

NFPA®

76

Standard for the
Fire Protection of
Telecommunications Facilities

2020



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NFPA® 76

Standard for the

Fire Protection of Telecommunications Facilities

2020 Edition

This edition of NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, was prepared by the Technical Committee on Telecommunications. It was issued by the Standards Council on November 4, 2019, with an effective date of November 24, 2019, and supersedes all previous editions.

This edition of NFPA 76 was approved as an American National Standard on November 24, 2019.

Origin and Development of NFPA 76

In April 1996, the NFPA Standards Council approved a new committee project to develop documents on fire protection for telecommunications networks. The Technical Committee on Telecommunications focused on network reliability of public telecommunications. The committee was responsive to fire protection challenges identified by the Network Reliability Council, which was sponsored by the Federal Communications Commission (FCC).

The first edition of NFPA 76, *Recommended Practice for the Fire Protection of Telecommunications Facilities*, published in 2002, was created to be used as a performance-based document in the format established by NFPA for performance documents.

The document was changed from a recommended practice to a standard for the 2005 edition. Requirements for large and small telecommunications facilities were combined into one chapter. A chapter was added for redundant-based or replacement-based approaches.

For the 2009 edition, the standard was edited to improve the language and clarify the technical committee's intent. Sections were revised to reflect changes to the signal-processing equipment areas. In addition, the requirements for early warning fire detection and very early warning fire detection were updated.

The 2012 edition featured a new section on aisle containment systems for telecommunications equipment and how these systems must be assessed for their interaction with fire protection features. Revisions were made to make the requirements of the standard easier to enforce. A number of definitions were extracted from *NFPA 70, National Electrical Code*, to define terms used in the body of the standard that were not defined in previous editions.

The 2016 edition included language that clarified and emphasized the intent of the standard as it applies to existing and altered facilities retroactively. A new chapter on small unoccupied structures, which were had been excluded from the scope of this standard, was added. The new chapter provided the minimum requirements to be applied to such structures.

The 2020 edition of the standard includes clarification of battery terminology. Flooded lead-acid and flooded NiCd batteries are now called *vented lead-acid* and *vented NiCd* batteries. The term *lithium* was changed to *lithium-ion* throughout the document to specify a type of lithium battery. Spill control requirements for sodium nickel batteries was deleted; these batteries do not need spill control because of the battery chemistry. The term *smoke detectors* was changed to *spot-type smoke detectors* to refer to a type of smoke detector that is discussed in the requirements and does not apply to other types of smoke detectors.

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Committee Scope: This Committee shall have primary responsibility for documents on fire protection for telecommunication networks.

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Facilities

2020 Edition

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex G.

Chapter 1 Administration

1.1* Scope. This standard provides requirements for fire protection of telecommunications facilities, including landline, cable, wireless, and satellite telecommunication services such as telephone/voice, voice over internet protocol (VoIP), internet, data, and video transmission that are rendered to the public.

1.1.1 Telecommunications facilities include signal-processing equipment areas, cable entrance facility areas, power areas, main distribution frame areas, standby engine areas, technical support areas, administrative areas, and building services and support areas occupied by a telecommunications service provider.

1.2* Purpose. The provisions of this standard shall provide a minimum level of fire protection in telecommunications facilities, provide a minimum level of life safety for the occupants, and protect the telecommunications equipment and service continuity.

1.3* Application. The provisions of this standard shall provide a reasonable level of protection from loss of life, property, and service continuity from fire.

1.3.1 The requirements of Chapter 4 shall determine the fire protection program for each facility.

1.3.1.1 Provisions for small structures that are normally unoccupied and that house telecommunications equipment, including on-grade, walk-in cabinets; on-grade huts; cell huts; and controlled environmental vaults (CEVs), are provided in Chapter 11.

1.3.2* For purposes of application of NFPA 101 and NFPA 5000, telecommunications facilities shall be classified as special-purpose industrial occupancies.

N 1.3.3 This standard shall apply to free-standing telecommunications facilities, as well as joint-use facilities where separated by a fire-resistance-rated partition in accordance with 6.1.4.2.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time this standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to telecommunications facilities that existed or were approved for construction or installation prior to the effective date of this standard.

1.4.1.1 Building alterations or new equipment installations in existing facilities shall provide a reasonable level of fire protection for the changed purposes of the facility.

1.4.1.2 Fire protection systems in excess of the features required in this standard shall be permitted to be left in service, removed, or abandoned in place.

1.4.1.3 Fire protection systems abandoned in place shall be clearly identified as no longer being in service.

1.4.2 The provisions of Chapters 9 and 10 shall apply to new and existing telecommunications facilities.

1.4.3 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.4 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction and only where it is clearly evident that a reasonable degree of safety is provided.

1.5* Design Options.

1.5.1 Fire protection for the individual hazard areas identified in the standard shall be based on the performance-based approach of Chapter 5, the prescriptive-based approach of Chapter 6, or the redundant- or replacement-based approach of Chapter 7.

1.5.2* Any of the three approaches shall be used selectively by hazard area or in any combination.

1.5.3 Protection of continuity from fire for telecommunications facilities using redundant or replacement-based approaches shall comply with Chapter 7.

1.5.4 Chapters 1, 4, 9, and 10 shall apply to all telecommunications facilities within the scope of this standard except those covered by Chapter 11, regardless of the design approach taken.

1.6 Equivalency. Nothing in this standard is intended to prevent the use of calculation methods, test methods, systems, methods, or devices of superior quality, strength, fire resistance, effectiveness, durability, and safety as alternatives to those required by this standard, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency, and the system, method, or device is approved for the intended purpose.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2018 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2018 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2018 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2020 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2018 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2019 edition.

NFPA 54/ANSI Z223.1, *National Fuel Gas Code*, 2018 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 70®, *National Electrical Code®*, 2020 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2019 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2019 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 2017 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2018 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2017 edition.

NFPA 101®, *Life Safety Code®*, 2018 edition.

NFPA 220, *Standard on Types of Building Construction*, 2018 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2019 edition.

NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, 2017 edition.

NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies*, 2017 edition.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces*, 2019 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2017 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2019 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2020 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2018 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2018 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2018.

ASTM E814, *Standard Test Method for Fire Tests of Penetration Firestop Systems*, 2013a, reapproved 2017.

ASTM E1537, *Standard Test Method for Fire Testing of Upholstered Furniture*, 2016.

ASTM E1966, *Standard Test Method for Fire Resistive Joint Systems*, 2015.

2.3.2 ATIS Publications. Alliance for Telecommunications Industry Solutions, 1200 G Street NW, Suite 500, Washington, DC 20005.

ATIS 0600307, *Fire Resistance Criteria — Ignitability Requirements for Equipment Assemblies, Ancillary Non-Metallic Apparatus, and Fire Spread Requirements for Wire and Cable*, 2014.

ATIS 0600319, *Equipment Assemblies — Fire Propagation Risk Assessment Criteria*, 2014.

2.3.3 CSA Publications. CSA Group, 178 Rexdale Boulevard, Toronto, ON M9W 1R3, Canada.

C22.2 No. 0.3, *Test Methods for Electrical Wires and Cables*, 2009, revised 2014.

2.3.4 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 44, *Thermoset-Insulated Wires and Cables*, 2017.

ANSI/UL 83, *Thermoplastic-Insulated Wire and Cables*, 2017.

ANSI/UL 444, *Communications Cables*, 2017.

ANSI/UL 568, *Nonmetallic Cable Tray Systems*, 2002.

ANSI/UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, 2018.

ANSI/UL 900, *Standard for Air Filter Units*, 2015.

ANSI/UL 1277, *Electrical Power and Control Tray Cables with Optional Optical-Fiber Members*, 2018.

ANSI/UL 1564, *Standard for Industrial Battery Chargers*, 2015.

ANSI/UL 1651, *Optical Fiber Cable*, 2015.

ANSI/UL 1666, *Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts*, 2007.

ANSI/UL 1685, *Standard for Vertical Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, 2015.

ANSI/UL 1973 *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*, 2018.

ANSI/UL 2024, *Cable Routing Assemblies and Communications Raceways*, 2014, revised 2015.

ANSI/UL 9540, *Outline of Investigation for Energy Storage Systems and Equipment*, 2016.

ANSI/UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*, 2007.

2.3.5 Other Publications.

California Technical Bulletin 133, *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*, State of California, Department of Consumer Affairs, 1625 North Market Boulevard, Suite N-119, Sacramento, CA 95834.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

Telcordia GR-63-CORE, *Network Equipment Building System (NEBS)TM Requirements: Physical Protection*, 2017.

2.4 References for Extracts in Mandatory Sections.

NFPA 1, *Fire Code*, 2018 edition.

NFPA 70®, *National Electrical Code*®, 2017 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2018 edition.

NFPA 101®, *Life Safety Code*®, 2018 edition.

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants*, 2015 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2017 edition.

NFPA 5000®, *Building Construction and Safety Code*®, 2018 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated

standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Abandoned Cables. Installed telecommunications, optical fiber, and electrical power cables that are not terminated at equipment and are not identified for future use.

N 3.3.2 Battery.

N 3.3.2.1 Lithium-Ion Battery. A storage battery that consists of lithium-ions imbedded in a carbon graphite or nickel metal oxide substrate. The electrolyte is a carbonate mixture or a gelled polymer. The lithium-ions are the charge carriers of the battery. [1, 2018]

N 3.3.2.2 Nickel Cadmium (NiCd) Battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative contains cadmium, and the electrolyte is potassium hydroxide. [1, 2018]

N 3.3.2.3 Sodium-Nickel Battery. A hermetically sealed storage battery that consists of a sodium negative electrode, a beta-alumina electrolyte, and a positive electrode of either nickel, nickel-chloride, or sodium-chloride. These batteries operate with an internal temperature over 500°F (260°C).

N 3.3.2.4* Valve-Regulated Lead Acid (VRLA). A lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount.

N 3.3.2.5* Vented (Flooded). A battery consisting of cells that have electrodes immersed in liquid electrolyte.

3.3.3 Building Automation System. An automated system used to control building functions such as HVAC control, lighting, and smoke management.

3.3.4 Cable Routing Assembly. A single channel or connected multiple channels, as well as associated fittings, forming a structural system that is used to support and route communications wires and cables, optical fiber cables, data cables associated with information technology and communications equipment, Class 2, Class 3, and Type PLTC cables, and power-limited fire alarm cables in plenum, riser, and general purpose applications. [70:100]

3.3.5 Cable Telecommunications. One- and two-way communications service provided over a network, generally through optical fiber or coaxial cable.

3.3.6 Central Office (CO). A telecommunications facility also known as a telephone exchange, wire center, or switching center.

3.3.7 Communications Raceway. An enclosed channel of nonmetallic materials designed expressly for holding communications wires and cables; optical fiber cables; data cables associated with information technology and communication equipment; Class 2, Class 3, and Type PLTC cables; and power-limited fire alarm cables in plenum, riser, and general-purpose applications. [70;100]

3.3.8 Contractor. One who contracts on predetermined terms to provide labor and materials and who is responsible for performance of a construction job in accordance with construction documents. [5000, 2018]

3.3.9 Controlled Environmental Vault (CEV). A partially or fully subterranean room, accessible by ladder, that houses telecommunications equipment and is under controlled temperature and humidity.

3.3.10 Firestop. A specific system, device, or construction consisting of the materials that fill the openings around penetrating items such as cables, cable trays, conduits, ducts, pipes, and their means of support through the wall or floor openings to prevent the spread of fire. [5000, 2018]

3.3.11 Hut.

3.3.11.1 Cell Hut. A small structure or enclosure that is normally unoccupied, is dedicated to the housing of cellular or wireless telecommunications equipment, and is associated with a nearby radio tower or antenna.

3.3.11.2 On-Grade Hut. A small, on-grade structure or enclosure that is normally unoccupied and houses telecommunications equipment.

N 3.3.12 Maximum Allowable Quantity (MAQ). The quantity of hazardous material permitted in a control area. [1, 2018]

N 3.3.13 Liquid Cooling. The removal of heat in electronic and mechanical devices through heat transfer properties of liquids.

3.3.14 Smoke Control. A system that utilizes fans to produce pressure differences so as to manage smoke movement. [90A, 2018]

3.3.15 Smoke Management System. An engineered system that includes all methods that can be used singly or in combination to modify smoke movement.

3.3.16 Smoke Removal. The control of smoke accumulation in the space where it is being generated by providing appropriate supply and exhaust to purge the smoke and prevent smoke movement to adjoining spaces.

3.3.17 Telecommunications. The transmission, receiving, switching, and management of signals, such as electrical, optical, or electromagnetic, by wire, fiber, or through the air.

Δ 3.3.18 Telecommunications Facility. A building or portion of a building that includes a telecommunications equipment area.

3.3.19 Utility. An organization, either designated by or recognized by public service commissions or public utility commissions, or recognized as such under federal, state, or local law, that installs, operates, and maintains electric supply or communication systems such as, but not limited to, telephone, wireless, VoIP, CATV, internet, satellite, or data service.

3.3.20* Voice over Internet Protocol (VoIP). Voice communication using internet protocol.

3.3.21 Walk-In Cabinet. An ongrade or partially belowgrade room, accessible without a ladder, that houses telecommunications equipment and is under controlled temperature and humidity.

3.4 Area Definitions.

3.4.1 Administrative Areas. Areas that typically include general offices (i.e., administrative, accounting, engineering), mailrooms, cafeterias, and customer service operation center types of working environments.

3.4.2 Building Services and Support Areas. Areas or rooms that typically include utility areas, mechanical equipment areas, ac electrical switch gear, maintenance shops, loading docks, and associated storage areas.

3.4.3 Cable Entrance Facility (CEF) Area. The area or enclosed room of a telecommunications facility that contains cable entrance facility equipment.

3.4.4 Cable Vault. See 3.4.3, Cable Entrance Facility (CEF) Area.

3.4.5 Hazard Area. An area with specific, established fuel loads and fire hazard characteristics.

3.4.6 Main Distribution Frame (MDF) Area. The area or enclosed room of a telecommunications facility that contains main distribution frame (MDF) equipment.

3.4.7 Nontelecommunications Equipment Area. An area within a telecommunications facility that is not defined as a telecommunications equipment area, which includes hazard areas such as administrative areas and building services and support areas.

3.4.8 Power Area. The area or enclosed room of a telecommunications facility that contains power equipment.

3.4.9 Signal-Processing Equipment Area. The area or enclosed room of a telecommunications facility that contains signal-processing equipment.

3.4.10 Standby Engine Area. The area or enclosed room of a telecommunications facility that contains standby engine equipment.

3.4.11* Technical Support Area. The area or space within a telecommunications facility that does not contain telecommunications equipment but contains limited furniture or office-type equipment or both and that directly supports the telecommunications equipment area.

3.4.12* Telecommunications Equipment Area. The area or enclosed room of a telecommunications facility that contains telecommunications equipment.

3.5* Detection Systems Definitions.

3.5.1 Early Warning Fire Detection (EWFD) Systems. Systems that use smoke, heat, or flame detectors to detect fires before high heat conditions threaten human life or cause significant damage to telecommunications service.

3.5.2 Port. An orifice, through which air is drawn to an air sampling-type detector.

3.5.3 Sampling Port. See 3.5.2, Port.

3.5.4 Standard Fire Detection (SFD) Systems. Systems that use fire detection–initiating devices to achieve certain life safety and property protection in accordance with applicable standards.

3.5.5 Very Early Warning Fire Detection (VEWFD) Systems. Systems that detect low-energy fires before the fire conditions threaten telecommunications service.

3.6 Equipment Definitions.

3.6.1 Building Services Equipment. Building mechanical, electrical, lighting, and power systems that are found in typical office buildings.

3.6.2* Cable Entrance Facility (CEF) Equipment. The wire and cable in the cable entrance facility.

3.6.3 Co-Located Telecommunications Equipment. Telecommunications equipment that is owned or leased and operated by other service providers (i.e., competitive local or long distance telephone service providers, internet service providers, or cable service providers) that is placed in a telecommunications facility owned by a different service provider.

3.6.4* Main Distribution Frame (MDF) Equipment. Rack-mounted termination blocks and electrical protection devices, cabling, wiring, and auxiliary equipment. The MDF wiring arrangement connects the wire and cable coming from the cable entrance facility to the wire and cable running to the signal-processing equipment and secondary cross connect frames.

3.6.5 Power Equipment. Power equipment that includes, but is not limited to, batteries, rectifiers, inverters, distribution cabinets, bus bars, and cabling and that primarily provides dc power to the signal-processing equipment.

3.6.6* Signal-Processing Equipment. The electronic equipment that performs the signal-processing operations such as switch or transport for audio, video, and data signals.

3.6.7 Standby Engine Equipment. Standby engine equipment that includes, but is not limited to, a reciprocating engine or turbine, a generator, starter batteries, and associated cabling and that provides standby power to the signal-processing equipment and potentially the entire telecommunications facility if the electrical utility's power is interrupted.

△ 3.6.8 Telecommunications Equipment. Equipment and systems normally found in a telecommunications facility that are used for transmitting, receiving, switching, and managing signals such as electrical, optical, or electromagnetic, by wire, fiber, or through the air through the use of wire, cable, and electrical/electronic equipment including signal-processing equipment, cable entrance equipment, batteries and power equipment, main distribution frame equipment, and standby engine equipment.

3.7 Performance-Based Approach Definitions.

3.7.1 Analysis.

3.7.1.1 Sensitivity Analysis. An analysis performed to determine the degree to which a predicted output will vary given a specified change in an input parameter, usually in relation to models. [5000, 2018]

3.7.1.2 Uncertainty Analysis. An analysis performed to determine the degree to which a predicted value will vary. [5000, 2018]

3.7.2* Exposure Fire. A fire that starts at a location that is remote from the area being protected and grows to expose that which is being protected. [101, 2018]

3.7.3* Fire Model. Mathematical prediction of fire growth, environmental conditions, and potential effects on structures, systems, or components based on the conservation equations or empirical data. [805, 2015]

3.7.4* Fire Scenario. A set of conditions that defines the development of fire, the spread of combustion products throughout a building or portion of a building, the reactions of people to fire, and the effects of combustion products. [101, 2018]

3.7.5 Fuel Load. The total quantity of combustible contents of a building, space, or fire area, including interior finish and trim, expressed in heat units or the equivalent weight in wood. [921, 2017]

3.7.6 Incapacitation. A condition under which humans do not function adequately and become unable to escape untenable conditions. [101, 2018]

3.7.7 Occupant Characteristics. The abilities or behaviors of people before and during a fire. [101, 2018]

3.7.8* Performance Criteria. Threshold values on measurement scales that are based on quantified performance objectives. [101, 2018]

3.7.9 Proposed Design. A design developed by a design team and submitted to the authority having jurisdiction for approval. [101, 2018]

3.7.10 Safe Location. A location remote or separated from the effects of a fire so that such effects no longer pose a threat. [101, 2018]

3.7.11 Safety Factor. A factor applied to a predicted value to ensure that a sufficient safety margin is maintained. [101, 2018]

3.7.12 Safety Margin. The difference between a predicted value and the actual value where a fault condition is expected. [101, 2018]

3.7.13 Verification Method. A procedure or process used to demonstrate or confirm that the proposed design meets the specified criteria. [101, 2018]

3.8 Aisle Containment Definitions.

3.8.1* Aisle. The passageway between telecommunications equipment or between telecommunications equipment and a wall that allows personnel access to the equipment for service or operation of the equipment.

3.8.2* Aisle Containment. An HVAC method deployed in the occupied area of an air-cooled telecommunications equipment space utilizing nonstructural separation of hot exhaust air from cooler intake air between equipment cabinets, rows of cabinets, or associated power and cooling infrastructure; containment is typically above and at both ends of a hot aisle or a cold aisle, in whole or part.

3.8.3* Cold Aisle. The aisle in front of the airflow intakes on the telecommunications equipment where HVAC cooling airflow is controlled.

3.8.4* Hot Air Collar. An air conveyance assembly used to direct heated exhaust air from telecommunications equipment cabinet(s), enclosure(s), or rack(s) directly to a return air path.

3.8.5* Hot Aisle. The aisle at the rear of the telecommunications equipment where heated exhaust air is controlled and directed into the aisle for return to the HVAC equipment.

Chapter 4 Risk Considerations

4.1 Risk Factors. Fire protection programs for telecommunications facilities shall be determined based on an evaluation of the risks and hazards associated with the site and services provided from the facility and the business continuity planning and disaster restoration capabilities of the telecommunications service provider specific to the site.

4.1.1 Fire protection programs shall be established with consideration given to the following factors:

- (1) Exposure threat to facility occupants, the general public, and exposed property from a fire occurring at, adjacent to, or within the facility
- (2) The importance of telecommunications service continuity in supporting public safety through emergency communications (such as 911), national defense communications requirements, video transmission of critical medical operations, and other vital data
- (3) Methods employed by a service provider, as part of a risk management or business continuity strategy, that allow service to remain viable during and after an event or to be replaced or restored
- (4) The potential for a given protection strategy to result in a service disruption or inhibit the ability of the service provider to restore service in a timely manner post-event

4.1.2* Telecommunications equipment areas located in a structure or building housing multiple tenants or occupancies that are or are not associated with the telecommunications equipment areas shall include additional risk analysis.

4.2 Service Continuity Risks.

4.2.1* Evaluation of Loss of Operations. In assessing and evaluating the damage and interruption potential of the loss of communication operations, attention shall be given to the impact of the loss of data, voice, and video communications links.

4.2.2 Risk Management Considerations.

4.2.2.1 The following elements shall be documented as part of the risk management analysis:

- (1) Life safety
- (2) Service continuity
- (3) Economic impact to customers due to loss of connectivity of voice and data
- (4) Size and value of the facility
- (5) Restoration plans
- (6) Availability of readily deployable replacement telecommunications infrastructure

- (7) Response time to an alarm
- (8) Local fire-fighting capabilities
- (9) Redundant telecommunications infrastructure
- (10) Reputation impact

4.2.2.2 A fire protection program shall be developed in conjunction with the considerations in 4.2.2 resulting in the use of one or more of the following strategies for areas within the telecommunications facility:

- (1) Performance-based approaches in accordance with Chapter 5
- (2) Prescriptive-based approaches in accordance with Chapter 6
- (3) Redundant facilities or plan for rapid replacement in accordance with Chapter 7

Chapter 5 Performance-Based Approaches

5.1 General.

5.1.1* Application. This chapter applies to telecommunications facilities, or a hazard within, designed to the performance-based option of Section 1.5.

5.1.2* Approved Qualifications. The performance-based design shall be prepared by a person with qualifications acceptable to the authority having jurisdiction.

5.1.3* Independent Review. An independent third-party review of the proposed design shall be conducted.

5.1.4 Final Determination. The authority having jurisdiction shall make the final determination as to whether a design meets the performance objectives of this standard.

5.1.5* Maintenance of Design Features. For the design features for each hazard area to continue to meet the performance goals and objectives of this standard, the design features shall be maintained for the life of the facility.

5.1.5.1 Compliance with all originally documented design assumptions and specifications shall be maintained.

5.1.5.2 Any variations from the design assumptions or specifications shall be submitted for approval by the authority having jurisdiction prior to the actual change.

5.1.6 Special Definitions. A list of terms used in this chapter follows:

- (1) Analysis
 - (a) Sensitivity Analysis. See 3.7.1.1.
 - (b) Uncertainty Analysis. See 3.7.1.2.
- (2) Exposure Fire. See 3.7.2.
- (3) Fire Model. See 3.7.3.
- (4) Fire Scenario. See 3.7.4.
- (5) Fuel Load. See 3.7.5.
- (6) Incapacitation. See 3.7.6.
- (7) Occupant Characteristics. See 3.7.7.
- (8) Performance Criteria. See 3.7.8.
- (9) Proposed Design. See 3.7.9.
- (10) Safe Location. See 3.7.10.
- (11) Safety Factor. See 3.7.11.
- (12) Safety Margin. See 3.7.12.
- (13) Verification Method. See 3.7.13.

5.2 Performance Objectives.

5.2.1 Life Safety Objectives. The facility design shall provide occupants of the telecommunications facility adequate time to exit the building or to reach a safe area of refuge without being exposed to untenable conditions.

5.2.2 Network Objectives.

5.2.2.1 The facility design shall limit the effects of a worst credible design fire in a nontelecommunications equipment area from causing an unacceptable network failure.

5.2.2.2 The facility design shall limit the effects of a worst credible design fire in a telecommunications equipment area from causing an unacceptable network failure.

5.3 Performance Criteria.

5.3.1* Life Safety Performance Criteria.

5.3.1.1 The fire protection and life safety design of the facility shall provide for tenable conditions along egress paths for the time required to evacuate occupants to a safe area using either of the following options:

- (1) NFPA 101 performance-based section
- (2) NFPA 101 prescriptive sections for industrial low occupancy

5.3.1.2 Where the NFPA 101 performance-based methodology is utilized to assess the level of life safety to be provided in the facility, the fire scenarios specified in this document shall be considered along with the scenarios provided in NFPA 101.

5.3.2 Network Performance Criteria.

5.3.2.1* Where telecommunications equipment is exposed to a worst credible fire scenario, the facility design shall limit temperatures in a manner that protects against unacceptable network failure.

5.3.2.2* Where telecommunications equipment is exposed to a worst credible fire scenario, the facility design shall limit the effects of products of pyrolysis or combustion in a manner that protects against unacceptable network failure.

5.4 Design Assumptions.

5.4.1 General. The design shall include documentation on the clear statement, data sources, and topics outlined in 5.4.1.1 through 5.4.1.4.

5.4.1.1 Assumptions shall provide the design basis for fire scenarios involving telecommunications facilities and shall be presented for those hazard areas expected in telecommunications facilities.

5.4.1.2 Assumptions used in the performance-based design shall be clearly stated and documented.

5.4.1.3 The sources of data used in analyses shall be documented.

5.4.1.4 Assumptions shall include, but not be limited to, the topics addressed in 5.4.2 through 5.4.5.

5.4.2 Assumptions Regarding Facility Characteristics.

5.4.2.1 Assumptions about the building dimensions, construction materials, furnishings, spatial geometry, number and size of openings, and other details that are input into calculations

or models shall be explicitly identified and documented and shall be consistent with the facility construction and content.

5.4.2.2 Assumptions regarding characteristics of the building or its contents, telecommunications equipment, or operations not inherent in the design specifications but that affect occupant behavior or the rate of hazard development shall be identified and documented.

5.4.3* Assumptions Regarding Operational Status and Effectiveness of Building Features and Systems.

5.4.3.1 All fire protection systems and features of the building shall comply with applicable NFPA standards for those systems and features.

5.4.3.2 The assumption of full operability and reliability shall not apply to those systems or features for which a scenario is specifically and explicitly defined to involve the impairment of that system or feature.

5.4.3.3* Assumptions about the performance of fire protection systems and building features shall be limited to the documented performance of the components of those systems or features.

5.4.4 Assumptions Regarding Emergency Response Personnel. Assumptions regarding the availability, speed of response, effectiveness, roles, and other characteristics of emergency response personnel shall be explicitly identified and documented.

5.4.5 Assumptions Regarding Off-Site Conditions. Assumptions regarding resources or conditions outside the property being designed that affect the ability of the building to meet the stated goals and objectives shall be identified and documented.

5.4.6 Consistency of Assumptions. The design shall not include mutually inconsistent assumptions.

5.4.7 Specific Facility Hazard Areas Assumptions. Assumptions shall provide the design basis for fire scenarios involving telecommunications facilities.

5.4.7.1 To facilitate design, analysis, and review, assumptions shall be presented for those hazard areas expected in telecommunications facilities.

5.4.7.2 Additional provisions not covered by the assumptions in Section 5.4 but that are necessary for the design to comply with the performance objectives shall be documented. (*See Annex F for assumptions applicable to specific facility hazard areas.*)

5.5* Fire Scenarios.

5.5.1 Design Fires. A performance-based design shall be based on the evaluation of fire safety design alternatives against design fires considered in the fire scenarios in 5.5.2.1 through 5.5.2.1.8.2.

5.5.1.1* Design fires shall be developed for each scenario using a method acceptable to the authority having jurisdiction and appropriate for the conditions.

5.5.1.2 The proposed design shall meet the goals and objectives if it achieves the performance criteria for each scenario.

5.5.2 Design Fire Scenarios.

5.5.2.1* Specified Scenarios.

5.5.2.1.1 General.

5.5.2.1.1.1 The evaluation of alternative designs against the scenario shall consider the following:

- (1) Actual or intended construction and geometry of confining boundaries
- (2) Size, configuration, and location of ventilation openings if any

5.5.2.1.1.2 Other scenarios shall be developed as needed to meet specific design situations.

5.5.2.1.1.3 Although life safety might not be a factor in all scenarios, the potential of occupant exposure to fire shall be considered in scenario development.

5.5.2.1.2* Electrical Component or Systems Fires.

5.5.2.1.2.1 These scenarios shall be representative of a fire that is as follows:

- (1) Ignited by an electrical overload or component failure in an electrical component or system
- (2) Located in a rack or cabinet
- (3) Located in a room dedicated to telecommunications operations that directly support network service

5.5.2.1.2.2 The design fire developed for these scenarios shall address the following:

- (1) The early stages in the fire development when the major damage mechanism is exposure of telecommunications equipment and circuits in proximity to the failed components in the rack or cabinet to corrosive and conductive products of combustion
- (2) Fire spread to other racks in a cabinet or cabinet-to-cabinet spread if the materials of construction and configuration facilitate such fire growth

5.5.2.1.3* Communications Cable or Power Cable Fires.

5.5.2.1.3.1 These scenarios shall be representative of a fire in cables or wires installed in or passing through the compartments under analysis.

5.5.2.1.3.2 The design fire developed for these scenarios shall consider the following:

- (1) The early stages in the fire development when the major damage mechanism is exposure of telecommunications equipment and circuits in the compartments to corrosive and conductive products of combustion
- (2) The later stage fire growth and peak heat release rates that could result in fire extension to additional fuel packages or compartments

5.5.2.1.4* Nontelecommunications Equipment Fires.

5.5.2.1.4.1 The following scenarios shall be representative of a free-burning fire:

- (1) Involvement with ordinary combustibles
- (2) Ignition by a small open flame source
- (3) Fire in technical support areas and ancillary areas such as administrative areas and building support areas where telecommunications equipment is not exposed or in areas containing telecommunications equipment

5.5.2.1.4.2 The design fire developed for these scenarios shall consider fire growth and peak heat release rates that could result in fire extension to additional fuel packages or compartments.

5.5.2.1.5* Ignitable Liquid Fires.

5.5.2.1.5.1 These scenarios shall consider the following:

- (1) Ignition of any flammable or combustible liquids located within the area in question
- (2) Subsequent ignition of exposed combustibles
- (3) Specific properties of the liquid fuel as related to the development of vapor-air mixtures that could result in deflagrations
- (4) Fire size based on the maximum potential exposed liquid surface area
- (5) Presence of liquid release or spill containment barriers

5.5.2.1.5.2 The design fire developed for these scenarios shall consider the following:

- (1) Rapid fire growth
- (2) Short time to reach peak heat release rates
- (3) Compartment damage that could result in rapid fire extension to additional compartments

5.5.2.1.6* Combustible Gas Fires.

5.5.2.1.6.1 These scenarios shall consider the following:

- (1) Those areas with the potential for the buildup and ignition of combustible gases
- (2) Rapid pressure rise with damage to exposed telecommunications equipment and compartment boundaries
- (3) Subsequent fire or rapid ignition of easily ignited combustible materials within the space or a combination of both

5.5.2.1.6.2 Fire exposure to adjacent telecommunications equipment and telecommunications equipment areas shall be based on the sustained burning of combustible materials within the area.

5.5.2.1.6.3 The design fire developed for these scenarios shall consider damage to telecommunications equipment and compartment boundaries due to the following:

- (1) Thermal and pressure effects from an explosion or deflagration
- (2) Rapid fire extension to additional compartments

5.5.2.1.7* Interior Exposure Fires.

5.5.2.1.7.1 These scenarios shall be representative of spread of fire and of passage of fire products as follows:

- (1) Fire originating in adjacent building spaces, including horizontal exposures
- (2) Exposures from above or below

5.5.2.1.7.2 The design fire developed for these scenarios shall consider the following:

- (1) The fire growth and peak heat release rates in the exposing compartment
- (2) The fire growth and peak heat release rates that would result from fire growth and spread within the exposed compartment

5.5.2.1.8* Exterior Exposure Fires.

5.5.2.1.8.1 These scenarios shall be representative of damage by exposure to smoke or thermal energy from an uncontrolled fire exterior to the building or space in question and shall consider the following:

- (1) Ignition of combustible exterior building finishes
- (2) Ignition of building contents exposed through openings or combustible materials adjacent to building openings
- (3) Damage resulting from smoke or corrosive products of combustion
- (4) Operation of fire detection and suppression systems caused by external smoke conveyed into the building

5.5.2.1.8.2 The design fire developed for these scenarios shall consider spread by the following:

- (1) Convection
- (2) Radiation
- (3) Direct flame contact

5.6 Methods of Assessing Performance.

5.6.1 General. A proposed design's performance shall be assessed relative to each performance objective in Section 5.2 and each applicable scenario in Section 5.5, with the assessment conducted through the use of appropriate calculation methods, including computerized modeling programs.

5.6.1.1 The proposed design shall be deemed to meet the goals and objectives if it achieves the performance criteria for each scenario.

5.6.1.2 The installation shall be deemed to meet the goals and objectives if its performance is verified.

5.6.2 Use. The design professional shall use the assessment methods to demonstrate that the proposed design will achieve the goals and objectives, as measured by the performance criteria in light of the safety margins and uncertainty analysis, for each scenario, given the assumptions.

5.6.3 Safety Factors. Safety factors shall be included in the design methods and calculations to reflect uncertainty in the assumptions and other factors associated with the performance-based design.

5.6.4 Output Data. The assessment methods used shall accurately and appropriately produce the necessary output data from input data based on the design specifications, assumptions, and scenarios.

5.6.5 Validity. Evidence shall be provided confirming that the assessment methods are valid and appropriate for the proposed facility, use, and conditions.

5.6.5.1 The validity and applicability of all mathematical models, computer models, scale models, or any combination used in developing a performance-based design shall be documented.

5.6.5.2 Limitations of models used shall be clearly stated.

5.6.6* Methods for Verifying Performance. The performance predicted by the performance design analysis shall be verified by field testing of the installed systems and subsystems.

5.7 Documentation.

5.7.1 General. All aspects of the design, including those described in 5.7.2 through Section 5.8, shall be documented.

5.7.2 Hazard Mitigation Specifications. All details of the proposed hazard mitigation plan to meet the stated goals and objectives shall be documented.

5.7.3 Building Design Specifications. All details of the proposed building design that affect the ability of the building to meet the stated goals and objectives shall be documented.

5.7.4 Survivability Criteria. Survivability criteria, with sources, shall be documented.

5.7.5 Fire Scenarios. Descriptions of fire scenarios shall be documented.

5.7.6 Input Data. Input data to models and assessment methods, including sensitivity analysis, shall be documented.

5.7.7 Output Data. Output data from models and assessment methods, including sensitivity analysis, shall be documented.

5.7.8 Safety Factors. Safety factors utilized shall be documented.

5.7.9 Prescriptive Elements. Any prescriptive elements used shall be documented.

5.8 Acceptance. Acceptance testing, evaluation, and approval by the authority having jurisdiction shall be documented.

Chapter 6 Prescriptive-Based Approaches

6.1 General.

6.1.1* Application. This chapter applies to telecommunications facilities, or a hazard area within, designed to the prescriptive-based option of Section 1.5.

6.1.2* Prescriptive Approach.

6.1.2.1 Where the performance-based approach of Chapter 5 or the redundant- or replacement-based approach of Chapter 7 are not used, the prescriptive requirements of this chapter shall apply.

6.1.2.2 Where two or more of the following equipment or hazard areas are within a single enclosed room, the most restrictive requirements shall be applicable to the entire enclosed room:

- (1) Heating, ventilating, and air-conditioning (HVAC) equipment installed to provide environmental control dedicated to the telecommunications equipment or telecommunications equipment areas
- (2) Signal-processing equipment areas or signal-processing equipment
- (3) Cable entrance facility areas or cable entrance facility equipment
- (4) Power areas or power equipment
- (5) Main distribution frame areas or main distribution frame equipment
- (6) Technical support areas

6.1.3* Determination of Signal-Processing Equipment Area. To determine which requirements to comply with in this chapter, the size of signal-processing equipment area shall be determined based on the total accumulated floor area(s) occupied by signal-processing equipment, including the access aisles between equipment and a 0.6 m (2 ft) wide access zone around the perimeter of signal-processing equipment.

6.1.4* Multiple Tenant Buildings.

6.1.4.1 Telecommunications facilities in multiple tenant buildings not controlled by a telecommunications service provider shall be housed in one of the following:

- (1) A building constructed in accordance with NFPA 220 Type I (443) or Type II (222) or (111)
- (2) A building provided with an automatic suppression system
- (3) A single-story building constructed in accordance with NFPA 220 Type II (000)

6.1.4.2 The telecommunications facility shall be separated from the remainder of the building by 2-hour fire-resistance-rated partitions.

6.1.4.2.1 HVAC penetrations in the telecommunications facility's required fire-resistance-rated partitions shall be in accordance with Section 6.6.

6.1.4.2.2 Within the building selected, the balance of this standard shall apply only to the telecommunications facility.

6.1.5 Co-Located Telecommunications Equipment. Major co-located telecommunications equipment installation, operation, and maintenance shall meet the requirements of this chapter.

6.2 Construction. Building construction shall be in accordance with Section 8.2.

6.3* Protection from Exposures. Exterior walls and openings shall be protected as required by the building code or shall be protected in accordance with the provisions of NFPA 80A where no building code is adopted.

6.4* Means of Egress. Means of egress shall be provided in accordance with NFPA 101 special-purpose industrial occupancy.

6.4.1 Aisles serving equipment frame lineups intended solely to support maintenance and wiring operations shall be permitted to be a minimum of 55.9 cm (22 in.) clear width.

6.4.2 Where one side of the equipment frame lineup perpendicular to the aisles is provided with emergency illumination and signage, no emergency illumination or exit signage shall be required for the maintenance and wiring aisles within the equipment frame area.

6.5* Means for Selective Depowering. Telecommunications facilities containing more than 232 m² (2500 ft²) of signal-processing equipment area shall be provided with a selective means for depowering in accordance with 6.5.1 and 6.5.2. (*See Annex E.*)

6.5.1* Means to selectively depower the building services equipment, power and lighting circuits, and telecommunications equipment shall be identified for incident intervention.

6.5.2* Power distribution equipment with appropriate marking shall be permitted to be used as a means to selectively depower. (*See Section 10.4 for an example.*)

6.6 Building Services Equipment.

6.6.1* Where an HVAC system is provided, it shall comply with one of the following:

- (1) An independent HVAC system that is dedicated for a single hazard area shall be provided.

- (2) An HVAC system that serves multiple hazard areas shall have automatic smoke dampers or combination fire/smoke dampers where they penetrate the compartment walls for the signal-processing equipment area, power area, or main distribution frame hazard areas.

- (3) An HVAC system that serves a hazard area for which smoke control is installed shall have smoke or combination fire/smoke dampers where they penetrate the compartment walls for which smoke control is installed.

6.6.1.1 Smoke dampers or combination fire/smoke dampers shall operate upon activation of smoke detectors in accordance with the requirements of NFPA 90A, unless the HVAC system is part of the smoke management system. (*See Section 8.7.*)

6.6.2 Smoke dampers or combination fire/smoke dampers installed in the ducts or air transfer openings shall be installed in accordance with NFPA 90A.

6.6.3 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems shall comply with NFPA 90A.

6.6.4 Air filters for use in HVAC systems shall comply with the requirements of ANSI/UL 900 and NFPA 90A.

6.6.5 HVAC systems shall be provided with either automatic shutdown or manual shutdown or both.

6.6.5.1 The automatic shutdown of the HVAC system shall be accomplished through the fire alarm system or the building automation system in accordance with NFPA 72.

6.6.5.2* Automatic shutdown of the HVAC system shall not take place prior to confirmation of the presence of smoke.

6.6.6 When the affected compartment is smoke isolated from the balance of the facility, the system design shall be reviewed to determine whether the balance of the HVAC system is to continue to operate.

6.6.7* HVAC systems in individual unaffected areas shall be permitted to continue to operate.

6.6.8* HVAC systems in individual affected areas shall be permitted to continue to operate until confirmation of circulation of smoke.

6.6.9 HVAC units shall be permitted to be shut down on an individual basis.

6.7 Emergency Lighting. Emergency lighting shall be provided in the telecommunications facility in accordance with NFPA 101.

6.7.1* The emergency lighting system shall be permitted to be powered by the telecommunications facility battery system.

6.7.2* Where the telecommunications facility battery system is utilized to power the emergency lighting system, it shall have adequate reserves to meet the loads of the telecommunications equipment and the emergency lighting load connected for the minimum time required in accordance with NFPA 101.

6.8 Signal-Processing Equipment Area.

6.8.1* General. Signal-processing equipment areas shall be arranged to enhance the survivability of the signal-processing

equipment for continuity of service in accordance with 6.8.2 through 6.8.11.

6.8.2 Construction.

6.8.2.1 Floor/Ceiling Assemblies. Floor/ceiling assemblies over signal-processing equipment areas shall be constructed to protect against the leakage of water from the roof or occupied areas above.

6.8.2.2 Raised Floors.

6.8.2.2.1 Structural supporting members and decking for raised floors shall be of noncombustible material.

6.8.2.2.2 Access sections or panels shall be provided in raised floors so that all the space beneath is accessible.

6.8.2.2.3* Dedicated floor puller(s) shall be provided to gain access beneath the raised floor and located at every fire-fighting access route to raised floor areas.

6.8.2.2.4 Cable openings in floors shall be made smooth or shall be otherwise protected to preclude the possibility of damage to the cables.

6.8.2.2.5 The space beneath any raised floor shall not be used for storage.

6.8.2.2.6 Abandoned cables shall be removed provided that they can be removed without damaging adjacent cables and the building structure or finish.

6.8.3* Compartmentation. Signal-processing equipment areas shall be separated from adjacent nontelecommunications equipment areas and standby engine areas by a minimum 1-hour fire-resistive construction in accordance with Sections 8.2 and 8.3.

6.8.4 Building Services Equipment.

6.8.4.1 Where building services equipment is provided, it shall be in accordance with Section 6.6.

6.8.4.2* Building services equipment shall be limited to that needed to support the signal-processing equipment areas and adjacent telecommunications equipment areas.

6.8.4.3 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing equipment areas shall not be required to comply with the requirements of 6.6.1(1), 6.6.1(2), and 6.8.4.2.

6.8.5 Signal-Processing Equipment.

▲ 6.8.5.1* All signal-processing equipment areas, whether owned or co-located, shall be designated as Level A, Level B, or Level C, based on the classification in accordance with 8.8.3 of the equipment within the area.

6.8.5.1.1 Where a 1-hour-rated fire separation is provided between signal-processing areas, each area shall be designated as Level A, Level B, or Level C, based on the classification in accordance with 8.8.3 of the signal-processing equipment within the area.

6.8.5.1.2 All new signal-processing equipment, whether owned or co-located, shall be classified as Level A, Level B, or Level C in accordance with 8.8.3.

6.8.5.1.3 All new wires and cables, whether owned or co-located, shall be in accordance with 8.8.2.

6.8.5.2* Wires, cables, and signal-processing equipment shall be installed and used in configurations and uses for which they have been tested and qualified.

6.8.5.3 Signal-processing equipment areas that contain only signal-processing equipment that complies with Level A of 8.8.3, and wires and cables that comply with 8.8.2, shall not require automatic fire suppression or smoke management.

6.8.5.4 Signal-processing equipment areas that contain Level B signal-processing equipment but no Level C signal-processing equipment, and wires and cables that comply with 8.8.2, shall be protected by one of the following:

- (1) A rated fire separation with a minimum fire resistance of 1 hour between hazard areas, and the hazard area protected throughout by smoke management and sufficient spatial separation to prevent fire and smoke damage to signal-processing equipment other than the signal-processing equipment of fire origin
- (2) A rated fire separation with a minimum fire resistance of 1 hour between hazard areas, and the hazard area protected throughout by automatic fire suppression and sufficient spatial separation to prevent fire and smoke damage to signal-processing equipment other than the signal-processing equipment of fire origin
- (3) A rated fire separation with a minimum fire resistance of 1 hour between hazard areas, with the Level B signal-processing equipment protected by automatic in-cabinet fire detection in compliance with 6.8.6, and in-cabinet fire suppression and sufficient spatial separation to prevent fire and smoke damage to signal-processing equipment other than the signal-processing equipment of fire origin

6.8.5.4.1 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing areas shall not be required to comply with 6.8.5.4.

6.8.5.5 Signal-processing equipment areas that contain Level C signal-processing equipment or wires or cables that do not comply with 8.8.2 shall be separated from other hazard areas with a minimum fire resistance of 1 hour, and the hazard area shall be protected throughout with smoke management, automatic fire suppression, and sufficient spatial separation to prevent fire and smoke damage to signal-processing equipment other than the signal-processing equipment of fire origin.

6.8.5.5.1 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing areas shall not be required to comply with 6.8.5.5.

6.8.5.6 Table 6.8.5.6 shall be used to determine fire protection requirements for signal-processing areas where new signal-processing equipment is added.

6.8.5.6.1 The fire protection requirements shall be based on the signal-processing equipment combination resulting from the addition of new signal-processing equipment.

6.8.5.6.2 The gradual conversion of an existing signal-processing equipment hazard area by adding new signal-processing equipment of varying fire resistance shall result in the same level of fire protection as the creation of a new hazard area containing the same classification level of signal-processing equipment within an existing telecommunications facility.

Table 6.8.5.6 Network Evolution — Fire Protection Requirements: Application for a Signal-Processing Hazard Area to Which New Signal-Processing Equipment Is Being Added, Resulting in a Signal-Processing Equipment Classification Combination

Signal-Processing Equipment Combination in Hazard Area	Option	Required Fire Protection Elements							Means of Depowering in Compliance with Section 6.5 ^g
		Fire Detection in Compliance with 6.8.6 ^c	Hazard Area Rated Fire Separation ^{2a}	Combination Fire/Smoke Dampers ^{2b}	Smoke Management ^{2c,d}	Sufficient Spatial Separation ^{2e}	In-Cabinet Detection and Suppression ^{2f}	Complete Hazard Area ^{2d}	
Level A		Yes	Yes	Yes	No	No	No	No	Yes
Level B, Select	Option 1	Yes	Yes	Yes	Yes	Yes	No	No	Yes
	Option 2	Yes	Yes	Yes	No	Yes	No	Yes	Yes
	Option 3	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Level C		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Levels A & B, Select	Option 1	Yes	Yes	Yes	Yes	Yes	No	No	Yes
	Option 2	Yes	Yes	Yes	No	Yes	No	Yes	Yes
	Option 3	Yes	Yes	Yes	No	Yes	Yes for Level B equipment	No	Yes
Levels A & C		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Levels B & C		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Levels A, B, & C		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

Note: Level A — see 8.8.3(1); Level B — see 8.8.3(2); Level C — see 8.8.3(3).

^aWith the addition of new equipment to a hazard area, upgrading of fire separations where they do not exist is provided in order to prevent unacceptable network outages.

^bCombination fire/smoke dampers are used to prevent fire and smoke damage to other hazard areas.

^cSmoke management systems are designed for the fires resulting from the selected equipment for the hazard area.

^dFire suppression is added to the hazard area if the design fire for the hazard area exceeds smoke management system capabilities to prevent signal-processing equipment damage.

^eSufficient spatial separation is provided to prevent fire and smoke damage to telecommunications equipment other than the telecommunications equipment of fire origin.

^fIn-cabinet fire detection in compliance with 6.8.6 and the use of in-cabinet fire suppression can be a more economical method than protection of the entire hazard area.

^gSelective depowering plan is provided for all options in buildings over 232 m² (2500 ft²). See Section 6.5.

6.8.6 Fire Detection.

6.8.6.1 General. In telecommunications facilities containing greater than 232 m² (2500 ft²) of signal-processing equipment areas, the signal-processing equipment areas shall be provided with a very early warning fire detection (VEWFD) system for detection and alarm processing in accordance with Chapter 8.

6.8.6.1.1 Raised floor areas that do not have a common airflow above and below the raised floor and contain combustibles below the raised floor shall be provided with an early warning fire detection (EWFD) system below the raised floor.

6.8.6.1.2 Where raised floor areas share common airflow above and below the raised floor, the VEWFD provided above the raised floor shall be considered adequate to protect the area below the raised floor.

6.8.6.2 General. In telecommunications facilities containing 232 m² (2500 ft²) or less of signal-processing equipment areas, the signal-processing equipment areas shall be provided with an EWFD system for detection and alarm processing in accordance with Chapter 8.

6.8.6.2.1 Raised floor areas that contain combustibles below the raised floor shall be provided with an EWFD system below the raised floor regardless of common airflow.

6.8.6.3 Installation, Testing, and Maintenance. All fire alarm, detection, and alarm notification equipment shall be installed, tested, and maintained in accordance with *NFPA 72*.

6.8.7 Fire Suppression.

6.8.7.1 Portable Fire Extinguishers. Signal-processing equipment areas shall be provided with listed portable fire extinguishers suitable for use on electronic signal-processing equipment in accordance with 8.6.3.

6.8.7.2 Automatic Fire Suppression. Where automatic fire suppression systems are provided, they shall be in accordance with 8.6.1 and 8.6.2.

N 6.8.8 Leak Detection for Liquid-Cooled Equipment.

N 6.8.8.1 Where liquid-cooling is used for signal-processing equipment, a leak detection system shall be provided.

N 6.8.8.2 The leak detection system shall be arranged to notify approved personnel.

6.8.9 Limitation of Combustibles. Signal-processing equipment areas shall not be used for the storage of combustible materials or other equipment unrelated to the switching, transmission of voice, data, or video signals, and associated power systems.

6.8.9.1 Limitations of combustible materials shall be in accordance with Chapter 9.

6.8.9.2 Technical support areas in accordance with Section 6.13 shall be permitted.

6.8.10 Special Hazards.

6.8.10.1 Hazardous operations, such as cutting and welding, shall not be conducted without special permits.

6.8.10.2 Heat-producing appliances not related to the support of signal-processing equipment shall not be permitted within the area.

6.8.11 Smoke Management Systems. Where smoke management systems are provided, they shall comply with Section 8.7.

6.9 Cable Entrance Facility Area.

6.9.1* General. Cable entrance facility areas shall be arranged to enhance survivability of the cable entrance facility equipment for continuity of service in accordance with 6.9.2 through 6.9.9.

6.9.2 Compartmentation.

6.9.2.1 Cable entrance facility areas shall be separated from adjacent telecommunications equipment areas and nontelecommunications equipment areas by a minimum of 2-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

6.9.2.2 The required fire resistance shall be permitted to be reduced to 1 hour where the cable entrance facility area is protected throughout by an automatic fire suppression system.

6.9.2.3 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing equipment areas shall not be required to comply with 6.9.2.1 and 6.9.2.2.

6.9.2.4 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing equipment areas shall have the cable entrance facility areas separated from adjacent nontelecommunications equipment and standby engine areas by a minimum of 1-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

6.9.2.5 Compartmentation shall not be required where the cable entrance terminates directly within the main distribution frame area.

6.9.3 Building Services Equipment.

6.9.3.1 Where building services equipment are provided, they shall be in accordance with Section 6.6.

6.9.3.2* Building services equipment shall be limited to that needed to support the cable entrance facility area.

6.9.4* Cable Entrance Facility Equipment.

6.9.4.1 All new wire and cables, other than entrance cables, installed in the cable entrance facility area, whether owned or co-located, shall be in accordance with 8.8.2 as appropriate for the type of wire and cable.

6.9.4.1.1 Cabling installed outside of the telecommunications facility shall be permitted to enter the cable entrance facility area, and it shall not extend beyond the cable entrance facility area.

6.9.4.2* Wire, cable, and equipment shall be installed and used in configurations and uses for which they have been tested and qualified.

6.9.4.3 Where telecommunications equipment is installed in the cable entrance facility and that telecommunications equipment does not comply with the fire safety requirements of Level A of Section 8.8.3(1), it shall be separated from the remainder of the telecommunications equipment area by either of the following:

- (1) Sufficient spatial separation and smoke management to prevent fire and smoke damage to equipment other than the equipment of fire origin
- (2) A rated fire separation with a minimum fire resistance of 1 hour

6.9.5 Fire Detection.

6.9.5.1 General.

6.9.5.1.1 Cable entrance facility areas shall be provided with an EWFD system for detection and alarm processing in accordance with Chapter 8.

6.9.5.1.2 Where ambient conditions prohibit the installation of automatic smoke detection, other appropriate automatic fire detection shall be permitted.

6.9.5.2* Installation, Testing, and Maintenance. All fire alarm, detection, and alarm notification equipment shall be installed, tested, and maintained in accordance with *NFPA 72*.

6.9.6 Fire Suppression.

6.9.6.1 Portable Fire Extinguishers. Cable entrance facility areas shall be provided with listed portable extinguishers suitable for use on energized cable and ordinary combustible fires in accordance with 8.6.3.

6.9.6.2 Automatic Fire Suppression. Where automatic fire suppression systems are provided, they shall be in accordance with 8.6.1 and 8.6.2.

6.9.7 Limitation of Combustibles.

6.9.7.1 Cable entrance facility areas shall not be used for the storage of combustible materials or other equipment not related to the cable entrance facility operations.

6.9.7.2 Limitations of combustible materials shall be in accordance with Chapter 9.

6.9.8 Special Hazards. Cable entrance facility areas shall be vented with either gravity vents or with positive venting in order to minimize the buildup of methane gas.

6.9.9 Smoke Management Systems. Where smoke management systems are provided, they shall comply with Section 8.7.

6.10 Power Areas.

6.10.1* General.

6.10.1.1 Power areas shall be arranged to enhance the survivability of power equipment for continuity of service in accordance with 6.10.2 through 6.10.10.

6.10.1.2 Batteries shall be permitted to be located in a dedicated power area or to be located with the equipment they support.

6.10.2 Compartmentation. Power areas shall be separated from adjacent nontelecommunications equipment areas and standby engine areas by a minimum of 1-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

6.10.3 Building Services Equipment.

6.10.3.1 Where building services equipment is provided, it shall be in accordance with Section 6.6.

6.10.3.2* Building services equipment shall be limited to that needed to support the power area and adjacent telecommunications equipment areas.

6.10.3.3 Telecommunications facilities containing less than 232 m² (2500 ft²) of signal-processing equipment area(s) shall not be required to comply with the requirements of 6.10.3.2.

6.10.4 Power Equipment.

6.10.4.1 All new wire, cables, and equipment installed in the power area, whether owned or co-located, shall be in accordance with Section 8.8 as appropriate for the type of wire, cable, and equipment.

6.10.4.2* Wire, cable, and equipment shall be installed and used in configurations and uses for which they have been tested and qualified.

6.10.4.3 Equipment that does not comply with the fire safety requirements of Level A of 8.8.3(1) shall be separated from the remainder of the telecommunications equipment area by either of the following:

- (1) Sufficient spatial separation and smoke management to prevent fire and smoke damage to equipment other than the equipment of fire origin
- (2) A rated fire separation with a minimum fire resistance of 1 hour

6.10.4.4 Wire and cable that do not comply with the fire safety requirements of 8.8.2 shall be separated from the remainder of the telecommunications equipment area by either of the following:

- (1) Sufficient spatial separation and smoke management to prevent fire and smoke damage to equipment other than the equipment of fire origin
- (2) A rated fire separation with a minimum fire resistance of 1 hour

6.10.5 Fire Detection.

6.10.5.1 General. Power areas shall be provided with an EWFD system for detection and alarm processing in accordance with Chapter 8.

6.10.5.2 Installation, Testing, and Maintenance. All fire alarm, detection, and alarm notification equipment shall be installed, tested, and maintained in accordance with *NFPA 72*.

6.10.6 Fire Suppression.

6.10.6.1 Portable Fire Extinguishers. Power areas shall be provided with listed portable extinguishers suitable for use on energized and electronic equipment in accordance with 8.6.3.

6.10.6.2 Automatic Fire Suppression. Where automatic fire suppression systems are provided in power areas, they shall be in accordance with 8.6.1 and 8.6.2.

6.10.7 Limitation of Combustibles. Power areas shall not be used for the storage of combustible materials or other equipment not related to the power area operations.

6.10.7.1 Limitation of combustible materials shall be in accordance with Chapter 9.

6.10.7.2 Technical support areas in accordance with Section 6.13 shall be permitted.

N 6.10.8 Batteries. Batteries used in power system areas shall comply with 6.10.8.

N 6.10.8.1 General.

N 6.10.8.1.1 Location and Occupancy Separation. Battery systems shall be permitted in the same room as the equipment that they support. [1:52.2.2.3.1]

N 6.10.8.1.1.1 Battery systems shall be housed in a noncombustible, locked cabinet or other enclosure to prevent access by unauthorized personnel unless located in a separate equipment room accessible only to authorized personnel. [1:52.2.2.3.2]

N 6.10.8.1.1.2 Battery systems shall be located in a room separated from other portions of the building by a minimum of a 1-hour fire barrier.

N 6.10.8.1.1.3 Where telecommunications equipment is located in a structure or building housing multiple tenants or occupancies that include business, industrial, mercantile, or storage, battery systems shall be located in a room separated from other portions of the building by a minimum of a 1-hour fire barrier.

N 6.10.8.1.1.4 Where telecommunications equipment is located in a structure or building housing multiple tenants or occupancies that include assembly, educational, detention, and correction facilities; health care, ambulatory health, ambulatory care, and day care centers; and residential board and care and residential occupancies, battery systems shall be located in a room separated from other portions of the building by a minimum of a 2-hour fire barrier.

N 6.10.8.1.2 Environment. The battery environment shall be controlled or analyzed to maintain temperature in a safe operating range for the specific battery technology used. [1:52.2.2.7]

N 6.10.8.1.2.1 Labels. Battery cabinets shall be provided with exterior labels that identify the manufacturer and model number of the system and electrical rating (i.e., voltage and current) of the contained battery system. [1:52.2.2.8.4]

N 6.10.8.1.2.2 Signs. Signs shall be provided within battery cabinets to indicate the relevant electrical, chemical, and fire hazard. [1:52.2.2.8.5]

N 6.10.8.1.3 Seismic Protection. Battery systems shall be seismically braced in accordance with the building code. [1:52.2.2.9]

N 6.10.8.2 Lead-Acid and Nickel-Cadmium Batteries.

N 6.10.8.2.1 General. Battery systems having an electrolyte capacity of more than 100 gal (378.5 L) in sprinklered buildings or 50 gal (189.3 L) in unsprinklered buildings for vented lead-acid, nickel-cadmium, and valve-regulated lead-acid (VRLA) batteries shall be in accordance with 6.10.8.2 and Table 6.10.8.2.1.

N 6.10.8.2.2 Safety Venting. Batteries shall be provided with safety venting caps per 6.10.8.2.2.1 and 6.10.8.2.2.2 [1:52.2.2.1]

N 6.10.8.2.2.1 Nonrecombinant Batteries. Vented lead-acid and nickel-cadmium shall be provided with safety venting caps. [1:52.2.2.1.1]

N 6.10.8.2.2.2 Recombinant Batteries. VRLA shall be equipped with self-resealing flame-arresting safety vents. [1:52.2.2.1.2]

N 6.10.8.2.3 Thermal Runaway. VRLA systems shall be provided with a listed device or other approved method to preclude, detect, and control thermal runaway. [1:52.2.2.2]

N 6.10.8.2.4 Spill Control.

N 6.10.8.2.4.1 Rooms, buildings, or areas containing free-flowing liquid electrolyte in individual vessels having a capacity of more than 55 gal (208 L) or multiple vessels having an aggregate capacity exceeding 1000 gal (3785 L) shall be provided with spill control to prevent the flow of liquids to adjoining areas. [1:52.2.2.4.1]

N 6.10.8.2.4.2* An approved method and materials for the control of a spill of electrolyte shall be provided that will be capable of controlling a spill from the single largest vessel. [1:52.2.2.4.2]

N 6.10.8.2.4.3 VRLA batteries with immobilized electrolyte shall not require spill control. [1:52.2.2.4.3]

N 6.10.8.2.5 Neutralization.

N 6.10.8.2.5.1* An approved method to neutralize spilled electrolyte shall be provided. [1:52.2.2.5.1]

N 6.10.8.2.5.2 For VRLA batteries, the method shall be capable of neutralizing a spill from the largest battery to a pH between 7.0 and 9.0. [1:52.2.2.5.2]

N 6.10.8.2.6* Ventilation. For vented lead-acid, vented nickel-cadmium, and VRLA batteries, ventilation shall be provided for

rooms and cabinets in accordance with the mechanical code and one of the following:

- (1) The ventilation system shall be designed to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room during the worst-case event of simultaneous “boost” charging of all the batteries, in accordance with nationally recognized standards.
- (2) Continuous ventilation shall be provided at a rate of not less than 1 ft³/min/ft² (5.1 L/sec/m²) of floor area of the room or cabinet.

N 6.10.8.2.7 Signs.

N 6.10.8.2.7.1 Doors or accesses into the following shall be provided with approved signs:

- (1) Rooms containing stationary storage battery systems
- (2) Other areas containing stationary storage battery systems

N 6.10.8.2.7.2 For rooms that contain VRLA batteries, the signs required by 6.10.8.2.7.1 shall state the following:

This room contains:

- (1) Stationary storage battery systems
- (2) Energized electrical circuits

[1:52.2.2.8.2]

N 6.10.8.2.7.3 For rooms that contain lead-acid or vented Ni-Cd batteries, the signs required by 6.10.8.2.7.1 shall state the following:

This room contains:

- (1) Stationary storage battery systems
- (2) Energized electrical circuits
- (3) Corrosive battery electrolyte

N 6.10.8.2.8 Smoke Detection.

N 6.10.8.2.8.1 An approved automatic smoke detection system shall be installed in rooms containing stationary battery storage systems in accordance with *NFPA 72*. [1:52.2.2.10]

N 6.10.8.2.8.2 Normally unoccupied, stand-alone telecommunications structures with a gross floor area of less than 1,500 ft² (140 m²) shall not be required to have the detection as indicated in 6.10.8.2.8.1. [1:52.2.2.10.2]

N Table 6.10.8.2.1 Lead-Acid and Nickel-Cadmium Battery Requirements

Requirement	Nonrecombinant Batteries		Recombinant Batteries
	Vented Lead-Acid	Vented Nickel-Cadmium (Ni-Cd)	Valve-Regulated Lead-Acid (VRLA)
Safety caps	Venting caps	Venting caps	Self-resealing flame-arresting caps
Thermal runaway management	Not required	Not required	Required
Spill control	Required	Required	Not required
Neutralization	Required	Required	Required
Ventilation	Required	Required	Required
Signage	Required	Required	Required
Seismic control	Required	Required	Required
Fire detection	Required	Required	Required

N 6.10.8.3 Additional Battery Technologies.

N 6.10.8.3.1 General. Lithium-ion or sodium-nickel battery systems having a capacity of more than 20 KWh (18.0 Mega joules) shall be in accordance with 6.10.8.3.

N 6.10.8.3.1.1 For batteries rated in amp-hours, KWh shall equal rated voltage times amp-hour rating divided by 1000.

N 6.10.8.3.2 Maximum Allowable Quantities.

N 6.10.8.3.2.1 Fire areas within buildings containing stationary storage battery systems exceeding the maximum allowable quantity of 600 KWh (2160 mJ) shall comply with all applicable ordinary-hazard and high-hazard requirements as identified in 6.2.2 of NFPA 101 and the building code.

N 6.10.8.3.2.2 Where approved by the AHJ, areas containing stationary storage battery systems that exceed 600 KWh (2160 mJ) shall be permitted to be treated as an ordinary-hazard and not a high-hazard classification based on a hazardous mitigation analysis in accordance with 6.10.8.3.4 and large-scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory.

N 6.10.8.3.3* Battery Arrays.

N 6.10.8.3.3.1 Battery arrays shall comply with 6.10.8.3.3.2 and 6.10.8.3.3.3 unless otherwise permitted by 6.10.8.3.3.4 or 6.10.8.3.3.5. [1:52.3.2.3.1]

N 6.10.8.3.3.2 Storage batteries, prepackaged stationary storage battery systems, and pre-engineered stationary storage battery systems shall be segregated into arrays not exceeding 50 KWh (180 Mega joules) each. [1:52.3.2.3.2]

N 6.10.8.3.3.3 Each array shall be spaced a minimum 3 ft (914 mm) from other arrays and from walls in the storage room or area. The storage arrangements shall comply with the egress provisions in NFPA 101. [1:52.3.2.3.3]

N 6.10.8.3.3.4 Listed pre-engineered stationary storage battery systems and prepackaged stationary storage battery systems shall not exceed 250 KWh (900 Mega joules) each. [1:52.3.2.3.4]

N 6.10.8.3.3.5 The AHJ shall be permitted to approve listed pre-engineered and prepackaged battery arrays with larger capacities or smaller battery array spacing if large-scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving one array will not propagate to an adjacent array, and be contained within the room for a duration equal to the fire resistance rating of the room separation required by 6.10.8.1.1.3. [1:52.3.2.3.5]

N 6.10.8.3.4 Hazard Mitigation Analysis. A failure mode and effects analysis (FMEA) or other approved hazard mitigation analysis shall be provided to the AHJ when any of the following conditions are present:

- (1) Battery technologies not specifically identified in 6.10.8.3.1 are provided.
- (2) More than one stationary storage battery technology is provided in a room or indoor area where there is a potential for adverse interaction between technologies.
- (3) When allowed as a basis for increasing maximum allowable quantities as specified in 6.10.8.3.2.

[1:52.3.2.4]

N 6.10.8.3.4.1 The analysis shall evaluate the consequences of the following failure modes, and others deemed necessary by the AHJ. Only single failure modes shall be considered for each mode:

- (1) Thermal runaway condition in a single module or array
- (2) Failure of a battery management system
- (3) Failure of a required ventilation system
- (4) Voltage surges on the primary electric supply
- (5) Short circuits on the load side of the stationary battery storage system
- (6) Failure of the smoke detection, fire suppression, or gas detection system

[1:52.3.2.4.1]

N 6.10.8.3.4.2 The AHJ shall be permitted to approve the hazardous mitigation analysis provided the consequences of the FMEA demonstrate the following:

- (1) Fires or explosions will be contained within unoccupied stationary storage battery system rooms for the minimum duration of the fire resistance rated specified in 6.10.8.1.1.2 or 6.10.8.1.1.3, as applicable
- (2) Fires and explosions in stationary storage battery system cabinets in occupied work centers allow occupants to safely evacuate
- (3) Toxic and highly toxic gases released during charging, discharging, and normal operation shall not exceed the permissible exposure limit (PEL)
- (4) Toxic and highly toxic gases released during fires and other fault conditions shall not reach concentrations in excess of IDLH level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area
- (5) Flammable gases released from batteries during charging, discharging, and normal operation shall not exceed 25 percent of the lower flammable limit (LFL)

[1:52.3.2.4.2]

N 6.10.8.3.4.3 Construction, equipment, and systems that are required for the lithium-ion or sodium-nickel battery systems to comply with the hazardous mitigation analysis shall be installed, maintained, and tested in accordance with nationally recognized standards and specified design parameters.

N 6.10.8.3.5 Listings. Storage batteries shall be listed in accordance with ANSI/UL 1973, *Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*. Prepackaged and pre-engineered lithium-ion or sodium-nickel battery systems shall be listed in accordance with ANSI/UL 9540, *Outline of Investigation for Energy Storage Systems and Equipment*.

N 6.10.8.3.5.1* Prepackaged and Pre-engineered Systems. Prepackaged and pre-engineered stationary storage battery systems shall be installed in accordance with their listing and the manufacturer's instructions. [1:52.3.2.5.1]

N 6.10.8.3.6 Installation.

N 6.10.8.3.6.1 Battery Management System. An approved battery management system shall be provided for monitoring and balancing cell voltages, currents, and temperatures within the manufacturer's specifications. The system shall transmit an alarm signal to an approved location if potentially hazardous temperatures or other conditions including short circuits, over-voltage (i.e., overcharge) or under voltage (i.e., over discharge) are detected. [1:52.3.2.6.1]

N 6.10.8.3.6.2 Battery Chargers. Battery chargers shall be compatible with the battery manufacturer's electrical ratings and charging specifications. Battery chargers shall be listed in accordance with the ANSI/UL 1564, *Standard for Industrial Battery Chargers*, or provided as part of a listed pre-engineered or prepackaged lithium-ion or sodium-nickel battery system.

N 6.10.8.3.6.3 Signage.

(A) Approved signage shall be provided on doors or in approved locations near entrances to battery system rooms.

(B) New signage installations shall require the following items:

- (1) Hazard identification markings in accordance with NFPA 704
- (2) "This room contains energized battery systems," or the equivalent
- (3) Identification of the type(s) of batteries present
- (4) AUTHORIZED PERSONNEL ONLY
- (5) Any potential hazards associated with the batteries

(C) Where the battery storage system disconnecting means is not within sight of the main service disconnect, placards or directories shall be installed at the locations of the main service disconnect to indicate the location of all battery storage disconnecting means in accordance with NFPA 70. [1:52.3.2.6.5.3]

(D) Existing stationary storage battery systems shall be permitted to include the signage required at the time it was installed. [1:52.3.2.6.5.4]

(E) Fire command centers in buildings containing stationary storage battery systems shall include signage or readily available documentation that describes the location of stationary storage battery systems, the types of batteries present, operating voltages, and location of electrical disconnects. [1:52.3.2.6.5.7]

N 6.10.8.3.6.4* Mixed Battery Systems. Different types of batteries shall not be installed in the same room or cabinet if there is a potential for unsafe interaction between them, as determined by the AHJ. [1:52.3.2.6.8]

N 6.10.8.3.7 Suppression and Detection.

N 6.10.8.3.7.1 Fire Suppression.

(A) Rooms containing stationary storage battery systems shall be protected by an automatic sprinkler system installed in accordance with Section 13.3 of NFPA 1 or an approved alternative suppression system.

(B) Commodity classifications for specific technologies of storage batteries shall be in accordance with Chapter 5 of NFPA 13. [1:52.3.2.7.1.1]

N 6.10.8.3.7.2 Smoke Detection. An approved automatic smoke detection system shall be installed in rooms containing stationary storage battery systems in accordance with NFPA 72, and the required automatic smoke detection system shall be supervised by an approved central, proprietary, or remote station service or a local alarm that will give an audible signal at a constantly attended location.

N 6.10.8.3.8 Thermal Runaway. Where required by 6.10.8.3.9, a listed device or other approved method shall be provided to preclude, detect, and control thermal runaway. [1:52.3.2.10]

N 6.10.8.3.9 Battery-Specific Protection. Stationary storage battery systems shall comply with 6.10.8.2 through 6.10.8.3.8 and this section, as applicable. [1:52.3.2.11]

N 6.10.8.3.9.1 Lithium-Ion Batteries. Stationary storage battery systems utilizing lithium-ion batteries shall be provided with thermal runaway monitoring in accordance with 6.10.8.3.8.

N 6.10.8.3.9.2 Sodium-Nickel Batteries. Stationary storage battery systems utilizing sodium-nickel batteries shall be provided with thermal runaway monitoring in accordance with 6.10.8.3.8.

N 6.10.8.3.10 Testing, Maintenance, and Repairs.

N 6.10.8.3.10.1 Stationary storage batteries and associated equipment and systems shall be tested and maintained in accordance with the manufacturer's instructions. [1:52.3.2.12.1]

N 6.10.8.3.10.2 Any storage batteries or system components used to replace existing units shall be compatible with the battery charger, battery management systems, other storage batteries, and other safety systems. [1:52.3.2.12.2]

N 6.10.8.4 Other Battery Types. Other battery types not addressed in 6.10.8.2 or 6.10.8.3 shall be in accordance with Chapter 52 of NFPA 1.

Δ 6.10.9* Special Hazards.

6.10.9.1* Where provided, alternative energy systems such as photovoltaic systems, fuel cells, microturbines, wind turbines, and similar energy source or storage systems shall comply with applicable codes and standards.

6.10.9.2 If installed in lightning-prone areas, the alternative energy installation shall comply with NFPA 780.

6.10.10 Smoke Management Systems. Where smoke management systems are provided, they shall comply with Section 8.7.

6.11 Main Distribution Frame Areas.

6.11.1* General. Main distribution frame areas shall be arranged to enhance the survivability of the main distribution frame equipment and adjacent signal-processing equipment in accordance with 6.11.2 through 6.11.11.

6.11.2 Construction.

6.11.2.1 Floor/Ceiling Assemblies. Floor/ceiling assemblies over main distribution frame areas shall be constructed to protect against the leakage of water from the roof or occupied areas above.

6.11.2.2 Raised Floors.

6.11.2.2.1 Structural supporting members and decking for raised floors shall be of noncombustible material.

6.11.2.2.2 Access sections or panels shall be provided in raised floors so that all the space beneath is accessible.

6.11.2.2.3* Dedicated floor puller(s) shall be provided to gain access beneath the raised floor and located at every fire-fighting access route to raised floor areas.

6.11.2.2.4 Cable openings in floors shall be made smooth or shall be otherwise protected to preclude the possibility of damage to the cables.

6.11.2.2.5 The space beneath any raised floor shall not be used for storage.

6.11.2.2.6 Abandoned cables shall be removed provided that they can be removed without damaging adjacent cables and the building structure or finish.