Reactive compensation: Who should bear the burden?

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After the black out in August, 2003 reactive compensation has been in the spotlight.

Several excellent dissertations have been given and ideas proposed including pricing of VARS, more regulation, validation and simulation of excitation systems, FACTS technology and incentives to energy providers so they can provide the VARS needed.

Most of them are directed to solutions at the generation, transmission and distribution level, but what is needed is a complete holistic approach to the problem. No matter how many capacitor banks, SVC, STATCOM, DVAR, advance excitation systems, SCADA controls or synchronous condensers you install, the fact is that reactive energy compensation needs to be applied as close to the point of reactive power consumption as possible. Ideally, the application of reactive energy compensation should take place at the loads which are distributed throughout the entire power system. The problem must be addressed first at the load and then move upstream. That has not been happening in U.S.A.

In the USA, power factor rates are uncommon and in many cases when they do exist they are not enforced, in order to "satisfy" the customer. This is neither a sound energy management strategy nor business practice. If the customer's load is highly reactive, then the rest of the system will bear the burden of that reactive energy demand. Even worse, high energy demand is in most cases combined with a high reactive load, such as air conditioners. Pole mounted capacitors and substation capacitor banks are often installed to help but their effects are limited since:

a) They are fixed capacitor units with high kVAR values,
b) Loads fluctuate, so a large (KVAR) capacitor bank might be needed in the summer but will never turn on in winter,
c) System configuration, loads and reactive demands change making it difficult to have the proper reactive support,
d) Capacitors banks do fail, especially pole mounted medium voltage types and no reactive support exists. It is estimated that at least 15 % of pole mounted capacitors are not working.
e) FACTS solutions are very expensive and once installed, they are typically impossible to change.

At most utilities, capacitor banks are considered as a voltage "regulator," especially on the distribution side. This is of course true but it neglects the other major benefit of capacitors; that is reactive compensation and the corresponding power factor correction.

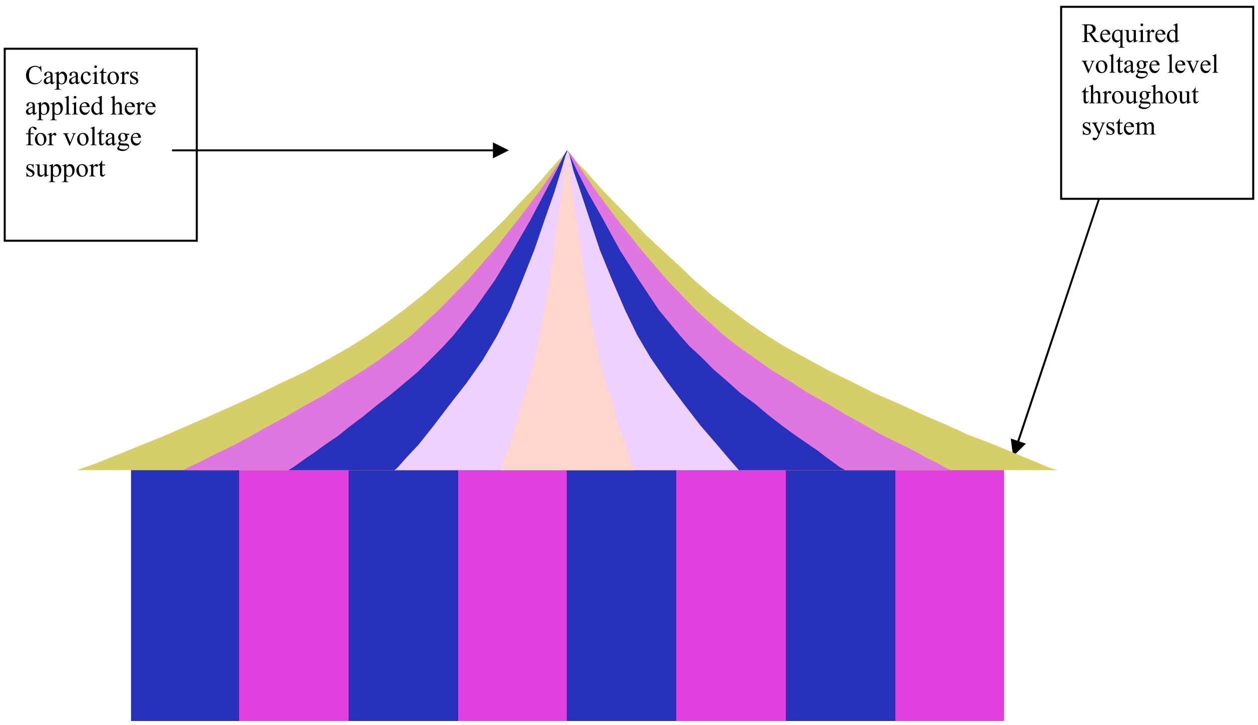
If power factor rates are implemented and enforced, utility customers will be forced to apply reactive compensation and the following benefits will be realized:

a) Reactive power will be generated where it is needed, at the load.
b) Customers will save energy since their $I^2 R$ losses will be reduced.
c) Voltage support will be achieved throughout the system. Rather than relying upon a limited number of pole mounted, substation banks or FACTS, reactive compensation will be applied exactly where it is needed by tens of thousands of

small reactive contribution throughout the distribution system, close to the load, where they can do the most good.

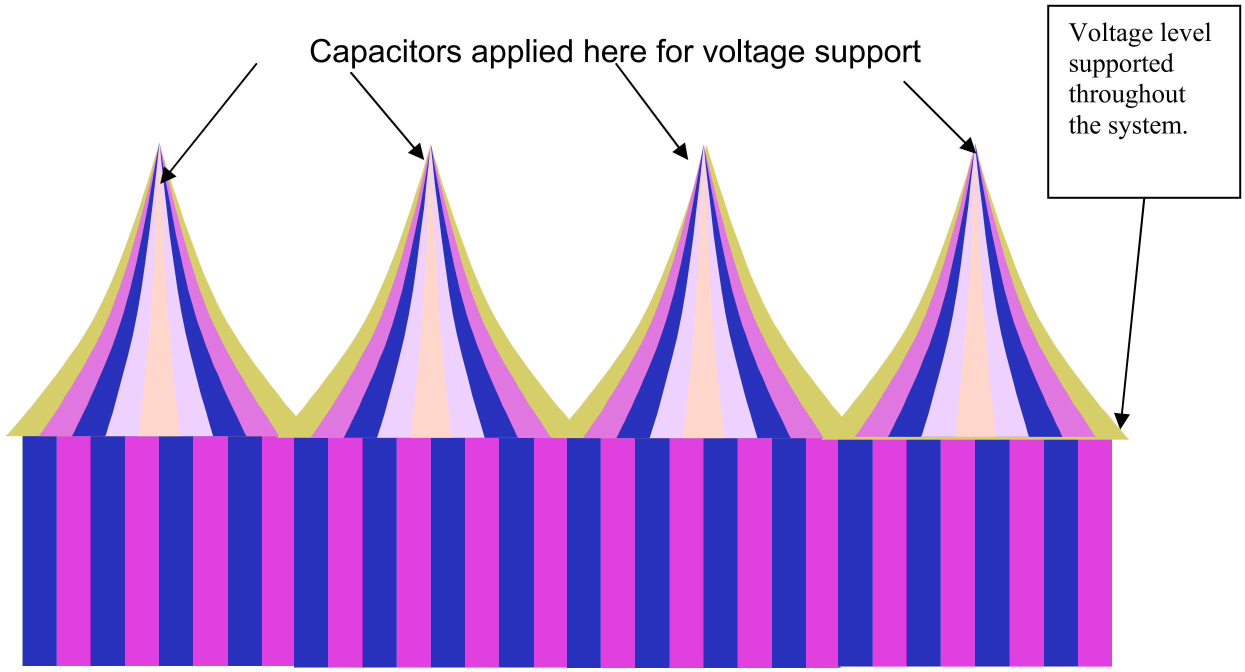
d) The investment needed by the utility is minimal. From the customer's point of view it is also negligible, since the investment for reactive compensation will be paid for through direct energy savings.
e) The customer's electrical assets will last longer because they will operate at lighter loads and at lower temperatures.
f) From the utility's perspective the electrical system will look as if the load is highly resistive instead as reactive.

Think of voltage support as a circus tent. That is what you have when only one capacitor bank is used on the utility system.



Voltage is supported in one place for all customers, with little ability to adapt to changing loads or reactive demand. When this system weakens or fails, the entire system may collapse.

Now consider tens of thousands of reactive compensation units throughout the system. Each is applied by the customer to compensate for their own reactive energy demands. With thousands of supports, or individual tents, the "ceiling" or capacity will be higher, more space available and voltage is supported throughout the entire system. Loss of an individual capacitor or reactive compensation unit has no effect on the overall system, but at most affects only one customer.



Is this difficult to accomplish? I do not think so. The world looks to the USA for ideas and innovation. In this case, it might be good for America to take a look at what the rest of world does for reactive compensation. Here are some examples.

Europe
Minimum power factors from 0.90 to 0.98 plus demand measurement in KVA (basically forces customers toward constant power factor of 1.0). It is interesting to note that the industrial capacitor market is larger in Germany than in the USA.

Brasil
Minimum power factor 0.92

México
Minimum power factor of 0.90 plus rebates for higher power factor

Conclusion
Properly located capacitors, applied close to the load, can reduce kWh consumption by as much as 3 percent. This may sound small but the magnitude of this savings is potentially over 100 billion Megawatts with a value of over $6 billion. For example, a 100 HP motor operating continuously at a rate of US$0.04 per KWH will save US$784.20 dollars in a single year. Furthermore, having achieved a power factor greater than 0.90, a motor or transformer will experience longer life.

So let's think small and correct power factor, and provide reactive energy, where it is needed and then move upstream.