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TIPS ON CONTRACTING

# Make your bid exceed the minimum safety requirements

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To be competitive, electrical contractors often supply low-voltage (LV) service entrance switchboards and switchgear that meet just the minimum safety requirements of the Canadian Electrical code.

For services above a certain rating, the Code stipulates:

- That a ground-fault relay must be used on the service entrance;
- That the relay shall be set for no more than 1200 amps;
- That it shall trip the breaker within one second.

As a provision for safety, this is a great improvement over earlier requirements; yet, it must be noted, this is just the bare minimum requirement in that this level of ground sensing and time delay provide for very limited coordination with downstream devices. As a result, the main service entrance device trips and causes an entire building or installation to suffer a blackout. This article discusses alternatives to improve coordination and protection.

To comply with the Code, all 3-phase 4-wire circuits — where the neutral is distributed and used for the load(s) — must be solidly grounded. Many 3-phase, 3-wire systems are also solidly grounded simply as a matter of habit. In such systems, the ground-fault sensing relays, which are applied at various levels in the distribution network, are time-current-coordinated. To achieve a fully coordinated system, many discrete relays have to be used, from the main down to the utilization equipment like motors. This approach encounters two issues:

- Cost due to the large number of ground-fault sensing relays;
- Increased time delay settings associated with the time coordination, causing longer operating times of relays. (The source relay has the longest delay in order to prevent the main relay from tripping first.)

Figure 1 shows a time-coordinated system of ground-fault relays in a low-voltage distribution set-up. GFP-1 responds after a time delay of 12 cycles to any ground fault that has not been cleared by GFP-2 or GFP-3. GFP-2 responds after delay of 6 cycles to any fault that has not been cleared by GFP-3. GFP-3 responds instantaneously to any fault on the branch circuit it protects.

To lower the cost, the designer of the distribution system might typically specify fewer relays. The lowest cost is achieved when only one relay is used — at the service entrance, meeting the bare minimum requirements of the Code.

The time delays, necessary for conventional time-current coordination, compromise equipment protection. In the event of an arcing ground fault in these solidly grounded systems, the circuit is tripped *with delay*, and the resulting damage can be unacceptable.

To address the equipment protection aspect, and yet maintain coordination and selectivity, zone-selective instantaneous protection (ZSIP) relays can be used. ZSIP eliminates the tripping time delay and reduces the exposure to equipment damage. Fig 2 shows a distribution system with ZSIP. Here, GFP-1 responds instantaneously to ground faults on the line side of GFP-2. GFP-2 responds instantaneously to faults on the load side of its location to the line side of GFP-3 and sends a restraining signal to GFP-1. GFP-3 responds instantaneously to faults on its load side and sends a restraining signal to GFP-2.

## Coordination and selectivity

Where there are multiple levels (i.e., zones) in the power system, there is a need for coordination of the zones so that, whenever possible, the higher levels are unaffected by downstream faults. The branch circuits are like tree branches and all of the relays will "see" the fault current in a particular branch when the fault is downstream. Usually, coordination is achieved by setting protective relay time-delays progressively higher, with upstream relays set to maximum delays so as to prevent nuisance tripping of the breaker.

Should a fault develop at a high level, requiring the time delay to expire before clearing the fault, this set-up can cause unnecessary damage. A better way is to use zone-selective instantaneous protection (ZSIP), where the ground-fault sensing relays are all set for instantaneous trip protection but are

wired together, and the downstream relay will signal upstream relay in the upper zone that it will clear the fault and block the upstream relay from tripping. This scheme provides coordination with instantaneous clearance of arcing faults, thus preventing major damage at all levels in the system.

Contractors can take a proactive approach and suggest to their customers that reduction of potential damage and fire can be achieved by retrofitting their existing distribution set-up with improved relaying systems.

When bidding for projects, contractors provide base bids to specifications but, in addition, should offer alternatives that improve distribution system protection and reduce risk of fire, equipment damage and loss.

On 3-phase 3-wire LV systems where solid grounding is specified, high-resistance grounding should be offered to improve power continuity, eliminate damage on the occurrence of ground fault, improve coordination and selectivity, and provide a system that enables safe operation and low maintenance cost. *EB*

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