

# Protective relays

A special type of relay is one which monitors the current, voltage, frequency, or any other type of electric power measurement either from a generating source or to a load for the purpose of triggering a circuit breaker to open in the event of an abnormal condition. These relays are referred to in the electrical power industry as *protective relays*.

The circuit breakers which are used to switch large quantities of electric power on and off are actually electromechanical relays, themselves. Unlike the circuit breakers found in residential and commercial use which determine when to trip (open) by means of a bimetallic strip inside that bends when it gets too hot from overcurrent, large industrial circuit breakers must be "told" by an external device when to open. Such breakers have two electromagnetic coils inside: one to close the breaker contacts and one to open them. The "trip" coil can be energized by one or more protective relays, as well as by hand switches, connected to switch 125 Volt DC power. DC power is used because it allows for a battery bank to supply close/trip power to the breaker control circuits in the event of a complete (AC) power failure.

Protective relays can monitor large AC currents by means of current transformers (CT's), which encircle the current-carrying conductors exiting a large circuit breaker, transformer, generator, or other device. Current transformers step down the monitored current to a secondary (output) range of 0 to 5 amps AC to power the protective relay. The current relay uses this 0-5 amp signal to power its internal mechanism, closing a contact to switch 125 Volt DC power to the breaker's trip coil if the monitored current becomes excessive.

Likewise, (protective) voltage relays can monitor high AC voltages by means of voltage, or potential, transformers (PT's) which step down the monitored voltage to a secondary range of 0 to 120 Volts AC, typically. Like (protective) current relays, this voltage signal powers the internal mechanism of the relay, closing a contact to switch 125 Volt DC power to the breaker's trip coil if the monitored voltage becomes excessive.

There are many types of protective relays, some with highly specialized functions. Not all monitor voltage or current, either. They all, however, share the common feature of outputting a contact closure signal which can be used to switch power to a breaker trip coil, close coil, or operator alarm panel. Most protective relay

functions have been categorized into an ANSI standard number code. Here are a few examples from that code list:

### *ANSI protective relay designation numbers*

12 = Overspeed  
24 = Overexcitation  
25 = Syncrocheck  
27 = Bus/Line undervoltage  
32 = Reverse power (anti-motoring)  
38 = Stator overtemp (RTD)  
39 = Bearing vibration  
40 = Loss of excitation  
46 = Negative sequence undercurrent (phase current imbalance)  
47 = Negative sequence undervoltage (phase voltage imbalance)  
49 = Bearing overtemp (RTD)  
50 = Instantaneous overcurrent  
51 = Time overcurrent  
51V = Time overcurrent -- voltage restrained  
55 = Power factor  
59 = Bus overvoltage  
60FL = Voltage transformer fuse failure  
67 = Phase/Ground directional current  
79 = Autoreclose  
81 = Bus over/underfrequency

#### **REVIEW:**

- Large electric circuit breakers do not contain within themselves the necessary mechanisms to automatically trip (open) in the event of overcurrent conditions. They must be "told" to trip by external devices.
- *Protective relays* are devices built to automatically trigger the actuation coils of large electric circuit breakers under certain conditions.

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