CAPACITOR BANK MONITORING

APPLICATION GUIDE

Introduction

Overhead capacitor banks, while highly effective and useful for reactive power management, are notorious for blowing fuses, creating a less than ideal or imbalanced level of voltage and VAR support. Since many capacitor banks are non-communicating, many utilities are therefore forced to perform manual patrols and inspections of their capacitor assets in order to verify that they are operating in their proper working condition. Without a large investment that enables Supervisory Control and Data Acquisition (SCADA) type communications to the capacitor's controller, these patrols have remained the only option for locating trouble spots.

In a field deployment with one of the largest utilities in North America, Aclara demonstrated that their Grid Monitoring platform provided a much more affordable and effective solution than patrolling lines and looking for blown fuses. By using Aclara's Smart Grid Sensors, utilities can ultimately save money because: 1.) The Aclara platform allows utilities to eliminate the wasted Operations and Maintenance (O&M) dollars spent inspecting overhead distribution capacitor banks. 2.) The Aclara platform is far more affordable than the alternative -- building a full blown SCADA to the capacitor's controller.

The purpose of this Application Guide is to outline the general purpose of the use case for using the platform to monitor capacitor banks so utilities can maximize their savings.

Deployment and Installation

Aclara's Smart Grid Sensors weigh approximately 5.5lbs and are designed for applications on standard distribution size conductors and neutrals. The line sensors can be easily mounted to a bracket and installed on the capacitor bank pole. The design of the bracket is such that the sensor can be removed or replaced without removal of the bracket. A picture of the installation can be found on the next page.

Capacitor Bank Monitoring Application

During normal operations, a three phase overhead distribution capacitor bank can expect to have little to no current flowing through the neutral connection. If a fuse operates, the unbalanced system will now cause current to flow on that neutral. By installing an Aclara sensor to measure the neutral current, utilities can detect the blown fuse events as they happen. This is exponentially much more affordable than a full blown SCADA solution to the capacitor's controller or sending out line patrols.

Instead of using batteries, Aclara's Smart Grid Sensors are inductively powered and will remain in "sleeping mode" until a blown fuse causes an open phase. The sensors use power harvesting technology to charge super capacitors that provide the energy to sense, record, and communicate data. Because they are inductively powered, sensors are a 100% maintenance-free solution once deployed.

Once a fuse blows, the neutral current will cause the power harvesting process to begin. The rate of charge on the super capacitors is dependent upon the amount of current present on the neutral. In testing, the time from initial current flow to first communication of a "Power On" event was less than an hour. For this application, hourly notification was a vast improvement over the typical "business as usual" scenario where the capacitor was allowed to sit for days, months or years before the discovery of the blown fuse.

After the initial "Power On", the sensor begins to report RMS Current values at a pre-determined time interval. This alerts the utility that there is a recent issue at the capacitor and an investigation should be initiated.

Aclara's MV Sensor monitoring a capacitor bank in a field deployment

Enlarged view of sensor.

Above is a photograph of the full installation. Aclara's sensor is installed on the opposite side of the pole from the capacitor, utilizing the bracket seen above. The capacitor's neutral wire is then passed through the sensor to allow for current measurements..

Additional Applications and Benefits

Aclara's line Sensors allow utilities to quickly gain real-time visibility into the grid. In addition to the stand alone capacitor bank monitoring application described above, sensors can be installed on a 3 phase feeder to monitor in near real time: 1.) How many times the capacitor operates and 2.) determine if there is a blown fuse or a bad oil switch, etc. By counting the number of operations, maintenance can be planned based on actual field data rather than time based schedules. When the sensors report an event, an analysis of the associated waveforms will determine if fault current was present, showing a blown fuse, or a bad switch.

Outside of capacitor bank monitoring, sensors are also used for substation monitoring and fault detection. Because the sensors provide highly accurate voltage and current measurements, installing them at the head of the circuit at critical substations can allow utilities to monitor load on circuits, detect faults and locate trouble on the network that could be investigated to prevent outages. A wide variety of utilities are using the Aclara Grid Monitoring platform to: 1.) monitor substations, 2.) monitor load on circuits and 3.) prevent outages; including Duke Energy, DTE Energy, Manitoba Hydro and Western Power Distribution -- you can read more about these case studies by visiting our website.

> "Getting data from the grid through sensors makes business sense. We are now of the mind set to monitor everything"
>
> Vince Dow
> Vice President, Distribution Operations, DTE Energy

Conclusion

Capacitor bank inspection and maintenance is often a large O&M expense for utilities. Additionally, when capacitors sit for months or years with blown fuses, utilities lose additional money by not getting the full voltage and VAR support they intended when they decided to invest in these solutions.

With the installation of the Aclara platform, these costs and expenses can not only be lowered, but the utility can spend their capital asset dollars in a much more efficient manner. With immediate notification of a blown fuse, utilities can limit field visits and take action only when there is an indication of an issue. Finally, by replacing fuses promptly, utilities can continue to take full advantage of the voltage and VAR benefits originally estimated in their capacitor bank investment.