Power distribution management 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.

Most distribution utilities have been comprehensively using IT solutions through their Outage Management System (OMS) that makes use of other systems like Customer Information System (CIS), Geographical Information System (GIS) and Interactive Voice Response System (IVRS). An outage management system has a network component/connectivity model of the distribution system. By combining the locations of outage calls from customers with knowledge of the locations of the protection devices (such as circuit breakers) on the network, a rule engine is used to predict the locations of outages. Based on this, restoration activities are charted out and the crew is dispatched for the same.

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).

In order to support proper decision making and O& M activities, DMS solutions should support the following functions:

The various sub functions of the same, carried out by the DMS are listed below:-

In territories such as the UK a core function of a DMS has always been to support safe switching and work on the networks. Control engineers prepare switching schedules to isolate and make safe a section of network before work is carried out, and the DMS validates these schedules using its network model. Switching schedules can combine telecontrolled and manual (on-site) switching operations. When the required section has been made safe, the DMS allows a Permit To Work (PTW) document to be issued. After its cancellation when the work has been finished, the switching schedule then facilitates restoration of the normal running arrangements. Switching components can also be tagged to reflect any Operational Restrictions that are in

force.

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.

The state estimator is an integral part of the overall monitoring and control systems for transmission networks. It is mainly aimed at providing a reliable estimate of the system voltages. This information from the state estimator flows to control centers and database servers across the network.[1] The variables of interest are indicative of parameters like margins to operating limits, health of equipment and required operator action. State estimators allow the calculation of these variables of interest with high confidence despite the facts that the measurements may be corrupted by noise, or could be missing or inaccurate.

Even though we may not be able to directly observe the state, it can be inferred from a scan of measurements which are assumed to be synchronized. The algorithms need to allow for the fact that presence of noise might skew the measurements. In a typical power system, the State is quasi-static. The time constants are sufficiently fast so that system dynamics decay away quickly (with respect to measurement frequency). The system appears to be progressing through a sequence of static states that are driven by various parameters like changes in load profile. The inputs of the state estimator can be given to various applications like Load Flow Analysis, Contingency Analysis, and other applications.