Wed Apr. 4th  L31

- XFMR Prot.
- Bus Diff.
  - Low Z
  - Mod Z
  - High Z
- Gen Diff., Gen Prot.
- Cap Bank
  - O.C.
  - Volt Diff.
Breaker-and-a-half Scheme

Bus 1

CT SEC.

I ≠ 0 during fault in zone.

EE 5210 - Power Systems Protection Spring 2001

Instructor: Bruce Mork Phone (906) 487-2857 Email: bamork@mtu.edu
- Avoid Zb related to CT cables
- Faster detection / trip
- More secure than Low-Z 87B
SEL-487B Bus Protection Relay
Busbar and Breaker Failure Protection, Automation, and Control System

Applications

- Use one SEL-487B for buses with 1–6 terminals. Interconnect three relays for protection of buses with 7–18 terminals.

- Provide integrated breaker failure protection for each terminal on the bus. Internal open-phase detection and SELogic® control equations provide for simplified local and remote backup tripping.

- Apply station automation and control with tripping outputs for all circuit breakers and status inputs for all disconnect switches and auxiliaries. The massive input and output capabilities of the SEL-487B provide an ideal platform for system integration.

- Improve and simplify relay interconnections using Mirrored Bits™ communications of internal logic points between SEL relays.

- Monitor each terminal current and station voltage from a single location. Simplify data acquisition by using one relay for analog and digital status monitoring.

SCHWEITZER ENGINEERING LABORATORIES, INC.
TEL: 509.332.1890 • FAX: 509.332.7990 • info@selinc.com • www.selinc.com
2350 NE Hopkins Court • Pullman, WA 99163-5603 USA
Copyright © SEL 2003 All rights reserved. Printed in USA, 20000602

Making Electric Power Safer, More Reliable, and More Economical™
Bus Diff Schemes

Focus: Application Details

- Low-Impedance Relay
- Dist Systems

EE 5210 - Power Systems Protection  Spring 2001
Dist/Switchgear
Insulators
Bus Bars

Top View
Bus Duct
Cubicle

Side View
Cables

Typical to have CTs only on load side of bus. C100 is typical!

EE 5210 - Power Systems Protection
Spring 2001
High Burden can cause unequal saturation of CTs.
Bus Diff - Ch. 10

- High Imp -
- Low Imp - O.C. Relay
- Partial Diff. - §10.12.3 (P. 353)

Coordinate with feeder relays, i.e., give feeder relays time to trip first.

Set pickup above max total feeder load current.
Partial Differential Schemes

Cheap but slow

Set pickup to be above Max Radial Load

Radial Loads won't feed bus fault unless large Machine.

EE 5210 - Power Systems Protection  Spring 2001
From: "Tom Ernst (MP)" <TERNST@mnpower.com>
To: ee5223-l@mtu.edu
Subject: Partial Differential Overcurrent Back-up

The partial differential overcurrent back-up scheme that Dr Mork discussed at the end of class on Wednesday is a really neat scheme from a coordination point of view. We typically use a bus differential scheme for selective high-speed bus fault detection and also have overcurrent back-up relays for feeder back-up and breaker failure protection. This overcurrent back-up is either a separate set of overcurrent relays on each source to the bus or one partial differential connected set of overcurrent relays.

In the first case, it is important that the bus tie breaker(s) trip before the transformer breaker(s) to assure that the correct transformer breaker trips (all transformer breaker relays are typically set the same and can not determine which bus or feeder is faulted). This means that the bus tie relays must be set to be slower than the feeder relays and the transformer relays must be set to be slower than the bus tie relays. The result is that the total back-up delay is two coordination delays slower than the feeder relays.

For the partial differential case, the back-up relays selectively trip the correct source breakers (transformer and bus tie) and can be set just one coordination delay slower than the feeder relays. The result is faster back-up protection.

The speed of the back-up tripping of the transformer breaker is important because this is generally the curve that needs to be below the transformer frequent through fault withstand capability curve. So using a partial differential back-up scheme reduces the maximum duration of through faults seen by the transformer.

For a variety of reasons (mostly misunderstanding) partial differential schemes are not widely used, especially in industrial settings. Another problem is that none of the micro-processor relay manufacturers have supported partial differential connections within their bus differential relays. They offer overcurrent relays on each input but do not give you the capability to sum CT inputs internally. If you have a spare CT input on the 87B you can parallel the CTs externally and then wire to the spare input (which is not included in the bus diff calculation) but this is awkward and complicated. (Over the years I've had just about every relay manufacturer tell me that no matter what they offer I will want more.....).

Thanks.......
Tom