

TechTopics No. 59

Control power sources for switchgear

Medium-voltage, metal-clad switchgear requires source(s) of control power for operation. Power is required for the circuit breakers and for auxiliary devices, such as microprocessor relays and meters. If the switchgear has space heaters, enclosure lighting or convenience outlets, 120/240 Vac power will also be needed for these items (space heaters, lighting and convenience outlets are standard on outdoor equipment and optional for indoor equipment).

For many installations, some source of 120/240 Vac power will be required. Very often, this source is a control power transformer (CPT) installed in the switchgear. It is preferred that the CPT be connected to the incoming power, ahead of any disconnect switch or main circuit breaker (some utilities will not allow the CPT to be connected on the line side of their revenue metering equipment). For dual-source systems, it is desirable to include an automatic transfer scheme for secondary power. If the CPT provides power for closing of circuit breakers, the CPT must have power before electrical closing of the circuit breakers is possible. If the switchgear has space heaters, the space heaters must be energized, especially when the main circuit breaker is open. Both of these reasons dictate that the CPT should be connected to the incoming power, not to the load side (e.g., main bus) of any switching device.

Alternating current (ac) control power is often used for spring charging and closing of circuit breakers. This is convenient, particularly if the ac source is from a CPT in the switchgear. If dc is used for tripping and ac is used for other purposes, then the size of the dc source is reduced if non-essential control power needs are served from the ac source.

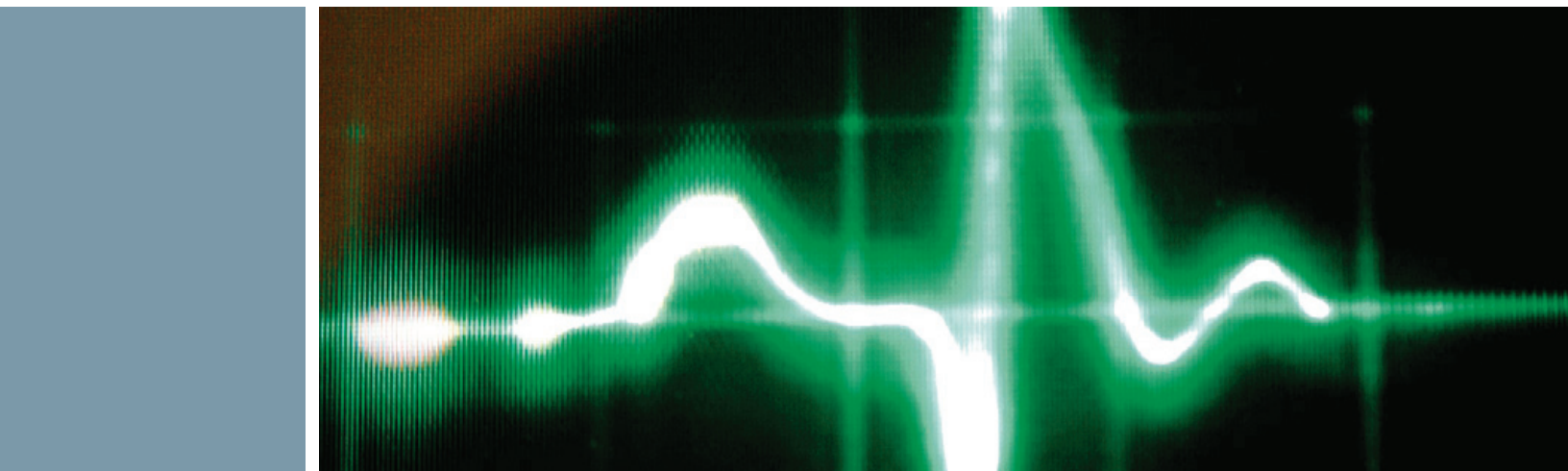
However, ac power obtained directly from the CPT is not acceptable for supplying the trip circuit of the circuit breakers. In the event of a short-circuit on the power system, the voltage supply to the primary of the CPT will be reduced to a very low value, perhaps to near zero if the fault location is close to the CPT. This will reduce the CPT secondary voltage to near zero, and there will be inadequate power to trip the circuit breaker.

To overcome this, capacitor tripping (refer to TechTopics No. 55 for a discussion of capacitor tripping) has been used for decades to trip medium-voltage circuit breakers when only an ac source from a CPT is available.

Another means to deal with this issue is to use an uninterruptible power supply to provide power for tripping of the circuit breaker with an ac source. This is relatively expensive and only rarely used. The long-term reliability of commercially available, light duty, small capacity UPS systems is also of concern.

A dc source is the preferred control power source for tripping of medium-voltage circuit breakers. Most frequently, the same dc source (battery) is used to supply power for closing and tripping, and the spring charging function. With the nearly universal use of modern microprocessor protective relays and meters, and the increasing use of communications together with remote control, a source of dc control power is becoming almost a necessity.

What factors influence the choice of control power source, and particularly the tripping source?



AC from local CPT:

- Inexpensive, particularly for isolated locations
- Requires capacitor trip if used for the tripping supply
- Capacitor life is limited and may require periodic replacement, particularly in high temperatures
- Relatively low maintenance cost, even if capacitor tripping used
- If used to supply devices with communications features, communication will be lost whenever the primary source is de-energized, and during severe short circuits.

DC from battery:

- Higher cost, particularly if battery is installed inside the switchgear
- Battery life depends on battery type and ambient temperatures
- Higher maintenance cost, particularly if electrolyte levels require periodic check
- Virtually necessary if communications and microprocessor relays are used.

In connection with battery life, a superb paper was presented at the IEEE Petroleum & Chemical Industry Committee technical conference (PCIC) in September, 2006 in Philadelphia. The paper dealt with real-world experience with a wide variety of battery types, and highlighted the severe negative effect of high ambient temperatures on the life expectancy of certain battery types. Siemens recommends this paper for your consideration: PCIC-2006-16 "Batteries, Always Expected to Perform But Why Don't They?", Roger N. Pocock (Saft America) and E. Roy Hamilton (Chevron ETC), contained in conference record IEEE Cat. No. 06CH37831.

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