



Breaker Failure Protection

PSRC – K2 WG



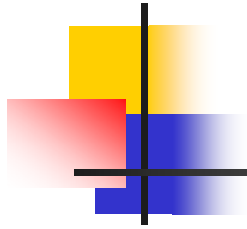
Last Publication on Breaker Failure Protection by PSRC

- An IEEE PSRC Report , “Summary Update of Practices on Breaker Failure Protection”, *IEEE Transaction Power Apparatus and Systems*, Vol. PAS-101, No. 3, pp 555-563 , March 1982



Why a Guide ?

- Things have changed in 20 years.
- New Engineers need guidance.
- Breaker Failure Function being incorporated in multifunction relays.



PSRC – K2

- Established 2001
- 60 Working Group members



K2 Members

- Roger Hedding, Chair
- S.Anderson
- Alex Apostlov
- John Appleyard
- Roy Ball
- George Bartok
- Ron Beazer
- Ken Behrendt
- Robert Beresh
- Martin Best
- Gustav Brunello
- Art Buanno
- Zeeky Bukhala
- Arvind Chaudhary, Vice Chair
- Simon Chano
- Terry Crawley
- Randy Crellin
- Randy Cunico
- Albert N. Darlington
- Paul Drum
- Walt Elmore
- David Emigh
- Jon Ferraro
- Kelly Gardner
- Tony Giuliani
- George Gresko



K2 Members

- Irwin Hassenwinkle
- Stan Horowitz
- Randy Horton
- Mohamed Ibrahim
- Bob Jackson
- Gerald Johnson
- Peter Kemp
- Tim Kern
- Shoukat Khan
- Mike Kloiber
- Gary Kobet
- Tom Lanigan
- Larry Lawhead
- Bill Lowe
- Vahid Madani
- Walter McCannon
- Mike McDonald
- Dean Miller
- Pratap Mysore
- Mukesh Nagpal
- George Nail
- Russell Patterson
- Frank Plumptre
- Elmo Price
- Dan Reckerd
- Don Sevcik
- Charles Sufana
- Joe Uchiyama
- Sahib Usman
- Don Ware
- James Whatley
- Roger Whittaker
- Skip Williams
- Ray Young
- Rich Young



Assignment

- This working group will investigate issues pertaining to breaker failure protection which will include : breaker failure mechanisms, fault detectors, breaker failure circuits, effect of bus configurations, effect of multifunction microprocessor relays, and the effect of modern breaker control schemes. **Prepare a guide covering the application of breaker failure protection to power circuit breakers.**

Why Breaker Failure Protection ?

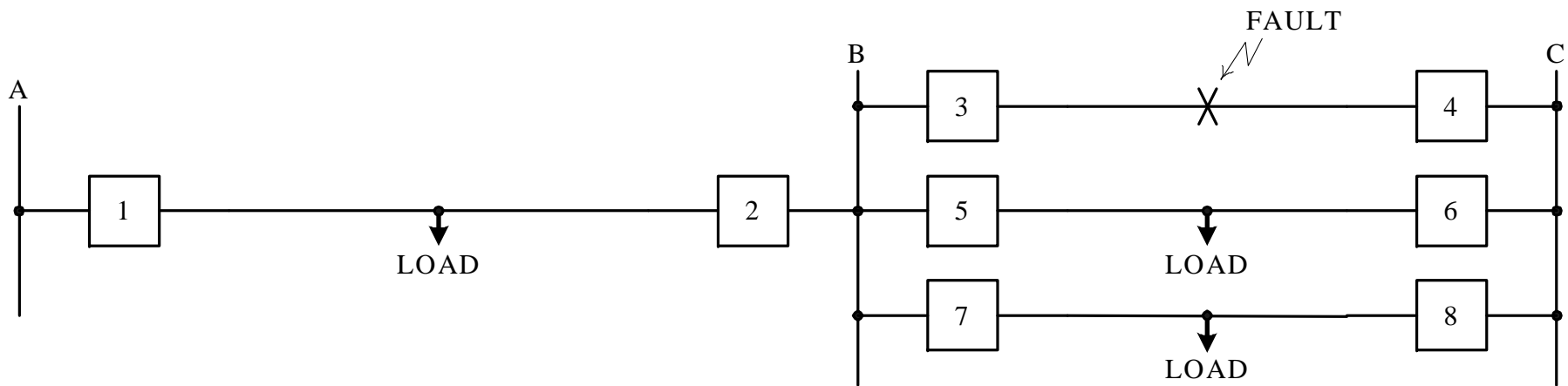
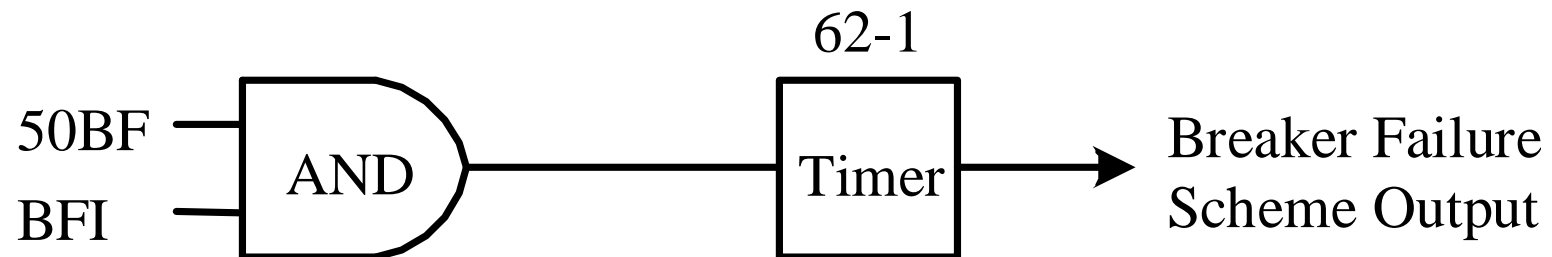


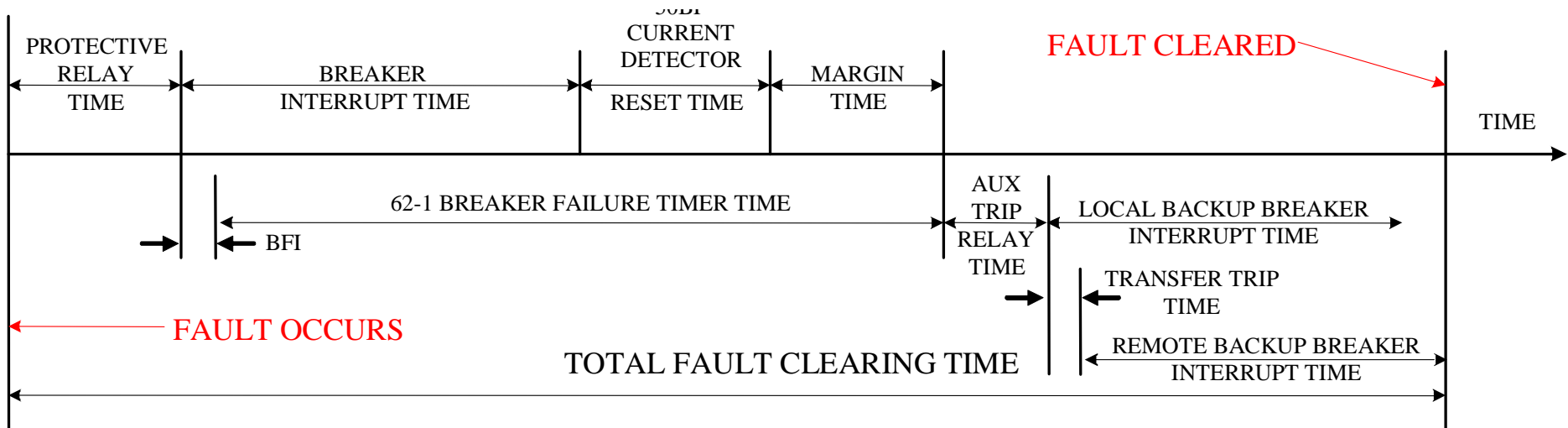
Figure 1 - Remote Breaker Clearing

Basic Breaker Failure Scheme





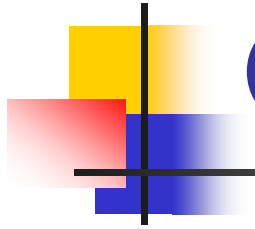
Timing Chart





Two Components

- Current Detector
- Breaker Failure Timer



Current Detector

- Detects current flow
- Pick up for minimum fault
- If phase current set above load current
- If ground current set above unbalance
- Drop out not delayed by dc offset
- Use 52a only if no current



Timer

- Longer than it takes the breaker to clear a fault
- Shorter than the Critical Clearing Time plus some margin.
- Could be longer for Line to Ground Faults than for Three Phase Faults



Critical clearing Time

- Dictated by Transient Stability limit
- Somewhere between 7 and 30 cycles
- Results from Stability Study



Total Clearing Time

The sum of :

BFI pick up + Breaker Failure Timer +
Auxiliary trip relay time + Local back up
breaker time + (Transfer trip time if
remote)



Transient Stability time

- Severity of Fault
- Loading on System
- Mass of Generators
- Type of Fault



Circuit Breaker Failure Modes

- Failure to Trip
- Failure to Clear



Failure to Trip

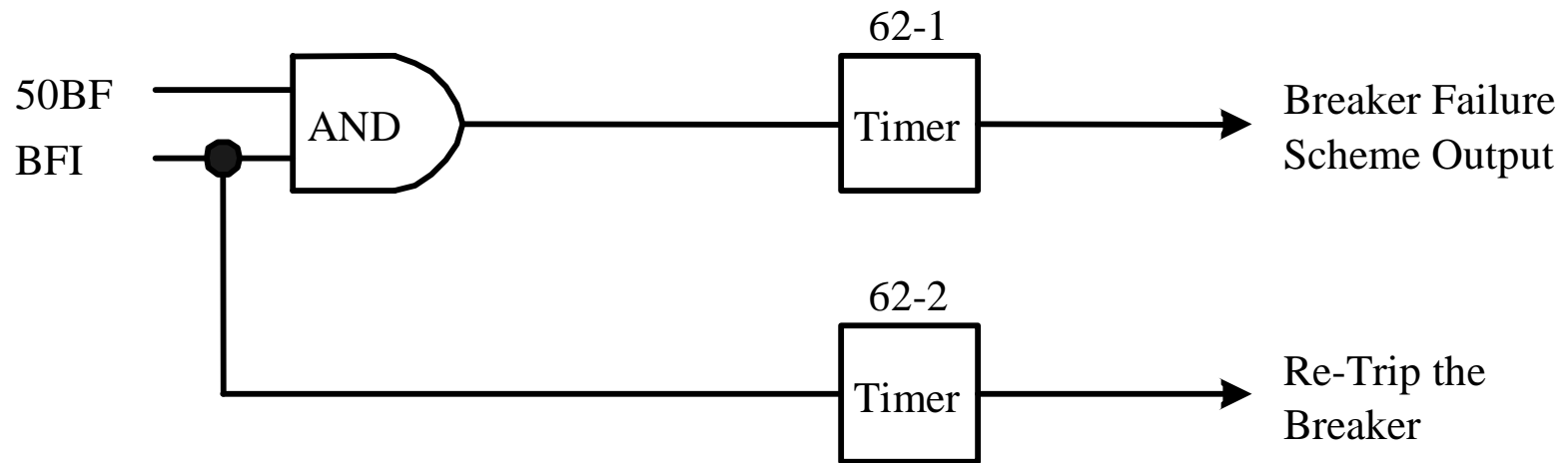
- Contacts do not open after trip circuit energized.
- Short or open in Trip coil
- Mechanical problem with breaker



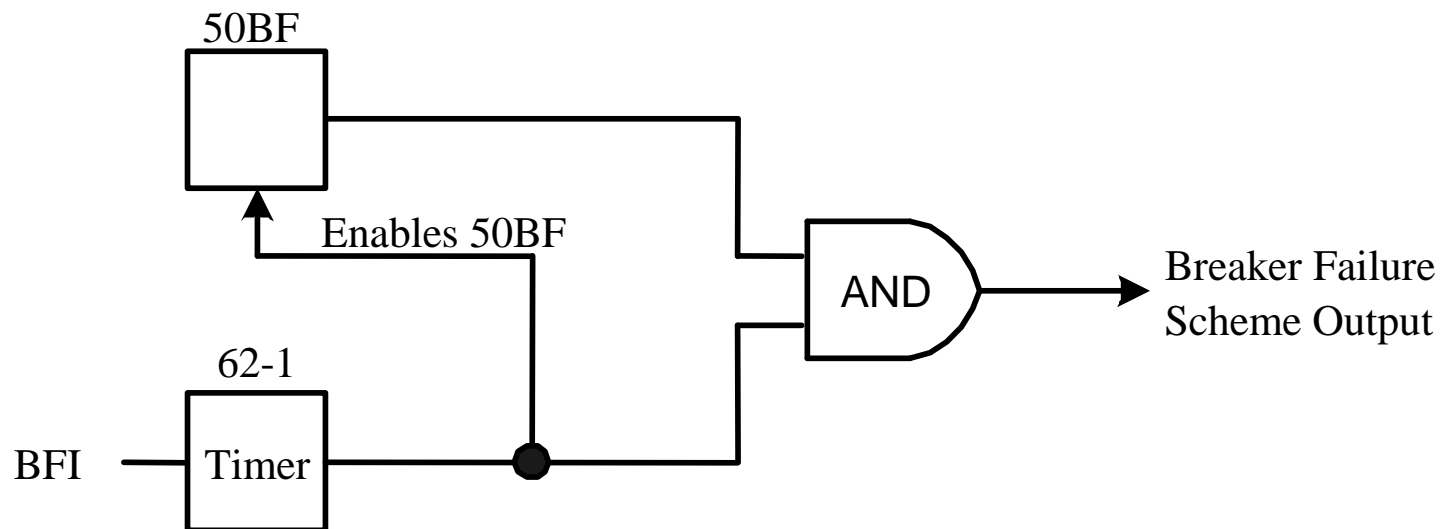
Failure to Clear

- Contacts open but fault not extinguished.
- Current continues to flow
- Mechanical or Dielectric problem
- Why auxiliary switches not reliable

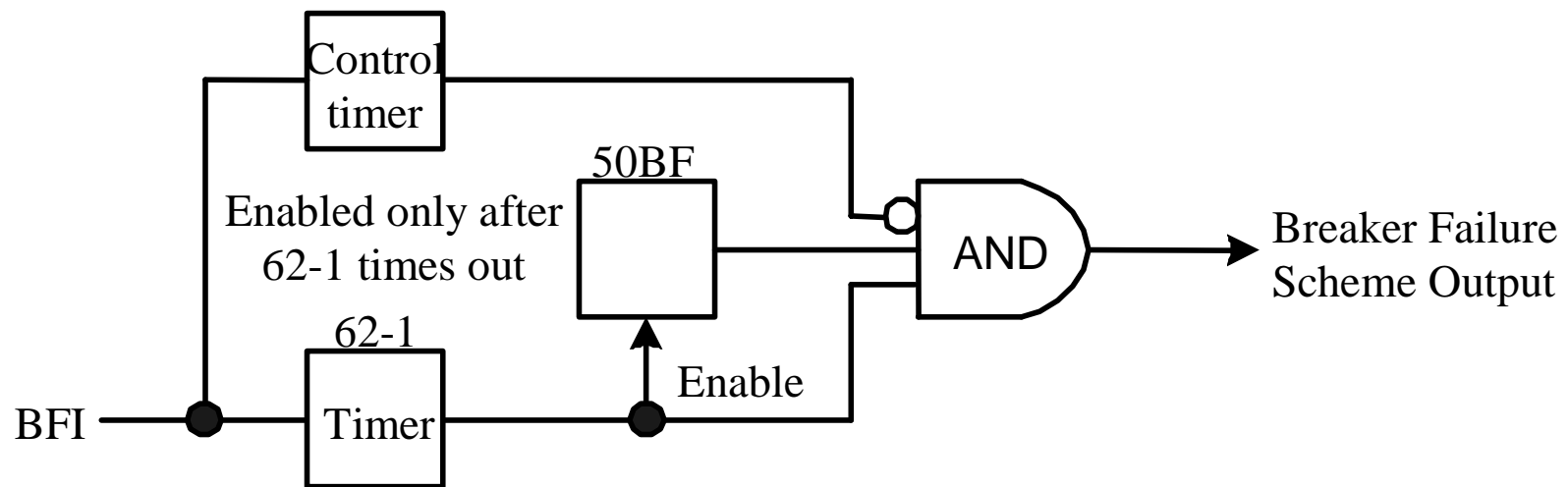
Breaker Failure ReTrip



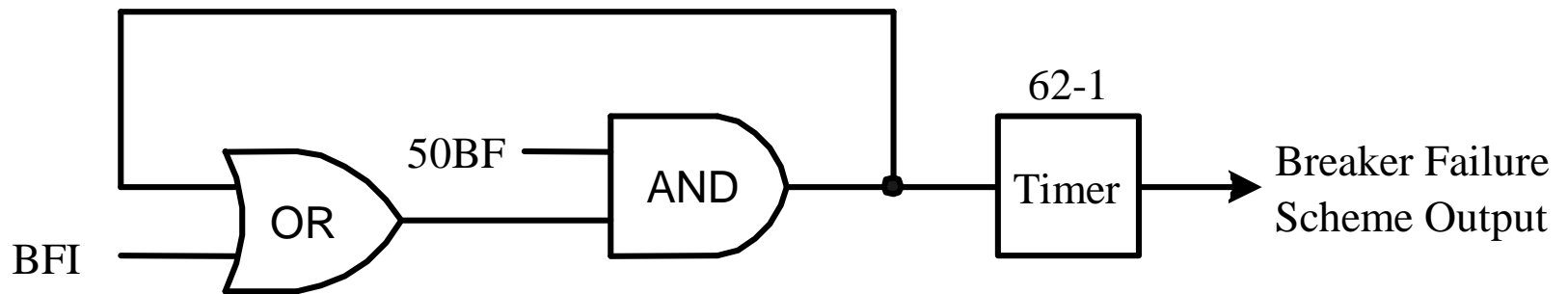
Elimination of 50BF Reset Time



Addition of Control Timer



Breaker Failure Seal-In

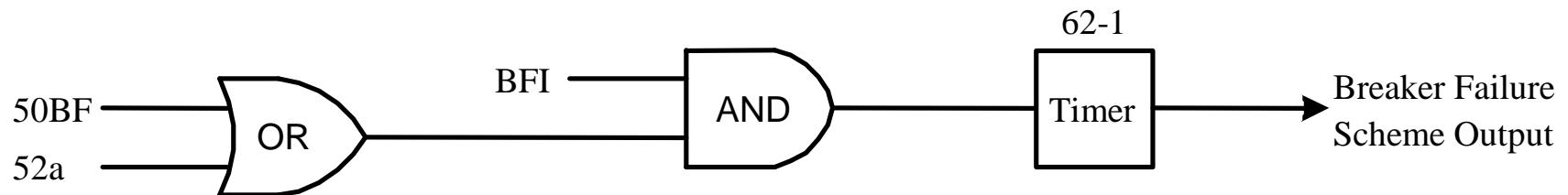




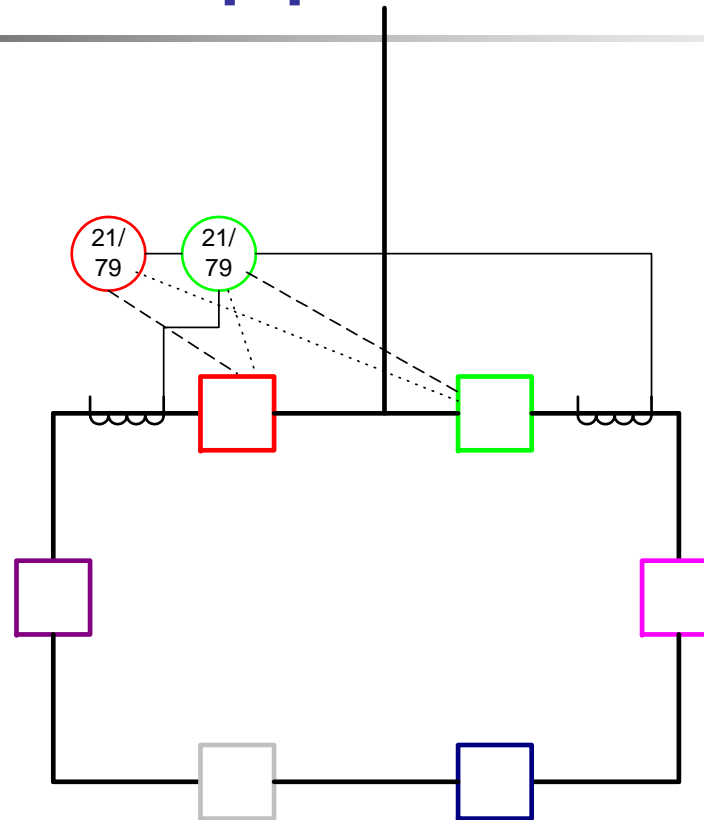
Minimum Fault Current

- Use where current magnitude may not be enough to pick up current detector
- Transformers
- Generators
- Harmonic Filters

Minimum Fault Current



Ring Bus Application



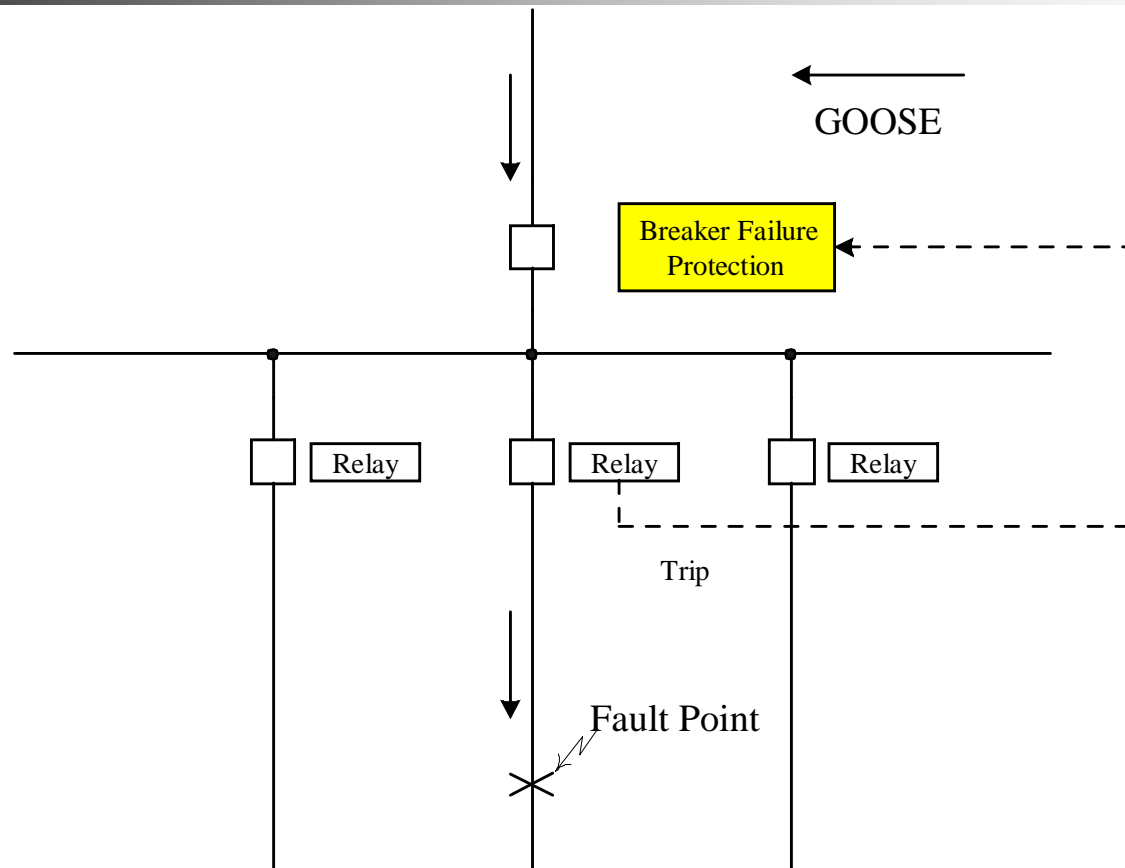
Ring Bus



Ring Bus

- Separate Ct inputs into relay
- Careful of current distribution after one breaker opens in setting current detectors.
- Another Working group (K5) to look into this issue.

Distributed Breaker Failure





Design Considerations

- Total Breaker Failure clearing time should be less than system stability limit.
- Independent of type of failure detected
- Should operate during loss of dc to breaker



Conclusions

- BFP should operate only when desired
- Timer setting should allow adequate margin between backup breaker clearing and system critical clearing time.
- Multiple timers can be used for different types of faults
- Use auxiliary contacts as last resort for BFI.



Conclusions

- Phase current detectors should be set above load to protect from scheme operating during testing.
- Seal in circuits should be used to insure breaker failure scheme does not drop out prematurely
- Care should be taken when applying breaker failure to ring bus and breaker and one half .



Questions ?
