ACS
Advanced Control Systems

Loss Minimization

Description

The Centrix Loss Minimization (LM) application is designed to automatically monitor and control individual switchable capacitor banks in order to minimize overhead feeder losses. Feeder loss minimization is realized by reducing reactive power flows while maintaining voltages and power factors within specified limits.

Centrix utilizes real–time data from feeder RTUs and IEDs, analyzing the prevailing substation and localized conditions and, as necessary, switches the individual capacitor banks of each feeder on or off in order to minimize the feeder's losses. This is performed while maintaining the calculated capacitor bank voltages and power factors within specified limits. LM coordinates its operations with the status of substation load tap-changing transformers (LTCs) and capacitor banks, although these devices may not be controlled by the system.

Centrix executes the LM function periodically at a user-selectable time interval (typically every 30 minutes) and alarms the user whenever a switch fails to operate. LM does not allow unbalanced switching of a capacitor bank to take place if an individual switch should fail; a failed switch causes the capacitor bank to be unavailable to LM. In addition, LM maintains a count of capacitor bank switch operations and will alarm the user when the number of counts exceeds a specified maximum over a specified time interval.

The user may selectively enable or disable monitoring and control of individual capacitor banks, and activate or deactivate the LM function itself. For individual capacitor banks, the user also has the ability to assign voltage limits, adjust switch operation count rates (maximum counts and time intervals), and reset accumulated switch operation counts to zero.

In the LM function, individual capacitor banks are processed on a per feeder basis. Similarly, the ON/OFF control commands to capacitor banks are also grouped based on each feeder. Capacitor banks that belong to a particular feeder are identified through network tracing by using network connectivity and dynamic switch status information.

In the process of capacitor bank control, individually operable capacitors on the feeder are identified by topology tracing from a feeder breaker downstream. Feeder loads are estimated to calculate voltage, branch flows, and power factors. The branch flows at capacitor locations are analyzed to find those capacitors whose branch reactive power exceeds a pre-determined limit. These capacitor banks are sorted in descending order based on their branch reactive power flows. Centrix selects the capacitor with the largest branch reactive power as a LM control candidate. Its impact on voltage and power factor at the capacitor location is calculated and checked against their corresponding limits. If any one of the two constraints is violated, this capacitor bank will be passed over and the next capacitor is processed. Otherwise, Centrix issues a control command to operate this capacitor bank. To prevent unbalance switching of a capacitor bank, Centrix always verifies that no commanded switch operation has failed. If so, this capacitor bank will be disabled for automation. The above process is repeated until no capacitor is found whose branch reactive power exceeds the limit.

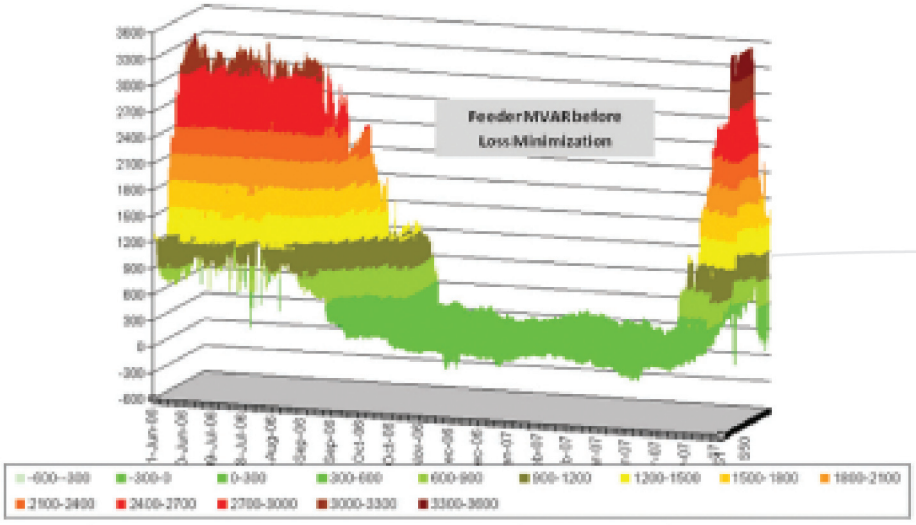
Benefits

- Reduces line losses
- Improves system reliability
- Adapts easily to system configuration changes
- Improves feeder voltage profile
- Improves system capacity
- Defers capital cost
- Reduces O&M expenditures
- Eliminates PF penalties
- Enables Conservation Voltage Reduction (CVR)

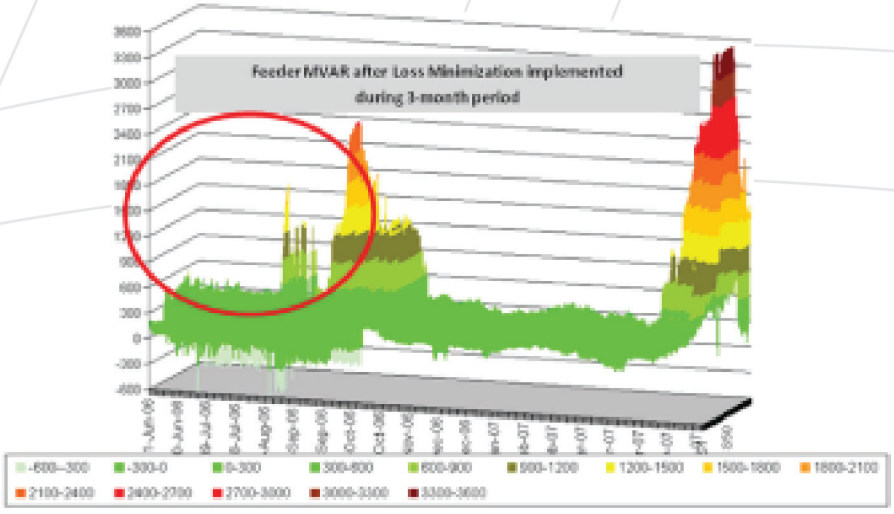
Proven Savings

The graphs on the back of this page show the reduction of feeder MVAR losses for an actual feeder case before and after loss minimization control. The MVAR loss minimization in this actual single feeder case was shown to represent a savings to the utility of $43,500 per year.

Loss Minimization



Annual feeder losses BEFORE implementing Loss Minimization



Annual feeder losses BEFORE implementing Loss Minimization

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