafter.

As above shows and typical power factor of equpmnts so we get idea how much that equpmnet can be lagged in the systems so by providing the reative power by different techniqied showed below we can mange it to unity power factror.this study carried out by using Load Flow analysis by using ETAP in this case.

The calculation of costing and selection of capacitor shows in example shown above. (Figure 5) ETAP software is sued to simulate the system by using this software the system data feed in the online diagram of the system and after running the program in different mode the value of Active ,Reactive power , frequency power factor % loading (Table 5), fault level, transient condition, harmonics analysis ETC data get from this software. Its works and helpful to apply conservation technique in real word environment and understand the system

VI: Recommendation for the Industry

- Electrical Load Management and Maximum Demand Control

- Step By Step Approach for Maximum Demand Control
- Rescheduling of Loads
- Shedding of Non-Essential Loads
- Reactive Power Compensation
- Improving Power Factor
- Energy Conservation with Energy Efficient Lighting
- Enterprise Energy Management (EEM)
- Procurement management
- Demand response
- Identification of Energy Conservation Opportunities
- Approaches to Energy Conservation Using Ac Variable Drives

VII: FUTURE SCOPE

Limitation and Future scope: future is great for the energy conservation lots of advantages over there mainly power saving, increasing life of system and economical advantage include some of the limitation as below

Limitation:

1) As one process is dependent on the other, very less load is available as a flexible load, hence there is much difficult in load management tech like brazing method.

2) TOD charges are not taken in to consideration because when load is constant average of TOD charges over 24 hours is zero.

3)All the motors & brazing oven both are running for 24 hrs .hence it is difficult to measure the speed of motor to study their performance.

4) System loss is assumed to be 1% and based on this annual cost saving is calculated.

Future scope of development:

a) With the use of harmonic analyzer, harmonic study can be carried out. Study different losses, harmonic distortion factor etc can be carried out.

b) Using photo sensors if the atomization in the lighting system is implemented, then considerable energy saving can be achieved.

VIII: CONCLUSION

As growth of industries increase power demand increase to limit the demand and cut energy bill get more output with maximum efficiency we need constant change in our consumption power system by adding new energy efficient technology. For that fist identify over consumption and study optimum efficient technology with advance payback with great efficiency and reliability.

From the careful study, use of different references & the observation obtained, the following salient conclusion can be drawn regarding the overall performance of the proposed work that has been presented in this thesis.

In case study considerable energy saving can be achieved by two ways

a) By reducing the requirement of electrical energy

b) By reducing the cost of energy with load management techniques without compromising the quality output. Total annual energy saving can be achieved around 10% of total energy consumption.

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APPENDIX

Type of load	Industrial sector	Tertiary sector
Motors	69 %	36 %
Lighting	6 %	30 %
Other	25 %	34 %

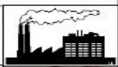
Sector		Conservation potential (%)	Energy Handled by Motors (%)
Industrial Sector		Up to 25	70-75%
Agriculture Sector		Up to 30	20-25%
Domestic Sector		Up to 20	2-3%
Commercial Sector		Up to 30	4-5%

Table 1 Basic consumption pattern

This stable shows the load distribution and paten of load in the typical industrial load. It's also shows the major load consumption sector in power electrical sector

no	Load	Monthly consumption Average	Saving %	saved unit	solution
1	FDV	35313	2	706.26	Panning
2	NEW BRAZING	176131.25	3	5283.9375	using thermal protection & electronics software
3	OLD BRAZING	64980	5	3249	planning & thermal & electrochemical process
4	I/C WELDING	71005.50	15	10650.825	High capacity Material & proper

					current setting microcontroller
5	ADMIN	17637.075	4	705.483	CFL & A/c Planning
6	PLANT OFFICE	1363.5	4	54.54	CFL & A/c Planning
7	CLINCHING LINE	27088.5	8	2167.08	Proper planning And Reuse Washing Material
8	ENGINEERING	19392	3	581.76	Planning & Proper Equipments
9	HLT- Tube mill	27849.5	15	4177.425	Pressure maintain & VFD
10	5 B	1730	2	34.6	on-off timer

Table 2: Potential Conservation area of auto industry

This table shows the potentially energy saving point of auto part industry

Typical Un-improved Power Factor by Equipment	
Equipment	**Power Factor**
Air Compressor & Pumps (external Motors)	75-80
Hermetic Motors (compressors)	50-80
Arc Welding	35-60
Resistance Welding	40-60
Machining	40-65
Arc Furnaces	75-90
Induction Furnaces (60Hz)	100
Standard Stamping	60-70
High Speed Stamping	45-60
Spraying	60-65

Motor Load Factor	Power Factor
Unloaded	17%
1/4 Loaded	55%
½ Loaded	73%
¾ Loaded	80%
Fully Loaded	84%
Overloaded (25%)	86%

Table 3 : typical power factor of equipment

Method	Advantages	Disadvantages
Individual Capacitors	Most technically efficient, most flexible	Higher installation and maintenance cost
Fixed Bank	Most economical, fewer installations	Less flexible, requires switches and/ or circuit breakers
Automatic Bank	Best for variable loads, prevents over voltages, low installation cost	Higher equipment cost
Combination	Most practical for larger numbers of motors	Least flexible

Table 4: copanstion techniquie

LUMPED LOAD Input Data

Lumped Load ID	Connected Bus ID	Rating kVA	Rating kV	Rating Amp	Rating % PF	% Load MTR	% Load STAT	Motor Loads: Loading kW	Loading kvar	% Impedance Machine Base R	X"	R/X"	m Fact. MW/PP
admin load	LV Bus 1	400.0	0.420	549.90	85.00	11	89	37.4	23.2	6.46	15.37	0.42	0.04
old tube mill	LV Bus 1	200.0	0.420	274.90	85.00	48	52	81.6	50.6	6.46	15.37	0.42	0.08
other load	LV Bus 1	240.0	0.420	329.90	85.00	8	92	16.3	10.1	6.46	15.37	0.42	0.02
Pump & A/c load	LV Bus 2	130.0	0.420	178.70	85.00	80	20	88.4	54.8	6.46	15.37	0.42	0.09
testing Machine	LV Bus 2	200.0	0.420	274.90	85.00	48	52	81.6	50.6	6.46	15.37	0.42	0.08
tube mill 2	LV Bus 2	400.0	0.420	549.90	85.00	84	16	285.6	177.0	6.46	15.37	0.42	0.29
Welding Section	LV Bus 2	200.0	0.420	274.90	85.00	49	51	83.3	51.6	6.46	15.37	0.42	0.08

Total Connected Lumped Loads (= 7): 1770.0 kVA

Table 5 : laod flow anaysis data table for system

Calculation Table for Capacitor Selection

Power factor Cos θ_2 after improvement (columns); Power factor Cos θ_1 before improvement (rows)

	1.0	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.85	0.80
0.5	1.73	1.59	1.53	1.48	1.44	1.40	1.37	1.34	1.30	1.28	1.25	1.11	0.98
0.52	1.64	1.50	1.44	1.39	1.35	1.32	1.28	1.25	1.22	1.19	1.16	1.02	0.89
0.55	1.52	1.38	1.32	1.27	1.23	1.19	1.16	1.12	1.09	1.06	1.04	0.90	0.77
0.57	1.44	1.30	1.24	1.19	1.15	1.11	1.08	1.05	1.01	0.99	0.96	0.82	0.69
0.6	1.33	1.19	1.13	1.08	1.04	1.01	0.97	0.94	0.91	0.88	0.85	0.71	0.58
0.62	1027	1.23	1.06	1.01	0.97	0.94	0.90	0.87	0.84	0.81	0.78	0.65	0.52
0.65	1.17	1.03	0.97	0.92	0.88	0.84	0.81	0.77	0.74	0.71	0.69	0.55	0.42
0.67	1.11	0.97	0.91	0.86	0.82	0.78	0.75	0.71	0.68	0.65	0.62	0.49	0.36
0.7	1.02	0.88	0.81	0.77	0.73	0.69	0.66	0.62	0.59	0.56	0.54	0.40	0.27
0.72	0.96	0.82	0.75	0.71	0.67	0.63	0.60	0.57	0.53	0.51	0.48	0.34	0.21
0.75	0.88	0.74	0.67	0.63	0.58	0.55	0.52	0.49	0.45	0.43	0.40	0.26	0.13
0.77	0.83	0.69	0.62	0.58	0.54	0.50	0.47	0.43	0.40	0.37	0.35	0.21	0.08
0.8	0.75	0.61	0.54	0.50	0.46	0.42	0.39	0.35	0.32	0.29	0.27	0.13	
0.82	0.70	0.56	0.49	0.45	0.41	0.37	0.34	0.30	0.27	0.24	0.21	0.08	
0.85	0.62	0.48	0.42	0.37	0.33	0.29	0.26	0.22	0.19	0.16	0.14		
0.87	0.57	0.42	0.36	0.32	0.28	0.24	0.20	0.17	0.14	0.11	0.08		
0.90	0.48	0.34	0.28	0.23	0.19	0.16	0.12	0.09	0.06	0.02			
0.91	0.45	0.31	0.25	0.21	0.16	0.13	0.09	0.06	0.02				
0.92	0.43	0.28	0.22	0.18	0.13	0.10	0.06	0.03					
0.93	0.40	0.25	0.19	0.15	0.10	0.07	0.03						
0.94	0.36	0.22	0.16	0.11	0.07	0.04							
0.95	0.33	0.18	0.12	0.08	0.04								
0.96	0.29	0.15	0.09	0.04									
0.97	0.25	0.11	0.05										
0.98	0.20	0.06											
0.99	0.14												

Table 6: selection Table for Power factor improvement using Capacitor

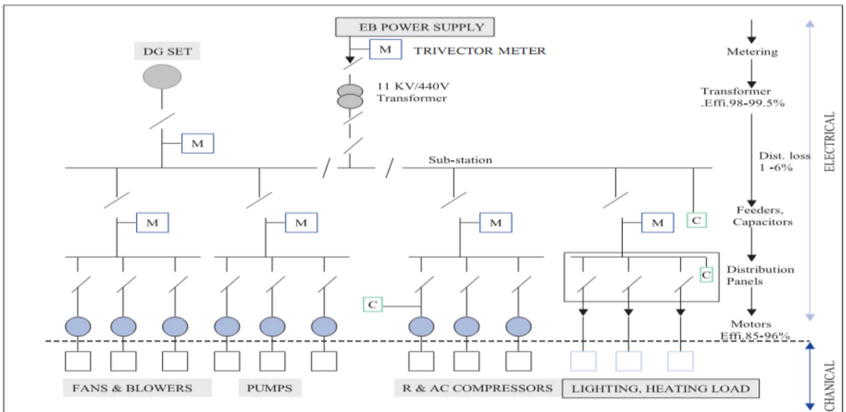


Figure 1.3 Electrical Distribution System –Single Line Diagram

Figure 1 one line diagaram of system

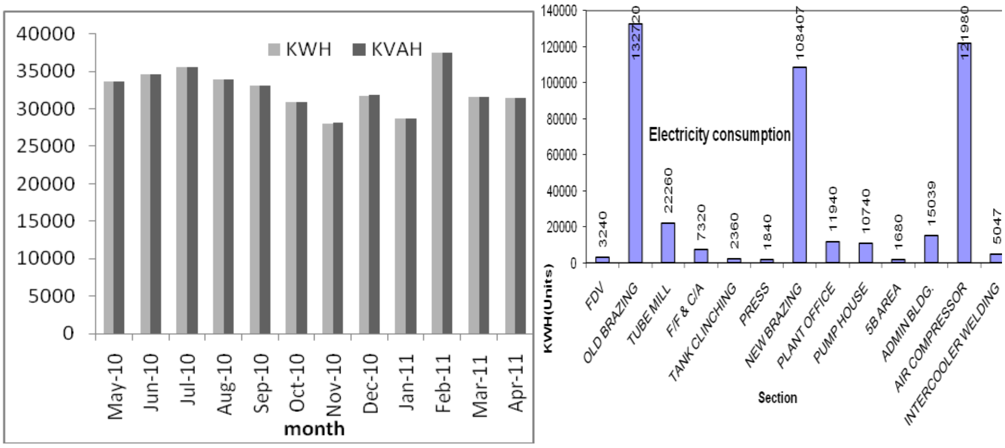


Figure 2 : Annual load cosuption aptten connected load

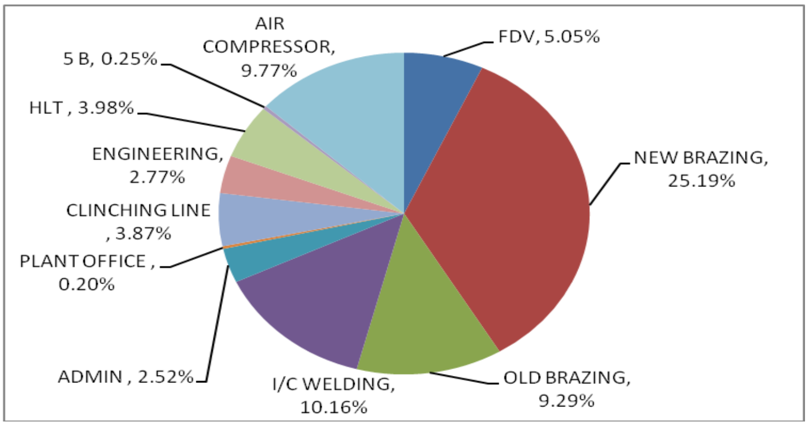


Figure 3: connected load pattern

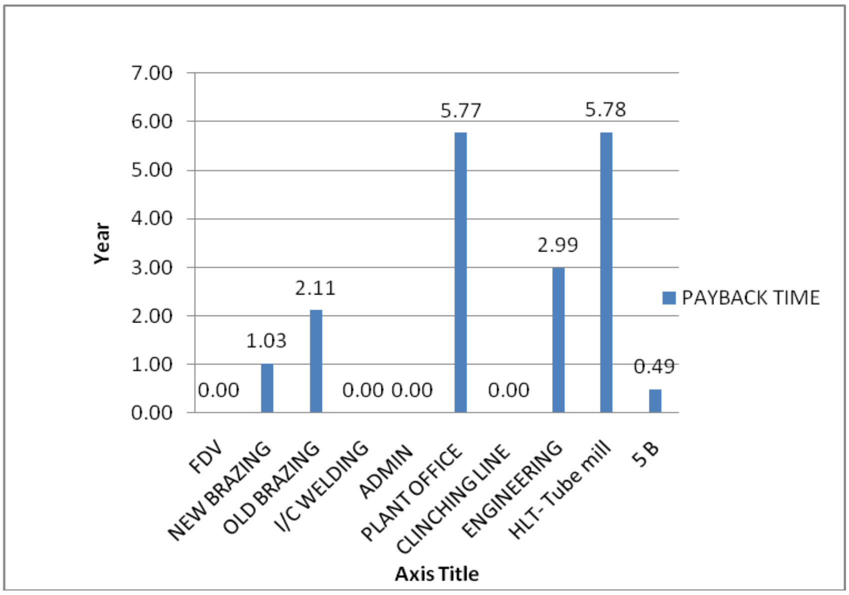


Figure 4: Payback period table

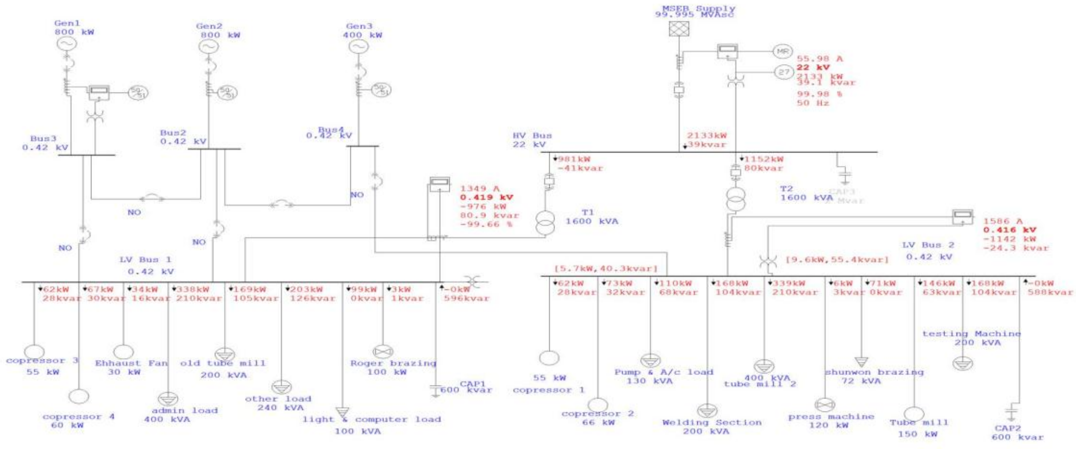


Figure 5: One line diagram of ETAP load flow