Current-limiting reactors (CLR) are placed in series with capacitor banks to limit the rate of rise of current to the values specified in the circuit breaker standards. But this arrangement has created circuit breaker failures when attempting to clear faults in between the reactor and the capacitor bank, due to high rate of rise of recovery voltage (RRRV) on the CLR side of the circuit breakers. The North America Electric Reliability Council (NERC) has issued an advisory directing utilities to evaluate the CLR installations on capacitor banks. Present mitigation methods are costly and must be redesigned when there is grid expansion. The high TRV problem is analyzed and a novel protection package is designed to overcome present deficiencies.

After detailed analysis of circuit breaker failures, two methods of TRV mitigation have been proposed by researchers, a) Add a surge capacitor to ground on the capacitor bank side of the breaker, and b) Add a surge capacitor across the reactor. A novel and simplified technique of surge capacitor calculation technique based on method b) is proposed and analyzed. The proposed calculation technique is independent of stray capacitances and thus eliminates uncertainties associated with them. The circuit breaker short circuit current rating is used which helps in avoiding costly design changes up on grid expansion. The proposed technique is extended to define a standardized protection package design for present and future installations.

The proposed calculation technique and the protection package design are validated for system voltage ratings of up to 161-kV and circuit breaker short-circuit current ratings of 63-kA and parameter sensitivity analysis performed. Standardized protection package is specified with 15.3-kV MCOV surge arrester, 22.8-kV 50-kVAr surge capacitors for CLRs up to 1 mH and fault current of 63-kA. A step-by-step protection package selection procedure based on look-up tables is created for new standard and non-standard CLR installations and for retrofitting of the existing installations. A paper detailing the design procedure and along with recommendations for possible addition to the circuit breaker standards has been submitted to IEEE.