POWER FACTOR IMPROVEMENT AND ENERGY CONSERVATION THROUGH USE OF INTELLIGENT POWER FACTOR CONTROLLER

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Introduction:

Increasingly, Indian Industry is paying one of the highest power tariffs in the world. This will get worse due to our dependence on imported fuel, escalation in fuel prices and depreciation of rupee. Further the gap between supply and demand is expanding leading to poor quality and lower quantity of power resulting in loss of production and profits.

The demand for energy is projected to grow twice as fast in Asia over the next 20 years. India is projected to claim a significant portion of this Asian demand. With increasing global competition countries with higher electricity costs can benefit significantly from improvements in Energy efficiency. Further improvements in energy efficiency are already proven to have the fastest payback, compared to improving availability through generation.

Areas / Avenues for Energy Conservation in Electrical Systems:

The areas for improvement in Electrical systems resulting in Energy Conservation are:

- Demand Side Management
- PF Management
- Reduction in Harmonics

Methodology for Achieving Energy Conservation:

Following are the steps to be taken for achieving Energy Conservation:

- Conducting Energy Audit: Energy Accounting is the first step to be taken to track energy usage and to determine the performance of the various electrical systems vis-a-vis their rated efficiency.
- Conducting Harmonic Audit: This enable us to determine the reasons, sources and origins of Harmonics generated in the Electrical System.
- Installation of Energy Management Systems: The system is used for recording and analyzing the consumption patterns, drawing comparisons and identifying inconsistencies in the plant and pin pointing wastages and lapses in the process.
- Corrective action: Based on the data and results obtained from the Energy

Management System and the findings of the Energy / Harmonic Audit corrective actions in terms of house keeping measures, retrofits to the existing systems and replacement of old machinery with energy efficient machines are implemented to achieve energy conservation.

Power Factor Management and Improvement

Power Factor improvement is one of the fastest ways to achieving Energy conservation and improving the bottom line. Following is required to be done for improvement of power factor.

- Study of various types of loads.
- Determination of the percentage of Inductive load.
- Determination of Transformer Capacity
- Determination of Power Factor under full load conditions by calculating the impedance of the transformer.

Once the data is made available the KVAr required to improve the power factor to the levels desired is determined. The next step would be to determine the banking pattern in the electrical system. This is done by first classifying the loads as major or minor. Second, to install capacitors at all major loads and finally to install capacitors at the PCC levels for the fine tuning of power factor preferably with the minimum banking pattern.

The effects of current, voltage, harmonics and temperature are to be addressed. These produce degradations in capacitors and contactors. These go unnoticed since the equipment is operating silently in a corner, until a catastrophic breakdown occurs.

Role of Intelligent Power Factor Controller

For any industry with dynamically varying loads, Automatic Power Factor Compensation affords the best return on investment. Since the KVAR investment required is smaller than with fixed capacitors needed to meet the entire load. Automatic Power Factor Correction also avoids leading PF situations by switching off extra capacitors.

Some of the desired benefit of installing a IPFC are:

<u>On equipment:</u>

- Reduce ware and tear of contactors
- Reduce Incidence of Field Failures
- Protect equipment

- Switch off banks on micro-interruptions and main faults
- Ensures re-connection time under all working modes

- Safeguard and increase equipment life
  - Switch off for excessive V, A, Harmonics
  - Intelligent Alarm Functions

At Site:

- Prevent Improper Manual Switching
  - Clear Alarm until discharge time has elapsed to prevent false alarms
  - Fool proof manual control
  - Disable re-connection prior to proper discharge
- Alert on Malfunctions
  - Alert on system failures reducing ability to achieve PF (fuses blown, banks out of service, contactors welded or open, etc)
  - Memory indication of past events
  - Alert on likely PF penalties (irregular compensation)
- Simply inspection
  - Manual Modes to simplify equipment check up

Case Study:

Penalty on low PF:

In Northern Region if PF is less than 0.90, penalty levied with respect to low PF is as follows:

Low PF penalty = (KWh * Rs.3.5) * difference in PF

In case of a customer M/s JVVN the details were as follows:

- Number of units consumed per month = 500000KWh
- PF maintained = 0.85 lag
- Since the PF was below 0.9 penalty was levied = (500000*3.5)*(0.9-0.85) = Rs.875

KVA usage

- kVA utilized for loading at 0.85 PF = 350KVA * 0.85 = 298KW
- KVA utilized for loading after PF correction to 0.99 PF= 350KVA*0.99 = 347kW
- In JVNN, for 298KW load they are using an extra 50KVA
- As per EB norms in North India the charges for KVA is Rs.300/-
- Therefore monthly saving on kVA if PF maintained at 0.99 will be Rs.300*50 = Rs.15000

PF Incentive

- The incentive for PF if maintained above 0.95 for every 0.01 improvement there is a 1% reduction on the KWh.
- If the PF at JVNN is maintained at 0.99 then the reduction in bill will be 4% of 500000 units = Rs. 20,000/-

Pay back Calculation:

Total saving achieved by using IPFC : Rs20,000+Rs.15000+Rs.875 = Rs35875.00

Total investment on APFC panel : Rs. /-1,50,000

Payback period: Less than 4 months

Conclusion :

The Intelligent Power Factor Controller improves energy efficiency by benefiting from the following advantages.

- Optimum utilization of Demand
- Reduce line losses
- Extra load can be connected without any additional demand sanction
- Demand penalty can be avoided
- Efficiency of the plant increases
- Zero cost maintenance
- Increases capacitors life
- Helps to avoid increase in system voltage.

By energy conservation the user is able to achieve a significant competitive edge in the global context as well as address a national priority.