Summary of Revision
C37.119-2016

K5 Membership

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BFP definition:

• A form of protection that is designed to detect failure of a circuit breaker to operate or interrupt a fault. Upon detection of a breaker failure during a fault condition the scheme is designed to take appropriate action to clear the fault. Upon detection of a breaker failure during a non-fault condition, the scheme may take other appropriate action.
Need for BFP

• Protection equipment failures happen

• Reach of remote backup, distance and overcurrent varies by condition

• Operation of remote backup removes much equipment from service and is delayed
Remote backup disadvantages vs advantage

- It does not know exactly when bkr is supposed to open (ie at subs B).
- More widespread impact
- Longer fault clearing time
- Difficult to set considering infeed and loadability requirement.

However, it is independent.
Local Backup advantages vs disadvantage

- Know exactly when bkr is supposed to open
- Minimal impact on system outage
- Faster clearing time
- With pilot, we can add DTT
- It may suffer from common mode failure
Why BFP?

• Mitigate protection system failures that would otherwise cause degradation of

  • Sensitivity
  • Selectivity
  • Speed
Breaker failure mode (during fault clearing or reclosing after fault clearing)

- Failure to Trip
- Failure to Clear
Other failure that can happen during non-fault clearing operation

• Loss of dielectric or mech. energy.
• Contact flash over
• Slow closing mechanism.
• Other mechanical failure.
Basic BFP scheme

• Initiation by breaker trip signal BFI
• Current (50BF)
• Timer
• Means to trip and close interlock adjacent breakers
• Optional
  • Retrip
  • DTT to lockout option
15 different BFP schemes (6 new)
BFP **Retrip** logic:

(Time Delay May be Zero Time)
Other examples of BFP schemes
Different timing charts
Minimum fault current scheme

Diagram showing logic gates and connections between inputs and outputs.
Breaker failure timer bypass scheme
Current differential breaker failure protection
Ground fault BF on both live tank ckt bkr and CT column failure
Series (tandem) breakers
Expanded Design Considerations

7. Breaker failure design considerations
   7.1 General considerations
   7.2 Breaker failure current supervision (50BF)
   7.3 Breaker failure as part of the primary protection for an element
   7.4 Breaker failure initiation
   7.5 Breaker failure actions
   7.6 Practical considerations, applying breaker failure protection to redundant control circuits
False BFI from DC grounds

• BFI respond above half battery voltage

• Minimize cable run length/capacitance

• Convey the BFI signal using GOOSE

• Binary inputs comply to Clause 7.2.7 of IEC 60255-26 (EMI)
Generator BFP (New!)

- Abnormal non-fault conditions of the generator can be damaging.
- Remote backup is of no benefit for non-fault.
- Industry re-regulation, transmission personnel less familiar with generator protection
- Convey the BFI signal using GOOSE
- Binary inputs comply to Clause 7.2.7 of IEC 60255-26 (EMI)
Generator BFP consideration

• Breaker status

• CT location critical

• Breaker arrangement critical
Failure to close detection

- C37.119 scope is expanded to cover performance failures of the breaker other than fault clearing failure such as failure to operate, either tripping or closing.

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Synchronizing breaker failure-to-close a

- Slow closing from differences in speed (slip), voltage, and angle across the breaker can twist shafts, fracture turbines, and fail windings (heat).

- Synchronizing system must account for slip rate, and breaker close speed to give close command in advance
BFR Settings

• Current detectors 50BF are per phase but can also include a ground current element

• Set 50BF sensitive enough to respond to any fault condition. Some prefer to set above max load yet min fault can be below the max load
BFR Settings

• Set timer long enough to allow successful fault clearing including some margin for subsidence

• If min fault current is quite low or non fault protection is needed then a 52a scheme might be applied
Communications based BFP

- Direct transfer trip is applied to trip and block closing of remote adjacent breakers via leased telephone lines, power line carrier, microwave, or fiber. Must be dependable and secure

- IEC 61850 based peer to peer Ethernet communications might be applied for BFP
Testing ensures BFP integrity

• Tests relays that initiate BFP
• Tests BFR timer
• Tests current detector pickup and reset

• Commission to verify each initiate signal and each lockout operational including breaker trip checks.
• IEEE C37.119-2016 Guide for Breaker Failure Protection of Power Circuit Breakers describes industry best practices when applying BFP

• Avoid single points of failure in the protection system to enhance reliability

• Learn peculiarities of how and why BFP is applied to generator breakers
• Learn how BF re-trip can mitigate consequences of testing error

• Learn about tandem breaker schemes, column ground protection, breaker differential protection, communication based schemes and testing of BFP

• Become familiar with C37.119-2016 to improve your understanding of BFP!
Q&A