Distribution power management control system

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In recent years, utilization of electrical energy increased exponentially and customer requirement and quality definitions of power were changed enormously. As electric energy became an essential part of daily life, its optimal usage and reliability became important. Real-time network view and dynamic decisions have become instrumental for optimizing resources and managing demands, leading to the need for distribution management systems in large-scale electrical networks.

In parallel with this, distribution utilities began to roll out Supervisory Control and Data Acquisition (SCADA) systems, initially only at their higher voltage substations. Over time, use of SCADA has progressively extended downwards to sites at lower voltage levels.

The typical data flow in a DMS has the SCADA system, the Information Storage & Retrieval (ISR) system, Communication (COM) Servers, Front-End Processors (FEPs) & Field Remote Terminal Units (FRTUs).

The network component/connectivity model, and associated diagrams, must always be kept absolutely up to date. The switching schedule facility therefore also allows "patches" to the network model to be applied to the live version at the appropriate stage(s) of the jobs. The term "patch" is derived from the method previously used to maintain the wallboard diagrams.

Due to the nonlinear nature of this problem, numerical methods are employed to obtain a solution that is within an acceptable tolerance. The load model needs to automatically calculate loads to match telemeter or forecasted feeder currents. It utilises customer type, load profiles and other information to properly distribute the load to each individual distribution transformer. Load-flow or Power flow studies are important for planning future expansion of power systems as well as in determining the best operation of existing systems.

Volt-VAR Control or VVC refers to the process of managing voltage levels and reactive power (VAR) throughout the power distribution systems. These two quantities are related, because as reactive power flows over an inductive line (and all lines have some inductance) that line sees a voltage drop. VVC encompasses devices that purposely inject reactive power into the grid to alter the size of that voltage drop, in addition to equipment that more directly controls voltage.

Electric Distribution Systems have long stretches of transmission line, multiple injection points and fluctuating consumer demand. These features are inherently vulnerable to instabilities or unpredicted system conditions that may lead to critical failure. Instability usually arises from power system oscillations due to faults, peak deficit or protection failures. Distribution load shedding and restoration schemes play a vital role in emergency operation and control in any utility.

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DMS needs to provide a modular automated load shedding & restoration application which automates emergency operation & control requirements for any utility. The application should cover various activities like Under Frequency Load Shedding (UFLS), limit violation and time of day based load shedding schemes which are usually performed by the operator.

Reliability and quality of power supply are key parameters which need to be ensured by any utility. Reduced outage time duration to customer, shall improve over all utility reliability indices hence FMSR or automated switching applications plays an important role. The two main features required by a FMSR are: Switching management & Suggested switching plan

The DMS application receives faults information from the SCADA system and processes the same for identification of faults and on running switching management application; the results are converted to action plans by the applications. The action plan includes switching ON/OFF the automatic load break switches / RMUs/Sectionalizer . The action plan can be verified in study mode provided by the functionality . The switching management can be manual/automatic based on the configuration.

On a similar note, Feeder Reconfiguration is also used for loss minimization. Due to several network and operational constraints utility network may be operated to its maximum capability without knowing its consequences of losses occurring. The overall energy losses and revenue losses due to these operations shall be minimized for effective operation. The DMS application utilizes switching management application for this, the losses minimization problem is solved by the optimal power flow algorithm and switching plans are created similar to above function

Distribution Load Forecasting (DLF) provides a structured interface for creating, managing and analyzing load forecasts. Accurate models for electric power load forecasting are essential to the operation and planning of a utility company. DLF helps an electric utility to make important decisions including decisions on purchasing electric power, load switching, as well as infrastructure development.