

Advances in Series-Compensated Line Protection

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Abstract

Series-compensated lines present some unique challenges for directional, distance, and differential elements because the transient response of the series capacitor is not readily predictable. The line reactance change and the subharmonic-frequency oscillations caused by the series capacitors may affect line protective relays. Microprocessor technology provides improved tools for solving series-compensated line protection problems.

After an outlook of transmission line series compensation, this paper reviews series-compensated line protection challenges, including voltage reversals, current reversals, and distance estimation errors. We then present modern solutions to improve directional, distance, and differential element operation in series-compensated lines, followed by relay setting guidelines, concluding with several cases of protection scheme operation for actual faults.

Discussion Points

1. This paper summarizes series-compensated line protection problems and discusses the limitations of traditional directional, distance, and differential elements.
7. The paper discusses modern solutions to series-compensated line protection problems, such as adaptive polarization, logic to prevent distance element overreach, and improved differential element characteristics.
8. The paper provides relay setting guidelines and shows the need for transient studies and tests to ensure secure and dependable operation of relays in series-compensated line applications.
9. Actual field data and fault records demonstrate the effectiveness of these protection solutions.
10. The paper can raise awareness of the need to carefully select and set the protection schemes for series-compensated lines.