Distribution Automation - A Utility Perspective

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Summary

A project entitled Intelligent Distribution Automation (IDA) is performed within the Sydkraft group. The aim of the project is to develop and demonstrate DA/DSM applications using power line communication and using other technologies under development.

The paper and presentation describes why the Sydkraft group is interested in DA/DSM and the project goals from the utility perspective. The paper also presents the different parts of the IDA project.

The presentation will in particular focus on issues concerning Distribution Automation.

What is Distribution Automation

Distribution Automation could be defined as a system that enables an electric utility to remotely monitor, coordinate and control components in the power system in a real-time mode from remote locations, as well as autonomous control.

The most promising functions of such a system include network supervision and control, voltage and reactive power control, feeder switching and sectionalising, protection functions, load control and remote meter reading.
Among other, EPRI has tried to define Distribution Automation and they suggests that it is defined as:

An integrated systems concept for the digital automation of distribution substations, feeders, and user functions. The concept includes control, monitoring, and protection of the distribution system as well as load management and remote metering of customer loads.

My interpretation of this definition is that Distribution Automation means utilising of modern technology in order to enhance reliability and increase efficiency of the power distribution system. It also includes the interaction between the distribution and transmission systems as well as the interaction between the distribution system and the customers.

Why are Sydkraft interested in DA/DSM

The interest in DA/DSM for Malmö Energi/Sydkraft could be described in the following points:

Observability and Controllability of the distribution system are of importance in order to getting better knowledge of network status and behavior, and in order to get better input data for planning of investments, reinforcements and maintenance.

A higher degree of Automation in the distribution system will lower costs of operation and will increase power quality from the customer's point of view.

Regarding Customer focus, the development of new products and adding value to customer services are important in order to maintain and increase the number of customers on a deregulated electricity market. New products could be more flexible tariffs “real time pricing”, local load control, customer display, etc. Examples of adding value could be more accurate billing, statistics, consulting in order to help the customer make efficient use of the electricity.

Finally, regarding Efficiency, it is not obvious why a network owner should be interested in efficiency, but in Sweden there are two main reasons. Firstly the Board for supervision of the electricity market is interested in increasing the efficiency of the power companies. Secondly it is to some extent possible for network owners in Sweden to earn money if it is made by increasing efficiency. It is also possible to achieve better cash flow with the aid of DA/DSM activities.

An other point of interest is what problems could arise when performing such a project and why it is rather difficult to move into a commercial and large-scale implementation of modern DA/DSM technology.
Some of the key issues addressing these problems are, in my opinion that:

**The cost of DA/DSM investments are still high.** The necessary components are still manufactured in rather small series, which lead to high costs. The development costs are also high. The necessary equipment for interfacing computers and electronics to the power system are also expensive, due to safety, EMC protection and so on. Components as computers and electronics are rather cheap. The key solution to this problem is to find different users of such a system who all could contribute to the costs, for example cost sharing between power network applications, customer applications, district heating applications, applications for municipal services, etc.

**The complexity and geographical distribution of the power distribution system** create problems concerning communication and data handling of large, distributed computer systems. These problems are not simple in systems with say about 10 000 distributed PC computers both in customer premises and in substations. Sydkraft have separate research projects analysing these problems.

**There is problems in evaluating benefits of DA/DSM.** The qualification of improved network supervision is difficult without advance knowledge of the free capacity or physical limits that can be detected with such a supervision. Furthermore, strategic benefits such as increased customer knowledge, are also difficult to quantify, but they have to be quantified and taken into consideration.

Use of a DA/DSM system concept will also affect the organisational structure of the distribution company. It will be possible to work more decentralised and will lead to that decisions concerning network planning and operation will be made faster and with higher accuracy. It will also be possible to improve cash-flow. To fully calculate the benefits of these strategic improvements is difficult.

**The IDA project**

IDA is the name of Sydkraft’s DA/DSM project. It started late 1993 and deals both with Distribution Automation as well as with DSM and customer applications.

The project is organized in different field test sites which are coordinated and partly financed by R&D Dept in Sydkraft.

During 1994, initial development and laboratory test were performed. The project continued during 1995 with field test of initial system design. Cooperation with IBM were established in 1995 in order to improve system design and to manufacture necessary equipment. Since late 1995, test of IBM equipment and improvement of field test equipment has been made.

A short description of the different field test sites:
Test Site Malmö Energi

In Malmö, the following are of interest:
- Distribution Automation in urban electricity distribution networks, mv and lv networks. Automation of secondary substations and mv networks are performed.
- Automatic meter reading of customer meters
- Measuring of Power Quality at customer sites
- DA used for planning and maintenance on demand
- Customer applications, especially Building Automation
- Cost/Benefit analysis

Test Site Blekinge

In Blekinge, the following are of interest:
- Load control used for resolving of problems in mv network. Load control is made by controlling customer’s electrical boilers.
- Substation control, primary substations
- Test of GSM communication
- Automatic meter reading of customer meters
- Customer Applications, as flexible tariffs and pricing

Test Site Österlen

Consists of the following parts:
- Fault location and sectionalizing of fault in overhead mv networks
- Automatic restoration of service in overhead mv networks
- Substation control, both primary and secondary substations
- Coordinated control of cascaded tap-changers
- Test of GSM communication
- Automatic meter reading of customer meters
- Customer Applications, as flexible tariffs and pricing

Natural gas/District heating distribution Applications

This part of the IDA project consists of a number of different smaller test site which demonstrates the following:

- Control of local production and distribution of district heating, mostly natural gas fired plants.
- Control of local natural gas distribution networks.

Application development

This parts of the IDA project are responsible for development of new applications, both on the customer level and on the computer systems level.
These project parts act as development groups, and their aim are to keep the technological knowledge on a high level as well as develop new functions responding to market needs.

Conclusions

In this presentation, a broad overview of the reasons for Sydkraft to participate in development of DA/DSM concepts based on power-line communication, is given.

Distribution Automation as the broad concept presented here is a rather new concept. Thus its implementation requires careful planning and evaluation. Changes and improvements have to be made step-wise and evaluated continuously. At the same time, the concept demands that DA/DSM systems is viewed as a whole and that the strategic goals are pursued efficiently, as well as to ensure that the system concept have a high degree of flexibility in order to meet future needs.