



EXHIBIT 450.11 A current limiter (a special type of high-interrupting-capacity fuse). (Courtesy of Ferraz Shawmut)

- Δ (C) **Grounding.** Where the secondary tie system is grounded, each transformer secondary supplying the tie system shall be grounded in accordance with 250.30 for separately derived systems.

450.7 Parallel Operation. Transformers shall be permitted to be operated in parallel and switched as a unit, provided the overcurrent protection for each transformer meets the requirements of 450.3(A) for primary and secondary protective devices over 1000 volts, or 450.3(B) for primary and secondary protective devices 1000 volts or less.

Parallel operation of transformers that are not switched as a unit can present dangerous backfeed situations for workers performing electrical maintenance. Appropriate lockout/tagout procedures must be implemented during maintenance of electrical equipment operated or connected in parallel. See *NFPA 70E®*, *Standard for Electrical Safety in the Workplace®*, for safety-related work practices and appropriate lockout/tagout procedures.

450.8 Guarding. Transformers shall be guarded as specified in 450.8(A) through (D).

(A) **Mechanical Protection.** Appropriate provisions shall be made to minimize the possibility of damage to transformers from external causes where the transformers are exposed to physical damage.

One method of providing mechanical protection is to strategically place bollards around the transformer. This practice provides a degree of protection from vehicles.

(B) **Case or Enclosure.** Dry-type transformers shall be provided with a noncombustible moisture-resistant case or enclosure that provides protection against the accidental insertion of foreign objects.

(C) **Exposed Energized Parts.** Switches or other equipment operating at 1000 volts, nominal, or less and serving only equipment within a transformer enclosure shall be permitted to be installed in the transformer enclosure if accessible to qualified persons only. All energized parts shall be guarded in accordance with 110.27 and 110.34.

(D) **Voltage Warning.** The operating voltage of exposed live parts of transformer installations shall be indicated by signs or visible markings on the equipment or structures.

- Δ **450.9 Ventilation.** The ventilation shall dispose of the transformer full-load heat losses without creating a temperature rise that is in excess of the transformer rating.

Informational Note No. 1: See IEEE C57.12.00-2015, *General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers*, and IEEE C57.12.01-2020, *General Requirements for Dry-Type Distribution and Power Transformers*, for additional information.

Informational Note No. 2: See IEEE C57.110-2018, *Recommended Practice for Establishing Liquid-Filled and Dry-Type Power and Distribution Transformer Capability When Supplying Nonsinusoidal Load Currents*, for more information where transformers are used with nonlinear loads that have nonsinusoidal currents that can result in additional losses and transformer heating.

Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer. Transformer top surfaces that are horizontal and readily accessible shall be marked to prohibit storage.

450.10 Grounding and Bonding.

(A) **Dry-Type Transformer Enclosures.** Where separate equipment grounding conductors and supply-side bonding jumpers are installed, a terminal bar for all grounding and bonding conductor connections shall be secured inside the transformer enclosure. The terminal bar shall be bonded to the enclosure in accordance with 250.12 and shall not be installed on or over any vented portion of the enclosure.

Exception: Where a dry-type transformer is equipped with wire-type connections (leads), the grounding and bonding connections shall be permitted to be connected together using any of the methods in 250.8 and shall be bonded to the enclosure if of metal.

An enclosure typically is not evaluated as a grounding and bonding device. The required busbar for equipment grounding conductors (EGCs) and bonding jumpers prohibits the practice of using the transformer metal enclosure as a connection point for these conductors.

(B) **Other Metal Parts.** Exposed non-current-carrying metal parts of transformer installations, including fences, guards, and so forth, shall be grounded and bonded under the conditions and in the manner specified for electrical equipment and other exposed metal parts in Parts V, VI, and VII of Article 250.

450.11 Marking.

(A) **General.** Each transformer shall be provided with a nameplate giving the following information: