High-Voltage Recloser Life-Cycle Testing

Project Highlights:

- Evaluate the long-term performance of new, high voltage reclosers
- Identify potential degradation mechanisms of high voltage reclosers when subjected to accelerated aging
- Understand accuracy of embedded recloser sensors
- Inform high voltage recloser specifications and deployment decisions

Background, Objectives, and New Learnings

Solid dielectric reclosers have been widely deployed on the distribution system in recent years to help improve reliability and meet the future needs of customers. Reclosers are used for fault interruption and isolation to reduce outages due to momentary interruptions and provide added system awareness due to their embedded sensing. These features allow for additional protective zones which can be easily integrated into advanced automated restoration schemes.

Another area where reclosers could provide reliability improvements is on the sub-transmission system (34.5kV to 69kV) as a replacement for transmission line switches. Line switches, like reclosers, operate infrequently but must do so reliably and consistently. Traditional line switches have a reputation for operational challenges, high maintenance requirements, and reliability issues. Reclosers may be advantageous over transmission line switches because they are self-contained with a vacuum interrupter, embedded sensing, and completely enclosed electro-mechanical mechanism. Reclosers typically require little maintenance beyond regular battery replacements in the controller. This has the possibility of decreasing the overall ownership costs relative to traditional line switches.

Recently, recloser manufacturers have released high voltage reclosers that are designed to be operated up to system voltages of 72kV. These high voltage (HV) reclosers have the potential to change how utilities operate their sub-transmission systems and expand beyond the capabilities available using traditional line switches.

However, there are currently no industry-standard designs or production tests for reclosers for voltages above 38kV. Manufacturers are using circuit breaker ratings and applying those ratings instead to HV recloser tests. While this testing may help to evaluate recloser functionality, it does not provide for an understanding of long-term performance of the design and materials used to construct the recloser.

The objective of this project is to subject an HV recloser to laboratory testing including an accelerated aging protocol and an evaluation to identify degradation mechanisms. EPRI plans to also perform functionality and accuracy testing of the recloser before and after aging.

Benefits

Utilities may benefit from this research through enhanced knowledge new to market recloser designs. An additional benefit from testing these reclosers is to understand potential life-cycle issues with these new designs.

The public benefits of this work could include a more reliable and cost-effective sub-transmission system that allows for additional protective devices and faster restoration.

Project Approach and Summary

EPRI plans to perform laboratory testing and analysis of HV reclosers to understand the design and life-cycle characteristics of the reclosers and to help inform utility specification and procurement decisions.

The project intends to perform the following tasks:

Task 1 – Functionality Testing
Perform laboratory testing to evaluate the performance and functionality of HV reclosers. The testing may include electrical testing as well as performance tests of individual components of the reclosers including wildlife guards and arresters.

Task 2 – Sensor Accuracy Testing
Evaluate the accuracy of the embedded voltage and current sensors. The recloser will be subjected to testing across a range of possible operating voltages and load currents.

Task 3 – Accelerated Aging
Subject the recloser to an accelerated aging test for a period of 2,500 hours. The recloser will be operated and energized during the aging process. The environmental stressors include rain, salt fog, humidity, thermal cycling, and ultraviolet.

Task 4 – Post-test Teardown
Conduct a thorough inspection of the recloser at the completion of testing. The HV recloser is then planned to be systematically dismantled and inspected to identify potential degradation mechanisms. Material samples may be taken for lab analysis. Additional electrical testing may be performed as needed throughout the process.

Deliverables

Each utility participating in this project will receive a detailed testing report that describes the tests performed, testing results, and findings of the post-test teardown.

The non-proprietary results of this work will be incorporated into EPRI's R&D programs and made available to the public for purchase or otherwise.

Price of Project

The price to participate is $90,000 for companies with distribution throughput greater than 50,000 GWh/yr. For all others, including those that do not have distribution throughput, the price is $60,000. Seven participants are needed to complete the full scope of the project. This project qualifies for Self-Directed Funding (SDF) or Tailored Collaboration (TC) funds. The project can be funded over two years.

Project Status and Schedule

This project is expected to commence upon participation of seven funders. EPRI then intends to develop a project schedule, incorporating component procurement lead time. Once the recloser is received, it will take approximately 8 months to complete the testing and reporting.

Who Should Join

Transmission and distribution utilities who have an interest in understanding the asset life-cycle performance of new-to-market recloser technologies for the control and automation of power systems between 38kV and 72kV.

Contact Information

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