Part VI. Marking

694.52 Power Systems Employing Energy Storage. Wind electric systems employing energy storage shall be marked with the maximum operating voltage, any equalization voltage, and the polarity of the grounded circuit conductor.

694.54 Identification of Power Sources. Wind turbine systems shall be marked with a plaque or directory installed in accordance with 705.10.

694.56 Instructions for Disabling Turbine. A plaque shall be installed at or adjacent to the turbine location providing basic instructions for disabling the turbine.

Part VII. Connection to Other Sources

694.60 Identified Interactive Equipment. Only inverters that are listed, labeled, and identified as interactive shall be permitted in interactive systems.

Δ **694.62 Installation.** Wind electric systems connected to other sources shall be installed in accordance with Parts I and II of Article 705.

694.66 Operating Voltage Range. Wind electric systems connected to dedicated branch or feeder circuits shall be permitted to exceed normal voltage operating ranges on these circuits, provided that the voltage at any distribution equipment supplying other loads remains within normal ranges.

Informational Note: Wind turbines might use the electric grid to dump energy from short-term wind gusts. See ANSI C84.1-2006, *Voltage Ratings for Electric Power Systems and Equipment (60 Hz)*, for information on normal operating voltages.

ARTICLE
695 Fire Pumps

Δ **695.1 Scope.**

(A) Covered. This article covers the installation of the following:

(1) Electric power sources and interconnecting circuits
(2) Switching and control equipment dedicated to fire pump drivers

Informational Note: Text that is followed by a reference in brackets has been extracted from NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*. Only editorial changes were made to the extracted text to make it consistent with this *Code*.

Δ **(B) Not Covered.** This article does not cover the following:

(1) The performance, maintenance, and acceptance testing of the fire pump system and the internal wiring of the components of the system
(2) The installation of pressure maintenance (jockey or makeup) pumps

Informational Note No. 1: See Article 430 for the installation of pressure maintenance (jockey or makeup) pumps supplied by the fire pump circuit or another source.

(3) Transfer equipment upstream of the fire pump transfer switch(es)

Informational Note No. 2: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, for further information.

(4) Water pumps installed in one- and two-family dwellings and used for fire suppression

Informational Note No. 3: See NFPA 13D-2019, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, for further information.

The requirements covering reliable power supplies for electric fire pump motors correlate with those in NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*. However, the *NEC*® and NFPA 20 have a distinct division of responsibility for fire pump requirements. Performance issues, including the determination of power supply reliability, are under the jurisdiction of the NFPA Technical Committee on Fire Pumps, while electrical installation requirements are within the purview of the National Electrical Code Committee.

An electric motor–driven fire pump such as the one shown in Exhibit 695.1 is covered by the requirements of Article 695. If a pump is installed in accordance with NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, the requirements of Article 695 and NFPA 20 do not apply to the electrical installation.

Although the installation requirements for pressure maintenance (jockey) pumps are not covered by Article 695, these pumps are permitted by NFPA 20 to be supplied by a fire pump service or feeder or by a separate supply.

In respect to the power supply for a fire pump, Article 695 permits a single source if it is deemed to be reliable by the AHJ. This differs from the approach taken in Article 700 for emergency systems, where in all cases there has to be some form of alternate power in the event of an interruption of the normal power source. There are a number of similarities between Articles 695 and 700 in respect to minimizing potential failure points in the circuit supplying equipment that performs the critical building and life safety functions covered in each article. Requirements such as protecting feeder circuit conductors with a 2-hour enclosure, a 2-hour fire-resistive cable system, or encasement in 2 inches of concrete are contained in both Articles 695 and 700.

N **695.2 Reconditioned Equipment.** Reconditioned fire pump controllers and transfer switches shall not be permitted.

Δ **695.3 Power Source(s) for Electric Motor-Driven Fire Pumps.** Electric motor-driven fire pumps shall have a reliable source of power.

EXHIBIT 695.1 An electric motor specifically listed for fire pump service. *(Courtesy of Liberty Mutual Insurance)*

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, 9.3.2 and A.9.3.2, for guidance on the determination of power source reliability.

(A) Individual Sources. Where reliable, and where capable of carrying indefinitely the sum of the locked-rotor current of the fire pump motor(s) and the pressure maintenance pump motor(s) and the full-load current of the associated fire pump accessory equipment when connected to this power supply, the power source for an electric motor driven fire pump shall be one or more of the following.

These two main requirements, reliability and locked-rotor capacity, ensure that the fire pump operates in the event of a fire without interruption of power and that the fire pump continues to operate until the fire is extinguished, the fire pump is purposely shut down, or the pump itself is destroyed.

The determination of whether the serving electric utility is a reliable source of power is an issue for the AHJ. The following excerpt from A.9.3.2 in Annex A of NFPA 20 elaborates on several key characteristics of a reliable power supply:

A reliable power source possesses the following characteristics:

(1) The source power plant has not experienced any shutdowns longer than 10 continuous hours in the year prior to plan submittal. NFPA 25 requires special undertakings (i.e., fire watches) when a water-based fire protection system is taken out of service for longer than 10 hours. If the normal source power plant has been intentionally shut down for longer than 10 hours in the past, it is reasonable to require a backup source of power.

(2) Power outages have not routinely been experienced in the area of the protected facility caused by failures in generation or transmission. This standard is not intended to require that the normal source of power be infallible to deem the power reliable. NFPA 20 does not intend to require a backup source of power for every installation using an electric motor–driven fire pump.

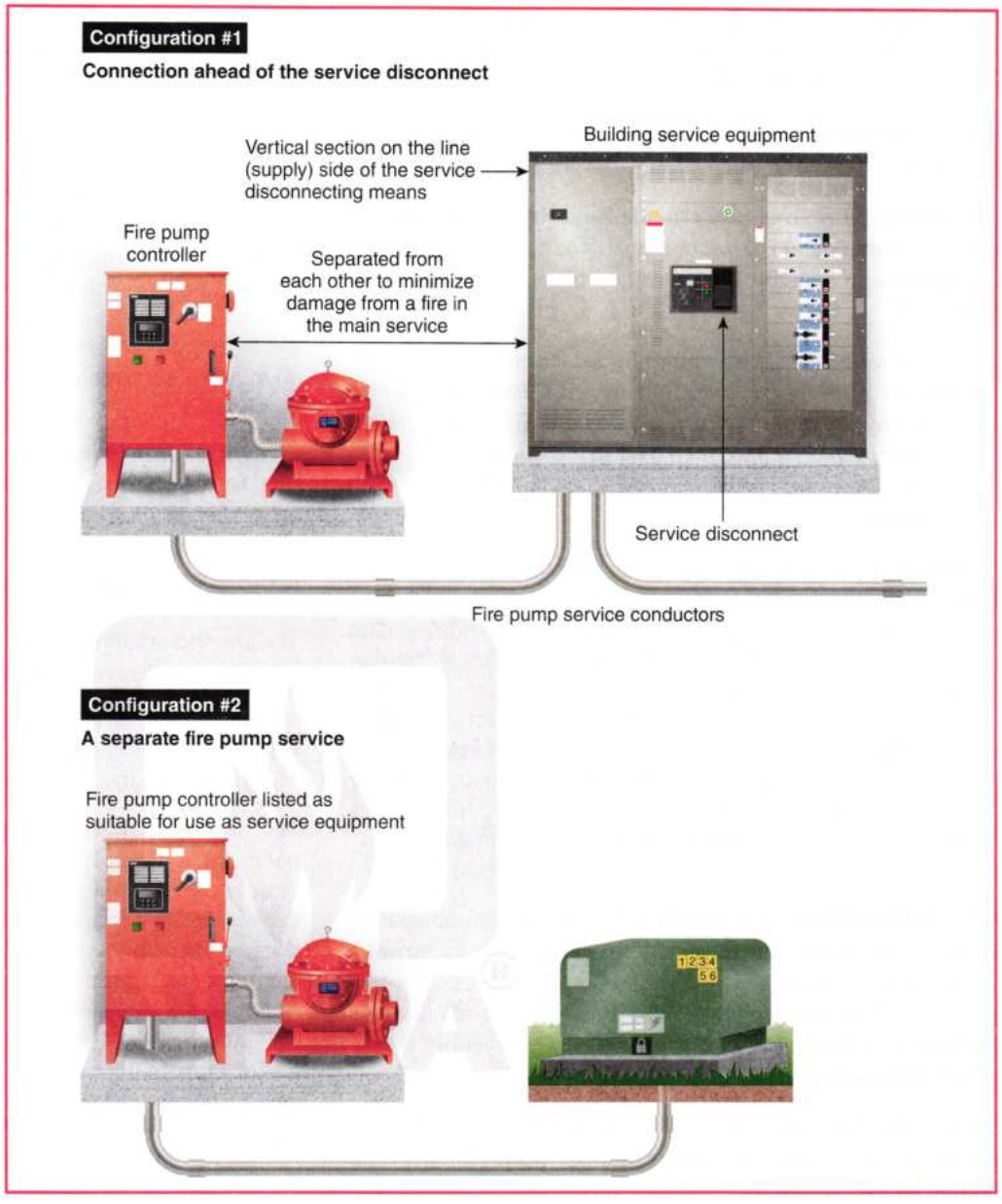
(3) The normal source of power is not supplied by overhead conductors outside the protected facility. Fire departments responding to an incident at the protected facility will not operate aerial apparatus near live overhead power lines, without exception. A backup source of power is required in case this scenario occurs and the normal source of power must be shut off. Additionally, many utility providers will remove power to the protected facility by physically cutting the overhead conductors. If the normal source of power is provided by overhead conductors, which will not be identified, the utility provider could mistakenly cut the overhead conductor supplying the fire pump.

(4) Only the disconnect switches and overcurrent protection devices permitted by 9.2.3 [of NFPA 20] are installed in the normal source of power. Power disconnection and activated overcurrent protection should occur only in the fire pump controller. The provisions of 9.2.2 [of NFPA 20] for the disconnect switch and overcurrent protection essentially require disconnection and overcurrent protection to occur in the fire pump controller. If unanticipated disconnect switches or overcurrent protection devices are installed in the normal source of power that do not meet the requirements of 9.2.2 [of NFPA 20], the normal source of power must be considered not reliable and a backup source of power is necessary.

Performance requirements for the alternate source of electric power can be found in NFPA 110, *Standard for Emergency and Standby Power Systems*.

(1) Electric Utility Service Connection. A fire pump shall be permitted to be supplied by a separate service, or from a connection located ahead of and not within the same cabinet, enclosure, vertical switchgear section, or vertical switchboard section as the service disconnecting means. The connection shall be located and arranged so as to minimize the possibility of damage by fire from within the premises and from exposing hazards. A tap ahead of the service disconnecting means shall comply with 230.82(5). The service equipment shall comply with the labeling requirements in 230.2 and the location requirements in 230.72(B). [**20:**9.2.2(1)]

EXHIBIT 695.2 Two permitted configurations for connecting to an electric utility–supplied service.



The top section of Exhibit 695.2 shows a single service in which a dedicated set of service-entrance conductors for the fire pump is tapped to the incoming service conductors ahead of and separate from the service disconnecting means. This tap is permitted under the conditions specified in 230.40, Exception No. 5, which references systems covered by 230.82(5). The bottom section of Exhibit 695.2 shows a dedicated service supplying the fire pump as permitted by 230.2(A)(1). Both configurations shown in Exhibit 695.2 minimize the potential for accidental disconnection during response to a fire.

(2) On-Site Power Production Facility. A fire pump shall be permitted to be supplied by an on-site power production facility. The source facility shall be located and protected to minimize the possibility of damage by fire. [**20:**9.2.2(3)]

On-site power production facilities are permitted to be used as the sole power source for an electrically driven fire pump motor. See Article 100 for the definition of the term *facility, on-site power production*.

(3) Dedicated Feeder. A dedicated feeder shall be permitted where it is derived from a service connection as described in 695.3(A)(1). [**20:**9.2.2(3)]

Informational Note: See NFPA 20-2019, *Standard for the Installation of Stationary Pumps for Fire Protection*, 9.2.2, for more information on normal power sources. Subsection 9.2.2(3) permits a "dedicated feeder" to be derived from a "dedicated service" disconnecting means. Subsection 9.2.2(5) permits a "dedicated transformer connection" that is supplied directly from a "dedicated service disconnecting means" where the service is not at utilization voltage.

(B) Multiple Sources. If reliable power cannot be obtained from a source described in 695.3(A), power shall be supplied by one of the following: [**20:**9.3.2]

(1) Individual Sources. An approved combination of two or more of the sources from 695.3(A).

(2) Individual Source and On-site Standby Generator. An approved combination of one or more of the sources in 695.3(A) and an on-site standby generator complying with 695.3(D). [**20:**9.3.4]

Exception to 695.3(B)(1) and (B)(2): An alternate source of power shall not be required where a back-up engine-driven fire pump, back-up steam turbine-driven fire pump, or back-up electric motor-driven fire pump with an independent power source in accordance with 695.3(A) or (C) is installed.

If none of the power supply sources specified in 695.3(A)(1) through (A)(3) can individually provide reliable power with adequate capacity, 695.3(B) permits an approved combination (two or more) of those sources or a combination of one or more of those sources with an on-site standby generator.

In lieu of installing an on-site standby generator, an engine- or steam turbine–driven fire pump can be provided as backup for an electric fire pump. In that instance, the electric fire pump is permitted to be supplied by only a single power source. This allowance provides some design options for augmenting an electric fire pump that is supplied by an unreliable source.

(C) Multibuilding Campus-Style Complexes. If the sources in 695.3(A) are not practicable and the installation is part of a multibuilding campus-style complex, feeder sources shall be permitted if approved by the authority having jurisdiction and installed in accordance with either 695.3(C)(1) and (C)(3) or (C)(2) and (C)(3).

(1) Feeder Sources. Two or more feeders shall be permitted as more than one power source if such feeders are connected to, or derived from, separate utility services. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

Δ **(2) Feeder and Alternate Source.** A feeder shall be permitted as a normal power source if an alternate power source independent from the feeder is provided. The connection(s), overcurrent protective device(s), and disconnecting means for such feeders shall meet the requirements of 695.4(B)(1)(b).

Section 695.3(C) allows fire pumps to be supplied by feeder circuits that are part of a medium- or high-voltage premises wiring system. This distribution arrangement is common in industrial and institutional campus settings. The conductors supplied by the higher voltage level distribution systems are not service conductors, because the service point and the service-disconnecting means generally are located at a campus distribution switchyard or distribution building. Also, all the distribution conductors on the load side of the service equipment, even though they resemble electric utility–type distribution, are considered to be feeders or — in some cases where the circuit supplies a single piece of utilization equipment — branch circuits.

A fire pump supplied by a radial loop type of distribution system (commonly used for medium- and high-voltage distribution) where the two feeders originate from a single substation has to be augmented by an on-site standby generator. In the system shown in Exhibit 695.3, the two feeders originate from different utility substations, a distribution arrangement that allows the two feeders, without an on-site standby generator, to be multiple sources for the electric fire pump as permitted by 695.3(C)(1).

(3) Selective Coordination. Overcurrent protective device(s) shall be selectively coordinated with all supply-side overcurrent protective device(s).

Selective coordination shall be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems. The selection shall be documented and made available to those authorized to design, install, maintain, and operate the system.

Exception: Selective coordination shall not be required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device.

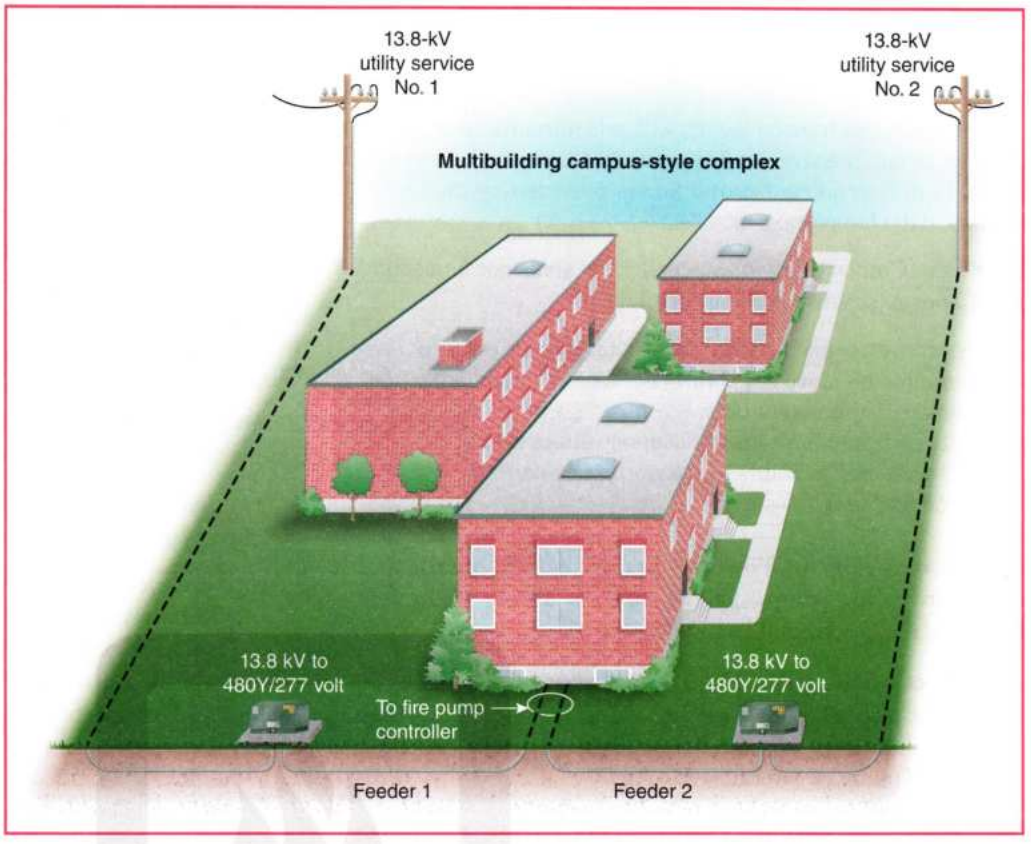
The term *coordination, selective (selective coordination)*, as defined in Article 100, indicates that a selectively coordinated system is one in which the operation of the overcurrent protective scheme localizes an overcurrent condition to the circuit conductors or equipment in which an overload or fault (short circuit or ground fault) has occurred. Because a fire suppression system is intended to provide occupants time to exit the building and to protect property, a selectively coordinated overcurrent protection scheme that localizes and minimizes the extent of an interruption of power due to the opening of a protective device is a critical safety element.

Design and verification of electrical system coordination can be achieved only through a coordination study performed by an engineer or other person with experience in designing coordinated electrical systems. A coordination study entails detailed analysis of electrical supply system fault-current characteristics. The design must integrate overcurrent protective devices (OCPDs) that interact by localizing the overcurrent condition and isolating that part of the emergency system. Modifications to the electrical system after the initial design and installation can affect the original implementation of the coordinated system.

(D) On-Site Standby Generator as Alternate Source. An on-site standby generator(s) used as an alternate source of power shall comply with 695.3(D)(1) through (D)(3). [**20:**9.6.2.1]

(1) Capacity. The generator shall have sufficient capacity to allow normal starting and running of the motor(s) driving the fire pump(s) while supplying all other simultaneously operated load(s). [**20:**9.6.1.1]

EXHIBIT 695.3 Multiple feeder sources for campus-style application.



Automatic shedding of one or more optional standby loads in order to comply with this capacity requirement shall be permitted.

Only the sources specified in 695.3(A)(1) through (A)(3) are required to be capable of indefinitely carrying the locked-rotor current of the fire pump motor. On-site standby generators are required only to be capable of carrying the starting and running current of the fire pump motor. The generator disconnecting means and the OCPD(s) for the electric-driven fire pump are not required to be sized for locked-rotor current of the fire pump motor(s).

(2) Connection. A tap ahead of the generator disconnecting means shall not be required. [**20:**9.6.1.2]

(3) Adjacent Disconnects. The requirements of 430.113 shall not apply.

(E) Arrangement. All power supplies shall be located and arranged to protect against damage by fire from within the premises and exposing hazards. [**20:**9.1.4]

Multiple power sources shall be arranged so that a fire at one source does not cause an interruption at the other source.

A risk assessment should be performed to determine potential fire hazard exposures to the installation. Determining compliance of the installation with this section requires review of individual building or structure characteristics. The type of construction, type of content, proximity of the building to other hazard exposures, and the location of the primary and alternate power sources for the fire pump should be considered.

(F) Transfer of Power. Transfer of power to the fire pump controller between the individual source and one alternate source shall take place within the pump room. [**20:**9.6.4]

(G) Power Source Selection. Selection of power source shall be performed by a transfer switch listed for fire pump service. [**20:**10.8.1.3.1]

Transfer switches specifically listed for fire pump service must meet additional requirements in the product standards, such as the following:

- They must be electrically operated and mechanically held. This eliminates contactor-type transfer switches or schemes that do not include a mechanical latching mechanism.
- They must be horsepower or ampere rated. Where rated in horsepower, the transfer switch must have a horsepower rating at least equal to the motor horsepower. The listing requirements for short-circuit current rating of transfer switches is a function of the OCPD installed ahead of the switch. Because the OCPD must be sized to at least 600 percent of the full-load current of the fire pump motor(s), the switch must be sized to coordinate with the OCPD rating.

(H) Overcurrent Device Selection. An instantaneous trip circuit breaker shall be permitted in lieu of the overcurrent devices

specified in 695.4(B)(2)(a)(1), provided that it is part of a transfer switch assembly listed for fire pump service that complies with 695.4(B)(2)(a)(2).

A listed fire pump transfer switch with a factory-installed instantaneous circuit breaker provides ground-fault and short-circuit protection. Overcurrent protection is provided by the circuit breaker in the fire pump controller.

(I) Phase Converters. Phase converters shall not be used to supply power to a fire pump. [**20:**9.1.7]

A phase converter used in a fire pump circuit would be in continuous operation because the controller has to be constantly powered. Voltage imbalance between phases under unloaded or lightly loaded conditions could adversely affect electronics integral to the controller. This is the reason phase converters are not permitted for fire pump service.

695.4 Continuity of Power. Circuits that supply electric motor–driven fire pumps shall be supervised from inadvertent disconnection as covered in 695.4(A) or (B).

(A) Direct Connection. The supply conductors shall directly connect the power source to a listed fire pump controller, a listed combination fire pump controller and power transfer switch, or a listed fire pump power transfer switch.

(B) Connection Through Disconnecting Means and Overcurrent Device.

Section 695.4(B) permits, but does not require, the installation of a disconnecting means and associated overcurrent protection between a power source and the fire pump control devices described in 695.4(B)(1). Other *NEC* requirements — such as 230.70 and 225.31 — could necessitate the installation of the disconnecting means and overcurrent protection covered in the requirements of 695.4(B). While not always possible, the best method to provide continuity of power is the direct connection of the source to the fire pump control equipment in accordance with 695.4(A). The permitted additional disconnect facilitates the creation of an electrically safe work condition as required by *NFPA 70E®, Standard of Electrical Safety in the Workplace®*, while maintenance of the fire pump controller is being performed.

(1) Number of Disconnecting Means.

(a) *General.* A single disconnecting means and associated overcurrent protective device(s) shall be permitted to be installed between the fire pump power source(s) and one of the following: [**20:**9.2.3]

(1) A listed fire pump controller
(2) A listed fire pump power transfer switch
(3) A listed combination fire pump controller and power transfer switch

(b) *Feeder Sources.* For systems installed under the provisions of 695.3(C) only, additional disconnecting means and the associated overcurrent protective device(s) shall be permitted.

(c) *On-Site Standby Generator.* Where an on-site standby generator is used to supply a fire pump, an additional disconnecting means and an associated overcurrent protective device(s) shall be permitted.

An on-site standby generator equipped with an integral disconnecting means and overcurrent protection is allowed in addition to a disconnecting means and overcurrent protection installed elsewhere in the alternate supply circuit to the fire pump. The second disconnecting means and overcurrent device could be located in distribution equipment and is required to comply with the requirements of 695.4(B)(2)(b) and 695.4(B)(3)(b) through (3)(e).

(2) Overcurrent Device Selection. Overcurrent devices shall comply with 695.4(B)(2)(a) or (B)(2)(b).

(a) *Individual Sources.* Overcurrent protection for individual sources shall comply with the following:

(1) Overcurrent protective device(s) shall be rated to carry indefinitely the sum of the locked-rotor current of the largest fire pump motor and the full-load current of all of the other pump motors and accessory equipment. [**20:**9.2.3.4] Where the locked-rotor current value does not correspond to a standard overcurrent device size, the next standard overcurrent device size shall be used in accordance with 240.6. The requirement to carry the locked-rotor currents indefinitely shall not apply to conductors or devices other than overcurrent devices in the fire pump motor circuit(s).

Exception: The requirement to carry the locked-rotor currents indefinitely shall not apply to feeder overcurrent protective devices installed in accordance with 695.3(C).

A key factor in the reliable power source equation is sizing the overcurrent protection in a supervised fire pump disconnecting means so it is able to carry locked-rotor current (LRC) indefinitely. Opening of the circuit by an overcurrent device installed in a fire pump circuit cannot be tolerated, except under short circuits or ground faults. The circuit has to perform as if a direct connection exists to the power source. Sizing for LRC applies only to OCPDs and not to the conductors or other devices in the fire pump motor circuit. Similar requirements are contained in 695.5(B) and 695.5(C)(2). Alternately, a listed fire pump assembly complying with 695.4(B)(2) is permitted.

It is unlikely that all fire pumps on a circuit will be under simultaneous locked-rotor conditions. Therefore, only the LRC of the largest fire pump motor is required. Full-load current is used for all other pump motors and accessory equipment.

(2) Overcurrent protection shall be provided by an assembly listed for fire pump service and complying with the following:

a. The overcurrent protective device shall not open within 2 minutes at 600 percent of the full-load current of the fire pump motor(s).