

## TechTopics Topic: Shunt Reactor Switching Applications

Shunt reactors are often used to compensate for the capacitive charging current in unloaded transmission lines. Shunt reactors may be connected directly to the line, but such application is relatively infrequent. More often, they are connected to the tertiary winding of a transformer, when compensation of a high voltage ( $\geq 115$  kV) line is required. Reactors are used to compensate for line capacitance when the line is lightly loaded, and are typically switched out as the load increases. Because the amount of compensation needed varies with loading on the line, shunt reactors are typically switched daily. The circuit breaker used for shunt reactor switching will thus experience a large number of operations.

The typical parameters associated with shunt reactor switching are these:

Current:	Up to 2000A
Power Factor:	15% lagging
Remarks:	During opening operations, multiple reignitions can excite resonant oscillations in the reactor coil.  For reactor currents of less than 600A high stresses can result from virtual current chopping.

The high rate of rise of recovery voltage during opening interruptions makes this a very difficult switching duty for historic interruption technologies, such as air magnetic circuit breakers. Vacuum circuit breakers are well suited to switching duties with high rate of rise of recovery voltage. Vacuum circuit breakers also require very little maintenance for the high number of operations.

Shunt reactors are somewhat like open circuit transformers, but they normally have a much lower value of inductance. The lower inductance results in a lower value of surge impedance. Therefore, they are less vulnerable to damage resulting from current chopping. However, if multiple reignitions occur, these can excite resonant oscillations in the reactor coil.

Because of the possibility of exciting resonances when multiple reignitions occur, we recommend that all shunt reactor applications incorporate a custom-engineered overvoltage protection circuit. The components of the overvoltage protection devices must always be individually matched to the network characteristics in order to assure proper protection. The circuit should include an RC-circuit to prevent resonant harmonics in the reactor coil. In addition, surge arrestors located at the reactor are recommended if the reactor current is 600A or less.

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