SATEC
Powerful Solutions

APPLICATION NOTE:

MONITORING MV DISTRIBUTION NETWORK

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Smart grid is an electrical network that allows bi-directional energy supply (rather than supplier to consumer only), receiving real time information and performing actions based on the information, in order to improve the reliability and security of the grid, power quality enhancement, reduction of network losses and managing the demands. These objectives can be achieved by controlling the active and reactive power, fast detection of faults and their location, voltage control and detection of illegal use of electricity. More and more resources around the world are invested in the smart grid in various areas from managed power plants, digital substations (including IEC 61850 communication protocol), controlling the distribution lines and transformers and down to the electricity consumer. This article will explore new technology to monitor medium (up to 35kV) voltage distribution network that is being implemented around the world.

The Technology

Cooperation between SATEC Ltd. from Israel and Lindsey Manufacturing Co. from the US provides a complete solution that includes the following components:

- Smart isolators that includes voltage and current sensors that replace the existing isolators and can be installed without cable cutouts or voltage disconnection. Figure 1 shows the isolator and its connection to the wires.

Figure 1: Smart Isolator

- Measurement cabinet which is installed on electricity pole that includes advanced power quality analyzer model SATEC PM175 which was specially adapted to the smart isolators, remote display for maximum safety and cellular modem for remote retrieval of the information (figure 2).

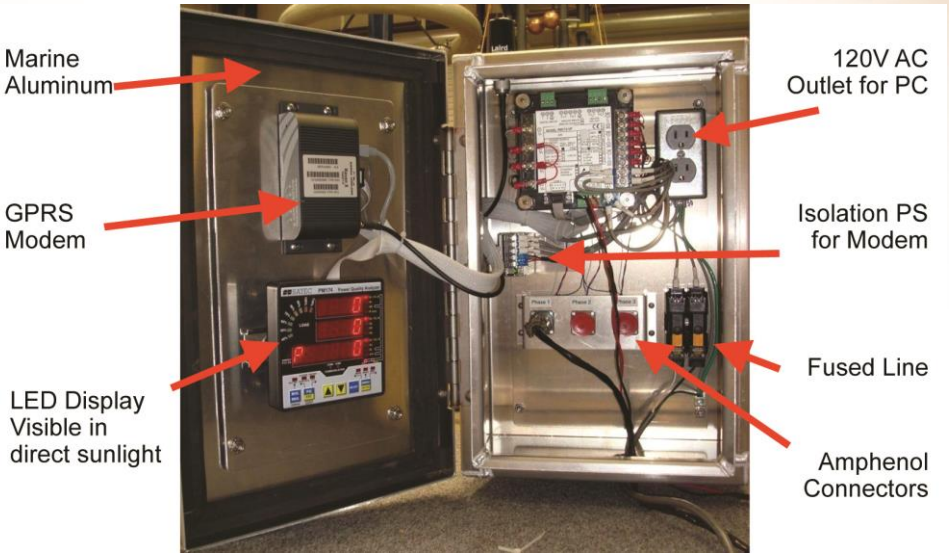

Figure 2: Measurement Cabinet

The technology has many important advantages, including:

High Accuracy

The sensor is based on resistor, which provides accurate measurement through the entire spectrum. Figure 3 compares the frequency response of the sensor and conventional transformer. As a result, the measurement system does not get saturated or resonant, which is extremely important during fault conditions. The SATEC PM175 includes multi dimensional calibration points (amplitude, frequency etc.), which provides 4 times better accuracy than the sensors itself and is very important for energy management.
Conventional power transformers get resonant at relatively low frequency. For example, the PT at figure 3 resonant at 1.2kHz, which is the 24th harmony. For power quality monitoring, measuring of harmonics is important and resonance at low frequencies does not allow correct measurement of harmonics. This makes the smart sensor one of the only solutions to correctly monitor compliance to EN50160 standard.

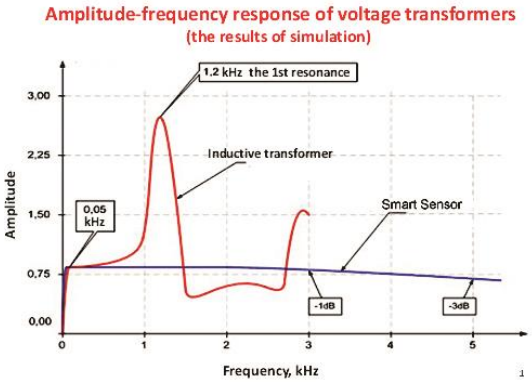

Figure 3: Comparing frequency response of smart sensor and conventional PT

Live installation

The isolators can be installed without cable cutouts or electricity disconnection, which makes the installation simple, quick and low cost. Figure 4 shows the system installation, which takes less than an hour following a short technicians' training.

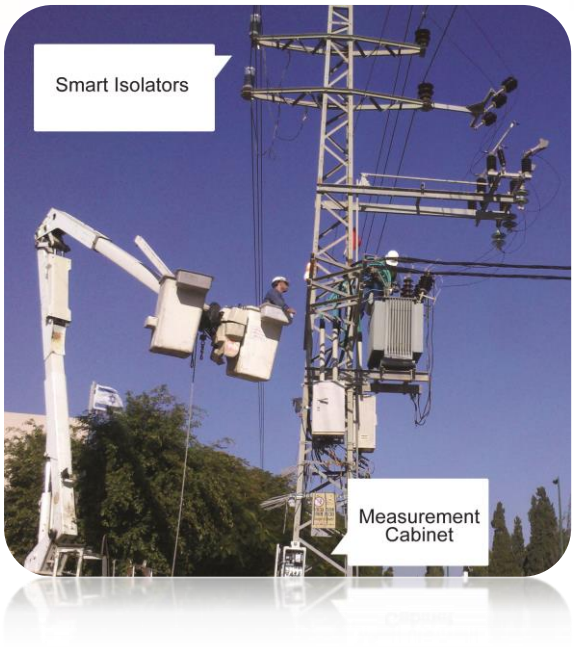

Figure 4 – Live Installation

Measurement & Logging

Measurement and precise logging of over 100 parameters of power, energy, harmonics, power quality and other events including waveforms and accurate time stamps.

Universal Solution

Universal solution that allows local and remote control - cellular communication for remote access with local display and backup in case that the cellular link is down.

Benefits

This technological solution fulfills wide needs of the electric utility:

- Demand response, by utilizing effective energy management
- Improvement of the network reliability and security
- Real time detection of faults and fast revealing of their location
- Monitoring and improvement of power quality
- Detection and prevention of non technical losses
- Reactive energy and voltage level management using reactive power control

Examples

The complete solution is being installed around the world by more and more utilities, as a key building block in the implementation of smart grid. Figure 5 shows an installation by Progress Energy in North Carolina, in which the project includes few thousand measurement cabinets and over ten thousand isolators. Immediately after the installation, the utility was able to optimize the way that the reactive energy is managed and to significantly reduce the network losses. This problem caused significant losses and the change saved a lot of money, which alone can justify the whole cost of the system.

Figure 5: North Carolina Installation

A recent project on 22kV network was installed in the middle-east, focusing on power quality. It allows monitoring the power quality in parallel to the network operation. All the information is sent to web based energy management software named ExpertPower, which gives maximum flexibility and ease of use. Figure 6 shows the waveform of 2 consecutive voltage drops which were logged by the system while figure 7 presents the RMS plot during these drops (the voltage was as low as 6.8kW on a 22kV network). The RMS plot calculates the RMS for each sample, which allows easy analysis of the faults.

Another system from SATEC Ltd., which is based on the most advanced power quality analyzer and revenue meter available on the market – EM920 (its European version is EM720), was introduced in T&D World magazine (July 2012) is utilized to manage the reactive energy and voltage control. Rather than the traditional use of tap changes in the transformers in order to control the voltage level, BG&E (the utility) switches power factor capacitors in order to optimize the voltage level and reduce the network losses.

Figure 6 – waveforms of voltage drops

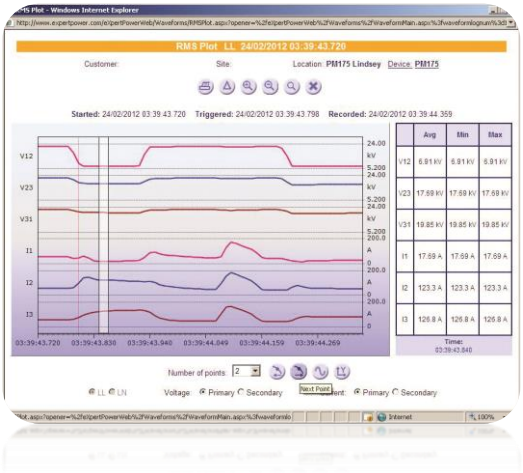

Figure 7 – RMS plot of voltage drops

Summary

The distribution network is critical part of the electrical network and investment in their management tools provides significant advantages. Utilities around the world know that by monitoring and control of distribution network it is possible to gain huge saving in the operation, energy efficiency, improved demand response, reduction of non-technical losses, improved network security and power quality as well as real time fault detection and location. The investment in the distribution network is much more cost effective than implementing smart grid technologies at the consumer level thanks to lower investment from one side and higher benefit from the other side.

About SATEC

SATEC Ltd. is a world leader in the fields of energy management and power quality monitoring. The 25 year old company has offices in the US, Spain, Israel, Japan, China and Australia and over 100 representatives around the world. Over quarter of a Million meters and power quality analyzers are installed around the globe. The company focuses only on energy management and power quality monitoring, which enable to provide the widest range of solutions from simple power meters to comprehensive bay controllers to substations with IEC 61850 communication.

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