The Brittleness of a Non-Reconfigurable Distribution Network Topology Approach

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Abstract:
Terminal distribution substations are central to system average interruption frequency index (SAIFI) and system average interruption duration index (SAIDI), as it is estimated that approximately 85% of the customer interruptions are due to failure at the distribution network. Enhancing resiliency within a distribution network typically centers upon the ability to switch to backup distribution feeders. The involved architectures typically involve distinct and disparate feeders connected through normally open tie switches, but the switches can be closed to allow certain interrupted customers to be temporarily transferred to adjacent feeders during outages. This paradigm is known as feeder reconfiguration (FRC), and it is a real-time operational control process within the overarching rubric of distribution automation; in this way, a distribution system can be reconfigured by closing tie (normally-open) switches (to re- energize healthy segments) and opening sectionalizing (normally-closed) switches (to isolate faulty segments). Obviously, the greater the numbers of switches, the greater the possibilities for reconfiguration and resiliency. The principal advantage of FRC is that the opening and closing of switching devices does not typically result in additional costs for distribution utilities. FRC can also be accelerated, via robust Fault detection, isolation, and service restoration (FDIR), which segues to the use of advanced distribution management systems (ADMS). ADMS can leverage artificial intelligence to detect and classify problems (e.g. incorrect load voltage profile, excessive technical power loss, phase voltage and current imbalances overloading of transformers and cables) quickly and accurately within the distribution network and restore services in a shorter period of time. Ironically, certain specious approaches to distribution system and terminal distribution substation "resiliency" do not incorporate robust FRC, do not add a greater number of switches, ...

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