PUBLISHED ARTICLE

Best Recloser for Distribution Networks

BACKGROUND

Many countries rely on diesel generation, coal, or hydropower to generate electricity. However, these generation methods aren't keeping up with demand due to urbanization, a growing middle class, electrification of heating sectors, electric vehicles, and heat pumps. While prices for energy haven't risen at the same rate as in other countries, it does contribute to a rise in inflation.

As the demand for electricity continues to rise, there is a growing expectation for reliable service, particularly in rural areas that often have limited access to electricity. However, the challenge of achieving uniformity in system upgrades is compounded by an aging infrastructure and the lack of conformity between regulatory bodies across different countries. In order to meet the increasing demand, countries are investing in solar and wind power, although these renewable sources still make up a relatively small percentage of overall generation.

The power distribution component market is currently undergoing significant expansion, primarily driven by the implementation of automation devices. These devices play a crucial role in regulating the distribution of electrical energy to various types of equipment. Moreover, there is a growing trend of integrating these components into high-voltage generation and industrial distribution networks. Additionally, the rising demand for transmission and distribution control systems is further enhancing the efficiency of the overall distribution process.

Fault Protection in Distributed Generation Networks

Due to urbanization and energy demand growing, power distribution companies are moving from centralized and conventional networks to decentralized networks requiring advanced control systems, distribution components, sensors, reclosers, switchgears, and software to monitor the network. The systems improve reliability by detecting faults, identifying the fault location, and restoring power quickly.

Faults in distribution networks are caused by various factors such as increased demand, environment, animals, and weather. The duration of these outages varies depending on the cause and location of the fault. Locating the fault is crucial for resolving the issue and restoring power.

More distributed generation can add additional fault current to the system and change the fault levels detected by relay protective devices. It is important to ensure equipment is sized to handle this additional current. Additionally, adjustments to pick-up current, time delay, and trip current values enable the fast curve to be utilized to meet specific distribution system needs, enabling efficient fault detection and restoration.

Distributed generation also presents other considerations for fault current level in distribution feeder protection. Some of these topics are presented to the right.

Reverse Power Flow: Fluctuations in fault current can cause power to flow in unintended directions, requiring protection schemes to account for reverse power flow and ensure coordination.

False Tripping: Variations in fault current can lead to false tripping, where protective devices interrupt power unnecessarily. Protection settings should be carefully adjusted to prevent false tripping while maintaining effective fault detection.

Blind Areas: Changes in fault current can create blind areas where fault detection and localization become challenging, potentially delaying isolation and restoration efforts.

Islanding: Fault current fluctuations can contribute to islanding, where a portion of the distribution system becomes electrically isolated. This poses safety risks and hinders system restoration.

Non-Synchronized Reclosing: Fault current level changes can disrupt the synchronization of reclosing operations, impacting restoration attempts and potentially causing further damage.

Additionally, multiple ground current paths can cause grounding problems, resulting in uneven fault current distribution and fault detection and mitigation challenges. Proper grounding design and coordination are essential for a safe and reliable electrical distribution system.

Distributed Generation and Radial Network Protection Systems

In the context of integrated distributed generation and radial networks, the accurate coordination of the recloser and fuse becomes an even greater challenge. In a radial network, it is crucial to ensure precise timing between the operation of the fuse and the recloser. Specifically, during the occurrence of a fault current, the recloser should detect the fault before the fuse after the recloser's fast curve but before its slow curve. When a fuse is combined with a recloser there is a risk that the fuse senses the fault current first and triggers prior to the recloser. When a distributed generation network is connected to a radial distribution feeder, this coordination between the fuse and recloser may be disrupted. This can be attributed to several factors:

- The fault current detected by the fuse may exceed that detected by the recloser, causing the fuse to operate before the recloser.
- False tripping may occur, wherein the protective devices trip due to a transient fault rather than a permanent fault.

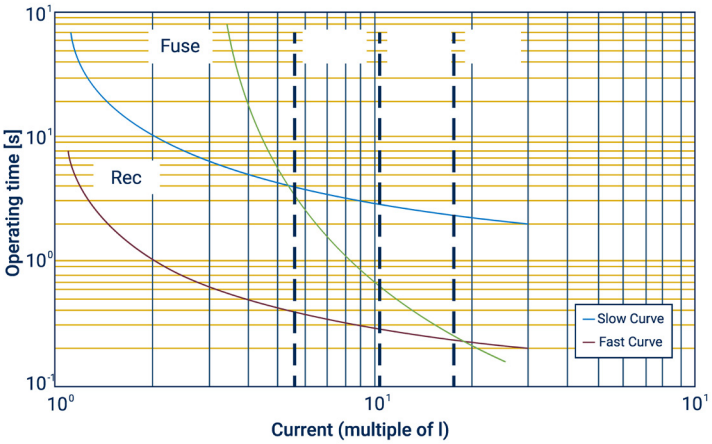

Fig. 1 – Fuse-Recloser coordination curves

These factors contribute to the complexity and potential difficulties faced when integrating distribute generation into radial networks, particularly with regards to maintaining accurate fuse-recloser coordination.

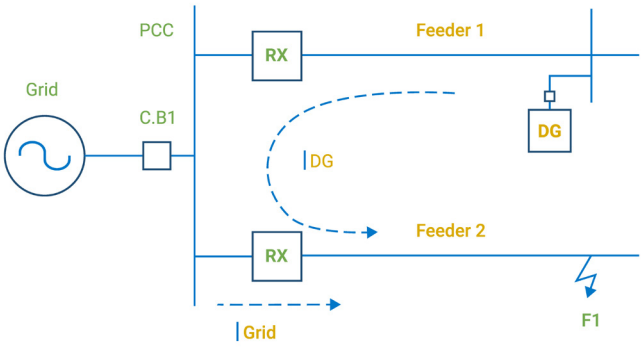

Fig. 2 – Example of possible false tripping due to a fault on another feeder

The integration of distributed generation with a radial feeder disrupts traditional protection coordination. Distributed generation introduces bi-directional power flow, impacting the coordination of protection devices and creating blind spots. It also decreases network stability and reliability, requiring changes in topology and protection arrangements. This process is complex, tedious, and expensive.

Advanced protection schemes and technologies are necessary to address these challenges and ensure reliable power system operation.

Recommended Solutions

Power generation companies vary in size and distribution networks. No matter the size of the distribution network, countries are looking for affordable, low-maintenance equipment that is proven and reliable.

One effective and affordable solution is utilizing modern reclosers to cover blind spots and improve protection in distribution networks with distributed generation. Extensive research and simulations have shown that strategically placing reclosers along feeders can enhance network reliability by addressing blind spots.

Modern reclosers offer faster operation compared to over-current relays, making them an ideal choice for improving network protection.

Recommended Solution – Technical Considerations

Reclosers have two main functions: providing over-current protection and ensuring reliability. Additionally, they have the capability to trip and reclose, effectively handling temporary faults. In traditional radial feeders, reclosers are designed to detect unidirectional current flow.

However, the integration of distributed generation in radial feeders alters the fault point impedance, necessitating the optimal placement of reclosers and adjustment of their settings.

Research findings indicate that as fault point impedance increases, the operating time of the protective relay also increases, leading to a blind area for the substation over-current relay. In contrast, the recloser's curve setting enables it to close faster than the feeder's over-current relay curve, allowing the recloser to operate more quickly. As a result, the recloser provides protection in areas that may be invisible to the substation's over-current relays. Furthermore, the recloser enhances feeder reliability by significantly reducing total outages.

Selecting the Right Recloser

Considering the requirements and pricing for the radial feeders most reclosers are designed for larger networks with SCADA integration. However, one standout option that satisfies the basic requirements, technical capabilities, and economic value is the Teros® recloser by G&W Electric.

The Teros recloser features a simplified mechanism with integrated sensors, making it ideal for distribution automation applications. Its modular platform enables quick and easy servicing. Additional benefits include a viewing window for clear visibility of the indicator, integration of 6 voltage sensors for site readiness, a modular layout for efficient servicing, standardized higher creepage modules, and a sealed mechanism for reduced damage risk.

The Teros recloser offers high-speed clearing of temporary faults and radial overcurrent protection. It provides enhanced reliability through sectionalizing, load break switching, and open tie points. The system can be seamlessly integrated with the controller through reconfiguration, automatic transfers, and compatibility with GE R650 or Ingeteam INGEPAC™ DA PT5 relay controls. Moreover, it offers options for alley-arm, cross-arm, or substation installations.

Teros Recloser Offers the Best Economic Value

A power distribution company must carefully manage its investment in the distribution network while ensuring system reliability and customer satisfaction. Finding the right balance between costs and benefits is crucial for optimal performance.

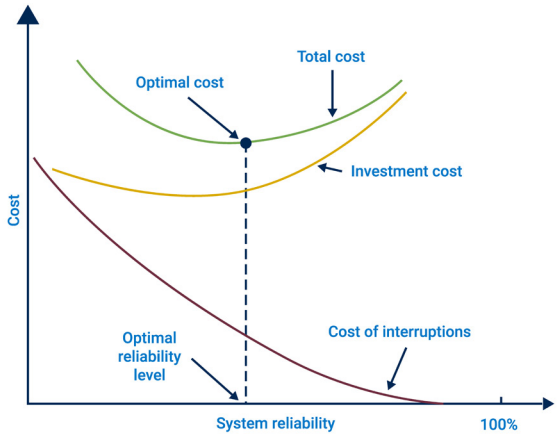

Fig. 4 – Cost versus system reliability

To achieve the best investment in protecting a radial feeder, it is recommended to install a recloser at the midpoint of the feeder if the load is uniformly distributed. This placement would result in an approximate 50% improvement in reliability for customers located upstream from the recloser.

Similarly, if two reclosers are installed, they should be positioned at one-third and two-thirds of the feeder length for optimal investment.

Finding this balance can be challenging, especially when dealing with multiple reclosers. However, the Teros recloser stands out in the market as it offers an economical solution without compromising performance. Compared to its larger counterparts, the Teros recloser provides equal or even better reliability at an affordable price. In essence, the Teros recloser ensures the highest level of reliability at minimal cost, making it an excellent choice for power companies.

CONCLUSION

The Teros recloser offers a cost-effective solution with numerous advantages for power generation companies. This three-phase gang-operated recloser is designed for both 15 kV and 27 kV systems and presents power generation companies with an ideal blend of affordability, reliability, and resiliency. Engineered as a modular, ready-to-deploy solution, the Teros recloser serves as a dependable and economical means to enhance system reliability and grid resilience.

CONTACT US
305 West Crossroads Pkwy
Bolingbrook, IL 60440 USA
Phone: 708.388.5010 | Fax: 708.388.0755

www.gwelec.com

G&W Electric
Engineered to order. Built to last.

GW84-2023