

(A) Areas Requiring Equipotential Planes. Equipotential planes shall be installed adjacent to all outdoor service equipment or disconnecting means that control equipment in or on water, that have a metallic enclosure and controls accessible to personnel, and that are likely to become energized. The equipotential plane shall encompass the area around the equipment and shall extend from the area directly below the equipment out not less than 900 mm (36 in.) in all directions from which a person would be able to stand and come in contact with the equipment.

(B) Areas Not Requiring Equipotential Planes. Equipotential planes shall not be required for the controlled equipment supplied by the service equipment or disconnecting means.

(C) Bonding.

(1) Bonded Parts. The parts specified in 682.33(C)(1) through (C)(3) shall be bonded together and to the electrical grounding system. Bonding conductors shall be solid copper, insulated, covered or bare, and not smaller than 8 AWG. Connections shall be made by exothermic welding or by listed pressure connectors or clamps that are labeled as being suitable for the purpose and are of stainless steel, brass, copper, or copper alloy.

(2) Outdoor Service Equipment and Disconnects. Outdoor service equipment or disconnecting means that control equipment in or on water, that have a metallic enclosure and controls accessible to personnel, and that are likely to become energized shall be bonded to the equipotential plane.

(3) Walking Surfaces. Surfaces directly below the equipment specified in 682.33(C)(2) but not less than 900 mm (36 in.) in all directions from the equipment from which a person would be able to stand and come in contact with the equipment shall be bonded to the equipotential plane. Bonding to this surface shall be wire mesh or other conductive elements on, embedded in, or placed under the walk surface within 75 mm (3 in.).

A person designated as a qualified person shall possess the skills and knowledge related to the construction and operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.

- (3) Effective safeguards approved by the authority having jurisdiction are established and maintained.

The integrated electrical systems commonly used in large and complex industrial processes are designed, installed, and operated under stringent on-site engineering supervision. The control equipment, including overcurrent devices, is located so that it is accessible to qualified personnel, but that location might not meet — and is not required to meet — the conditions described in the Article 100 definition of the term *accessible, readily (readily accessible)*. Locating overcurrent devices and their associated disconnecting means so that they are not readily accessible to unqualified personnel is one of the preventive measures used to help maintain continuity of operation.

For some industrial processes, the sudden loss of electric power to vital equipment is an unacceptable level of risk, and an orderly shutdown procedure is necessary to prevent severe equipment damage, injury to personnel, or — in some extreme cases — catastrophic failure. Orderly shutdown is commonly employed in nuclear power-generating facilities, paper mills, and other areas with hazardous processes.

685.3 Application of Other Articles. The articles/sections in Table 685.3 apply to particular cases of installation of conductors and equipment, where there are orderly shutdown requirements that are in addition to those of this article or are modifications of them.

TABLE 685.3 Application of Other Articles

Conductor/Equipment	Section
More than one building or other structure	225, Part II
Ground-fault protection of equipment	230.95, Exception
Protection of conductors	240.4
Electrical system coordination	240.12
Ground-fault protection of equipment	240.13(1)
Grounding ac systems of 50 volts to less than 1000 volts	250.21
Equipment protection	427.22
Orderly shutdown	430.44
Disconnection	430.75, Exception Nos. 1 and 2
Disconnecting means in sight from controller	430.102(A), Exception No. 2
Energy from more than one source	430.113, Exception Nos. 1 and 2
Disconnecting means	645.10, Exception
Uninterruptible power supplies (UPS)	645.11(1)
Point of connection	705.12

ARTICLE

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Integrated Electrical Systems

Part I. General

685.1 Scope. This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An *integrated electrical system* as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

- (1) An orderly shutdown is required to minimize personnel hazard and equipment damage.
- (2) The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.