

Lesson Learned

Underfrequency Relay Misoperation

Primary Interest Groups

Generator Operators
Generator Owners

Problem Statement

An event occurred in which an underfrequency (81) relay used in generator protection misoperated during switching. This resulted in multiple generators being tripped off line causing the loss of more than 50 MW of generation.

Details

The bus is normally configured such that an open bus-tie disconnect switch separates two sets of generators. Each set of generators has an 81 relay that trips all of the generators on its respective side when an underfrequency condition is detected. When the buses are tied together, with the bus-tie disconnect closed, an auxiliary set of contacts enables a cross-trip, so either underfrequency relay can trip the generators on both sides.

During the process of isolating a circuit breaker for maintenance, a breaker disconnect switch was opened. This action also de-energized the potential device which provided sensing voltage to the 81 relay on that side of the bus. The operator then closed the bus tie disconnect enabling the cross-trip. Since the de-energized underfrequency relay had produced a sustained trip signal, all running generators received a trip as soon as the bus tie disconnect was closed. The de-energized 81 relay erroneously produced a trip signal for this condition.

The 81 relay used in this application was an older model, equipped with solid state logic to block the trip for a loss of sensing voltage, as occurs when the potential device is de-energized. On this occasion, the 81 relay internal logic failed to operate as designed and the relay produced a trip output as the potential device was de-energized.

Corrective Actions

The following are examples of solutions that could be deployed to prevent a recurrence of this event:

- Install a trip cutout on the 81 relay, and include opening the cutout as part of the circuit breaker isolation procedure.
- Incorporate an auxiliary contact (89a) from the circuit breaker disconnect switch (if available) to supervise the 81 relay trip. The 81 trip would be disabled anytime the circuit breaker disconnect is opened.
- Upgrade the solid state underfrequency relays to microprocessor-based models that do not rely on discrete, solid-state electronic components whose performance may change over time. A relay trip cutout should be included in the design.

Lesson Learned

Underfrequency relay protection schemes should properly discriminate between an underfrequency condition and de-energized substation equipment. The design of these relay schemes should include sufficient safeguards to prevent relay misoperation when substation equipment is in a de-energized state.

For more information please contact:

Earl Shockley
Director of Event Analysis and Investigation
earl.shockley@nerc.net
404-446-2560 ext. 270

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