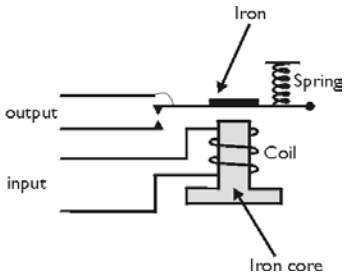
Relay Applications

In general, a relay is used to isolate one electrical circuit from another. It allows a low current control circuit to make or break an *electrically isolated* high current circuit path. In power systems, the point of a relay is to sense an abnormal or "fault" condition in the system and send a signal to a circuit breaker to prevent potential damage to equipment. There are three technologies currently available in relays: 1) electromechanical relays, 2) solid-state relays, and 3) computer (microprocessor) relays.

In the early 1900s, utilities used electromechanical relays to protect lines from faults. They were very basic (using springs and induction disks) but worked quickly and well enough. These relays operated independently and did not communicate with the utility. So, linemen found out about an outage by looking for targets (red flags) in the substation or when a customer called or came by to visit the utility.

Electromechanical Relays

An electromechanical relay is constructed from a coil of wire wound round a cylinder of iron. When a current flows through the coil, it generates a magnetic field that causes the iron to act like a magnet. A flat springy strip of iron is located close to the cylinder. When the cylinder is magnetized, the iron strip is attracted, which, in turn, opens or closes a switch. **Figure 1** The relay (simplified arrangement).



Solid-State Relays

Solid -state and semiconductor relays are both names of a relay like device, which works like a normal relay. Those are usually called also with short name SSR. An SSR is a semiconductor device that can be used in place of a mechanical relay to switch electricity to a load in many applications. Solid-state relays are purely electronic, normally composed of a low current control side (equivalent to the coil on an electromechanical relay) and a high-current load side (equivalent to the contact on a conventional relay). SSRs typically also feature electrical isolation to several thousand volts between the control and load sides. Because of this isolation, the load side of the relay is actually powered by the switched line; both line voltage and a load (not to mention a control signal) must be present for the relay to operate.

Digital (Microprocessor) Relays

Relays must be reliable, quick, and economical. Microprocessor relays perform all of the functions of an electromechanical relay, in addition to recording events, data acquisition, and may be programmed with control logic. The microprocessor is responsible for the execution of relay programs, maintenance of various timing functions, and communication with its peripheral equipment. Note that one microprocessor relay replaces three or four electromechanical relays.

Internally, the relay monitors the power system values using processors. The main processor, commonly known as the central processing unit (CPU), performs the algorithmic and control logic. Currents and voltages are not measured directly off the line. In all cases, a current and voltage transformer steps the quantities down to a value that can be acquired using a digital signal processor (DSP) in conjunction with an analog-to-digital data system. Digital inputs and outputs are used to interface with control interfaces as well as maintain current and voltage ratings. Analog inputs and outputs are used for interfacing with the Supervisory Control and Data Acquisition (SCADA) systems.

Where is the industry going?

Utility engineers now mix and match devices, choosing the necessary electronic equipment based on what needs to be done, what kind of communications is required, and how much intelligence is necessary. As they integrate, expect a decrease in hardware costs and the amount of work necessary to automate a substation. As costs come down, utilities will be more likely to automate in order to improve power delivery and quality, defer infrastructure purchase, preserve existing infrastructure, and also reduce power and reactive losses.

Protective Relaying Internet Sources:

1) http://www.selinc.com/: Schweitzer Engineering Laboratories

2) http://www.geindustrial.com/pm/notes/artsci/: General Electric: Philosophy of Relaying

3) http://oge.apogee.net/pd/: Review of Electrical Systems (Protective Relaying)

4) http://eent1.tamu.edu/ee679/handouts.htm: Texas A & M