Chapter 26

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SMART SWITCH CONCEPTS

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1. Introduction of Smart Switch

The change of operating conditions by putting on of the Switch or initiation of emergency conditions (faulted circuit) is accompanied with transient processes. The physical nature of a transient process is redistribution of the stored energy between inductive and capacitive network elements. In some cases, opening of the Switch may induce high frequency overvoltage, while closing may cause high inrush currents, and emergency conditions may initiate overcurrent. These have a negative influence on electrical parameters of the network and cause the accelerated equipment deterioration. Here in this chapter a Smart Switch is being described where all these could be avoided by smart switching. It involves serial switching of each phase according to the developed algorithm at the instant of current or voltage zero crossing. Such switching allows eliminating dangerous inrush currents and overvoltage and increasing the switching life of the equipment. Smart switching is efficient under normal operating conditions both at Smart Switch closing, and at opening. Smart closing of a reactive load by a Switch allows minimizing inrush currents, while Smart opening reduces the probability for restrikes and overvoltage generation. Smart opening of

faulted currents gives a possibility to reduce time of arcing to minimal values, which provides decreasing the electrical erosion of an arc-extinguishing device and increasing the switch lifetime. In the present scenario after fault, switches take 2 to 3 power cycles for opening the faulted circuit. By smart opening, it improves power quality parameters, increases the lifetime of the power equipment and enhances switching capabilities of a normal switch, that's Smart Switch.

Currently Circuit Breaker (CB) is being used as **Load Break Switch** in medium voltage networks as making and breaking current at normal conditions. Circuit Breakers are characterized by longer life, high reliability, simple construction and reduced service costs. Along with positive operating features, circuit breakers, however, have some disadvantages: during CB switching operations (opening and closing), dangerous overvoltage and inrush currents usually generated. According to the investigations [3], active implementation of Smart Switches in 33 kV networks of utility resulted in the increase of single phase-to-ground faults caused by switching overvoltage. Switching operation may cause the following unfavorable processes: prestrikes at Switch closing, current chopping before the natural zero crossing, restrikes at Switch opening caused by insufficient electrical strength of a contact gap just after the arc extinction. These processes may increase overvoltage levels and probability of their occurrence.

Current chopping is typical for circuit breakers with any arc-extinguishing medium (i. e., live-tank oil, vacuum, SF6). Current chopping causes a release of the energy stored in the magnetic field of inductances and concentrated at capacitor plates [4]. Levels of overvoltage at current chopping are influenced by the value of the chopping current, the load inductance (or power) and the feeder capacitance (i. e., the length of an overhead or a cable line). Prestrikes may also induce overvoltage which are dangerous for the equipment. The number of prestrikes and overvoltage levels are determined by the character of the electric strength changing between closing contacts and the ability of a circuit breaker/Switch to extinguish high-frequency currents [4]. Arc reigniting in a Switch with a good contact material may occur because of the low dielectric strength across a contact gap after arc quenching that corresponds to a small distance between the contacts. The further process development depends on the possibility of arc quenching. An arc