



Smart Distribution Protection

The Smart Grid is now on the front pages of the newspapers. But if you ask different people what it is – you will always get a different answer. I think that **a grid is smart when everything that is required to protect, control and monitor it is performed in a smart way.**

The protection of distribution systems in the last century (and in many places still today) was very simple and diverse in different parts of the world. I remember when I started my career as a protection engineer many years ago that we used on some distribution feeders three electromechanical relays – two for phase overcurrent protection and one for ground. The logic, as explained to me at the time, was that any phase-to-phase fault will involve at least one of the two relays and if it is a phase-to-ground fault – it will be detected by the ground overcurrent relay. Since there was only one source, the relays did not have to be directional - so no need for voltage inputs either. The fault clearing time was not a big concern, as well as the time intervals and number of shots during multi-shot reclosing sequences.

The protection of distribution buses was based on the use of overcurrent relays located on the transformers connected to the distribution system. Considering the requirements for coordination of these relays with the feeder protection relays, it is clear that the time it will take to trip the breaker may be quite long, exposing the loads connected to the distribution system to voltage sags and swells with significant duration. But this was not a big deal – maybe the lights in homes or offices will dim for awhile. High speed fault

clearing was a requirement for the transmission system.

If there was a system disturbance – an underfrequency relay will trip a fixed group of distribution feeders, regardless of the load on each of them. And if we think about the settings of all these relays – they were based on the worst case scenario, making the setting process more art than science.

Well, these were the good old days. Today we live in a different century and in a different world. The sensitivity of computers and computer controlled processes to voltage variations and their duration is changing the requirements for fault clearing times and making them closer to the ones for transmission protection devices. The use of microprocessor based multifunctional intelligent electronic devices as the typical distribution protection relays, combined with the need for improvements in their performance is pushing protection specialists towards optimization of distribution protection. This is the reason to select this as the subject of the cover story in this issue of the magazine.

In order to meet the requirements for improved performance of the distribution system protection it is important to understand the changes in the distribution systems and the protection technology:

- The availability of distributed energy resources of different types that have different short circuit current contributions and require the use of directional protection relays

- The impact of changes in the topology of the electric power system on the distribution protection relays that requires the implementation of adaptive protection

- The need for high-speed protection for faults on distribution buses

- The functions available in microprocessor based relays that can be used to optimize the protection of distribution systems

All these issues are discussed in several articles and covered in industry reports and standards referenced in this edition of the magazine.

Even though the concepts of Main 1 and Main 2 are more relevant to transmission line protection, some of the arguments in the article covering this subject can also help distribution protection specialists in the definition of their protection philosophy.

With all the talk about the Smart Grid of the future, the articles in this issue of the magazine demonstrate that we have all the tools to make the protection of the distribution system smart as well. To achieve it we need to have the vision and take the action.

"Vision without action is a daydream. Action without vision is a nightmare."

Japanese proverb