

Relay protection channel delay



Overview

The PCR at each terminal periodically estimates the communication channel delay time by sending a signal to the remote relay, which then transmits the signal back.

Key Takeaways

Relay protection channel delay is the latency in communication channels that can affect the speed and accuracy of protective relays in detecting and isolating faults.

Definition and Measurement

Relay protection channel delay occurs when signals transmitted between relays at different terminals of a line experience latency due to the communication medium. In phase comparison relay (PCR) systems, for example, each relay estimates the one-way channel delay by sending a signal to the remote relay and measuring the round-trip time, dividing it by two to obtain an average delay. This delay is then used to correct the phase comparison between local and remote voltage and current measurements to determine if a fault is internal or external to the line.

Asymmetrical or excessive delays can lead to incorrect tripping decisions, as seen in cases where leased third-party networks introduced inconsistent delays.

Typical Delay Ranges

Modern teleprotection systems over dedicated fiber or TDM networks achieve very low latencies, typically 3 to 8 milliseconds for high-speed schemes like POTT (Permissive Overreaching Transfer Trip) or DCUB (Directional Comparison Unblocking). Older analog or asynchronous systems had delays of 8 to 12 milliseconds or more. The speed of the channel directly affects the relay's ability to clear faults quickly, which is critical for system stability, minimizing equipment damage, and maintaining power quality.

Impact on Protection Schemes Channel delays influence the performance of various protection schemes: Phase Comparison Relays (PCR): Sensitive to asymmetrical delays; incorrect delay estimation can cause false trips.

POTT and DCU

B Schemes: Designed to tolerate small propagation delays and channel asymmetry while maintaining high-speed fault clearing. **Differential Protection:** Relies on synchronized measurements; excessive delay can reduce sensitivity or selectivity.

Mitigation Strategies

To minimize the impact of channel delays: Use dedicated communication channels rather than leased or shared networks to reduce variability. Estimate and compensate for channel delay in relay algorithms, including directional comparison and phase shift corrections. Design protection schemes tolerant to small delays, such as POTT or DCUB, which can maintain security and dependability even with minor latency.

Regular testing and monitoring of communication channels to detect asymmetry or excessive latency.

Practical Considerations

Fast and reliable relay operation is essential to limit voltage dips, reduce post-fault load peaks, and maintain network stability. The total relay operating time includes channel delay, relay processing time, and breaker operation time. Proper coordination and safety margins are necessary to ensure selectivity and dependability, especially in networks with multiple relays and varying fault current magnitudes.

In summary, relay protection channel delay is a critical factor in the design and operation of modern protection systems, and careful measurement, compensation, and network design are required to ensure accurate and fast fault clearing.

Article Content

Lesson Learned

The PCR at each terminal periodically estimates the communication channel delay time by sending a signal to the remote relay, which then transmits the signal back. This “round-trip” signal

Communications Systems Performance Guide for Electric Protection

Most relays can be set to block relay operation on channel drop-out and do not restore operation until the delay is determined or a predetermined number of good messages are received.

Distribution Automation Handbook

The re-quired delay depends on the features of the relay type applied, the accuracy limit factors of the CTs and the implementation of the interlocking channel.

Power System Protective Relays: Principles & Practices

A device that functions to give a desired amount of time delay before or after any point of operation in a switching sequence or protective relay system, except as specifically provided by incomplete

Speed and Security Considerations for Protection Channels

This paper describes the communications requirements for various protection and control applications, including channel time, channel asymmetry requirements, and jitter.

Performance of IEC 61850 Sampled Values Relays for a Real-World

The channel delay setting is set by using the measured maximum network delay of the subscribed streams combined with the number of lost SV messages the relay is required to ride through by

Microsoft Word

Specifically, the use of the same communication channel for primary line current differential protection and backup distance protection is discussed. Analysis of the effect of varying communication channel

Basic protection relay knowledge

Definite time delay means that the protection operate time dose not change or depend on the fault type or the fault current magnitude. Inverse time delay, on the other hand, depends on the current

Protective Relaying Philosophy and Design Guidelines

Speed of a protective relay communication channel is a measure of the time it takes to assert an element in the receiving relay after a logic status change is initiated in the transmitting relay.

Model the real-time failure rate of protection channels due to ...

Based on the characteristics of the protection signal transmission, this paper proposes a method to model the real time failure rate of the protection communication channel introduced by the

Communications Systems Performance Guide for Electric Protection

Some modern microprocessor relays use a channel-based messaging system to determine the end-to-end delay while transmitting the data between the relays or a time-based

Basics of Protective Relaying and Design Principles

The protection system of Fig. 3.2 operates as follows: If there is a fault on one of the feeder elements, many or all relays upstream (i.e., between the fault and the supplying system) will pick-up (activate)

C37.113-2015

Information on the concepts of protection of ac transmission lines is presented in this guide. Applications of the concepts to accepted transmission line-protection schemes are also

Power System Protective Relays: Principles & Practices

Abstract: Protective relays and devices have been developed over 100 years ago to provide “last line” of defense for the electrical systems. They are intended to quickly identify a fault and isolate it so the

Protective Relaying Philosophy and Design Guidelines

For the loss of both fibers channels for required dual pilot protection systems, the associated transmission line is requested to be taken out of service or, if possible, tripping delay time immedi

How to calculate relay settings for IEC 61850-9-2 Sampled ...

How to calculate relay settings for IEC 61850-9-2 Sampled Values Channel Latency Network latency is a measurement of delay in a system. Latency accounts for processing delays,

Channel Performance Considerations for Ethernet Circuits Applied to ...

2. Scope This report discusses the use of Ethernet transport for teleprotection services (directional comparison pilot protection, transfer trip and line current differential protection); plus, the circuit

Protection Basics

Protection System Elements Protective relays Circuit breakers CTs and VTs (instrument transformers) Communications channels DC supply system Control cables

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