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INTELLIGENT POWER FACTOR STABLIZATION FOR INDUSTRIAL APPLICATION

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Abatract:- *Power factor is the ratio between active power and apparent power. As many of the loads are inductive in nature; current will lag the voltage and so power factor become low. The lagging power factor is improved by connecting the static capacitors at the load side. Micro Controller accomplishes the process of improving the power factor. Demand for electrical power is more compared to electrical power generated. Reducing the loss of electrical power in industries can give a better conservation of electrical energy this can be implemented by controlling the power factor. Controlling power factor can save 40% of the power that is used, it not only saves the electric power but also it saves billing charges for industries. The ultimate aim is to control the power factor using micro controller technology. The basic central processing unit used here is c8051f133 Micro Controller. The input to the controller are obtained using instrumentation transformer. The Micro Controller calculates the actual power factor. When this power is less than the present value of the Micro Controller sends the signal to the relay circuit with switches on the capacitor banks in step until the power factor is corrected to the present values. Similarly when the actual power factor is more than the present values, the capacitor banks are switched off in steps. The present values and actual values are displayed in LCD unit. The relay circuit is basically a transistor switching circuit which is switched on and off by the signal from micro controller.*

Keywords:-*APFC, Relay, DIGsILENT, Microcontroller, Power Factor.*

I. INTRODUCTION

It is a known fact that electricity is transferred through conductors from the generating station to the load center via power station. A long transmission line usually does the transfer of power. The general losses are heat losses and corona losses. Due to the flow of current, the losses or heat loss occurs. It is not possible to minimize the loss below a certain limit.At normal conditions there are a minimum loss, which is unavoidable. But during load variations, at different durations the consumption of current increases. Therefore the current drawn through the HV line also increases which result in the increases of losses.
The Power factor plays an important role in A.C circuits since power consumed depends upon this factor.
For Single phase supply
$P = VLIL \cos \varphi$
$IL= P/ (VL\cos \varphi)$
For three phase supply
$P = 3VI \cos \varphi$
$IL= P/ (3V \cos \varphi)$

II. PROBLEM STATMENT

A. Large KVA rating of Equipment: The electrical machinery (e.g., alternators, transformer, and switchgear) is always rated in KVA Now, It is clear that KVA rating of the equipment Is inversely proportional to power factor. The smaller the power factor, the larger is the KVA rating. Therefore, at low power factor, the KVA rating of the equipment's has to be made more, making the equipment larger and expensive.

B. Greater Conductor size: To transmit or distribute a fixed amount of power at constant voltage, the conductor will have to carry more current at low power factor. This necessitates larger conductor size

C. Larger copper losses: The Larger current at low power factor causes losses in all the elements of the supply system. This result in poor efficiency**.**

D. Poor Voltage regulation: The large current at low lagging power factor causes greater voltage drops in alternators, transformers, transmission lines and distributors. This results in the decreased voltage available at the supply end, thus impairing the performance of utilization devices. In order to keep the receiving and voltage within the permissible limits, extra equipment is required.

E. Reduced handling capacity of system: The lagging power factor reduces the handling capacity of all the elements of the system. It is because the reactive component of current prevents the full utilization of installed capacity.

F. Causes of Low Power Factor: Low power factor is undesirable from economical point of view. Normally, the power factor of the whole load on the supply system is lower than 0.8. The following are the causes of low power factor. Most of the A.C. motors are of induction type, which have low lagging power factor. These motors work at a power factor, which is extremely small on light load and rises to 0.8 or 0.9 at full load. Are lamps, electric discharge lamps and industrial heating furnaces operating at low lagging power factor.

G. The load on the power system is varying: being high on during morning and low at other times. During low load period, supply voltage is increased which increases the magnetization current. This result in the decreased power facto**r.**

III. BLOCK DIAGRAM

It uses a potential transformer to supply the voltage to the Zero Voltage Crossing circuit, which detects the zero crossing of the voltage wave form, for every 10 ms – by comparing the voltage pulses applied to the operational amplifier. These voltage pulses from the operational amplifier are applied to the microcontroller as interrupt signals.

Similarly, a current transformer is used here to give the current wave to the ZCS circuit wherein the operational amplifier output is enabled for every 10 ms by comparing the zero position of the current with the predefined setting. This signal is also applied to the microcontroller as an interrupt signal. The microcontroller finds time elapse between these two interrupts and substitutes it in a certain equation for calculating the power factor.

If this power factor value is in between 0.95 to 1, then the microcontroller doesn’t send any command signals to the relay driver to switch the capacitors on. But, if it is less than 0.95, then the microcontroller sends command signals to the relay driver so that the capacitor comes in parallel with the load. Therefore, these capacitors reduce the lagging nature of the load by giving leading currents to it. The number of capacitors’ switching depends on the value of the power factor – very low power factor needs all the capacitor, whereas high power factor needs none of those.

In this way, one can improve the lagging power factor so that the losses will be minimized and therefore, the penalty imposed by the power supply companies will be minimized. We hope that you have got a better understanding of this power factor correction concept with the above application-oriented example. Therefore, you as a reader can share your doubts, comments and suggestions in the comment section and also can contact us for any help regarding any project or similar sort of projects.

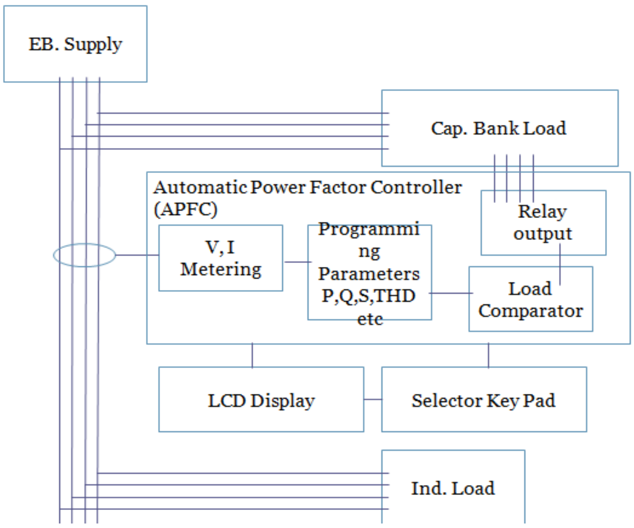

Figure 1.Block diagram for automatic power factor control

IV. STIMULATION AND OBSERVATION

The software that we are using is DIGSILENT power factory .The DIGSILENT has set standard and trends in power system modeling, analysis and simulation for more than 25 years. The proven advantages of the Power Factory software are its overall functional integration, its applicability to the modeling of generation, transmission distribution and industrial girds, and the analysis of these grids' interactions. With Power Factory Version 15, DIGSILENT presents further steps towards seamless integration of functionality and data management within a multi-user environment.
DIGSILENT Power Factory is the most economical solution, as data handling, modeling capability and overall functionality replace a set of other software systems, thereby minimizing project execution costs and training requirements. The all-in-one Power Factory solution promotes highly- optimized workflow .DIGSILENT Power Factory is easy to use and caster for all standards power system analysis needs, including high –end applications in new technologies such as wind power and distributed generation and the handling of very large power system. In addition to the stand-alone solution, the Power Factory engine can be smoothly integrated into GIS,DMS and EMS supporting open system standards.

By stimulating without any power factor correction the result obtained is as shown below

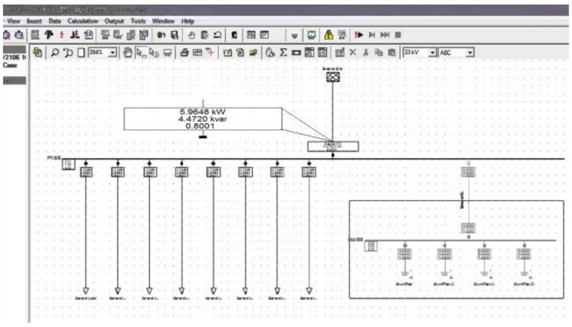

Figure 2.power factor simulation without power factor compensation

And the result obtained by using power factor correction is as shown below

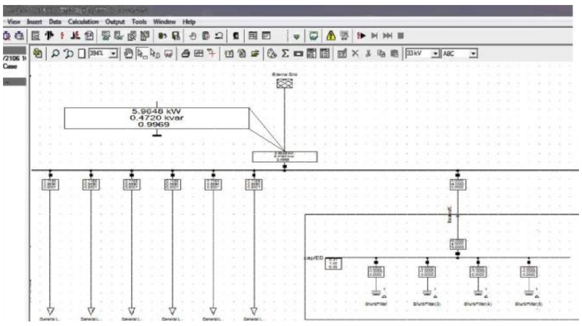

Figure 3.power factor simulation with power factor compensation

V. RESULT AND CONCLUSION

Even at 90% power factor the reactive power requirement is 48% of the real power. At low power factors, the reactive power demand is much higher. Therefore, some form of power factor correction is required in all the industrial facilities. The power factor of any operating system can be lagging or leading. The direction of active and reactive power can be used to determine the nature of the factor. If the both the real and reactive power flow in the same direction, then the power factor is lagging. If the reactive power flows in the opposite direction to that of the real power, then the power factor is leading. A typical lagging power factor load is an inductor motor. A typical leading power factor is a capacitor. Some typical plant power factors of industrial plants are presented below.

VI. FUTURE ENHANCEMENTS

The automotive power factor correction using capacitive load banks is very efficient as it reduces the cost by decreasing the power drawn from the supply. As it operates automatically, manpower are not required and this Automated Power factor Correction using capacitive load banks can also be used for the both industrial and household purposes in the future.

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