**Chapter 11 Building Services**

11.1 Electrical Fire Safety

11.1.1 General

Section 11.1 shall apply to permanent and temporary electrical appliances, equipment, fixtures, and wiring.

11.1.2 Permanent Wiring, Fixtures, and Equipment

11.1.2.1

All new electrical wiring, fixtures, appliances and equipment shall be installed in accordance with NFPA 70.

11.1.2.2

Unless determined to present an imminent danger, existing electrical wiring, fixtures, appliances, and equipment shall be permitted to be maintained in accordance with the edition of NFPA 70 in effect at the time of the installation.

11.1.2.2.1\*

Where the AHJ determines that there is sufficient evidence that existing electrical wiring, fixtures, appliances, or equipment is potentially unsafe, the AHJ is authorized to require an evaluation of the existing electrical wiring, fixtures, appliances, or equipment, or portion thereof, by a qualified person.

11.1.2.2.2

The qualified person shall provide a report to the AHJ with an assessment of the condition of the electrical wiring, fixtures, appliances, or equipment along with recommendations for any needed repairs to correct the unsafe condition (s).

11.1.2.3

Permanent wiring abandoned in place shall be tagged or otherwise identified at its termination and junction points as "Abandoned in Place" or removed from all accessible areas and insulated from contact with other live electrical wiring or devices.

11.1.3 Multiplug Adapters

11.1.3.1

Multiplug adapters, such as multiplug extension cords, cube adapters, strip plugs, and other devices, shall be listed and used in accordance with their listing.

11.1.3.2

Multiplug adapters shall not be used as a substitute for permanent wiring or receptacles.

11.1.4 Relocatable Power Taps

11.1.4.1

Relocatable power taps shall be listed to UL 1363, Relocatable Power Taps, or UL 1363A, Outline of Investigation for Special Purpose Relocatable Power Taps, where applicable.

11.1.4.2

The relocatable power taps shall be directly connected to a permanently installed receptacle.

11.1.4.3

Relocatable power tap cords shall not extend through walls, ceilings, or floors; under doors or floor coverings; or be subject to environmental or physical damage.

11.1.5\* Extension Cords

11.1.5.1

Extension cords shall be plugged directly into an approved receptacle, power tap, or multiplug adapter and shall, except for approved multiplug extension cords, serve only one portable appliance.

11.1.5.2\*

The ampacity of the extension cords shall not be less than the rated capacity of the portable appliance supplied by the cord.

11.1.5.3

The extension cords shall be maintained in good condition without splices, deterioration, or damage.

11.1.5.4

Extension cords shall be grounded when servicing grounded portable appliances.

11.1.5.5

Extension cords and flexible cords shall not be affixed to structures; extend through walls, ceilings, or floors, or under doors or floor coverings; or be subject to environmental or physical damage.

11.1.5.6\*

Extension cords shall be permitted to be used on portable appliances to the nearest receptacle where receptacle spacing is in accordance with NFPA 70.

11.1.6 Temporary Installations

11.1.6.1 Scope

The provisions of 11.1.6 apply to temporary electric power and lighting installations. [70:590.1]

11.1.6.2 All Wiring Installations

11.1.6.2.1 Other Articles

Except as specifically modified in Article 590 of NFPA 70, all other requirements of NFPA 70 for permanent wiring shall apply to temporary wiring installations. [70:590.2(A)]

11.1.6.2.2 Approval

Temporary wiring methods shall be acceptable only if approved based on the conditions of use and any special requirements of the temporary installation. [70:590.2(B)]

11.1.6.3 Time Constraints

11.1.6.3.1 During the Period of Construction

Temporary electric power and lighting installations shall be permitted during the period of construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities. [70:590.3(A)]

11.1.6.3.2 90 Days

Temporary electric power and lighting installations shall be permitted for a period not to exceed 90 days for holiday decorative lighting and similar purposes. [70:590.3(B)]

11.1.6.3.3 Emergencies and Tests

Temporary electric power and lighting installations shall be permitted during emergencies and for tests, experiments, and developmental work. [70:590.3(C)]

11.1.6.3.4 Removal

Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed. [70:590.3(D)]

11.1.7 Building Disconnect

11.1.7.1\*

Means shall be provided for the fire department to disconnect the electrical service to a building, structure, or facility when the electrical installation is covered under the scope of NFPA 70.

11.1.7.2

The disconnecting means shall be maintained accessible to the fire department.

11.1.7.3 Identification of Disconnecting Means

11.1.7.3.1

Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. In other than one- or two-family dwellings, the marking shall include the identification of the circuit source that supplies the disconnecting means. The marking shall be of sufficient durability to withstand the environment involved. [70:110.22(A)]

11.1.8 Covers

All panelboard and switchboards, pull boxes, junction boxes, switches, receptacles, and conduit bodies shall be provided with covers compatible with the box or conduit body construction and suitable for the conditions of use.

11.2 Heating, Ventilation, and Air-Conditioning

11.2.1 Air-Conditioning, Heating, Ventilating Ductwork, and Related Equipment

Air-conditioning, heating, ventilating ductwork, and related equipment shall be in accordance with NFPA 90A or NFPA 90B as applicable, unless such installations are approved existing installations, which shall be permitted to be continued in service. [101:9.2.1]

11.2.2 Ventilating or Heat-Producing Equipment

Ventilating or heat-producing equipment shall be in accordance with NFPA 31, NFPA 54, NFPA 70, NFPA 91, or NFPA 211, as applicable, unless such installations are approved existing installations, which shall be permitted to be continued in service. [101:9.2.2]

11.3 Elevators, Escalators, and Conveyors

11.3.1 Fire Fighters' Emergency Operations

11.3.1.1

All new elevators shall conform to the fire fighters' emergency operations requirements of ASME A17.1/CSA B44, Safety Code for Elevators and Escalators. [101:9.4.3.1]

11.3.1.2

All existing elevators having a travel distance of 25 ft (7620 mm) or more above or below the level that best serves the needs of emergency personnel for fire-fighting or rescue purposes shall conform to the fire fighters' emergency operations requirements of ASME A17.3, Safety Code for Existing Elevators and Escalators. [101:9.4.3.2]

11.3.2 Number of Cars

The number of elevator cars permitted in a hoistway shall be in accordance with 8.6.9.4 of NFPA 101. [101:9.4.4]

11.3.3\* Elevator Machine Rooms

Elevator machine rooms that contain solid-state equipment for elevators, other than existing elevators, having a travel distance exceeding 50 ft (15 m) above the level of exit discharge or exceeding 30 ft (9.1 m) below the level of exit discharge shall be provided with independent ventilation or air-conditioning systems to maintain temperature during fire fighters' emergency operations for elevator operation (see 11.3.1). The operating temperature shall be established by the elevator equipment manufacturer's specifications. When standby power is connected to the elevator, the machine room ventilation or air-conditioning shall be connected to standby power. [101:9.4.5]

11.3.4 Elevator Testing

11.3.4.1

Elevators shall be subject to periodic inspections and tests as specified in ASME A17.1/CSA B44, Safety Code for Elevators and Escalators. [101:9.4.6.1]

11.3.4.2

All elevators equipped with fire fighters' emergency operations in accordance with 11.3.1 shall be subject to a monthly operation with a written record of the findings made and kept on the premises as required by ASME A17.1/CSA B44, Safety Code for Elevators and Escalators. [101:9.4.6.2]

11.3.4.3

The elevator inspections and tests required by 11.3.4.1 shall be performed at frequencies complying with one of the following:

Inspection and test frequencies specified in Appendix N of ASME A17.1/CSA B44, Safety Code for Elevators and Escalators

Inspection and test frequencies specified by the AHJ

[101:9.4.6.3]

11.3.5 Openings to Exit Enclosures

Conveyors, elevators, dumbwaiters, and pneumatic conveyors serving various stories of a building shall not open to an exit enclosure. [101:9.4.7]

11.3.6 Standardized Fire Service Elevator Keys

11.3.6.1

Buildings with elevators equipped with Phase I emergency recall, Phase II emergency in-car operation, or a fire service access elevator shall be equipped to operate with a standardized fire service key complying with ASME A17.1/CSA B44, Safety Code for Elevators and Escalators, except as otherwise permitted by 11.3.6.

11.3.6.2

Existing buildings with elevators equipped with Phase I emergency recall or Phase II emergency in-car operation shall be permitted to comply with 11.3.6.3.

11.3.6.3 Existing Buildings

Existing buildings shall be in compliance with the provisions of 11.3.6.3.1 one year after adoption by the AHJ.

11.3.6.3.1

Where a standardized key cylinder cannot be installed in an existing elevator key switch assembly, the building's nonstandardized fire service elevator keys shall be provided in an access box in accordance with 11.3.6.3.1.1 through 11.3.6.3.1.6.

11.3.6.3.1.1

The access box shall be compatible with an existing rapid-entry access box system in use in the jurisdiction and approved by the AHJ.

11.3.6.3.1.2

The front cover shall be permanently labeled with the words "Fire Department Use Only — Elevator Keys."

11.3.6.3.1.3

The access box shall be mounted at each elevator bank at the lobby nearest to the lowest level of fire department access.

11.3.6.3.1.4

The access box shall be mounted at a location approved by the AHJ.

11.3.6.3.1.5

Contents of the access box shall be limited to the fire service elevator key. Additional elevator access tools, keys, and information pertinent to emergency planning or elevator access shall be permitted when authorized by the AHJ.

11.3.6.3.1.6

In buildings with two or more elevator banks, a single access box shall be permitted to be used where such elevator banks are separated by not more than 30 ft (9140 mm). Additional access boxes shall be provided for each individual elevator or elevator bank separated by more than 30 ft (9140 mm).

11.3.6.3.1.7

A single access box shall be permitted to be located adjacent to a fire command center, or the nonstandard fire service elevator key shall be secured in an access box used for other purposes and located in accordance with 18.2.2.1 when approved by the AHJ.

11.3.7 Elevators for Occupant-Controlled Evacuation Prior to Phase I Emergency Recall Operations and Fire Service Access Elevators

An approved method to prevent automatic sprinkler water from infiltrating into the hoistway enclosure from the operation of the automatic sprinkler system outside the enclosed occupant evacuation elevator lobby shall be provided where the hoistway serves elevators in accordance with any of the following:

Occupant-controlled evacuation elevators in accordance with Section 7.14 of NFPA 101

Occupant-controlled evacuation elevators in accordance with the building code

Fire service access elevators in accordance with the building code

11.4 Utilities

Equipment using fuel gas and related gas piping shall be in accordance with NFPA 54 or NFPA 58. (See Chapter 69 for LP-Gas fuel supply and storage installations.)

11.4.1

Existing installations shall be permitted to be continued in service, subject to approval by the AHJ.

11.4.2

Aboveground gas meters, regulators, and piping exposed to vehicular damage shall be protected in accordance with 60.5.1.9.

11.5 Heating Appliances

11.5.1 General

11.5.1.1

The installation of stationary liquid fuel-burning appliances, including but not limited to industrial-, commercial-, and residential-type steam, hot water, or warm air heating appliances; domestic-type range burners; space heaters; and portable liquid fuel-burning equipment shall comply with Section 11.5 and NFPA 31.

11.5.1.2

Section 11.5 shall also apply to all accessories and control systems, whether electric, thermostatic, or mechanical, and all electrical wiring connected to liquid fuel-burning appliances. [31:1.1.2]

11.5.1.3

Section 11.5 shall also apply to the installation of liquid fuel storage and supply systems connected to liquid fuel-burning appliances. [31:1.1.3]

11.5.1.4

Section 11.5 shall also apply to those multifueled appliances in which a liquid fuel is one of the standard or optional fuels. [31:1.1.4]

11.5.1.5\*

Section 11.5 shall not apply to internal combustion engines, oil lamps, or portable devices not specifically covered in NFPA 31. (See Chapter 11 of NFPA 31 for portable devices that are covered in NFPA 31.) [31:1.1.5]

11.5.1.6

The installation of gas-fired heating appliances shall comply with Section 11.5 and NFPA 54. (See Chapter 69 for LP-Gas fuel supply and storage installations.)

11.5.1.7

All heating appliances shall be approved or listed.

11.5.1.8 Permits

Permits, where required, shall comply with Section 1.12.

11.5.1.9

Electrical wiring and utilization equipment used in connection with oil-burning appliances or equipment shall be installed in accordance with Section 11.1. [31:4.4.1]

11.5.1.10 Acceptable Liquid Fuels

11.5.1.10.1\*

The type and grade of liquid fuel used in a liquid fuel-burning appliance shall be that type and grade for which the appliance is listed and approved or is stipulated by the manufacturer. Liquid fuels shall meet one of the following specifications and shall not contain gasoline or any other flammable liquid:

ASTM D396, Standard Specification for Fuel Oils

ASTM D3699, Standard Specification for Kerosine

ASTM D6448, Industrial Burner Fuels from Used Lube Oils

ASTM D6751, Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels

ASTM D6823, Standard Specification for Commercial Boiler Fuels with Used Lubricating Oils

ASTM D7666, Standard Specification for Triglyceride Burner Fuel

[31:4.5.1]

11.5.1.10.2

Appliances that burn crankcase oil or used oil shall not be used in a residential occupancy. Such appliances shall only be used if all of the following conditions are met:

The installation is in a commercial or industrial occupancy.

The oil-burning appliance is designed to burn crankcase oil or used oil and is listed for such use.

The appliance is installed in accordance with the manufacturer's instructions and with the terms of its listing.

The installation meets the applicable requirements of Section 4.6 of NFPA 31 and Chapter 12 of NFPA 31.

[31:4.5.2]

11.5.1.10.3\*

Where heavy oils are used, the following shall be required:

The oil-burning appliance shall be designed to burn such fuels.

Means shall be provided to maintain the oil at its proper atomizing temperature.

Automatically operated burners that require preheating of oil shall be arranged so that no oil can be delivered for combustion until the oil is at the proper atomizing temperature.

\*Use of an oil-fired appliance that is listed in accordance with UL 296A, Waste Oil-Burning Air-Heating Appliances, shall be deemed as meeting the intent of 11.5.1.10.3(1) through 11.5.1.10.3(3).

[31:4.5.3]

11.5.1.10.4

A properly sized and rated oil filter or strainer shall be installed in the oil supply line to an oil burner. [31:4.5.4]

11.5.1.11 Clothes Dryers

11.5.1.11.1

Clothes dryers shall be cleaned to maintain the lint trap and keep the mechanical and heating components free from excessive accumulations of lint.

11.5.1.11.2

The requirements of 11.5.1.11.1 shall not apply to clothes dryers in individual dwelling units of residential occupancies.

11.5.2 Kerosene Burners and Oil Stoves

11.5.2.1

Kerosene burners and oil stoves shall be equipped with a primary safety control furnished as an integral part of the appliance by the manufacturer to stop the flow of oil in the event of flame failure. Barometric oil feed shall not be considered a primary safety control.

11.5.2.2

A conversion range oil burner shall be equipped with a thermal (heat-actuated) valve in the oil supply line, located in the burner compartment of the stove.

11.5.2.3

Kerosene heaters shall be listed and labeled in accordance with UL 647, Unvented Kerosene-Fired Room Heaters and Portable Heaters, and their use shall meet all of the following:

Adequate ventilation shall be provided.

Kerosene heaters shall not be placed on carpeting.

Kerosene heaters shall be located not less than 3 ft (0.9 m) from combustible furnishings and drapes.

Only approved Type 1-K water clear kerosene shall be used.

Kerosene heaters shall be allowed to cool before refueling.

11.5.3 Portable Electric Heater

11.5.3.1

The AHJ shall be permitted to prohibit use of portable electric heaters in occupancies or situations where such use or operation would present an undue danger to life or property.

11.5.3.2

Portable electric heaters shall be designed and located so that they cannot be easily overturned.

11.5.3.3

All portable electric heaters shall be listed.

11.5.4 Vents

All chimneys, smokestacks, or similar devices for conveying smoke or hot gases to the outer air and the stoves, furnaces, incinerators, boilers, or any other heat-producing devices or appliances shall be installed and maintained in accordance with NFPA 54 and NFPA 211.

11.6 Waste Chutes, Incinerators, and Laundry Chutes

Diagram

UpCodes Diagrams

P

Rubbish and Laundry Chutes

11.6.1 Enclosure

11.6.1.1

Waste chutes and laundry chutes shall be separately enclosed by walls or partitions in accordance with the provisions of Section 12.7. [101:9.5.1.1]

11.6.1.2

Chute intake openings shall be protected in accordance with Section 12.7. [101:9.5.1.2]

11.6.1.3

The doors of chutes specified in 11.6.1.2 shall open only to a room that is designed and used exclusively for accessing the chute opening. [101:9.5.1.3]

11.6.1.4

Chute service opening rooms shall be separated from other spaces in accordance with Section 8.7 of NFPA 101. [101:9.5.1.4]

11.6.1.5

The requirements of 11.6.1.1 through 11.6.1.4 shall not apply where otherwise permitted by the following:

Existing installations having properly enclosed service chutes and properly installed and maintained chute intake doors shall be permitted to have chute intake doors open to a corridor or normally occupied space.

Waste chutes and laundry chutes shall be permitted to open into rooms not exceeding 400 ft 2 (37 m 2) that are used for storage, provided that the room is protected by automatic sprinklers.

[101:9.5.1.5]

11.6.2 Installation and Maintenance

Waste chutes, laundry chutes, and incinerators shall be installed and maintained in accordance with NFPA 82 unless such installations are approved existing installations, which shall be permitted to be continued in service. [101:9.5.2]

11.7 Stationary Generators and Standby Power Systems

11.7.1 Scope

11.7.1.1

Stationary generators and standby power systems shall comply with Section 11.7.

11.7.1.2

Section 11.7 shall not apply to portable generators. (See Section 10.15.)

11.7.2 Stationary Combustion Engines and Gas Turbines Installation

Stationary generator sets shall be installed in accordance with NFPA 37 and NFPA 70.

11.7.3 Emergency and Legally Required Standby Power Systems

11.7.3.1 General

New stationary generators for emergency use or for legally required standby power required by this Code, the building code, or other codes and standards shall be installed in accordance with NFPA 110.

11.7.3.2 Acceptance

Newly installed stationary generators for emergency use or for legally required standby power for fire protection systems and features shall demonstrate the capacity of the energy converter, with its controls and accessories, to survive without damage from common and abnormal disturbances in actual load circuits by any of the following means:

By tests on separate prototype models

By acceptance tests on the system components as performed by the component suppliers

By listing for emergency service as a completely factory-assembled and factory-tested apparatus

11.7.4 Stored Electrical Energy Emergency and Legally Required Standby Power System Installation

Stored electrical energy systems required by this Code, the building code, or other NFPA codes and standards shall be installed in accordance with NFPA 111 and NFPA 70.

11.7.5 Maintenance and Testing

11.7.5.1

Stationary generators used for emergency or legally required standby power shall be tested and maintained in accordance with NFPA 110 and NFPA 37.

11.7.5.2

Stationary generators required by this Code, the building code, or other NFPA codes and standards shall be maintained in accordance with NFPA 110.

11.7.5.3

Stored electrical energy systems required by this Code, the building code, or other NFPA codes and standards shall be maintained in accordance with NFPA 111.

11.8\* Smoke Control

11.8.1

Newly installed smoke-control systems shall be inspected by the AHJ and tested in accordance with the criteria established in the approved design documents, NFPA 204 and NFPA 92.

11.8.2

Smoke-control systems shall have an approved maintenance and testing program to ensure operational integrity in accordance with this section. Components of such systems shall be operated, maintained, and tested in accordance with their operation and maintenance manuals.

11.8.2.1 Testing

Operational testing of the smoke-control system shall be in accordance with NFPA 92, and shall include all equipment related to the system including, but not limited to, initiating devices, fans, dampers, controls, doors, and windows.

11.8.2.1.1

An approved written schedule for such operational tests shall be established.

11.8.2.2

Test records shall be maintained on the premises and must indicate the date of such testing, the qualified service personnel, and any corrective measures needed or taken.

11.8.3

All smoke-control systems and devices shall be maintained in a reliable operating condition and shall be replaced or repaired where defective.

11.8.4

The AHJ shall be notified when any smoke-control system is out of service for more than 4 hours in a 24-hour period and again upon restoration of service of such systems.

11.8.5

The AHJ shall be permitted to require the building to be evacuated or an approved fire watch to be provided for all portions left unprotected by the fire protection system shutdown until the fire protection system has been returned to service.

11.9 Emergency Command Center

Where required, emergency command centers shall comply with Section 11.9.

Upcodes Diagrams

11.9.1

The location, design, content, and fire department access of the emergency command center shall be approved by the fire department.

11.9.2

The emergency command center shall be separated from the remainder of the building by a fire barrier having a fire resistance rating of not less than 1 hour.

11.9.3

New emergency command center rooms shall be a minimum of 200 ft2 (19 m2) with a minimum dimension of 10 ft (3050 mm).

11.9.3.1

Existing emergency command center rooms shall be maintained with the minimum square footage and dimensions previously approved by the AHJ.

11.9.4

The following shall be provided in the emergency command center:

The fire department communication unit

A telephone for fire department use with controlled access to the public telephone system

Schematic building plans indicating the typical floor plan and detailing the building core means of egress, fire protection systems, fire-fighting equipment, and fire department access

Work table

If applicable, hazardous material management plans for the building

11.9.5

Where otherwise required, the following devices or functions shall be provided within the emergency command center:

The emergency voice/alarm communication system unit

Fire detection and alarm system annunciator unit

Annunciator visually indicating the location of the elevators and whether they are operational

Status indicators and controls for air-handling systems

Controls for unlocking stairway doors simultaneously

Sprinkler valve and waterflow detector display panels

Emergency and standby power status indicators

Fire pump status indicators

Generator supervision devices and manual start and transfer features

Public address system, where specifically required by other sections of this Code

Controls required for smoke control

11.9.6 Emergency Command Center Acceptance Testing

Devices, equipment, components, and sequences shall be individually tested in accordance with appropriate standards and manufacturers' documented instructions.

11.10\* In-Building Emergency Responder Communication Enhancement Systems

11.10.1 Permits

11.10.1.1

Where required by the AHJ, an installation permit shall comply with Section 1.12.

11.10.1.2

Where required by the AHJ, a renewable permit in accordance with 9.6.6.2 of NFPA 1221 shall be issued at the conclusion of successful acceptance testing.

11.10.2 General

In all new and existing buildings, minimum radio signal strength for emergency services department communications shall be maintained at a level determined by the AHJ.

11.10.3

In-building emergency responder communication enhancement systems shall comply with the design, installation, testing, inspection, and maintenance requirements in Section 9.6 of NFPA 1221 and 11.10.3.1 through 11.10.11 of this Code.

11.10.3.1 Listed and Labeled

In-building emergency responder communication enhancement systems installed within buildings shall be listed and labeled in accordance with UL 2524, In-building 2-Way Emergency Radio Communication Enhancement Systems.

11.10.3.2\*

In-building emergency responder communication enhancement systems capable of operating on frequencies licensed to any public safety agency by the Federal Communications Commission (FCC) or other radio licensing authority shall not be installed without prior coordination and approval of the AHJ.

11.10.4\* Lightning Protection

Systems shall have lightning protection that complies with NFPA 780. [1221:9.6.3]

11.10.5 Enclosures

All repeater, transmitter, receiver, signal booster components, optical-to-RF and RF-to-optical converters, external filters, batteries, and battery system components shall be contained in a NEMA4- or NEMA4X-type enclosure (s). [1221:9.6.11.2]

11.10.5.1

Batteries that require venting shall be stored in NEMA3R-type enclosures.

11.10.6 Oscillation Detection and Control

Bi-directional amplifiers (BDAs) used in in-building emergency responder communication enhancement systems shall have oscillation detection and control circuitry.

11.10.7\* Minimum Signal Strength Into the Building

In addition to the requirements in 9.6.8.1 of NFPA 1221, the inbound signal strength shall be a minimum of -95 dBm throughout the coverage area and sufficient to provide not less than a delivered audio quality (DAQ) of 3.0 or an equivalent signal-to-interference-plus-noise ratio (SINR) applicable to the technology for either analog or digital signals.

11.10.8 Mounting of the Donor Antenna(s)

11.10.8.1

To maintain proper alignment with the system designed donor site, donor antennas shall meet one of the following:

Antennas shall be permanently affixed on the building.

Where approved, antennas shall be mounted on a movable sled with a visible sign stating "Movement or repositioning of this antenna is prohibited without approval from the AHJ."

11.10.8.2

The antenna installation shall also be in accordance with the applicable requirements of the building code for weather protection of the building envelope.

11.10.9 Radio Communication Antenna Density

11.10.9.1\*

In-building emergency responder communication enhancement systems shall be engineered to minimize the near-far effect.

11.10.9.2

In-building emergency responder communication enhancement system designs shall include sufficient antenna density to address reduced gain conditions.

11.10.10

Where an in-building emergency responder communication enhancement system is required and such system, components, or equipment has a negative impact on the normal operations of the facility at which it is installed, the AHJ shall have the authority to accept an automatically activated responder system.

11.10.11 Acceptance Test Procedure

Where an in-building emergency responder communication enhancement system is required, the building owner shall have the system tested on completion of installation to verify that two-way coverage on each floor of the building is not less than the coverage specified in 9.6.7.3 or 9.6.7.4 of NFPA 1221 as applicable.

11.10.11.1 Test Procedure

The test procedure, as required by 11.10.11, shall be conducted as follows:

Each floor of the building shall be divided into a grid of 20 approximately equal test areas.

The test shall be conducted using a calibrated portable radio of the latest brand and model used by the agency talking through the agency's radio communications system or equipment approved by the AHJ.

Failure of more than one test area shall result in failure of the test.

A test location approximately in the center of each test area shall be selected for the test, with the radio enabled to verify two-way communications to and from the outside of the building through the public agency's radio communications system, as follows:

Once the test location has been selected, that location shall represent the entire test area.

Failure in the selected test location shall be considered to be a failure of that test area and additional test locations shall not be permitted.

All signal boosters or amplifiers shall be tested to verify that the gain is the same as it was upon initial installation and acceptance or set to optimize the performance of the system under all operating conditions.

At the time of installation and at subsequent annual inspections, a spectrum analyzer or other suitable test equipment shall be utilized to ensure spurious oscillations are not being generated by the subject signal booster.

Systems shall be tested using two portable radios simultaneously conducting subjective voice quality checks, as follows:

One portable radio shall be positioned not more than 10 ft (3048 mm) from the indoor antenna.

The second portable radio shall be positioned at a distance that represents the farthest distance from any indoor antenna.

With both portable radios simultaneously keyed up on different frequencies within the same band, subjective audio testing shall be conducted and comply with DAQ levels as specified in 9.6.8.1 or 9.6.8.2 of NFPA 1221 as applicable.

11.11 Medical Gas and Vacuum Systems

Medical gas and vacuum systems shall comply with NFPA 99.

11.12 Photovoltaic Systems

11.12.1 General

11.12.1.1

Photovoltaic systems shall be designed and installed in accordance with Section 11.12.

11.12.1.2

Electrical portions of photovoltaic systems shall be designed and installed in accordance with NFPA 70.

11.12.2 Building-Mounted Photovoltaic (PV) and Building Integrated Photovoltaic (BIPV) Installations

11.12.2.1\* Marking

Photovoltaic systems shall be permanently marked as specified in 11.12.2.1.1 through 11.12.2.1.6.3.

11.12.2.1.1\* Rapid Shutdown Marking

Buildings with a rooftop-mounted PV system and buildings with a BIPV system installed as the roof covering shall be provided with permanent labels as described in 11.12.2.1.1.1 through 11.12.2.1.1.9.

11.12.2.1.1.1 Rapid Shutdown Type

The type of PV system rapid shutdown shall be labeled as described in 11.12.2.1.1.1.1 or 11.12.2.1.1.1.2.

11.12.2.1.1.1.1 Buildings With Rapid Shutdown

PV systems that shut down the PV system and reduce shock hazard in the array and conductors leaving the array shall be labeled as follows:

SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN.

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY.

11.12.2.1.1.1.2

PV systems that only shut down conductors outside the array shall be labeled as follows:

SOLAR PV SYSTEM IS EQUIPPED WITH RAPID SHUTDOWN.

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN CONDUCTORS OUTSIDE THE ARRAY. CONDUCTORS WITHIN ARRAY REMAIN ENERGIZED IN SUNLIGHT.

11.12.2.1.1.2

The label required by 11.12.2.1.1.1 shall be both of the following:

Reflective

Lettered as follows:

All letters capitalized

All letters having a minimum height of 3/8 in. (9.5 mm)

All letters in white on a red background

11.12.2.1.1.3

The label required by 11.12.2.1.1.1 shall include a simple diagram of a building with a roof.

11.12.2.1.1.4

Diagram sections in red shall signify sections of the PV system that are not shut down when the rapid shutdown switch is operated.

11.12.2.1.1.5

Sections of the diagram in green shall signify sections of the PV system that are shut down when the rapid shutdown switch is operated.

11.12.2.1.1.6

Buildings with PV systems shall have both of the following:

A permanent label located at each service equipment location to which the PV systems are connected or at a readily visible location approved by the fire department

The location of rapid shutdown initiation devices indicated on the permanent label

11.12.2.1.1.7 Buildings With More Than One Rapid Shutdown Type

For buildings that have PV systems with both rapid shutdown types, or a rapid shutdown type and a PV system with no rapid shutdown, a detailed plan view diagram of the roof shall be provided showing each PV system and a dotted line around areas that remain energized after the rapid shutdown switch is operated.

11.12.2.1.1.8 Rapid Shutdown Switch

The rapid shutdown switch shall have a permanent label located at a readily visible location on or no more than 3 ft (1 m) from the switch that includes the following words:

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

11.12.2.1.1.9

The label required by 11.12.2.1.1.8 shall be both of the following:

Reflective

Lettered as follows:

All letters capitalized

All letters having a minimum height of 3/8 in. (9.5 mm)

All letters in white on red background

11.12.2.1.2 Marking

11.12.2.1.2.1

Each PV system disconnecting means shall plainly indicate whether in the open (off) or closed (on) position.

11.12.2.1.2.2

Each PV system disconnecting means shall be permanently marked "PV SYSTEM DISCONNECT" or equivalent.

11.12.2.1.2.3

Additional markings shall be permitted based upon the specific system configuration.

11.12.2.1.2.4

For PV system disconnecting means where the line and load terminals may be energized in the open position, the device shall be marked with the following words or equivalent wording approved by the fire department:

WARNING: ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

11.12.2.1.2.5

The warning sign(s) or label(s) shall comply with 110.21(B) of NFPA 70.

11.12.2.1.3 Marking and Labeling Required

Unless located and arranged so the purpose is evident, the following wiring methods and enclosures that contain PV power source conductors shall be marked with the words WARNING: PHOTOVOLTAIC POWER SOURCE or SOLAR PV DC CIRCUIT by means of permanently affixed labels or other approved permanent marking approved by the fire department:

Exposed raceways, cable trays, and other wiring methods

Covers or enclosures of pull boxes and junction boxes

Conduit bodies in which any of the available conduit openings are unused

11.12.2.1.3.1 Marking and Labeling Required

(A)

The labels or markings shall be visible after installation.

(B)

All letters shall be as follows:

Capitalized

Minimum height of 3/8 in. (9.5 mm)

White on a red background

(C)

Labels shall appear on every section of the wiring system that is separated by enclosures, walls, partitions, ceilings, or floors.

(D)

Spacing between labels or markings, or between a label and a marking, shall not be more than 10 ft (3 m).

(E)

Labels required by 11.12.2.1.3 shall be suitable for the environment where they are installed.

(F)

Labels required by 11.12.2.1.3 shall be maintained and replaced if removed or damaged, or if the label becomes illegible.

11.12.2.1.4 Identification of Power Sources

11.12.2.1.4.1

A permanent plaque or directory shall be installed at each service equipment location, or at a readily visible location approved by the fire department.

11.12.2.1.4.2

Where installations consist of multiple co-located power production sources, the permanent plaque or directory shall be permitted to identify the sources as a group(s).

11.12.2.1.4.3

Plaques or directories permitted by 11.12.2.1.4.2 shall not be required to identify each power source individually.

11.12.2.1.4.4

The plaque or directory shall denote the location of each power source disconnecting means for the building or structure and be grouped with other plaques or directories for other on-site sources.

11.12.2.1.4.5

The plaque or directory shall be marked with the wording "CAUTION: MULTIPLE SOURCES OF POWER."

11.12.2.1.4.6

Any posted diagrams shall be correctly oriented with respect to the diagram's location. The marking shall comply with 110.21(B) of NFPA 70.

11.12.2.1.5 Installer Information

A label shall be installed adjacent to the main disconnect indicating the name and emergency telephone number of the company currently servicing the PV system.

11.12.2.1.6 Markings for Building Integrated PV (BIPV) Systems

11.12.2.1.6.1

BIPV systems installed as the roof covering shall have markings to identify any areas with electrical hazards hidden from view.

11.12.2.1.6.2

Marking shall be both of the following:

Reflective

Visible from grade

11.12.2.1.6.3

The AHJ shall be permitted to reduce or exempt marking requirements for BIPV systems installed as the roof covering when they are listed in accordance with 690.12(B)(2) of NFPA 70.

11.12.3 Rooftop Access and Ventilation

11.12.3.1 General

11.12.3.1.1

Access pathways, setbacks, and spacing requirements shall be required to provide emergency access to the roof, provide pathways to specific areas of the roof, provide for smoke ventilation opportunity areas, and to provide emergency egress from the roof.

11.12.3.1.2

The AHJ shall be permitted to reduce or modify roof access based upon fire department ventilation procedures or alternative methods that ensure adequate fire department access, pathways, and smoke ventilation.

11.12.3.1.3

The AHJ shall be permitted to reduce or modify roof access for BIPV systems installed as the roof covering when they are listed in accordance with 690.12(B) (2) of NFPA 70.

11.12.3.2 One- And Two-Family Dwellings and Townhouses

11.12.3.2.1

Photovoltaic systems installed on one- and two-family dwellings and townhouses shall provide roof access in accordance with 11.12.3.2.

11.12.3.2.2

Designation of ridges shall not apply to roofs with 2 in 12 or less pitch.

11.12.3.2.3\* Access Pathways

11.12.3.2.3.1

Not less than two 36 in. (914 mm) wide access pathways on separate roof planes, from gutter to ridge, shall be provided on all buildings.

11.12.3.2.3.2

One access pathway shall be provided on the street or driveway side of the roof.

11.12.3.2.3.3

For each roof plane with a PV array, a 36 in. (914 mm) wide access pathway from gutter to ridge shall be provided on the same roof plane as the PV array, on an adjacent roof plane, or straddling the same and adjacent roof planes.

11.12.3.2.3.4

Access pathways shall be located in areas with minimal obstructions such as vent pipes, conduit, or mechanical equipment.

11.12.3.2.4 Setbacks at Ridge

11.12.3.2.4.1

For PV arrays occupying up to 33 percent of the plan view roof area, a minimum 18 in. (457 mm) setback shall be provided on either side of a horizontal ridge.

11.12.3.2.4.2

For PV arrays occupying more than 33 percent of the plan view roof area, a minimum of 36 in. (914 mm) setback shall be provided on either side of a horizontal ridge.

11.12.3.2.5 Alternative Setbacks at Ridge

11.12.3.2.5.1

For one- and two-family dwellings with an automatic sprinkler system installed within the dwelling in accordance with 13.3.2.19, for PV arrays occupying up to 66 percent of the plan view roof area, a minimum 18 in. (457 mm) setback shall be provided on either side of a horizontal ridge.

11.12.3.2.5.2

For PV arrays occupying more than 66 percent of the plan view roof area on sprinklered one- and two-family dwellings, a minimum 36 in. (914 mm) setback shall be provided on either side of a horizontal ridge.

11.12.3.3 Buildings Other Than One- And Two-Family Dwellings and Townhouses

11.12.3.3.1 Roof Access

11.12.3.3.1.1

Photovoltaic systems installed on any building other than one- and two-family dwellings and townhouses shall provide roof access in accordance with 11.12.3.3.

11.12.3.3.1.2

Where the AHJ determines that the roof configuration is similar to a one- and two-family dwelling or townhouse, the AHJ shall allow the roof access requirements of 11.12.3.2.

11.12.3.3.1.3

Detached, nonhabitable structures, including, but not limited to, parking shade structures, carports, solar trellises, and similar structures, shall not be required to provide roof access.

11.12.3.3.2 Perimeter Pathways

11.12.3.3.2.1

A minimum 48 in. (1219 mm) wide perimeter pathway shall be provided around the edges of the roof for buildings with a length or width of 250 ft (76.2 m) or less along either axis.

11.12.3.3.2.2

A minimum 6 ft (1829 mm) wide perimeter pathway shall be provided around the edges of the roof for buildings having length or width greater than 250 ft (76.2 m) along either axis.

11.12.3.3.3 Other Pathways

Pathways shall be over areas capable of supporting firefighters accessing the roof and shall be provided between array sections as follows:

Pathways shall be provided in a straight line 48 in. (1219 mm) or greater in width to all ventilation hatches and roof standpipes.

Pathways shall be provided 48 in. (1219 mm) or greater in width around roof access hatches with at least one 48 in. (1219 mm) or greater in width pathway to the parapet or roof edge.

Pathways shall be provided at intervals no greater than 150 ft (46 m) throughout the length and width of the roof.

11.12.3.3.4 Smoke Ventilation

11.12.3.3.4.1

A minimum 48 in. (1219 mm) wide pathway shall be provided bordering all sides of non-gravity-operated smoke and heat vents and bordering at least one side of gravity-operated smoke and heat vents.

11.12.3.3.4.2

Ventilation options between array sections shall be at least one of the following:

\* A pathway 96 in. (2438 mm) or greater in width

\* A pathway 48 in. (1219 mm) or greater in width and bordering on existing roof skylights at intervals no greater than 150 ft (46 m) throughout the length and width of the roof

\* A pathway 48 in. (1219 mm) or greater in width and bordering 48 in. (1219 mm) by 96 in. (2438 mm) with venting cutouts options every 20 ft (6096 mm)

11.12.3.3.5 Minimizing Obstructions in Pathways

Pathways shall be located in areas with minimal obstructions such as vent pipes, conduit, or mechanical equipment to reduce trip hazards and maximize ventilation opportunities.

11.12.3.4 Emergency Escape and Rescue Openings

11.12.3.4.1

Where rooftop-mounted PV systems or BIPV systems installed as the roof covering are installed on a roof plane directly below an emergency escape and rescue opening, a minimum 36 in. (914 mm) wide access pathway shall be provided to at least one emergency escape and rescue opening for each sleeping room.

11.12.3.4.2

The AHJ shall be permitted to reduce or exempt access pathways at emergency escape and rescue openings for BIPV installed as the roof covering when they are listed in accordance with 690.12(B) (2) of NFPA 70.

11.12.4 Ground-Mounted Photovoltaic System Installations

Ground-mounted photovoltaic systems shall be installed in accordance with 11.12.4.1 and 11.12.4.2.

11.12.4.1\* Clearances

A clear area of 10 ft (3048 mm) around ground-mounted photovoltaic installations shall be provided.

11.12.4.2\* Vegetation Management Plan

A vegetation management plan or noncombustible base acceptable to the AHJ shall be approved and maintained under and around the installation where required by the AHJ.

