NFPA® 76

Standard for the

Fire Protection of Telecommunications Facilities

2009 Edition

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This edition of NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities,* was prepared by the Technical Committee on Telecommunications and acted on by NFPA at its June Association Technical Meeting held June 2? , 2008, in Las Vegas, NV. It was issued by the Standards Council on July 24, 2008, with an effective date of October 10, 2008, and supersedes all previous editions.

This edition of NFPA 76 was approved as an American National Standard on October 10, 2008.

Origin and Development of NFPA 76

In April of 1996, the NFPA Standards Council approved a new committee project to develop documents on fire protection for telecommunication 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, published in 2002, was a recommended practice that was arranged for use 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 in the 2005 edition. Requirements for large and small telecommunications facilities were combined into one chapter. A chapter was added for redundant- or replacement-based approaches.

The 2009 edition has been 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.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

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

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Fire Protection of Telecommunications Facilities
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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.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (? between the paragraphs that remain.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex G. 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.

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Information on referenced 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 where telecommunications services such as telephone (landline, wireless) transmission, data transmission, internet transmission, voice-over internet protocol (VoIP) transmission, and video transmission 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.

1.1.2* This standard specifically excludes telecommunications facilities with less than 46.5 m^2 (500 ft^2) of signal-processing equipment areas.

1.2 Purpose.

The purpose of this standard is to provide a reasonable level of fire protection in telecommunications facilities, to provide a reasonable level of life safety for the occupants, and to protect the telecommunications equipment and service continuity.

1.2.1 This standard is intended to avoid requirements that could involve unnecessary complications for or interference with the normal use, occupancy, and operations of telecommunications facilities and equipment.

1.2.2* This standard provides a means by which the industry's accepted fire safety methods are applied to continue the historically good fire safety record of these facilities.

1.3* Application.

The provisions of this standard are considered necessary to provide a reasonable level of protection from loss of life, property, and service

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continuity from fire and explosion.

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

1.3.2 For purposes of application of NFPA *101* and *NFPA 5000*, telecommunications facilities are classified as special purpose or industrial low occupancy, respectively.

1.3.3 Telecommunications facilities are unique in their fire resistive/limited combustibility construction and the degree of control and high standards for content ignition and combustibility.

1.3.3.1 In recognition of this, automatic suppression systems are required only under limited and specific conditions.

1.3.3.2 These provisions reflect situations and the state of the art at the time the standard was issued.

1.3.4 The provisions of this standard shall not be applied retroactively to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of the standard.

1.3.5* Alterations or new installations in existing facilities shall not diminish the level of protection below that which existed prior to the alteration.

1.4* Design Options.

This standard provides performance-based, prescriptive-based, and redundant- or replacement-based design options.

1.4.1 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.

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

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

1.4.4 Chapters 1, 4, 9, and 10 shall apply to all telecommunications facilities within the scope of this standard, regardless of the design approach taken.

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1.5 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*, 2009 edition.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2007 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems,* 2009 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2007 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2007 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2008 edition.

NFPA 30, *Flammable and Combustible Liquids Code,* 2008 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines,* 2006 edition.

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NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work,* 2009 edition.

NFPA 54, *National Fuel Gas Code,* 2009 edition.

NFPA 70®, *National Electrical Code®,* 2008 edition.

NFPA 72®, *National Fire Alarm Code®,* 2007 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2007 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2009 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations,* 2008 edition.

NFPA *101®*, *Life Safety Code®,* 2009 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2005 edition.

NFPA 220, *Standard on Types of Building Construction,* 2009 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* 2004 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials,* 2006 edition.

NFPA 252, *Standard Methods of Fire Tests of Door Assemblies,* 2008 edition.

NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies,* 2007 edition.

NFPA 262, *Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces,* 2007 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems,* 2006 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems,* 2008 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* 2008 edition.

NFPA 5000®, *Building Construction and Safety Code®,* 2009 edition.

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2.3 Other Publications.

2.3.1 ANSI Publications.

American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI T1.307, *Fire Resistance Criteria ? Ignitability Requirements for Equipment Assemblies, Ancillary Non-Metallic Apparatus, and Fire Spread Requirements for Wire and Cable*, 2003.

ANSI T1.319, *Equipment Assemblies ? Fire Propagation Risk Assessment Criteria*, 2002.

2.3.2 ASTM Publications.

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

ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, 1997.

ASTM E 1537, *Standard Method of Fire Testing of Upholstered Furniture*, 1999.

ASTM E 1966, *Standard Test Method for Fire Resistive Joint Systems*, 1998.

2.3.3 CSA Publications.

Canadian Standards Association, 5060 Spectrum Way, Mississauga, Ontario, L4W 5N6, Canada.

C22.2 No. 03, *Test Methods for Electrical Wires and Cables*, 1996.

2.3.4 IEEE Publications.

Institute of Electrical and Electronics Engineers, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE 1202, *Standard for the Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies*, 2006.

2.3.5 UL Publications.

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

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UL 44, *Thermoset-Insulated Wires and Cables,* 2005.

UL 83, *Thermoplastic-Insulated Wire and Cables,* 2008.

UL 444, *Communications Cables,* 2002.

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

UL 900, *Standard for Air Filter Units*, 2004.

UL 1277, *Electrical Power and Control Tray Cables and Optional Optical-Fiber Members,* 2001.

UL 1651, *Optical Fiber Cable,* 1997.

UL 1666, *Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts*, 2000, with revisions through July 12, 2002.

UL 1685, *Standard for Vertical Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables*, 1997, with revisions through November 29, 2000.

UL 2024, *Optical Fiber and Communication Cable Raceway,* 2004.

UL 2024A, *Outline of Investigation for Optical Fiber Cable Routing Assemblies.*

2.3.6 Other Publications.

UL 60950, *Application Guideline,* 2000.

Telcordia GR-63-CORE, *Network Equipment Building System (NEBS)? Requirements: Physical Protection*, 2002.

California Technical Bulletin 133, *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*.

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

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2.4 References for Extracts in Mandatory Sections.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems,* 2009 edition.

NFPA 92B, *Standard for Smoke Management Systems in Malls, Atria, and Large Spaces,* 2009 edition.

NFPA *101®*, *Life Safety Code®,* 2009 edition.

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants,* 2006 edition.

NFPA 921, *Guide for Fire and Explosion Investigations,* 2008 edition.

NFPA 5000®, *Building Construction and Safety Code®,* 2009 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

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

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Standard. A document, the main text of which contains only mandatory provisions using the word 撈hall? 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 shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

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

3.3.2 Cable TV. One- and two-way communications service provided over a video network, generally through coaxial cable.

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

3.3.4 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,*** 2009]

3.3.5 Firestop. A specific system, device, or construction consisting of the materials that fill the openings around penetrating items such as cables, cable trays, conduit, ducts, pipes, and their means of support through wall or floor openings to prevent the spread of fire. [***5000,*** 2009]

3.3.6 Smoke Control. A system that utilizes fans to produce pressure differences so as to manage smoke movement. [**90A,** 2009]

3.3.7 Smoke Management System. An engineered system that includes all methods that can be used singly or in combination to modify smoke movement. [**92B,** 2009]

3.3.8 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.

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

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3.3.10 Telecommunications Facility. A building or portion of a building that includes telecommunications equipment area and support areas.

3.3.11 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.

3.3.12* VoIP, Voice over Internet Protocol. Voice communication using internet protocol.

3.4 Area Definitions.

3.4.1 Administrative Areas. These areas 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. These areas or rooms typically include utility areas, mechanical equipment areas, 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.

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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杢ype detector.

3.5.3 Sampling Port. See 3.5.2, Port.

3.5.4 Sensor. A device, such as a photoelectric cell, that receives and responds to stimulus.

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

3.5.6 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

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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 provides 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. The wire, cable, and electrical/electronic equipment including signal-processing equipment, cable entrance equipment, 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***, 2009]

3.7.1.2 Uncertainty Analysis. An analysis performed to determine the degree to which a predicted value will vary. [***5000***, 2009]

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***, 2009]

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,** 2006]

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***, 2009]

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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,** 2008]

3.7.6 Incapacitation. A condition under which humans do not function adequately and become unable to escape untenable conditions. [***101,*** 2009]

3.7.7 Occupant Characteristics. The abilities or behaviors of people before and during a fire. [***101,*** 2009]

3.7.8* Performance Criteria. Threshold values on measurement scales that are based on quantified performance objectives. [***101,*** 2009]

3.7.9 Proposed Design. A design developed by a design team and submitted to the authority having jurisdiction for approval. [***101,*** 2009]

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,*** 2009]

3.7.11 Safety Factor. A factor applied to a predicted value to ensure that a sufficient safety margin is maintained. [***101,*** 2009]

3.7.12 Safety Margin. The difference between a predicted value and the actual value where a fault condition is expected. [***101,*** 2009]

3.7.13 Verification Method. A procedure or process used to demonstrate or confirm that the proposed design meets the specified criteria. [***101,*** 2009]

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.

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(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 within a reasonable period post-event.

(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) Size and value of the facility

(4) Restoration plans

(5) Availability of readily deployable replacement telecommunications infrastructure

(6) Response time to an alarm

(7) Local fire-fighting capabilities

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(8) Redundant telecommunications infrastructure

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 1.4.

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.

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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.

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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

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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

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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.

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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

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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杞 ir 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

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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

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

(1) Convection

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(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.

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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 1.4.

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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)

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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 telecommunication 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.

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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 Depowering.

See Annex E. Telecommunications facilities containing more than 232 m^2 (2500 ft^2) of signal-processing equipment area shall be provided with a

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means for depowering in accordance with 6.5.1 through 6.5.3.

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

6.5.2* Power distribution/disconnect equipment with appropriate marking shall be permitted to be used as a means to disconnect power.

6.5.3 A depowering procedure shall be developed in accordance with Section 10.6.

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 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 be rated as either Class 1 or Class 2 in accordance with 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

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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.

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 6.8.10.

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.

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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 not be allowed to accumulate.

6.8.2.2.7 Cables not identified for future use shall be removed.

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 m^2 (2500 ft^2) 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 signal-processing 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.

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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 m^2 (2500 ft^2) 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.

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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.

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

		Required Fire Protection Elements							
							Fire Suppression in Compliance with 6.8.5.4.1 or 6.8.5.5.1		
Signal-Processing Equipment Combination in Hazard Area	**Option**	**Fire Detection in Compliance with 6.8.6?**	**Hazard Area Rated Fire Separation?**	**Combination Fire/Smoke Dampers?**	**Smoke Management?**	**Sufficient Spatial Separation?**	**In Cabinet Detection and Suppression?**	**Complete Hazard Area?**	**Means of Depowering in Compliance with Section 6.5?**
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
See notes			1	2	3 and 4	5	6	4	7

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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

		Required Fire Protection Elements							
							Fire Suppression in Compliance with 6.8.5.4.1 or 6.8.5.5.1		
Signal-Processing Equipment Combination in Hazard Area	Option	Fire Detection in Compliance with 6.8.6?	Hazard Area Rated Fire Separation?	Combination Fire/Smoke Dampers?	Smoke Management?	Sufficient Spatial Separation?	In Cabinet Detection and Suppression?	Complete Hazard Area?	Means of Depowering in Compliance with Section 6.5?

Level A ? See 8.8.3(1).
Level B ? See 8.8.3(2).
Level C ? See 8.8.3(3).
NOTES:
1. With 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.
2. Combination fire/smoke dampers are used to prevent fire and smoke damage to other hazard areas.
3. Smoke management systems are designed for the fires resulting from the selected equipment for the hazard area.
4. Fire 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.
5. Sufficient spatial separation is provided to prevent fire and smoke damage to telecommunications equipment other than the telecommunications equipment of fire origin.
6. In-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.
7. Power-down plan is provided for ALL options. See Section 6.5, Means for Depowering.

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

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signal-processing equipment within an existing telecommunications facility.

6.8.6 Fire Detection.

6.8.6.1 General. In telecommunications facilities containing greater than 232 m^2 (2500 ft^2) 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 In telecommunications facilities containing 232 m^2 (2500 ft^2) or less of signal-processing equipment areas, the signal-processing equipment areas shall be provided with an early warning fire detection (EWFD) system for detection and alarm processing in accordance with Chapter 8.

6.8.6.1.2 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 EWFD system below the raised floor.

6.8.6.1.3 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 Installation. All fire alarm, detection, and alarm notification equipment shall be installed 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.

6.8.8 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.

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

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

6.8.9 Special Hazards.

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

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

6.8.10 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 m^2 (2500 ft^2) 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 m^2 (2500 ft^2) 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.

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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. All fire alarm, detection, and alarm notification equipment shall be installed 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.

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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 6.10.9.

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 m^2 (2500 ft^2) 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.

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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. All fire alarm, detection, and alarm notification equipment shall be installed 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.

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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.

6.10.8* Special Hazards. Stationary battery system areas shall comply with NFPA 1.

6.10.9 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 and 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 not be allowed to accumulate.

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6.11.2.2.7 Cables not identified for future use shall be removed.

6.11.3* Compartmentation. Main distribution frame 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.

6.11.4 Building Services Equipment.

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

6.11.4.2* Building services equipment shall be limited to that needed to support the main distribution frame area and adjacent telecommunications equipment areas.

6.11.4.3 Telecommunications facilities containing less than 232 m^2 (2500 ft^2) of signal-processing equipment area(s) shall not be required to comply with the requirements of 6.6.1(1), 6.6.1(2), and 6.11.4.2.

6.11.5 Main Distribution Frame (MDF) Equipment.

6.11.5.1* The main distribution frame (MDF) area shall be classified as Level A or Level C in accordance with 8.8.3.

6.11.5.1.1 All new MDF equipment, whether owned or co-located, shall be classified as Level A or Level C in accordance with 8.8.3.

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

6.11.5.2* Wires, cables, and equipment shall be used in configurations and uses for which they have been tested and qualified.

6.11.5.3 An MDF that complies with Level A of 8.8.3(1), and with wires and cables in accordance with 8.8.2, shall not require automatic fire suppression, smoke management, or separation from other MDF areas that comply with Level A of 8.8.3(1).

6.11.5.4 An MDF that complies with Level A of 8.8.3(1), and with wires and cables in accordance with 8.8.2, shall not require automatic fire suppression, smoke management, or separation from signal-processing equipment that complies with Level A of 8.8.3(1).

6.11.5.5 Facilities containing 232 m^2 (2500 ft^2) of signal-processing equipment area, and containing an MDF consisting of significant components that do not comply with Level A of 8.8.3(1), or significant wires and cables that do not comply with 8.8.2, shall have an MDF area separated from other telecommunications equipment areas by 1-hour fire-resistance-rated construction, or the area shall be protected throughout

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by an automatic fire suppression system.

6.11.5.6 Facilities containing 232 m^2 (2500 ft^2) or less of signal-processing equipment area, and containing an MDF consisting of significant wires and cables that do not comply with 8.8.2, shall have main distribution area 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 telecommunications equipment other than the equipment of fire origin

(2) A rated fire separation with a minimum fire resistance of 1 hour

6.11.6 Fire Detection.

6.11.6.1 General. In telecommunications facilities containing greater than 232 m^2 (2500 ft^2) of signal-processing equipment areas, the main distribution frame areas shall be provided with a very early warning fire detection (VEWFD) system for detection and alarm processing in accordance with Chapter 8.

6.11.6.1.1 In telecommunications facilities containing 232 m^2 (2500 ft^2) or less of signal-processing equipment areas, the main distribution frame areas shall be provided with an early warning fire detection (EWFD) system for detection and alarm processing in accordance with Chapter 8.

6.11.6.1.2 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 EWFD system below the raised floor.

6.11.6.1.3 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.

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

6.11.7 Fire Suppression.

6.11.7.1 Portable Fire Extinguishers. Main distribution frame areas shall be provided with listed portable fire extinguishers suitable for use on energized equipment in accordance with 8.6.3.

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

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8.6.2.

6.11.8 Limitation of Combustibles. Main distribution frame areas shall not be used for the storage of combustible materials or other equipment not related to the main distribution frame operations.

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

6.11.9 Technical Support Areas. Technical support areas in accordance with Section 6.13 shall be permitted.

6.11.10 Special Hazards. Heat-producing appliances not related to support of main distribution frame operations shall not be permitted.

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

6.12 Standby Engine Areas.

6.12.1 General.

6.12.1.1 Standby engine areas shall be arranged to prevent the spread of fire to adjacent areas and to reduce the hazards associated with the fuel supply for the generator in accordance with 6.12.1.2 through 6.12.10.

6.12.1.2 Standby engines shall be installed and maintained in accordance with NFPA 110.

6.12.2 Construction. Where used, soundproofing shall be of noncombustible or limited-combustible materials.

6.12.3 Compartmentation.

6.12.3.1* Standby engine areas shall be separated from adjacent areas by a minimum of 2-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3, or for standby engine areas protected by automatic fire suppression systems, the fire resistance rating of the enclosure shall be permitted to be reduced to a minimum of 1 hour.

6.12.3.2 Telecommunications facilities containing less than 232 m^2 (2500 ft^2) of signal-processing equipment area shall have the standby engine area separated from other areas by a minimum of 1-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

6.12.4* Fuel Control.

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6.12.4.1 To limit fire spread and flashback, fuel supplies to standby engines shall be controlled by containment, by automatic fuel cutoffs in lines supplying the standby engine and any tanks in the compartment, and by control of effluent.

6.12.4.2 Telecommunications facilities containing less than 232 m^2 (2500 ft^2) of signal-processing equipment area(s) shall not be required to comply with 6.12.4.2.

6.12.5* Building Services Equipment. Building services equipment shall be provided in accordance with Section 6.6 and shall be limited to that needed to support the area.

6.12.6 Standby Engine Installation. Standby engine installations shall comply with NFPA 30, NFPA 37, and NFPA 54, as applicable.

6.12.6.1 Seismic Protection. Seismic bracing shall be provided in seismic zones in accordance with NFPA 110.

6.12.7 Fire Detection.

6.12.7.1 General. Standby engine installations shall be provided with a heat or flame detection system for detection and alarm processing in accordance with Chapter 8.

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

6.12.8 Fire Suppression.

6.12.8.1 Portable Fire Extinguishers. Standby engine areas shall be provided with listed portable extinguishers suitable for use on both energized equipment and expected liquid or gaseous fuel fires in accordance with 8.6.3.

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

6.12.9 Limitation of Combustibles.

6.12.9.1 Standby engine areas shall not be used for the storage of combustible materials or other equipment not related to standby engine operations.

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

6.12.10 Smoke Management Systems. Where smoke management systems are used in standby engine areas, they shall comply with Section

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8.7.

6.13 Technical Support Areas.

6.13.1 General.

6.13.1.1 Technical support areas shall be arranged to enhance the survivability of the adjacent telecommunications equipment areas in accordance with 6.13.1.2 through 6.13.2.2.

6.13.1.2 Small work areas shall be permitted within the signal-processing equipment, power, and main distribution frame areas if the following conditions are met:

(1) Case furniture, including desks, is constructed of noncombustible material (e.g., metal). The construction can include a high-pressure laminate veneer on desktop.

(2) Any paper records, manuals, and drawings are stored in fully enclosed noncombustible cabinets or cases.

(3) Space dividers and system furniture panels and chairs with upholstered assemblies exhibit a maximum rate of heat release not exceeding 80 kW and a maximum total heat released not exceeding 25 MJ within the first 10 minutes of test when tested in accordance with one of the following:

   (a) ASTM E 1537

   (b) California Technical Bulletin 133

(4) Noncombustible containers are provided for combustible material.

(5) The amount of records within the area are kept to the absolute minimum required for essential and efficient operation.

(6) Only records that are essential to the operations are permitted to be kept in the area.

6.13.2 Fire Protection Measures.

6.13.2.1 Technical support areas shall be provided with one of the following as applicable in accordance with Chapter 8 for detection and alarm processing:

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(1) Standard fire detection systems when they are not part of a telecommunications equipment area.

(2) For telecommunications facilities containing greater than 232 m^2 (2500 ft^2) of signal-processing area(s), technical support areas shall be provided with VEWFD systems when they are within the telecommunications signal-processing equipment and main distribution frame area.

(3) For telecommunications facilities containing greater than 232 m^2 (2500 ft^2) of signal-processing area(s), technical support areas shall be provided with EWFD systems when they are within the power area.

(4) For telecommunications facilities containing less than 232 m^2 (2500 ft^2) of signal-processing area(s), technical support areas shall be provided with EWFD systems when they are within the telecommunications equipment area.

6.13.2.2 Portable fire extinguishers shall be provided in accordance with 8.6.3.

6.13.2.3 Where automatic suppression systems are provided in technical support areas, they shall be in accordance with the requirements of 8.6.1 and 8.6.2.

6.14 Administrative Areas.

6.14.1 General. Administrative areas shall be arranged to prevent the spread of fire to adjacent telecommunications equipment areas in accordance with 6.14.2 through 6.14.5.

6.14.2 Construction.

6.14.2.1 Where used, soundproofing shall be of noncombustible or limited-combustible materials.

6.14.2.2 Floor assemblies over telecommunications equipment areas shall be constructed to protect against the penetration of water.

6.14.3 Compartmentation. Administrative areas shall be separated from adjacent telecommunications equipment areas by a minimum of 1-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

6.14.4 Fire Protection. Administrative areas shall be protected by either a standard fire detection system or an automatic fire suppression system in accordance with Chapter 8.

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6.14.4.1 Fire Detection.

6.14.4.1.1 Where a fire detection system is provided, it shall be in accordance with the Chapter 8 requirements for detection and alarm processing.

6.14.4.1.2 All fire alarm, detection, and alarm notification equipment shall be installed and maintained in accordance with *NFPA 72*.

6.14.4.2 Fire Suppression.

6.14.4.2.1 Portable Fire Extinguishers. Administrative areas shall be provided with listed portable extinguishers for use in accordance with 8.6.3.

6.14.4.2.2 Automatic Fire Suppression. Where automatic suppression systems are provided in administrative areas, they shall be in accordance with the requirements of 8.6.1 and 8.6.2.

6.14.5 Cooking Areas. Cooking areas shall be protected in accordance with NFPA 96.

6.15 Building Service and Support Areas.

6.15.1 General. Building service and support areas shall be arranged to enhance the survivability of the adjacent telecommunications equipment areas for continuity of service in accordance with 6.15.2 through 6.15.8.

6.15.2 Construction.

6.15.2.1 Where used, soundproofing shall be of noncombustible or limited-combustible materials.

6.15.2.2 Floor assemblies over telecommunications equipment areas shall be constructed to protect against the penetration of water.

6.15.3 Compartmentation.

6.15.3.1 Telecommunications facilities containing greater than 232 m^2 (2500 ft^2) of signal-processing equipment area shall have the building service and support areas separated from adjacent telecommunications equipment areas by a minimum of 2-hour fire-resistance-rated construction or by a minimum of 1-hour fire-resistance-rated construction where automatic fire suppression is provided within the building services and support area compartment(s).

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6.15.3.2 Telecommunications facilities containing less than 232 m^2 (2500 ft^2) of signal-processing equipment area shall have the building service and support areas separated from adjacent telecommunications equipment areas by a minimum of 1-hour fire-resistance-rated construction.

6.15.3.3 Building services and support areas shall be separated from adjacent nontelecommunications equipment areas by a minimum of 1-hour fire-resistance-rated construction.

6.15.3.4 All construction shall be in accordance with Sections 8.2 and 8.3.

6.15.4 Fire Protection. Building service and support areas shall be protected by either a standard fire detection system or an automatic fire suppression system.

6.15.4.1 Fire Detection.

6.15.4.1.1 Where a fire detection system is provided, it shall be in accordance with the Chapter 8 requirements for detection and alarm processing.

6.15.4.1.2 All fire alarm, detection, and alarm notification equipment shall be installed and maintained in accordance with *NFPA 72*.

6.15.4.2 Fire Suppression.

6.15.4.2.1 Portable Fire Extinguishers. Building services and support areas shall be provided with listed portable extinguishers for use in accordance with 8.6.3.

6.15.4.2.2 Automatic Fire Suppression. Where automatic suppression systems are provided in building services and support areas, they shall be in accordance with the requirements of 8.6.1 and 8.6.2.

6.15.5 HVAC Systems. An HVAC system(s) shall be installed in accordance with NFPA 90A.

6.15.6 Electrical. Nontelecommunications power circuits shall be installed in accordance with *NFPA 70*.

6.15.7 Lightning and Surge Protection. Lightning and surge protection, where provided, shall be installed in accordance with NFPA 780 and *NFPA 70*, respectively.

6.15.8 Special Hazards. Flammable and combustible liquids and aerosols shall be stored in listed fire-rated storage cabinets.

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Chapter 7 Redundant- or Replacement-Based Approaches

7.1* Redundancy or Replacement Approach.

Where the performance-based approach of Chapter 5 or the prescriptive elements of Chapter 6 are not used, the requirements of this chapter shall apply.

7.1.1 Application. This chapter applies to telecommunications facilities or a hazard area within, for which service continuity is provided by the following:

(1) Redundancy on site

(2) Redundancy off site

(3) Replacement

7.1.1.1 Redundancy On Site.

7.1.1.1.1 The telecommunications owner/operator shall be permitted to provide complete functionally redundant equipment in the same facility with manual or automatic transfer of service.

7.1.1.1.2 To ensure on-site service continuity when using the redundant on-site approach, the redundant equipment systems shall be physically separated using 1-hour fire-resistance-rated construction and a smoke management system shall be provided.

7.1.1.2 Redundancy Off Site. The telecommunications owner/operator shall be permitted to provide complete functionally redundant equipment at a remote facility with manual or automatic transfer of service.

7.1.1.3 Replacement. The telecommunications owner/operator shall be permitted to protect telecommunications service with replacement telecommunications equipment, facilities, or both where service can be quickly restored.

7.1.2 Maintenance of Redundancy or Replacement Approach. For the redundancy or replacement approach to continue to meet the

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performance goals and objectives of this standard, the selected approach shall be maintained for the life of the facility.

7.2 Construction.

Where the replacement approach necessitates that the building survive a fire, the building construction shall be in accordance with Sections 8.2 and 8.3.

7.3* Protection from Exposures.

Exterior walls and openings shall be protected.

7.4 Means of Egress.

Means of egress shall be provided in accordance with NFPA *101*.

7.5 Means for Depowering.

Telecommunications facilities containing more than 232 m^2 (2500 ft^2) of signal-processing equipment areas shall be provided with a means for depowering in accordance with 7.5.1 through 7.5.4. *(See Annex E.)*

7.5.1 General. Signal-processing equipment area(s) shall be based on the total accumulated floor area within a telecommunications facility 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 each signal-processing equipment area.

7.5.2 Means to disconnect power from building services equipment, power and lighting circuits, and telecommunications equipment shall be identified for incident intervention.

7.5.3 Power distribution/disconnect equipment with appropriate marking shall be permitted to be used as a means to disconnect power.

7.5.4 A depowering procedure shall be developed in accordance with Section 10.6.

7.6 Telecommunications Equipment Areas.

7.6.1 Emergency Lighting. Emergency lighting shall be provided in the facility in accordance with NFPA *101*.

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7.6.2* **Compartmentation.** Where administrative, building services and support, and standby engine areas are provided in the telecommunications facility, they shall be separated from telecommunications equipment areas by 1-hour fire-resistance-rated construction in accordance with Sections 8.2 and 8.3.

7.6.3 Telecommunications Equipment.

7.6.3.1 All new wire, cable, and signal-processing telecommunications equipment installed, whether owned or co-located, shall be in accordance with Section 8.8 for the type of wire, cables, and signal-processing telecommunications equipment.

7.6.3.2* Signal-processing telecommunications equipment shall be industry standard compliant and shall be installed and used in configurations and uses for which it has been tested and qualified.

7.6.3.3 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

7.6.3.4 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

7.6.4 Fire Detection.

7.6.4.1 Where the replacement approach is adopted, areas within telecommunications facilities shall be provided with a standard fire detection system for detection and alarm processing in accordance with Chapter 8.

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7.6.4.2 Where the redundancy approach is used, a fire detection system shall be provided for detection and alarm processing in accordance with Chapters 6 and 8.

7.6.4.3 Installation and maintenance shall be in accordance with *NFPA 72*.

7.6.5 Fire Suppression.

7.6.5.1 Portable Fire Extinguishers. Portable extinguishers suitable for use on energized equipment and/or ordinary combustible fires shall be provided in accordance with 8.6.3.

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

7.6.6 Limitation of Combustibles.

7.6.6.1 Telecommunications facilities shall not be utilized for the storage of combustible materials or other equipment not related to the switching and transmission of voice, data, and video signals.

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

7.6.7 Special Hazards.

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

7.6.7.2 Heat-producing appliances not related to the support of telecommunications equipment shall not be permitted within the area.

7.6.8 Smoke Management. Where smoke management systems are used, they shall comply with Section 8.7.

7.7 Building Services Equipment.

7.7.1 Building services equipment shall be provided in accordance with Section 6.6.

7.7.2* Building services equipment shall be limited to that needed to support the area and adjacent telecommunications equipment areas, excluding the standby engine area and cable entrance facility area.

7.8 Emergency Lighting.

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

7.8.1* Emergency lighting system shall be permitted to be powered by the telecommunications facility battery system.

7.8.2* Where the telecommunications facility battery system is used 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*.

Chapter 8 Fire Protection Elements

8.1 General.

Chapter 8 contains fire protection elements used to meet the prescriptive requirements of Chapters 6 and 7 and shall not be applied independently of Chapters 6 and 7.

8.2 Construction.

8.2.1 Buildings. Buildings housing telecommunications facilities shall be of noncombustible construction in accordance with NFPA 220.

8.2.2 Interior Walls. All interior walls shall be of noncombustible or limited-combustible construction.

8.3* Compartmentation.

The telecommunications facility shall be separated from other occupancies within the building by fire-resistance-rated construction, which is commensurate with the exposure but not less than 1 hour.

8.3.1 Fire-Resistance-Rated Construction. Where required elsewhere in this document, fire-resistance-rated construction shall be provided around designated areas.

8.3.1.1 The fire resistance rating of the assembly shall correspond to the highest rating required for the separated areas.

8.3.1.2 Fire-resistance-rated partitions shall extend from the foundation or floor below to the underside of the roof or floor deck above to

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provide a complete separation.

8.3.2 Protection of Fire-Resistance-Rated Construction Openings.

8.3.2.1 Doors. Doors shall be fire tested under positive pressure to NFPA 252 and shall be installed in accordance with NFPA 80.

8.3.2.1.1 The fire rating of the door assemblies shall correspond to the fire rating of the partition assemblies, as follows:

(1) One-hour partition shall have 1-hour fire-resistance-rated door assembly.

(2) Two-hour partition shall have 1? hour fire-resistance-rated door assembly.

(3) Three-hour partition shall have 3-hour fire-resistance-rated door assembly.

8.3.2.1.2 Doors shall be self-closing or automatic-closing upon designated alarm signal activation.

8.3.2.2 Glazing Materials in Doors. Glazing materials in doors shall be fire tested under positive pressure to NFPA 252 and shall be installed in accordance with NFPA 80.

8.3.2.3 Glazing Materials in Fire-Resistance-Rated Construction. Glazing materials in fire-resistance-rated walls shall have an equal fire resistance rating as the wall or be protected with an automatic fire-resistance-rated shutter in accordance with NFPA 80.

8.3.2.3.1 The fire-resistance-rated glazing material shall be fire tested to NFPA 257.

8.3.2.3.2 The fire-resistance-rated glazing material shall be listed and labeled.

8.3.2.4 Construction Joints.

8.3.2.4.1 Joints in or between walls and floor/ceiling assemblies of fire-resistance-rated construction shall be fire tested in accordance with ASTM E 1966.

8.3.2.4.2 The fire-resistance-rated joint systems shall be listed.

8.3.3 Penetrations in Fire-Resistance-Rated Construction.

8.3.3.1 Pipes, Conduits, Cables, and Cable Trays.

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8.3.3.1.1 Pipes, conduits, cables, and cable trays that penetrate fire-resistance-rated construction shall be protected with assemblies tested in accordance with ASTM E 814 or NFPA 251.

8.3.3.1.2 The penetration firestop systems shall be listed.

8.3.3.2 HVAC Systems. Fire dampers, smoke dampers, or combination fire/smoke dampers shall be installed to protect penetrations of fire-resistance-rated walls, floor/ceiling assemblies, and smoke barriers created by HVAC system elements in accordance with NFPA 90A.

8.3.3.2.1 Combination fire/smoke dampers in the affected area shall be automatically activated by a smoke detection system installed throughout the area or by duct smoke detectors installed in the duct adjacent to the dampers.

8.3.3.2.2 The annular space around the HVAC system ductwork through fire-resistance-rated construction and smoke barriers shall be protected with a listed firestop system in accordance with ASTM E 814 or NFPA 251.

8.4 Alarm Processing.

8.4.1 General.

8.4.1.1* Alarm processing described in Section 8.4 shall be provided.

8.4.1.2 Fire alarm, supervisory, and trouble signals shall be annunciated at a constantly attended location.

8.4.1.3* Use of VEWFD systems with an alert (pre-alarm) condition shall provide for an initial response by authorized personnel prior to fire department notification.

8.4.1.3.1 The initial response shall be by owner-designated personnel such as a telecommunications facilities person or technician.

8.4.1.4 Alarm monitoring centers maintained by the telecommunications service provider that have dedicated personnel 24 hours per day 7 days per week shall be permitted to be the supervising station.

8.4.1.5 Supervising stations meeting the requirements of *NFPA 72* for proprietary or central station service shall be acceptable supervising stations.

8.4.2 Signaling. Fire alarm control units shall provide for receipt and processing of signals for transmission to an approved supervising station.

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8.4.2.1 Fire Alarm Signals.

8.4.2.1.1 Disposition of fire alarm signals shall conform to the requirements of *NFPA 72*.

8.4.2.1.2 Manual fire alarm signals shall be initiated by manual pull stations.

8.4.2.1.3 Automatic fire alarm signals shall be initiated by, but not be limited to, the following:

(1) Smoke detectors

(2) Heat detectors

(3) Flame detectors

(4) Suppression system release

(5) Waterflow initiating devices

8.4.2.1.4 Fire alarm signals shall take precedence in processing over all other signals.

8.4.2.1.5 The automatic or manual initiation of alarm conditions shall cause the building fire alarm notification appliances to operate in accordance with the requirements of *NFPA 72*.

8.4.2.1.6 Fire alarm signals shall be automatically and immediately transmitted to a constantly attended supervising station.

8.4.2.1.7 The supervising station shall immediately notify the local fire service of any fire alarm signal and, in addition, shall provide the fire service with information as to the site location and any special conditions that could exist.

8.4.2.1.8 Designated telecommunications personnel shall be dispatched to the site immediately upon receipt of alarm.

8.4.2.1.9 The fire alarm system shall be restored to its normal operating condition as soon as possible after the disposition of the cause of the alarm signal.

8.4.2.1.10 Systems shall be arranged so that loss of commercial power does not cause a fire alarm signal.

8.4.2.2 Supervisory Signals.

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8.4.2.2.1 Disposition of supervisory signals shall conform to the requirements of *NFPA 72*.

8.4.2.2.2* Supervisory signals shall be given priority over all other general building maintenance alarm signals.

8.4.2.2.3 Supervisory signals shall be immediately transmitted to a supervising station.

8.4.2.2.4 Supervisory signals shall include, but not be limited to, the following:

(1) Alert signal (pre-alarm) from a VEWFD system

(2) Fire alarm initiating devices, where designated as such (e.g., duct smoke detectors)

(3) Sprinkler valve supervisory switches

(4) Fire pump off-normal conditions

(5) Other abnormal fire safety杩elated conditions

8.4.2.2.5* Where provided, hydrogen gas danger level, methane gas danger level, battery room ventilation fan failure, and similar off-normal condition of safety-related items shall be transmitted as supervisory signals to the supervising station described in 8.4.1.5 or alarm monitoring center described in 8.4.1.4 and shall be permitted to be displayed on the local fire alarm system as a supervisory signal.

8.4.2.2.6 Where hydrogen gas danger level, methane gas danger level, or battery room ventilation fan failure monitoring is provided, and the off-normal condition represents a potential danger to on-site personnel, it shall initiate a local audible and visible warning signal to alert occupants in the area of danger.

8.4.2.2.7 The alert pre-alarm signal from a VEWFD system shall be distinguishable from all other fire alarm, supervisory, and trouble signals.

8.4.2.2.8 Where required, the supervisory station operator shall initiate the following actions upon receipt of a supervisory signal:

(1) Communicate immediately with the designated person(s) to ascertain the reason for the signal

(2) Investigate, unless supervisory conditions are promptly restored to normal

(3) Notify the fire department

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(4) Notify the authority having jurisdiction when the fire protection systems are wholly or partially out of service for 8 hours or more

(5) Provide written notice to the authority having jurisdiction as to the nature of the signal, time of occurrence, and restoration of service, when telecommunications equipment has been out of service for 8 hours or more

8.4.2.2.9 Supervisory signals shall not cause activation of building fire alarm notification appliances.

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8.4.2.3 Trouble Signals.

8.4.2.3.1 Disposition of fire alarm system trouble signals shall conform to the requirements of *NFPA 72*.

8.4.2.3.2 Trouble signals shall include, but not be limited to, the following:

(1) Ground fault condition

(2) Open or short circuit fault

(3) Loss of primary power

(4) Fire alarm system component failure

(5) Alarm transmitter failure

(6) Microprocessor failure

8.4.2.3.3* Trouble signals shall be responded to in accordance with *NFPA 72*.

8.4.2.3.4 Where required, notification of trouble conditions to the local fire department shall be provided.

8.4.2.3.4.1 Where monitoring systems provide the supervising station with detailed trouble information that allows determination of the degree of system impairment, response shall be permitted to be delayed until the next working day where it is determined that the trouble does not affect the ability to detect and report a fire condition.

8.4.3 Signal Path Integrity. Wiring between the fire alarm control unit and the telecommunications equipment that processes the signals to be sent to the supervising station shall be monitored for integrity such that an open, shorted, or ground fault condition on any conductor(s) shall

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cause a trouble signal to be indicated at a supervising station.

8.4.3.1 Systems using a method of switching ground in normal operation shall not cause a trouble indication upon grounded condition.

8.4.3.2 The requirements of 8.4.3 shall not apply where the distance between the fire control unit and the telecommunications equipment that processes the signal to be sent to the supervising station is no more than 0.9 m (3 ft).

8.4.3.3 The requirements of 8.4.3 shall not apply where the primary notification location for alarm, supervisory, and trouble signals is an approved supervising station and the monitoring is accomplished in accordance with the requirements of *NFPA 72*.

8.5 Fire Detection.

8.5.1 General.

8.5.1.1 Fire detection systems shall be designed, installed, and maintained to provide the level of protection required in Chapters 6 and 7.

8.5.1.2 The levels of protection shall be as follows:

(1) VEWFD (very early warning fire detection)

(2) EWFD (early warning fire detection)

(3) SFD (standard fire detection)

8.5.2 Detection Systems.

8.5.2.1 EWFD and VEWFD smoke detection systems shall use sensors or ports with spacing that is less than that normally required by *NFPA 72*.

8.5.2.2 Flame detection systems provided for EWFD use shall be installed to provide line-of-sight detection for critical areas of a room where flaming fires can occur in a rapid manner.

8.5.3 Installation.

8.5.3.1 VEWFD.

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8.5.3.1.1 Where required by Chapters 6 and 7, VEWFD systems shall be in accordance with 8.5.3.1.2 through 8.5.3.1.2.6.

8.5.3.1.2 VEWFD Sensor and Port Installation.

8.5.3.1.2.1* Every type of sensor and port installed in an area shall be limited to a maximum coverage area of 18.6 m^2 (200 ft^2).

8.5.3.1.2.2* Where two levels (high and low) of ports or sensors are provided, the following requirements shall be met:

(1) Each level shall be limited to a coverage of 37.2 m^2 (400 ft^2) or less per port or sensor.

(2) The coverage limitation between high and low levels shall be limited to 18.6 m^2 (200 ft^2) or less providing for staggered port or sensor arrangements between each level.

8.5.3.1.2.3* Sensors or ports shall be installed to monitor return air from the space.

(A) Where stand-alone packaged HVAC units are installed, sensors or ports shall be installed where return air is brought back to the unit.

(B) Sensors or ports shall be installed such that each covers no greater than 0.4 m^2 (4 ft^2) of the return air opening.

8.5.3.1.2.4* Where air-sampling systems are installed, the systems shall be designed using manufacturer-provided listed criteria.

8.5.3.1.2.5* Minimum sensitivity settings above ambient air-borne levels for the VEWFD systems installed shall be as follows:

(1) Alert condition includes the following:

(a) Air-sampling systems: 0.2 percent per foot obscuration (effective sensitivity at each port)

(b) Spot-type sensors: 0.2 percent per foot obscuration

(2) Alarm condition includes the following:

(a) Air-sampling systems: 1.0 percent per foot obscuration (effective sensitivity at each port)

(b) Spot-type sensors: 1.0 percent per foot obscuration

8.5.3.1.2.6 Maximum transport time from the most remote port to the detection unit of an air-sampling system shall not exceed 60 seconds.

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8.5.3.2 EWFD.

8.5.3.2.1 Smoke Detection Systems.

8.5.3.2.1.1 Where required by Chapters 6 and 7, EWFD systems shall be in accordance with 8.5.3.2.1.2 through 8.5.3.2.1.5.

8.5.3.2.1.2* The area of coverage for a single sensor or port shall be limited to 37.2 m^2 (400 ft^2).

8.5.3.2.1.3 The minimum alarm sensitivity setting at the sensor or port used for EWFD in telecommunications equipment areas shall be 1.5 percent per foot.

8.5.3.2.1.4 Maximum transport time from the most remote port to the detection unit of an air-sampling system shall be a maximum of 90 seconds.

8.5.3.2.1.5* Where air-sampling systems are installed, the systems shall be designed using manufacturer-provided listed criteria.

8.5.3.2.2 Flame Detection Systems.

8.5.3.2.2.1 Where required by Chapters 6 and 7, flame detection systems shall be installed in accordance with this subparagraph.

8.5.3.2.2.2* Flame detection systems shall be installed to provide line-of-sight detection for critical areas of the area.

8.5.3.3 SFD. Where required by Chapters 6 and 7, SFD systems shall comply with the requirements of *NFPA 72*.

8.6 Fire-Extinguishing Systems.

8.6.1* General. Where provided, fire suppression systems shall comply with 8.6.2.

8.6.2 Automatic Fire Suppression.

8.6.2.1 General.

8.6.2.1.1* Where provided, automatic fire suppression systems in telecommunications facilities shall comply with 8.6.2.1.2 through 8.6.2.5.3.

8.6.2.1.2 Activation of any fire suppression system shall transmit an alarm immediately to a constantly attended location.

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8.6.2.2 Sprinkler Systems.

8.6.2.2.1* Where provided, sprinkler systems shall be designed and installed in accordance with the requirements of NFPA 13, and tested, and maintained in accordance with the requirements of NFPA 25.

8.6.2.2.2 All piping for dry pipe and pre-action sprinkler systems shall be installed with a pitch in accordance with NFPA 13 whether or not the piping is subjected to freezing conditions.

8.6.2.2.3 Detection systems installed to actuate pre-action sprinkler systems shall be installed in accordance with Section 8.5.

8.6.2.3 Clean Agents.

8.6.2.3.1* Where provided, clean agent extinguishing systems shall be designed, installed, and maintained in accordance with the requirements of NFPA 2001.

8.6.2.3.2 Detection systems installed to actuate clean agent suppression systems shall be designed in accordance with Section 8.5.

8.6.2.3.3 Detection shall be either cross-zoned or an equivalent method shall be used to minimize the potential of false discharges.

8.6.2.4 Halon Systems.

8.6.2.4.1* Where provided, halon systems shall be designed, installed, and maintained in accordance with NFPA 12A.

8.6.2.4.2 Detection systems used to actuate halon suppression systems shall be designed in accordance with Section 8.5.

8.6.2.4.3 Detection shall be either cross-zoned or an equivalent method shall be used to minimize the potential of false discharges.

8.6.2.5 Water Mist Fire Protection Systems.

8.6.2.5.1 Where provided, water mist fire protection systems shall be installed in accordance with the requirements of NFPA 750.

8.6.2.5.2 Water mist fire protection systems shall be designed and installed for the specific hazards and protection objectives specified in the listing.

8.6.2.5.3 Detection systems utilized for the operation of water mist fire protection systems shall be installed in accordance with Section 8.5 or the listing criteria.

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8.6.3 Manual Fire Suppression.

8.6.3.1 Portable Fire Extinguishers.

8.6.3.1.1 The selection, placement, and maintenance of portable fire extinguishers shall be in accordance with NFPA 10.

8.6.3.1.2 Where required, listed portable extinguishers suitable for use on energized telecommunications equipment shall be provided.

8.6.3.1.3* Dry chemical and corrosive liquid agent portable fire extinguishers shall not be installed in signal-processing equipment areas, main distribution frame areas, and power areas.

8.6.3.2* Standpipes. Where standpipes are provided, they shall be installed and maintained in accordance with NFPA 14.

8.7 Smoke Management Systems.

8.7.1* General. Where provided, smoke management systems shall comply with 8.7.2 through 8.7.4.2. *(See Annex D.)*

8.7.2* Design and Installation. Where provided, smoke management systems shall be designed, installed, and acceptance tested in accordance with accepted engineering practice.

8.7.2.1 Operation of the smoke management system installed in the signal-processing equipment area, cable entrance facility area, power area, main distribution frame area, or standby engine area shall be automatically activated or manually activated from a location outside of the area.

8.7.2.2* Where mechanical exhaust systems are installed, a source of makeup air shall be provided.

8.7.2.3* Exhaust points shall be used to reduce the possibility of smoke being drawn into noninvolved telecommunications equipment.

8.7.2.4 The smoke exhaust shall discharge to the outside of the building, away from fresh air intakes, make-up air intakes, and building openings.

8.7.2.5* All operational components of the smoke management system shall be tested annually to verify their operation.

8.7.3* Smoke Removal. Provision shall be made for the removal or purging of smoke from areas outside of smoke management zones.

8.7.4 Power Supply. The smoke management system shall be powered from a source protected against accidental depowering.

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8.7.4.1 Loss of Power or Control Signal. The loss of power or control signal shall cause the closure of the smoke management system dampers.

8.7.4.2* Manual Override. A means of manual override of the smoke management system shall be provided.

8.8 Telecommunications Equipment Ignition and Fire Resistance.

8.8.1* General. Where needed to achieve an objective of a performance-based design permitted by Chapter 5 or to meet the prescriptive requirements permitted by Chapters 6 and 7, the telecommunications equipment, cables, wiring, and associated components shall comply with the provisions of Section 8.8.

8.8.2 Wire and Cables.

8.8.2.1 Telecommunications cables shall be listed to the requirements of ANSI/UL 444.

8.8.2.2 Telecommunications wires shall be listed to the requirements for cross-connect wire in ANSI/UL 444.

8.8.2.3 Optical fiber cables shall be listed to the requirements of ANSI/UL 1651.

8.8.2.4 Wires and cables intended for powering signal-processing equipment and insulated ground wires shall be listed to the requirements of ANSI/UL 1277, or ANSI/UL 44, or ANSI/UL 83, or shall be specifically listed for the purpose.

8.8.2.5 Nonmetallic communications raceways and nonmetallic optical fiber raceways shall be listed to the requirements of ANSI/UL 2024.

8.8.2.6 Optical fiber cable routing assemblies other than raceways shall be listed to the requirements of UL 2024A.

8.8.2.7 Nonmetallic cable trays shall be listed to the requirements of ANSI/UL 568.

8.8.2.8 Raised Floor and Ceiling Cavity Plenums.

8.8.2.8.1 Telecommunications cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and insulated ground wires installed in plenums shall be listed as having a maximum flame spread of 1.52 m (5.0 ft), a maximum peak optical density of 0.50, and a maximum average optical density of 0.150 when tested in accordance with NFPA 262, or Flame and Smoke Test in the Appendix to CSA C22.2 No. 0.3-M-1996 (FT6 Rating).

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8.8.2.8.2 Nonmetallic communications raceways and nonmetallic optical fiber raceways installed in plenums shall be listed as having a maximum flame spread of 1.52 m (5.0 ft), a maximum peak optical density of 0.50, and a maximum average optical density of 0.150 when tested per ANSI/UL 2024, or Flame and Smoke Test in the Appendix to CSA C22.2 No. 0.3-M-1996 (FT6 Rating).

8.8.2.8.3 Optical fiber cable routing assemblies other than raceways shall be listed to the requirements of ANSI/UL 2024A.

8.8.2.8.4* Nonmetallic cable trays used in plenums shall be listed for use in plenums.

8.8.2.9 Risers.

8.8.2.9.1 Telecommunications cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, insulated ground wires, nonmetallic communications raceways, nonmetallic optical fiber raceways and nonmetallic cable trays installed vertically between floors in a building shall comply with ANSI/UL 1666. These cables shall demonstrate limited smoke generation by testing in accordance with UL 1685.

8.8.2.9.2 Telecommunications cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and insulated ground wires meeting the requirements of 8.8.2.8.1 shall be permitted. Nonmetallic communications raceways and nonmetallic optical fiber raceways, meeting the requirements of 8.8.2.8.2 shall be permitted. Nonmetallic optical fiber cable routing assemblies meeting the requirements of 8.8.2.8.3 shall be permitted.

8.8.2.9.3 Nonmetallic optical fiber cable routing assemblies other than raceways shall be listed to the requirements of UL 2024A.

8.8.2.9.4 Nonmetallic optical fiber cable routing assemblies meeting the requirements of 8.8.2.8.4 shall be permitted.

8.8.2.10 Installations Other Than Risers and Plenums. Installations of telecommunications wires and cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and insulated ground wires in spaces other than risers or plenums shall comply with 8.8.2.10.1 or 8.8.2.10.2 or 8.8.2.10.3.

8.8.2.10.1 Telecommunications wires and cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and insulated ground wires shall be listed as not spreading fire to the top of the tray and shall demonstrate limited smoke generation in the vertical-tray flame test in UL 1685.

8.8.2.10.2 Telecommunications wires and cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and

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insulated ground wires shall be listed as meeting the requirements of the FT-4 test in CSA Vertical Flame Test ? Cables in Cable Trays in the *Test Methods for Electrical Wires and Cables*, C22.2 No. 0.3-M-1996, with char length not to exceed 1.5 m (4 ft 11 in.). These cables shall demonstrate limited smoke generation by testing in accordance with UL 1685.

8.8.2.10.3 Telecommunications cables, optical fiber cables, wires and cables intended for powering signal-processing equipment, and insulated ground wires meeting the requirements of 8.8.2.8.1 or 8.8.2.9.1 shall be permitted.

8.8.2.10.4 Nonmetallic communications raceways and nonmetallic optical fiber raceways shall not spread fire to the top of the tray in the vertical-tray flame test in ANSI/UL 2024.

8.8.2.10.5 Nonmetallic optical fiber cable routing assemblies other than raceways shall be listed to the requirements of UL 2024A.

8.8.2.10.6 Nonmetallic communications raceways, nonmetallic optical fiber raceways, and routing assemblies meeting the requirements of 8.8.2.8.2 or 8.8.2.9.1 shall be permitted.

8.8.2.10.7 Nonmetallic optical fiber cable routing assemblies meeting the requirements of 8.8.2.8.4 or 8.8.2.9.3 shall be permitted.

8.8.3* Major Telecommunications Equipment Systems. Major telecommunications equipment shall be classified as follows:

(1) *Level A*. Equipment that meets the fire resistance criteria specified in Telcordia GR-63-CORE, following the methodologies specified in ANSI T1.307 and ANSI T1.319

(2) *Level B*. Equipment that meets the requirements of UL 60950 only, and does not qualify for Level A classification

(3) *Level C*. Equipment that does not meet the requirements of either Level A or Level B

8.8.4 Nonlabeled Wire, Cable, and Telecommunications Equipment. Where wire, cable, and telecommunications equipment are not labeled to indicate compliance with the requirements of Section 8.8, the documentation regarding compliance with the fire resistance criteria specified in Section 8.8 shall be readily available.

Chapter 9 Fire Prevention

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9.1* Housekeeping.

9.1.1* Removal or Storage of Combustibles. Combustibles shall be removed daily or shall be stored appropriately in protected storage rooms, noncombustible enclosed storage cabinets or bins, noncombustible covered refuse containers, or listed self-extinguishing-type trash receptacles.

9.1.2* Limiting Other Combustibles.

9.1.2.1 Combustible materials, such as packing materials and office supplies, shall not be stored in areas exposing critical telecommunications equipment and related components unless these materials are located in noncombustible cabinets or are within nontelecommunications equipment areas provided with fire suppression systems.

9.1.2.2 Areas around the outside of the facility shall be free of combustibles.

9.1.3* Portable Heating Appliances. Portable heaters shall not be permitted except where temporarily permitted by the building management.

9.1.4* Heat-Producing Appliances. The use of portable heat-producing appliances shall not be located in any telecommunications equipment area, computer room, individual office areas, individual office cubicles, storage areas, or shipping areas.

9.1.5* Smoking. Smoking, carrying, or depositing any lighted or smoldering substance shall not be permitted in telecommunications equipment and building support areas and all additional areas identified by local management as a risk to the network operation.

9.1.5.1* Designated Smoking Areas. If a designated smoking area is to be allowed in other areas of the building, local management shall conduct a fire risk analysis prior to designating such areas.

9.1.5.2 Signage.

9.1.5.2.1 In buildings where smoking is prohibited, signs shall be posted at the entrances to the building.

9.1.5.2.2 If smoking is permitted only in designated areas, signs shall be posted at the entrances of the building and at the designated area that state, 撐 moking only permitted in the designated smoking area.?

9.1.5.2.3 In buildings where smoking is permitted, 揑 o Smoking? signs shall be posted in conspicuous designated locations where smoking is prohibited.

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9.1.6* Hot Work.

9.1.6.1 Prior to conducting hot work, a hot work permit shall be acquired.

9.1.6.2 The hot work permit shall comply with Chapter 9 and NFPA 51B for areas not designed for this type of operation.

9.1.7* Flammable and Combustible Liquids and Gases.

9.1.7.1 The storage, handling, and use of flammable and combustible liquids, including waste liquids, shall comply with the requirements of NFPA 30.

9.1.7.2 All flammable and combustible liquids shall be stored in approved fire-rated cabinets at the end of each shift.

9.1.7.3* Propane stored in cylinders and containers on the exterior of the telecommunication facility shall comply with NFPA 54 and NFPA 51B.

9.1.7.4 Combustible gas storage within the telecommunications area shall not be permitted except in the standby engine area.

9.1.8 Clear Access. Clear and unobstructed access to telecommunications facilities shall be maintained for fire and EMS operations.

9.2* Nontelecommunications Electrical Equipment and Wiring.

9.2.1 The installation and maintenance of non-telecommunications-related electrical equipment and wiring, such as the use of listed electrical fittings, materials, and equipment, shall be in accordance with *NFPA 70*.

9.2.2* Electrical Cords.

9.2.2.1 Electrical extension cords shall be used only when a flexible, temporary connection is necessary, and never for permanent wiring.

9.2.2.2 Flexible electrical cords shall be adequate to carry the anticipated amperage and shall be listed.

9.2.2.3 Cords shall not be permitted under carpets, rugs, or chair mats.

9.2.2.4 Cords shall be placed in a cord tray to avoid tripping hazards and wear.

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9.3* Construction, Alterations, and Equipment Installations.

All construction and alteration projects shall comply with NFPA 241.

9.3.1 Staging Areas. Staging areas assigned for crating, de-crating, and containment of combustibles for telecommunications equipment installation and removal shall be designed with appropriate detection or separation or both and managed so as not to lower the overall level of fire safety within the telecommunications building.

9.3.2 Cutting and Welding Activities. Cutting and welding activities shall comply with 9.1.6, and portable fire extinguishers shall be provided and shall comply with 8.6.3.1.

9.3.3* Use and Storage of Combustible Materials. Combustible materials for construction and installation that directly supports telecommunications equipment installation shall not exceed more than a 7 day supply in telecommunications equipment areas.

9.3.4* Building Construction and Alteration Work. The delivery, storage, construction, and cleanup associated with building construction and alteration work shall be performed in accordance with NFPA 241.

9.3.4.1 In buildings under construction, renovation, or alteration, adequate escape facilities shall be maintained at all times for the use of construction workers.

9.3.4.2 Escape facilities shall consist of doors, walkways, stairs, ramps, fire escapes, ladders, or other approved means or devices arranged in accordance with NFPA *101*.

9.3.5 Bus Bar Protection During Construction Work. Provisions shall be provided to protect the bus bars when building construction activity occurs in the area around or over live bus bars.

9.3.6* Fire Prevention Awareness for Contractors.

9.3.6.1 Telecommunications companies shall provide awareness information to contractors of fire prevention and protection issues or measures within telecommunications facilities.

9.3.6.2 Contractors shall disseminate this information to all of their employees and their contractors prior to commencement of work.

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9.4 Employee Awareness.

All employees shall be provided information regarding fire prevention policies, procedures, and fire safety hazards.

9.5* Physical Security.

9.5.1 A key box(es), where required by the authority having jurisdiction, shall be listed and installed in an accessible location.

9.5.2 The operator of the premises shall immediately notify the authority having jurisdiction and provide the new key(s) when a lock shall be changed or re-keyed, and a key(s) to that lock shall be contained in the key box.

9.6 Means of Egress.

All means of egress shall be maintained in accordance with the requirements of NFPA *101*.

9.7 Displays and Decorations.

Displays, holiday trees, or other decorations shall not be allowed in telecommunications equipment areas.

9.7.1 Displays, holiday trees, or other decorations shall not be allowed to obstruct corridors, exit ways, or other means of egress.

9.7.2 Natural cut holiday trees shall not be permitted.

9.7.3 Artificial holiday trees, displays, and decorations shall be labeled or otherwise identified or certified by the manufacturer as being flame retardant or flame resistive.

9.7.4 Only listed electric lights and wiring shall be used on holiday trees and similar decorations.

9.7.5 Electric lights shall be prohibited on metal artificial trees, displays, and other decorations not labeled for the use of listed lights.

9.8* Open Flame Devices.

9.8.1 In nontelecommunications areas, the use of solid-fueled heat sources for warming of food trays shall be permitted and shall be constantly attended and operated with the approval of management.

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9.8.2 Other open flames shall only be permitted as otherwise stated in this document.

9.8.3 Portable fire extinguishers shall be provided in accordance with NFPA 10.

9.9* Cable Management.

The management of telecommunications and power cables shall be based on the consideration of potential fuel load and hazards within any given telecommunications equipment area or hazard area.

9.9.1* For new cable distribution installations, ac, dc, and telecommunications cable shall be run in separate paths and not mixed.

9.9.2 Points or tips of metal horns and other protruding devices on cable racks and ladders shall be insulated from the cables.

9.9.3* Abandoned cables shall not be allowed to accumulate.

9.9.3.1 Cables not identified for future use shall be removed.

9.9.3.2 All cables that have been cut and abandoned in place shall be capped.

9.10* Vacant Areas.

Vacant areas or spaces in a building shall be reviewed annually for the fire risk.

Chapter 10 Pre-Fire Planning, Damage Control, and Emergency Recovery

10.1 General.

See Annex E.

10.1.1 Pre-Fire Plan. Management of each facility shall develop and implement a written pre-fire plan.

10.1.1.1 The pre-fire plan shall be reviewed and updated annually and where personnel changes, management structure realignment, or facility changes occur.

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10.1.1.2 All employees of the facility shall be provided with appropriate information regarding their emergency assignments, relocation, or evacuation during an emergency.

10.1.1.3* This plan shall identify authority responsibilities and actions of employees.

10.1.1.4 All documentation shall be in writing and approved by the management of the facility.

10.1.1.5 For telecommunications facilities containing more than 232 m^2 (2500 ft^2) of signal-processing equipment areas, the plan shall include an annual exercise to ensure that management and staff can implement and work with the plan and incorporate lessons learned from the exercise into an updated plan.

10.1.2 Elements. A pre-fire plan shall be developed and shall include the following:

(1) Identification of an emergency contact and telephone number

(2) Life safety issues of the occupants of the facility

(3) Life safety of the responding fire fighters to the facility

(4) Life safety issues of the community provided by the telecommunications facility through its normal operation and its continuity during fire emergencies (e.g., 911-type services)

10.2 Fire Safety Manager.

Management shall appoint a fire safety manager who is responsible for the protection of the facility from fire.

10.2.1 The fire safety manager's duties shall include the following:

(1) Pre-fire planning

(2) Life safety systems

(3) Fire prevention programs

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(4) Fire inspections

(5) Periodic property surveys

(6) Proper operation of fire suppression and detection equipment and portable fire extinguishers

10.2.2 Other duties shall include, where requested, the familiarization of the local fire department personnel with the unique aspects of telecommunications buildings and the signal-processing facilities contained therein.

10.3* Life Safety of Occupants of the Facility.

As part of the pre-fire plan, a building evacuation procedure shall be developed, exercised, and updated annually.

10.3.1 All employees shall receive orientation regarding the building evacuation procedure.

10.3.2 In circumstances regarding specially assigned tasks, orientation shall be provided.

10.4* Fire Safety of Fire Fighters.

10.4.1 Fire Department Information. Where requested by the local fire department, the following shall be provided:

(1) A general description of the telecommunications equipment within the building and how it is powered

(2) An up-to-date floor plan(s)

(3) Actions to be taken concerning ventilation and the prevention of contamination of areas not affected by the fire

10.4.2* Fire Service Orientation and Information. When requested by the local fire department, orientation and information shall be provided to the fire personnel by the company management as follows:

(1) A general description of the facilities and all the telecommunications equipment

(2) An orientation walk-through of the facility to address all the orientation and information issues to ensure that life safety and service continuity is upheld

(3) The strategy and tactics to confine, suppress, and limit an incident's impact in the telecommunications equipment area

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10.5* Damage Control Procedure.

A damage control procedure shall be developed for each telecommunications facility.

10.6* Disconnecting Power.

10.6.1 A depowering procedure shall be required for selective disconnect of portions of the facility electrical systems to provide orderly shutdown of power to increase safety of fire fighters and operating personnel and to minimize disruption of communications services to the community served *(see Sections 6.5)* and 7.5.

10.6.2 Disconnecting power to portions of the electrical systems shall be performed only after the investigation and evaluation indicates either one or both of the following:

(1) Intervention will mitigate the event.

(2) Removal of a circuit pack or power to an overloaded circuit will terminate the event.

10.7* Emergency Recovery Procedures for Continued Operations.

A recovery procedure shall be developed for each telecommunications facility.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 It is not the intent to apply this standard to the telecommunications rooms used to provide private telecommunications services. Telecommunications facilities are referred to as telephone exchanges in NFPA *101* and *NFPA 5000*. The 2009 edition of NFPA *101* classifies telephone exchanges as special purpose industrial occupancies, and the 2009 edition of *NFPA 5000* classifies telephone exchanges as industrial low.

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A.1.1.2 For calculating the signal-processing equipment area, see 6.1.3.

A.1.2.2 Fire loss records for the industry are compiled infrequently. The most current authoritative study can be found in the Federal Communications Commission Network Reliability Council Report to the Nation, Section G, 揊 ire Prevention in Telecommunications Facilities.? This report includes a compilation of fire incidents, a root cause of analysis, and recommended countermeasures and business practices. Additional information is found in Chapters 9 through 27 of the *NFPA Fire Protection Handbook*. In general, the lessons learned in the prior incidents have been incorporated into this document.

The telecommunications industry has achieved a remarkably good fire safety record over many years with the exception of a few highly visible incidents, which do not diminish the overall performance record.

A.1.3 This document contains both performance and prescriptive requirements for new buildings and installations. Existing buildings and installations were designed using prescriptive features and are difficult to summarize into one comprehensive set of prescriptive requirements. Existing buildings could benefit from an evaluation using a performance-based perspective.

The performance of the varying prescriptive standards in existing buildings has been validated over time. Care should be taken when this document is applied in existing buildings because the new prescriptive requirements could vary from the existing standard.

A.1.3.5 Protection features in excess of those features required in this document can be left in service, removed, or abandoned in place. If abandoned in place, such systems should be clearly identified as no longer being in service.

A.1.4 Users of this standard outside of the United States and Canada should be aware that telecommunications equipment and cables used in the United States and Canada have fire resistance properties that limit flame spread and fire growth.

A.1.4.2 Telecommunications facilities declared as being replaceable under Chapter 7 should not contain telecommunications equipment hazard areas that are not replaceable.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance

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with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase 揳 uthority having jurisdiction,? or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.12 VoIP, Voice over Internet Protocol. VoIP communications does not use a defined connection for the duration of the call. It is most probable that segments of the call will be routed over a variety of connections and through a variety of telecommunications facilities. The transmission of voice telecommunications using VoIP can result in a variety of telecommunications facilities (i.e., the internet cloud) being used for the completion of one call.

A.3.4.11 Technical Support Area. These areas are usually separated from the equipment area by glass or solid partitions and have one or two computer workstations where technicians program the signal-processing equipment. These areas are not occupied on a full-time basis.

A.3.4.12 Telecommunications Equipment Area. This includes hazard areas such as a signal-processing equipment area, cable entrance facility (CEF) area, power area (including batteries), main distribution frame (MDF) area, standby engine area, and technical support areas contiguous to the above hazard areas and noncontiguous technical support areas.

The tree shown in Figure A.3.4.12 assists in understanding the space/area and equipment hierarchy in telecommunications facilities.

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Telecommunications Facility

Telecommunications Equipment Area
- Cable Entrance Facility (CEF) Area
  - Cable Entrance Facility (CEF) Equipment
- Power Area
  - Power Equipment
    - Technical Support Area (contiguous with above area)
- Main Distribution Frame (MDF) Area
  - Main Distribution Frame (MDF) Equipment
    - Technical Support Area (contiguous with above area)
- Standby Engine Area
  - Standby Engine Equipment
- Signal-Processing Equipment Area
  - Switching Equipment
    - Technical Support Area (contiguous with above area)
  - Transport/Access Equipment
    - Technical Support Area (contiguous with above area)
  - Video Headend
    - Technical Support Area (contiguous with above area)
- Technical Support Area

Nontelecommunications Equipment Area
- Administrative Area
- Building Services and Support Area

FIGURE A.3.4.12 Space/Area and Equipment Hierarchy in Telecommunications Facility.

A.3.6.2 Cable Entrance Facility (CEF) Equipment. Large cables from the outside are spliced to smaller cables or wires that run to the main distribution frame or signal-processing equipment.

A.3.6.4 Main Distribution Frame (MDF) Equipment. Auxiliary equipment could include central testing equipment used to determine the electrical characteristics of the circuits.

A.3.6.6 Signal-Processing Equipment. This equipment typically includes, but is not limited to, switch and transport/access equipment, servers,

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routers, computers, and cable television equipment that establishes any form of one- or two-way communications. The equipment is generally owned or leased by a telecommunications company offering wired telephone, wireless, cable television, or internet service.

A.3.7.2 Exposure Fire. This term usually refers to a fire that starts outside a building (e.g., wildland fire or vehicle fire) and that consequently exposes the building to a fire. Exposure fires include fires starting in areas or floors occupied by other tenants of a multiple-tenant building.

A.3.7.3 Fire Model. Due to the complex nature of the principles involved, fire models are often packaged as computer software. Relevant input data, assumptions, and limitations needed to properly implement the model should be considered. The user should be aware of the limitations of the software or calculation method and not exceed these limitations.

A.3.7.4 Fire Scenario. The fire scenario describes factors critical to the outcome of the fire such as ignition sources and locations, nature and configuration of the fuel, ventilation, characteristics and locations of occupants, and condition of the supporting structure and other equipment.

A.3.7.8 Performance Criteria. Engineering terms include temperatures, radiant heat flux, and levels of exposure to fire products. Performance criteria provide threshold values that are treated as data for calculations used to develop a proposed design and implementation plan.

A.4.1.2 The hazard of adjacent tenants/occupancies should be identified and evaluated with respect to the consequences that could result from a fire or explosion exposure to the telecommunications equipment areas.

A.4.2.1 The complexity and scope of signal-processing operations can make it necessary to provide internal redundancy, alternative routing, and in some cases dual access terminal in order to prevent communication outages.

A.5.1.1 The objectives of this standard are as follows:

(1) Provide fire protection measures so that the risk of injury or death due to fire in a telecommunications facility is comparable to the levels of risk abatement for similar business-type uses

(2) Provide fire protection measures so that telecommunications equipment is not damaged due to a fire to a point that the damage will have an unacceptable impact on network operation

(3) Provide fire protection measures so that property is not damaged due to a fire to a point that the damage will have an unacceptable impact on property

A.5.1.2 Qualifications should include experience, education, and credentials that demonstrate knowledgeable and responsible use of applicable

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models and methods.

A.5.1.3 A third-party reviewer is a person(s) selected to review proposed performance-based designs.

A.5.1.5 Continued compliance with the goals and objectives of this standard involves many things. The building construction ? including openings, interior finish, and fire- and smoke-resistive construction; contents and hazards within the facility; and the facility fire protection systems ? should retain at least the same level of performance as provided by the original design parameters. The use and hazards should not change to the degree that assumptions made about life safety and network reliability characteristics, combustibility of furnishings, and existence of trained personnel are no longer valid.

In addition, actions provided by other personnel, such as emergency responders, should not be diminished below the documented assumed levels. Also, actions needed to maintain reliability of systems at the anticipated level should meet the initial design criteria. Significant changes in any of these factors should result in a review of the performance plan.

A.5.3.1 See Figure A.5.3.1.

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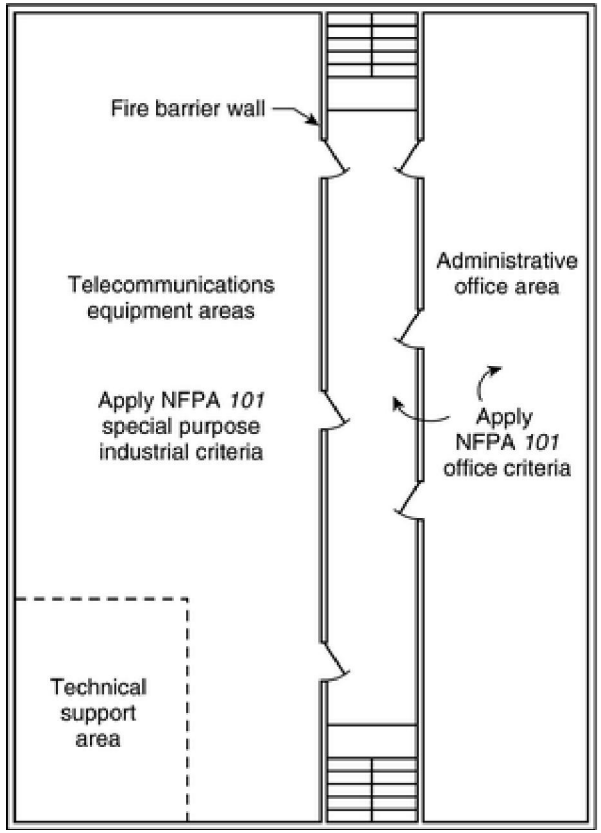

FIGURE A.5.3.1 Example of the Application of NFPA *101* to Telecommunications Equipment Areas and an Administrative Office Area.

A.5.3.2.1 One method that has been demonstrated to provide a measure of the ability of equipment to withstand elevated temperature exposure is ANSI 304. Additional information can be found in Telcordia's GR-63-CORE.

A.5.3.2.2 Acid corrosion and conductive products of combustion have been known to cause problems after fires. *(Also see Annex D.)* The

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following extract is from Barbara T. Reagor's article in the *Journal of Fire Sciences*, Reagor, B. 搭 moke Corrosivity: Generation, Impact, Detection and Protection Colloquium on Smoke Corrosivity,? (*Journal of Fire Sciences*, Baltimore, Maryland, November 7? , 1991).

In general, an electronic switch would be expected to accumulate zinc chloride levels in the range of 30 to 60 μg/in.^{2} (micrograms per square inch) from interaction with the normal environment over its expected lifetime of 20+ years. A clean product is expected to have less than 10 μg/in.^{2} of chloride contamination present. After exposure to a fire involving halogenated materials, we have observed levels that range from 30 to 6000 μg/in.^{2} As a general rule we have found that telecommunications equipment with contamination levels below 200 μg/in.^{2} can be easily restored to service with very little impact on long-term reliability. Telecommunications equipment with exposure from 200 to 600 μg/in.^{2}, can also be restored to service as long as no unusual corrosion problems arise and the environment was strictly controlled soon after the fire. However, as the contamination level rises above 600 μg/in.^{2}, the effectiveness of cleaning dwindles and the cost of cleaning quickly approaches the replacement cost of the telecommunications equipment.

A.5.4.3 This category of assumptions applies both to systems and features required by this document, that reference applicable standards, and to any additional systems or features included in the design at the discretion of the builder. The referenced standards are hereby expected to state maintenance, testing, and other requirements needed to provide positive assurance of an acceptable level of reliability. The referenced standards themselves could be prescriptive or performance based.

A.5.4.3.3 Systems addressed by this standard include automatic fire suppression systems and fire alarm systems. Performance issues that need to be documented could include response time indexes, discharge densities, and distribution patterns. Calculations should not include an unlimited supply of extinguishing agent if only a limited supply will be provided in the actual structure or building.

A.5.5 Scenarios define the challenge to which telecommunications equipment, personnel, and buildings can be exposed. Fire scenarios capture and limit value judgments on the type and severity of the fire challenge to which a proposed fire safety system should respond. The fire safety system includes any and all aspects of the proposed design that are intended to mitigate the effects of a fire, such as materials control, smoke management, egress system, automatic detection and suppression, barriers, staff training, and placement of manual extinguishers.

To provide a comprehensive design (i.e., demonstrate how the fire safety system will respond to a variety of fires), more than one scenario needs to be considered. Scenarios are composed of an initial fire location, an ignition source, the first and second fuel items ignited, and the geometry and ventilation features of confining spaces. In telecommunications areas, the early smoke generation rate and initial growth in fire severity could be significant considerations.

It is desirable to run a wide variety of different fire scenarios to evaluate the range of effects on telecommunications equipment, personnel, and

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buildings. Fire scenarios should not be limited to a single or a couple of 搴 orst credible? fire scenarios. Scenarios should not always assume that fire safety systems will function as designed. Furthermore, failure modes and reliability of systems should be included in scenario development.

A.5.5.1.1 The scenario specifications should be as challenging as could realistically occur in the area.

A.5.5.2.1 Design fires are typically quantified in terms of their potential generation of heat, smoke, and combustion gases that are released into the environment. The generation of these products could be represented as time-based rates (heat release rates or mass production rates). A fire's heat release is partitioned between the radiative fraction and the convected fraction transported by the plume. Radiation and convection heat transfer modes control the thermal impact of the fire and should be considered. Smoke and combustion gases are the fire's mass effluent and are generically termed *species*. In any particular fire scenario, species such as particulate smoke, CO, HCl, HBr, HF, and so forth could be important in terms of telecommunications equipment survivability and life safety hazard and should be quantified when indicated.

Heat release rates and species generation rates for specific burning objects can be obtained from the following:

(1) Full-scale fire tests

(2) Estimations from correlation

(3) Generic fire curves (*t*-squared curves)

(4) Predictions from fire models

(5) References, including the *SFPE Handbook of Fire Protection Engineering, Drysdale's Introduction to Fire Dynamics,* and the *SFPE Guide to Performance-Based Design*

Numerous data sources, fire test methods, correlation, and predictive models are available in the fire safety research and engineering literature. Specific data sources and fire test methods that could be appropriate for fire scenario development are identified in the appendices of the individual scenarios.

A.5.5.2.1.2 An example of such a scenario would have the failure or fire initiated in a component or system where damaging combustion products would be generated and transported to a nearby critical target. Fire could spread to other components located on different racks or cabinets, depending on the fire exposure from the initially ignited component or systems and the ignition properties of the exposed materials.

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Factors to be considered in developing design fire curves for component or systems fire scenarios include the following:

(1) Chemical composition of wiring insulation, circuit boards and substrates, and electrical components

(2) Species generation rates of overheated, electrically energized components or devices

(3) Heat release rate and species generation rates of ignited items, and the potential for fire spread to other items based on the exposure fire and the ease of ignition of other items (racks or cabinets)

Significant amounts of combustion (pyrolysis) products could be generated prior to flaming ignition with overheated, electrically energized telecommunications equipment. These products could pose a direct threat to critical network equipment. Therefore, particular attention should be placed on the pre-ignition scenario development.

Fire tests involving energized signal-processing equipment have demonstrated that where ignition is attributable to an electrical fault, such fires are slow to develop but do release great volumes of corrosive smoke soon after ignition. Products of combustion emitted during such tests included chlorine from combusted plastics, tin and lead from solder connections, zinc from transistor chip coatings, copper and bromine from circuit boards, manganese, silicon, and so forth. When combined with moisture, chlorine formed hydrochloric acid, and ionic chlorides formed electrically conducting compounds that can lead to corrosion damage and electrical shorts or signal noise in the system. [揊 ire Extinguishment Testing of Sprinkler Protected Telecommunications Equipment,? Bell Northern Research, 1987; 揂 he Special Need for a Smoke Exhaust System to Minimize Secondary Damage to Electronic Telephone Switching Equipment,? H. H. Angus & Associates, 1992.]

Research sponsored by the Nuclear Regulatory Commission and performed by Sandia National Laboratories of the effects of smoke on electronic circuit reliability was performed. The research suggests that particle deposition onto circuit packs leads to bridging and resultant current leakage that contributes to the deterioration of telecommunications equipment performance and a loss of reliability. [Tanaka, Nowlen, and Anderson, 揂 ircuit Bridging of Components by Smoke,? NUREG/CR-6476 SAND96-2633; Tanaka, 揂 ffects of Smoke on Functional Circuits,? NUREG/CR-6542 SAND97-2544.]

Two useful benchmarks in considering signal-processing equipment fires are a fully involved printed circuit board fire, which can release 5 kW, and a fully involved frame, which can release 150 kW, heat release rate. This higher heat release rate was observed in testing to Telcordia GR-63-CORE (formerly Bellcore).

A.5.5.2.1.3 The ignition is electrical in nature and caused by an electrical overload or short circuit fault. An example of such a scenario would be arcing ignition of cable insulation resulting in a growing fire and an inability to interrupt power due to failure or absence of emergency power

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disconnection. Factors to be considered in developing design fire curves for cable fire scenarios include the following:

(1) Rating of cables (plenum, riser, vertical tray, FMRC Group 1, 2, or 3 of *FMRC Specification Test Standard for Cable Insulation*, Class No. 3972, other appropriate tests)

(2) Quantity of cables

(3) Orientation of cables (vertical or horizontal)

(4) Quantity and composition of materials used in cable construction (jacketing and insulation)

(5) Presence or absence of fire-stopping materials

Literature values for heat release and species generation rates for cable fires measured in large-scale calorimeter tests can be useful as a basis for scenario and design fire development.

A.5.5.2.1.4 An example of such a scenario would be ignition of construction waste by a defective or damaged electrical extension cord igniting equipment packaging in a signal-processing equipment area or rack space. Another example would be ignition of computer equipment in an office module and failure to achieve closure of openings connecting to telecommunications equipment areas. Literature values for heat release and species generation rates for typical nontelecommunications equipment fuel packages measured in large-scale calorimeter tests can be useful as a basis for scenario and design fire development. Typical fuels and sources of data can be found in the *SFPE Handbook of Fire Protection Engineering* and in reports of full-scale tests by the Building Fire and Research Laboratories at the National Institute of Standards and Technology.

In the absence of available literature data, large-scale calorimeter tests can be conducted. In some cases, typical nontelecommunications equipment fuel package fire scenarios could be represented by 捞 tandard? *t*-squared fires commonly referred to as 捞 low, medium, fast, and ultra-fast? fires *(see NFPA 72and SFPE Handbook of Fire Protection Engineering)*. Design fire curves should include the heat release contributions of the first fuel ignited and the subsequent fuel packages associated with the scenario in question.

A.5.5.2.1.5 An example of such a scenario would be failure of a fuel line on an operating generator, vaporization of the spilled fuel on a hot surface with subsequent ignition resulting in a flash fire or deflagration. Another example of such a scenario would be an accidental spill and ignition of a flammable liquid solvent in telecommunications equipment areas and nontelecommunications equipment areas.

Factors to be considered in developing design fire curves for ignitable liquid fires include the following:

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(1) Volatility and flash point of liquid

(2) Initial quantity spilled and rate of additional liquid release

(3) Liquid surface area and burning rate

In some cases, the growth phase of ignitable liquid fire scenarios could be represented by 搒tandard? *t*-squared fires commonly referred to as 摵ast or ultra-fast? fires *(see NFPA 72and SFPE Handbook of Fire Protection Engineering)*.

Some flammable liquids with high vapor pressures can result in explosive range mixtures and damaging deflagrations. Flash fires or deflagrations can also result from accidental releases of liquids into heated environments or onto surfaces above their flash points. Overpressures from explosions and deflagrations can cause further release of fuel or failure of compartment boundaries. Guidance for determining pressure rise is provided in NFPA 68.

A.5.5.2.1.6 An example of such a scenario would be a combustible gas leaking into a cable entrance facility or vault from sources outside the telecommunications facility followed by ignition of an explosive mixture. Another example of such a scenario would be accumulation of hydrogen gas produced from battery use in an area with inadequate ventilation followed by ignition of an explosive mixture. Guidance for determining pressure rise can be found in NFPA 68.

A.5.5.2.1.7 An example of such a scenario would be a fire in a nontelecommunications third-party controlled space involving flaming ignition of stored upholstered furniture that is controlled but not extinguished by a sprinkler system. The fire compartment is open to a corridor that is common to a leased area containing telecommunications equipment such as signal-processing equipment.

Factors to consider in analysis of interior exposure fire scenarios include the following:

(1) The nature and degree of closure of the opening between compartments

(2) Integrity of fire and smoke barriers between compartments

(3) The presence or absence of telecommunications equipment in the exposed area

Experimental values of heat release rate and species generation rates for suppressed and unsuppressed full-scale compartment fires are available in the literature and can be a basis for the interior exposure fire.

A.5.5.2.1.8 An example of such a scenario would be a fire involving chemicals producing corrosive products of combustion and a failure of the

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detection system to shut down air intakes for the HVAC serving a central office facility.

Factors to consider in analysis of exterior exposure fire scenarios include the following:

(1) Existing and potential property uses of the adjacent property

(2) Property line setback (separation distance)

(3) Exposure geometry (shape factor)

(4) Radiant flux required for ignition

(5) Ignition and flame spread properties of exposed materials

(6) Degree of closure or protection of outside air intake

A.5.6.6 The performance predicted by the performance design analysis should be verified by field testing of the installed systems and subsystems. Where a fire detection system is used in a performance-based approach, system performance should be verified by test. VEWFD systems should be designed, installed, and maintained to detect the products of combustion from the Heated Wire Tests described in Annex B. EWFD systems should be designed, installed, and maintained to detect the products of combustion from the Lactose膜 otassium Chlorate Test described in Annex B.

It should be recognized that there are potential fire scenarios in most telecommunications facilities that can grow to the point where a major service interruption can occur before an effective response can be mounted by facility personnel. Examples of such scenarios include fires of incendiary origin and arcing short circuits in battery plants or other primary power systems or cables. Because fires involving these scenarios are rare, the performance objectives and design approaches in this document have been developed to provide protection against more frequently occurring scenarios.

The performance verification indicated in 5.6.6 is based in part on the criteria in BS 6266. The criteria define test fires for the VEWFD and EWFD levels of fire detection discussed in this document. The appropriate test fire is used to properly demonstrate fire detection system operation at initial acceptance and subsequent periodic system testing.

Fire detection systems should be designed, installed, and maintained to detect the test fires referenced in this section when the HVAC system serving the area is operating at normal air exchange rates, and also when the HVAC system is shut off. They should also be designed, installed,

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and maintained to detect the test fires when telecommunications equipment in the area is fully operational.

It is common practice in some companies for some areas to have minimal HVAC for energy conservation purposes. This is typical in colder regions where mechanical cooling is not necessary to relieve the heat gain from telecommunications equipment with high energy density. Fan cycling is also a typical condition for telecommunications equipment with lower energy density that does not produce as much heat (e.g., frame areas, many transmission systems). Because a fire of a given size can cause the same damage irrespective of airflow in the area, it is essential that the fire detection system be able to function in any foreseeable condition. This recommendation can also ensure adequate fire detection in the event of fan failure.

A.6.1 Figure A.6.1 provides a summary of requirements from Chapter 6.

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Telecommunications Equipment Area	Detection	Automatic Suppression	Smoke Management System	Equipment Characteristics Scenario	1	2	3	4	5	6	7	8	9	10	11	12	13	14
					Telecommunications Equipment Area													
					Common Area Containing Some or All of the Following: Signal-Processing Equipment Area, Power, Main Distribution Frame, and Contiguous Technical Support Area										Signal-Processing Equipment Area Including Contiguous Technical Support Area		Power Area Including Contiguous Technical Support Area	
					VEWFD										VEWFD		EWFD	
					No	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No		No	Yes
					No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	
Common Area Containing Some or All of the Following: Signal-Processing Equipment Area, Power, Main Distribution Frame, and Contiguous Technical Support Area	VEWFD	No	No	**1** Level A Compliant Equipment*, Wire or Cable*	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	1
		No	Yes	**2** Level A Compliant Telecommunication Equipment* Except Level C Compliant Power Equipment*, Wire or Cable*	1	NR	1	NR	1	NR	1	1	1	1	1	1	1	1
		Yes	Yes	**3** Level A Compliant Telecommunication Equipment* Except Level C Compliant Power Equipment*, Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	1	1	1
		No	Yes	**4** Level A Compliant Telecommunication Equipment* Except Level C Compliant MDF Equipment*, Wire or Cable*	1	NR	1	NR	1	NR	1	1	1	1	1	1	1	1
		Yes	Yes	**5** Level A Compliant Telecommunication Equipment* Except Level C Compliant MDF Equipment*, Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	1	1	1
		No	Yes	**6** Level A Compliant Telecommunication Equipment*, Wire or Cable* - Some Level C Signal-Processing Equipment*	1	NR	1	NR	1	NR	1	1	1	1	1	NR	1	1
		Yes	Yes	**7** Level A Compliant Telecommunication Equipment* Except Level C Compliant Power and MDF Equipment*, Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	1	1	1
		Yes	Yes	**8** Level A Compliant Telecommunication Equipment* Except Level C Compliant Power and MDF Equipment*, Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	1	1	1
		Yes	Yes	**9** Compliant Telecommunications Equipment or Wire or Cable* — Except Level C MDF and Signal-Processing Equipment, Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	1	1	1
		Yes	Yes	**10** Level C Compliant Equipment or Noncompliant Wire or Cable*	1	1	NR	1	NR	1	NR	NR	NR	NR	1	NR	1	NR
Signal-Processing Equipment Area Including Contiguous Technical Support Area	VEWFD	No	No	**11** Level A Compliant Equipment* or Wire or Cable*	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	1
			Yes	**12** Level C Compliant Equipment* or Noncompliant Wire or Cable *	1	1	1	1	1	NR	1	1	1	NR	1	NR	1	NR
Power Area Including Contiguous Technical Support Area	EWFD	No	No	**13** Level A Compliant Equipment and Wire or Cable*	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	1
		Yes		**14** Level C Compliant Equipment* or noncompliant Wire or Cable*	1	1	1	1	1	1	1	1	1	NR	1	NR	1	NR
Main Distribution Frame Including Contiguous Technical Support Area	VEWFD	No	No	**15** Level A Compliant Equipment, Wire and Cable*	NR	1	1	1	1	1	1	1	1	1	N/A	1	NR	1
				16 Level C Compliant Equipment* or Noncompliant Wire or Cable*	1	1	1	1	1	1	1	1	1	1	1	N/A	1	NR
Cable Entrance Facility	EWFD	Yes	No	**17**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		No	No	**18**	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	VEWFD	No	No	**19** Direct Termination on MDF Level A Compliant Equipment* and Wire or Cable*	NR	1	1	1	1	1	1	1	1	1	NR	1	NR	1
Standby Engine Area	STD Heat or Flame	No	No	**20** Automatic Fuel Cutoff	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Yes	No	**21** Automatic Fuel Cutoff	2	2	2	2	2	2	2	2	2	2	1	1	1	1
Nontelecommunications Equipment Area																		
Administration Area	STD	No	No	**22**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	NR	Yes	No	**23**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Building Service and Support Area	STD	No	No	**24**	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	NR	Yes	No	**25**	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Space Occupied by Third Parties	N/A	N/A	N/A	**26**	2	2	2	2	2	2	2	2	2	2	2	2	2	2

1: Rating in table refers to minimum floor, ceiling, and wall separation recommendations only. Additional separation may be required for structural elements due to building type.
2: Additional provisions may be required as per 4.1.2 in multiple-tenant buildings not controlled by telecommunications operator.
*: as per Section 8.8
NR: No rating
SABC: See applicable building code.

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FIGURE A.6.1 Telecommunications Facilities with Signal-Processing Equipment Areas Greater Than 232 m^2 (2500 ft^2).

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Telecommunications Equipment Area	Detection	Automatic Suppression	Smoke Management System	Equipment Characteristics Scenario	Telecommunications Equipment Area: Main Distribution Frame Including Contiguous Technical Support Area		Cable Entrance Facility			Standby Engine Area		Nontelecommunications Equipment Area: Administration Area		Building Service and Support Area		Space Occupied by Third Parties
	VEWFD	No	No	15	NR	1	1	2	NR	2	1	1	1	2	1	2
	VEWFD	No	Yes	16	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	17	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	Yes	18	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	19	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	20	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	Yes	21	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	22	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	23	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	24	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	25	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	No	26	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	No	27	1	1	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	Yes	28	1	N/A	1	2	1	2	1	1	1	2	1	2
	VEWFD	Yes	Yes	29	NR	1	1	2	NR	2	1	1	1	2	1	2
	VEWFD	No	No	30	1	NR	1	2	1	2	1	1	1	2	1	2
	VEWFD	No	No	31	NR	1	1	2	NR	2	1	1	1	2	1	2
	EWFD	Yes	No	32	1	NR	1	NR	1	2	1	1	1	2	1	2
	EWFD	No	No	33	1	1	NR	2	1	2	2	1	1	2	1	2
	VEWFD	No	No	34	2	2	2	NR	2	2	1	2	2	2	2	2
	STD Heat or Flame	No	No	35	2	2	2	2	2	NR	2	2	2	2	2	2
	STD Heat or Flame	Yes	No	36	1	1	1	2	1	2	NR	2	2	2	2	2
Nontelecommunications Equipment Area																
	STD	No	No	37	1	1	1	2	1	2	2	NR	NR	1	1	SABC
	NR	Yes	No	38	1	1	1	2	1	2	2	NR	NR		1	SABC
	STD	No	No	39	2	2	2	2	2	2	2	1	1	NR	NR	SABC
	NR	Yes	No	40	1	1	1	2	1	2	2	1	1	NR	NR	SABC
	N/A	N/A	N/A	41	2	2	2	2	2	2	2	SABC	SABC	SABC	SABC	SABC

Common Area Containing Some or All of the Following: Signal-Processing Equipment Area, Power, Main Distribution Frame, and Contiguous Technical Support Area

Signal-Processing Equipment Area Including Contiguous Technical Support Area

Power Area Including Contiguous Technical Support Area

Main Distribution Frame Including Contiguous Technical Support Area

Cable Entrance Facility

Standby Engine Area

Administration Area

Building Service and Support Area

Space Occupied by Third Parties

1: Rating in table refers to minimum floor, ceiling, and wall separation recommendations only. Additional separation may be required for structural elements due to building type.
2: Additional provisions may be required as per 4.1.2 in multiple-tenant buildings not controlled by telecommunications operator.
*: as per Section 8.8
NR: No rating
SABC: See applicable building code.

FIGURE A.6.1 ***Continued***

The fire protection required is based on noncombustible construction, fire ratings of major systems installed in the telecommunications areas, compartmentation of fire areas, EWFD and VEWFD systems, and effective response of trained individuals.

Traditional telecommunications industry practices for fire safety have been largely based on a chain of necessary actions and elements. Any missing action or element breaks the chain and increases the fire risk. The successful chain includes the following:

(1) Excellent fire prevention practices

(2) Noncombustible construction

(3) Compartmentation

(4) Fire-resistance-rated equipment

(5) Fire-resistance-rated cable

(6) Very early warning fire detection

(7) Rigorous alarm processing and notification

(8) Rapid response by knowledgeable personnel

(9) Power interruption

(10) Fire suppression, when needed

(11) Smoke ventilation, when needed

The prescriptive solutions found in this standard are based on maintaining this chain unbroken for the life of a telecommunications facility.

Those prescriptive solutions are based on the widespread use of fire-resistance-rated telecommunications equipment and cables. Successful fire protection of major portions of the U.S. telecommunications network includes a strong reliance on very slowly developing fires in fire-resistive equipment and cables, flawless response, and manual intervention. Rigorous implementation of that strategy and sequence has enabled large portions of the industry to compile its remarkable fire record.

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For areas in which the predominant equipment and cable is not fire resistance rated, the chain is broken. An alternative strategy is required, generally including automatic suppression systems. Indeed, segments of the industry rely upon automatic suppression systems as part of its network fire protection practices.

A.6.1.2 The prescriptive approach consists of elements including fire-resistant major telecommunications equipment systems, cable, and wire; compartmentation; fire detection; alarm processing; and manual intervention strategies as the primary means to prevent major network failure due to fire.

A.6.1.3 See Figure A.6.1.3(a) and Figure A.6.1.3(b).

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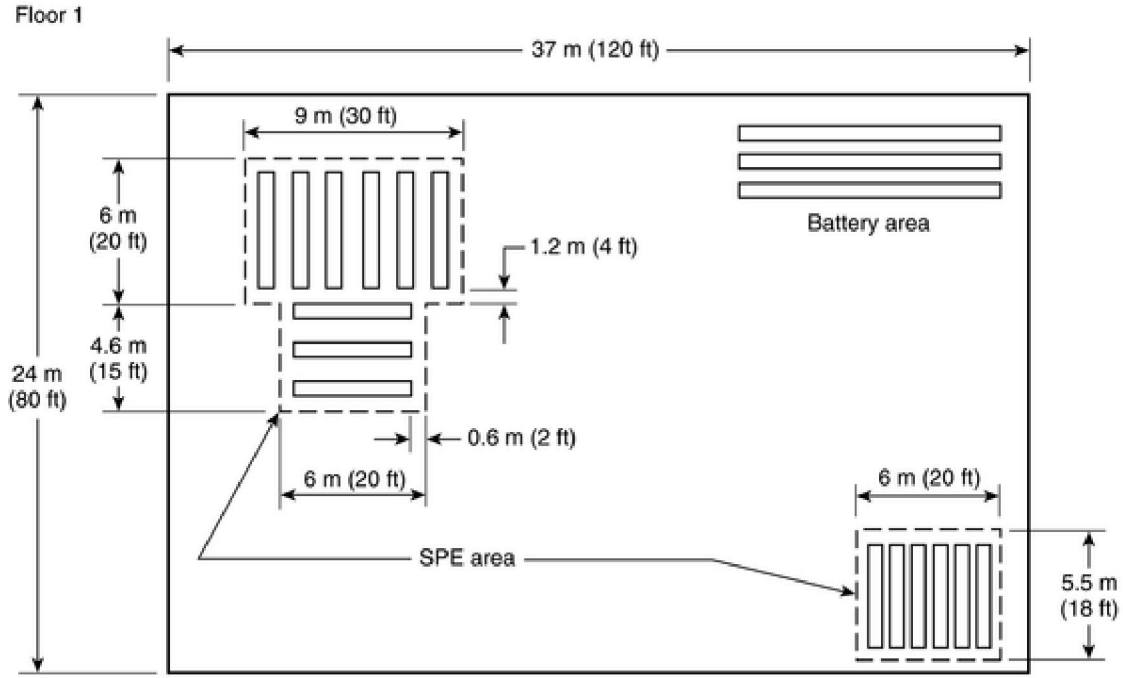

Calculated signal-processing equipment (SPE) area is 117 m^2 (1260 ft^2).
The calculations do not consider the room size.
The battery area is not an SPE area.
The 232 m^2 (2500 ft^2) threshold is not exceeded if a single story facility.

FIGURE A.6.1.3(a) Example 1 of Calculated Signal-Processing Equipment Area.

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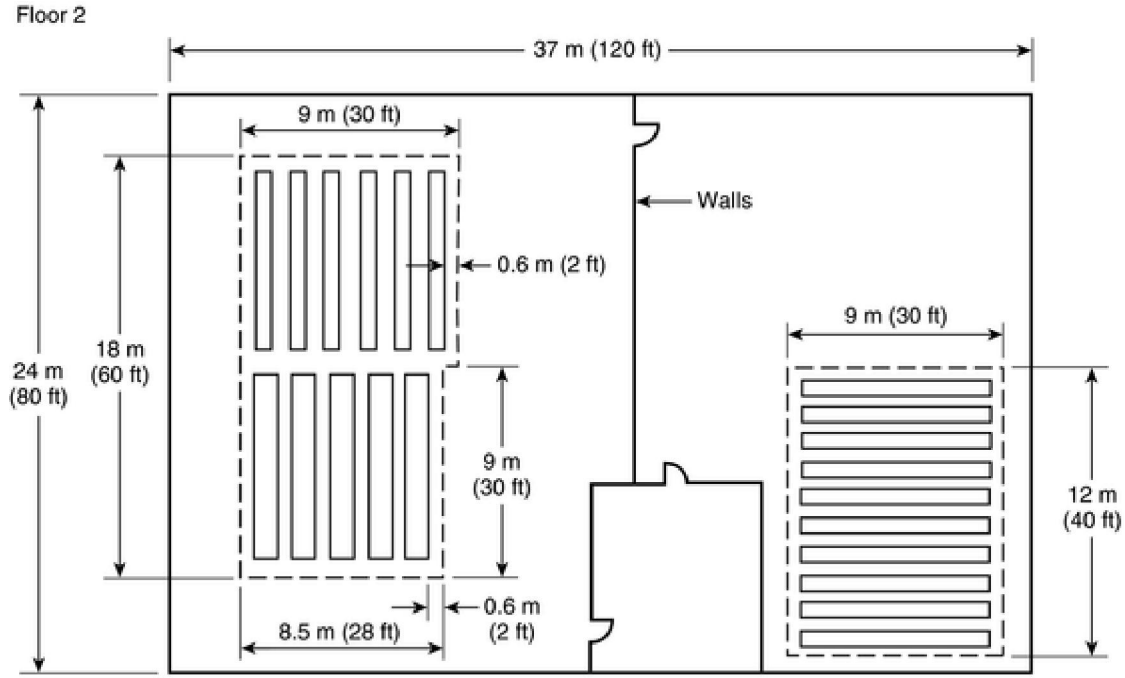

Calculated signal-processing equipment (SPE) area is 273 m^2 (2940 ft^2).
The calculations do not consider the room size.
Floor 1 and Floor 2 SPE areas in the same building should be added together to determine the accumulated SPE area in a multistory telecommunications facility.

FIGURE A.6.1.3(b) Example 2 of Calculated Signal-Processing Equipment Area.

A.6.1.4 The objective in multiple-tenant buildings not controlled by the telecommunications service providers is to ensure that the telecommunications facility is located in a building that has a low probability of a catastrophic fire loss. As such, care should be taken in selecting the host structure to house the telecommunications facility, both from a fire protection and risk consideration *(see Chapter 4)*.

A.6.3 Site selection should anticipate exposures from other hazards such as flood and earthquake.

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A.6.4 Standard 29 CFR 1910.268(b)(1)iii, 搈 elecommunications,? specifies that wiring and maintenance aisles are working spaces and are not part of the means of egress for purposes of 29 CFR 1910.34.

A.6.5 The intent is to provide a procedure and any necessary marking of disconnect equipment to remove all sources of power from specific equipment or building areas that could be electrically overloaded or involved in a fire incident. The intent is not to provide an emergency power off capability as required in Article 645 of *NFPA 70* and NFPA 75, because the use of telecommunications equipment and the consequences of disconnecting power are more severe than for the IT equipment covered by the requirements of *NFPA 70* and NFPA 75. The means to disconnect power should not be readily available to a casual occupant of the facility. It is permitted to require special knowledge of the power systems to operate the disconnecting means.

A.6.5.1 The depowering procedure often includes special marking of otherwise standard power disconnect equipment. The depowering procedure is permitted to be progressive, depending upon the severity of the incident, from circuit pack to equipment bay to area of a central office *(see Figure A.6.5.1)*.

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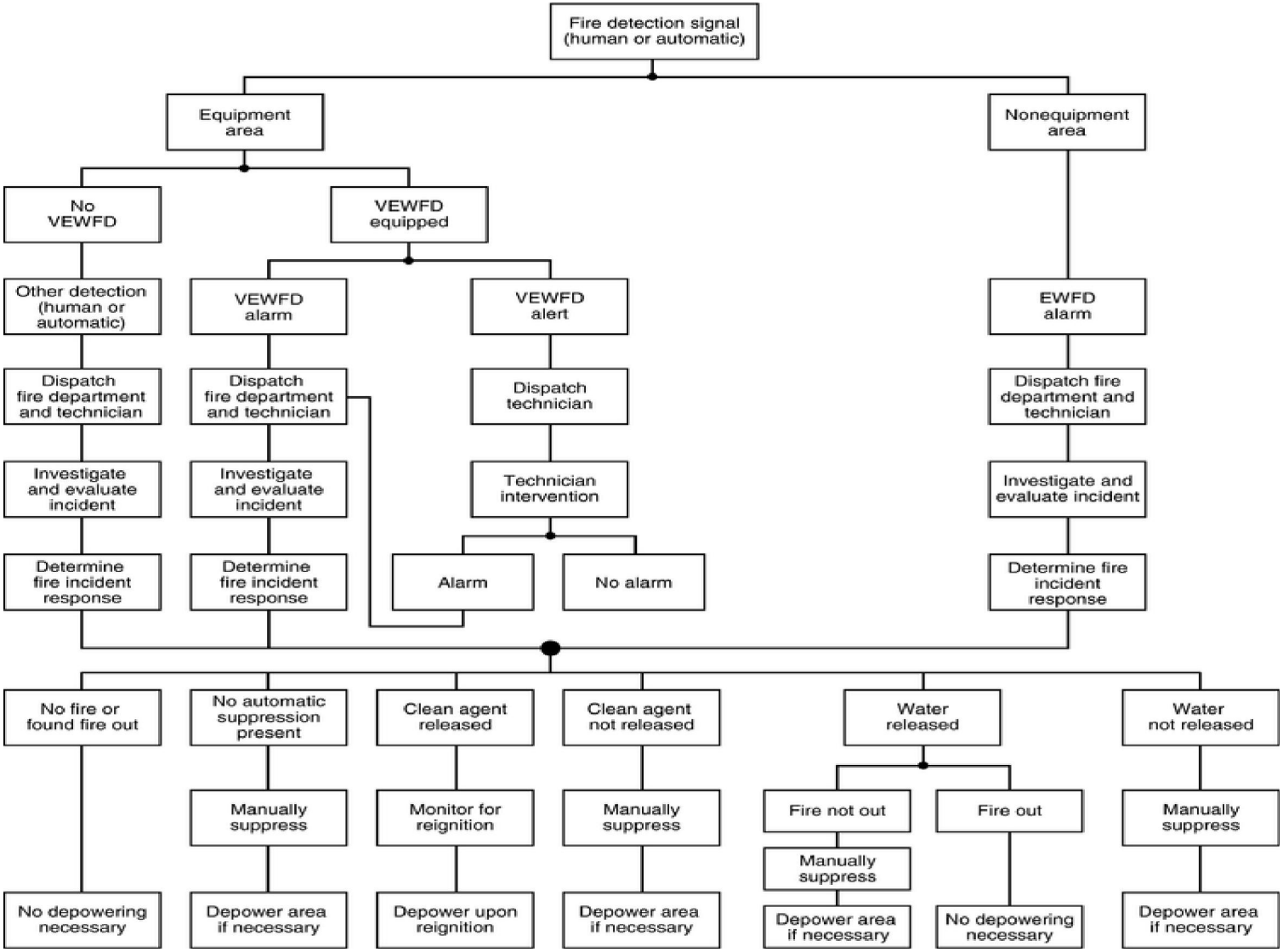
Fire detection signal (human or automatic)
Equipment area
Nonequipment area
No VEWFD
VEWFD equipped
Other detection (human or automatic)
VEWFD alarm
VEWFD alert
EWFD alarm
Dispatch fire department and technician
Dispatch fire department and technician
Dispatch technician
Dispatch fire department and technician
Investigate and evaluate incident
Investigate and evaluate incident
Technician intervention
Investigate and evaluate incident
Determine fire incident response
Determine fire incident response
Alarm
No alarm
Determine fire incident response
No fire or found fire out
No automatic suppression present
Clean agent released
Clean agent not released
Water released
Water not released
Manually suppress
Monitor for reignition
Manually suppress
Fire not out
Fire out
Manually suppress
Manually suppress
No depowering necessary
Depower area if necessary
Depower upon reignition
Depower area if necessary
Depower area if necessary
No depowering necessary
Depower area if necessary

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FIGURE A.6.5.1 Depowering Decision Tree.

A.6.5.2 Figure A.6.5.2(a) and Figure A.6.5.2(b) show typical telecommunications facility power sources indicating selective disconnect points and dc power distribution.

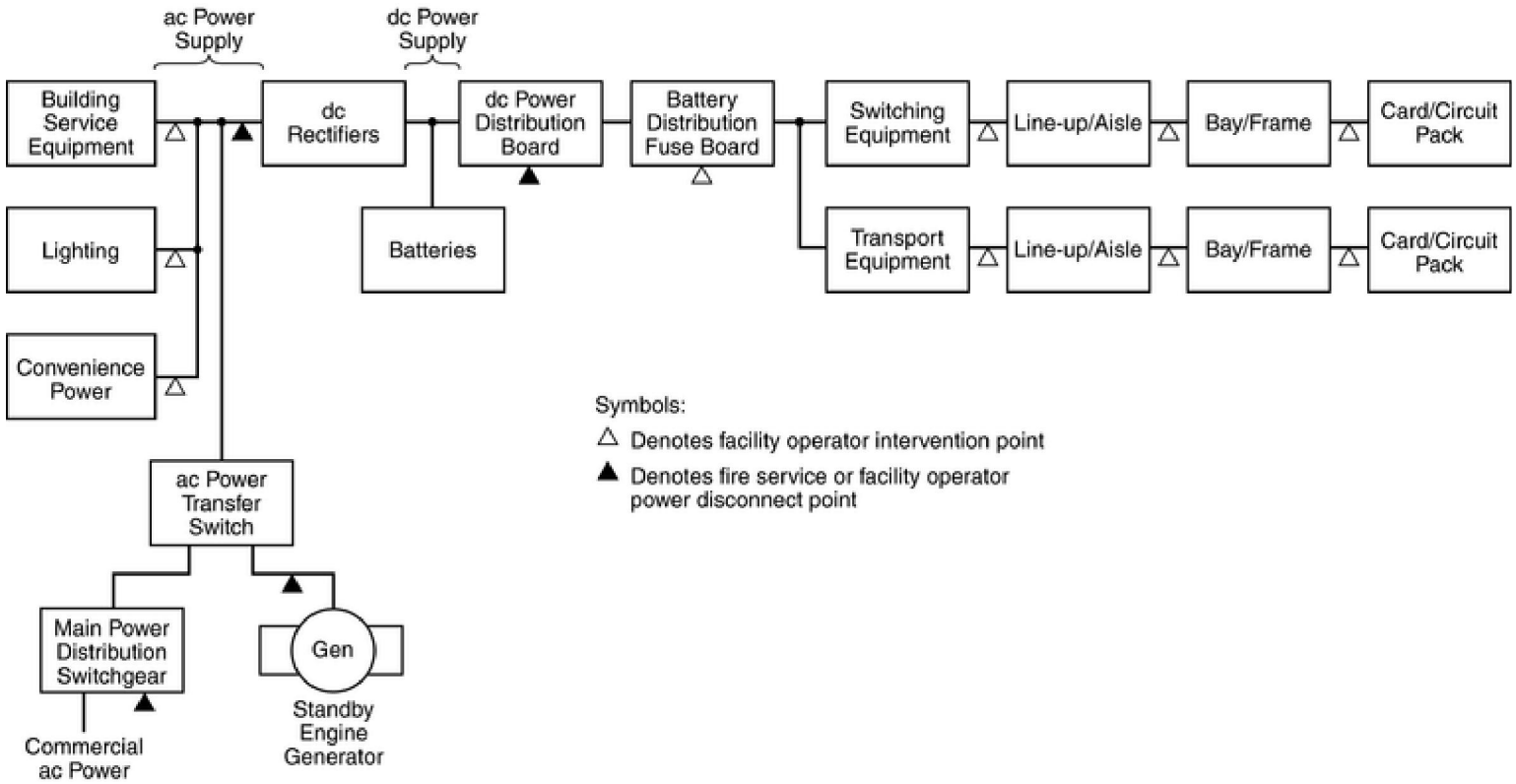

FIGURE A.6.5.2(a) Typical Telecommunications Facility Power Sources Indicating Selective Disconnect Points.

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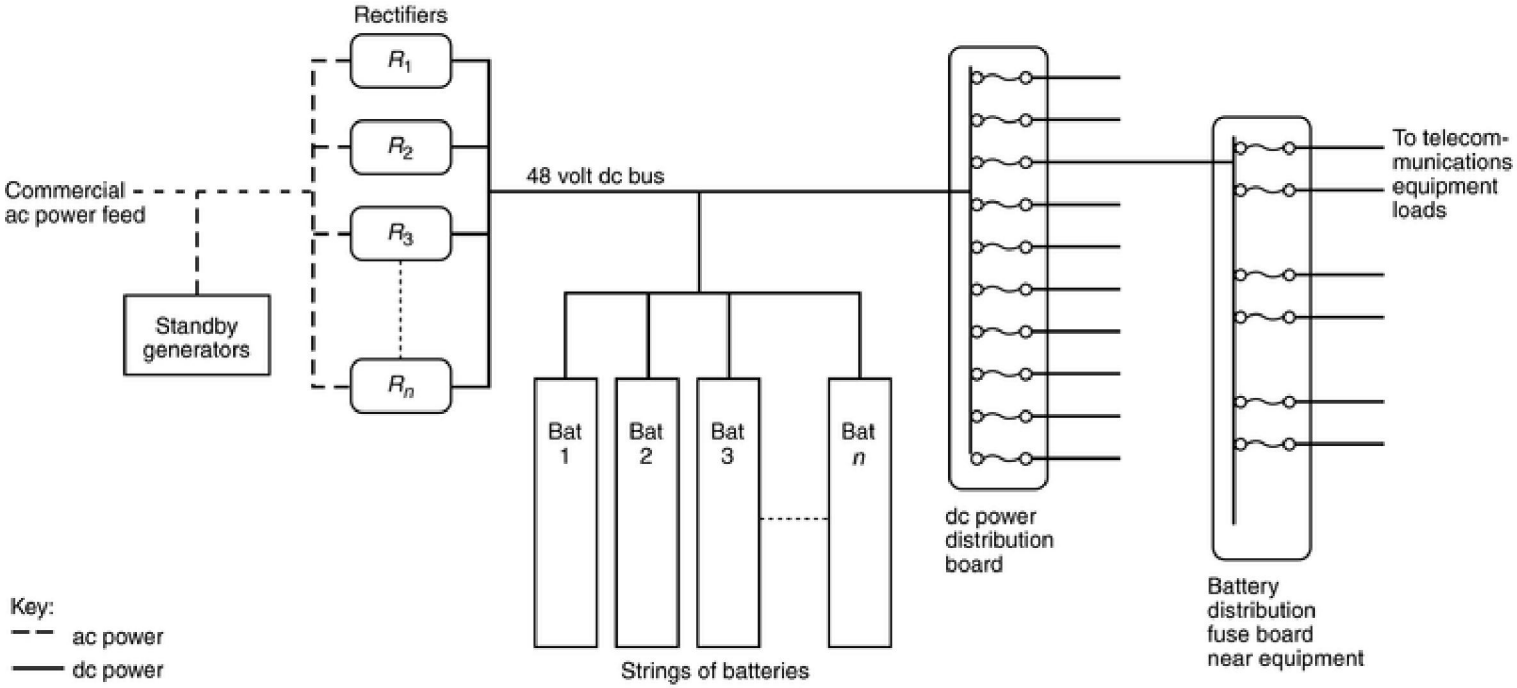

FIGURE A.6.5.2(b) Typical Telecommunications Facility dc Power Distribution.

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A.6.6.5.2 The confirmation of the presence of smoke can be accomplished by the following:

(1) Cross-zoning

(2) Time/smoke density factors

(3) Activation of multiple detectors

(4) Manual pull station in combination with detection strategy

(5) Heat detection

(6) Automatic suppression system actuation

A.6.6.7 The objective is to prevent undesirable smoke movement between compartments or areas or both while permitting HVAC operation to prevent telecommunications equipment from overheating.

A.6.6.8 HVAC operation within a fire-affected compartment is permitted until it circulates smoke that contributes to the signal-processing equipment contamination.

A.6.7.1 The telecommunications facility normally has a battery system to operate the telecommunications equipment during power failure. This enables the public to use the communication network during power failures or planned outages for equipment servicing. In selected cases, where the telecommunications company acknowledges adequate power reserve, the battery system can be used as a source for emergency lighting systems as required by NFPA *101*.

A.6.7.2 The telecommunications facility battery system is normally designed for a 3-hour battery reserve when the facility has an auto start backup generator. Longer battery reserves can be supplied when the facility is served by a portable or manual start backup generator.

A.6.8.1 Signal-processing equipment areas should be arranged to provide protection against fires in adjacent areas; to provide protection against fire spread to adjacent equipment; and to provide protection from fire, smoke, and related thermal and nonthermal equipment damage.

Large cables enter a telecommunications facility in underground ducts. These ducts can collect combustible gases and liquids and direct them toward the telecommunications facility. The cable penetrations should be sealed to prevent gas and liquid intrusion into the building.

A.6.8.2.2.3 Floor pullers should be located in break-open boxes.

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A.6.8.3 Compliance with compartmentation should be achieved in existing signal-processing equipment areas, provided rated separations and listed penetrations are practicable.

A.6.8.4.2 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in signal-processing equipment areas. Self-contained air-conditioning units should be located outside of the signal-processing equipment areas unless there is a need to place them within the signal-processing equipment areas. It is preferable to install HVAC ducts serving non-signal-processing equipment areas so that they do not pass through signal-processing equipment areas.

A.6.8.5.1 The signal-processing equipment area is designated according to the classification level of the signal-processing equipment within the area, thus determining the level of risk of fire ignition and fire spread for the area.

A.6.8.5.2 A provision of wires, cables, and signal-processing equipment that is resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.6.9.1 Cable entrance facilities should be arranged to minimize the intrusion of gas into the building, to limit the fuel load, to prevent the spread of fire and smoke to other areas, and to prevent the intrusion of unwanted electrical sheath currents.

A.6.9.3.2 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in the cable entrance facility area. Self-contained air-conditioning or heating units located inside the cable entrance facility area should not service other areas. It is preferable to install HVAC ducts serving other areas so that they do not pass through the cable entrance facility area.

A.6.9.4 Cable entering the cable entrance facility from outside normally does not have any fire-resistive properties, because it is buried and not exposed to fire. This incoming cable is then spliced to cable, which complies with 8.8.2, in order to connect to equipment elsewhere in the facility.

A.6.9.4.2 A provision of wire, cable, and equipment that are resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.6.9.5.2 A provision of signal-processing equipment that is resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.6.10.1 Power areas should be arranged to enhance the survivability of power equipment for continuity of service and be arranged to provide protection against fire and smoke spread to adjacent areas, to provide protection against fire and smoke spread to adjacent telecommunications

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equipment, and to provide for the capability to disconnect power from signal-processing telecommunications equipment to facilitate emergency intervention.

A.6.10.3.2 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in power areas. Self-contained air-conditioning units should be located outside of the power areas unless there is a need to place them within the power areas. It is preferable to install HVAC ducts serving other areas so that they do not pass through the power areas.

A.6.10.4.2 A provision of wire, cable, and equipment that is resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.6.10.5 Batteries meeting the fire resistance recommendations might not be available at the time this document is published.

A.6.10.8 Where spill containment systems are used, they should be evaluated to address flammability. The assessment should take into consideration the ignition resistance and propensity to propagate fire of the product assembly with consideration of the contribution of the components (outer encasement, absorbent materials, liners, or other components).

A previous loss investigation determined that the fire originated in the battery rack and that the flame spread was promoted by the flammability of the fabric covering on the acid spill containment bags.

ASTM E 648 can be used to determine the critical flux for propagation of flames along spill containment systems when installed on a floor. The most stringent requirement of model building or fire codes is Class 1, which has critical flux of 0.45 W/cm^2.

A.6.11.1 Main distribution frame areas should be arranged to provide protection against fires in adjacent areas, to protect against fire spread to adjacent telecommunications equipment, to provide protection from smoke and related nonthermal damage, and to enhance the survivability of the main distribution frame equipment and adjacent signal-processing equipment.

A.6.11.2.2.3 Floor pullers should be located in break-open boxes.

A.6.11.3 Compliance with compartmentation should be achieved in existing main frame distribution areas, provided rated separations and listed penetrations can be achieved.

A.6.11.4.2 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in main distribution frame areas. Self-contained air-conditioning units should be located outside of the main distribution frame areas unless there is a need to place them within the main distribution frame areas. It is preferable to install HVAC ducts serving others areas so that they do not pass through the main

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distribution frame areas.

A.6.11.5.1 The main distribution frame (MDF) consists of numerous structural frames supporting wires, cables, and MDF equipment connected together to create a large assembly. The area with the assembled MDF should be classified as Level A or Level C in accordance with 8.8.3 in order to determine the fire protection requirements.

A.6.11.5.2 A provision of wires, cable, and equipment that is resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.6.12.3.1 Standby engine areas for multiple-tenant buildings should comply with the requirements of Section 6.12. Fuel handling for the standby engines should be in accordance with NFPA 30, except that the volume requirements for tank location and fuel protection should apply to the total aggregated volume in the tank storage area.

A.6.12.4 Appropriate segregation of the fuel supply is accomplished with a thermally actuated valve or equivalent in the fuel line to the standby generator to isolate the fuel sources from the engine in the event of fire. Drainage or secondary containment systems or both should be provided to prevent fuel spills or leaks from contaminating soils or public drainage systems.

A.6.12.5 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in standby engine equipment areas. Self-contained air-conditioning units should be located outside of the standby engine equipment areas unless there is a need to place them within the telecommunications equipment areas.

A.7.1 See A.6.1.

A.7.3 Exposure protection should be provided in accordance with NFPA 80A.

A.7.6.2 If separate rooms are desired, the signal-processing equipment area should be separated with noncombustible construction.

A.7.6.3.2 The provisions of wire, cable, and equipment that is resistant to ignition and subsequent fire spread has a direct reduction on the frequency and severity of fires in telecommunications facilities.

A.7.7.2 Central building services equipment (i.e., chillers, pumps, main air handlers, boilers) should not be located in telecommunications equipment areas. Self-contained air-conditioning units should be located outside of the telecommunications equipment areas unless there is a need to place them within the telecommunications equipment areas.

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A.7.8.1 The telecommunications facility normally has a battery system to operate the telecommunications equipment during power failure. This enables the public to use the communication network during power failures or planned outages for equipment servicing. In selected cases, where the telecommunications company acknowledges adequate power reserve, the battery system can be used as a source for emergency lighting systems as required by NFPA *101*.

A.7.8.2 The telecommunications facility battery system is normally designed for a 3-hour battery reserve when the facility has an auto start backup generator. Longer battery reserves can be supplied when the facility is served by a portable or manual start backup generator.

A.8.3 Compartmentation is provided to reduce the spread of fire and smoke between the telecommunications facility and other building occupancies.

A.8.4.1.1 Alarm processing includes automatic or manual actions and responses to be performed as a result of a change in status of monitored alarm initiating devices, supervisory initiating devices, and trouble conditions.

A.8.4.1.3 In determining desired response time, whether or not a telecommunications equipment building could be unstaffed for any period of time should be considered as part of a response strategy as well as anticipated response time to an alert signal by owner or operator-designated personnel.

A.8.4.2.2.2 Generally, alert signals from VEWFD systems should not be transmitted to the municipal fire department.

A.8.4.2.2.5 Where hydrogen gas danger level, methane gas danger level, and battery room ventilation fan failure are not monitored by an alarm monitoring center complying with 8.4.1.4, they should be monitored by the fire alarm system as supervisory devices.

A.8.4.2.3.3 Trouble signals should be responded to and remedied by local, trained telecommunications personnel.

A.8.5.3.1.2.1 In general, two sensors or ports per 6.1 m × 6.1 m (20 ft × 20 ft) building bay will be necessary. This size bay is typical but not universal in many traditional central offices. Installation of sensors and ports should be determined on a case-by-case basis for buildings and enclosures that are different from the typical building bay design. The sensors or ports do not need to be located directly in the center of the bay but should be located so that they are exposed to the movement of smoke. The sensor or port should not be located within 0.9 m (3 ft) of supply duct registers. Locations selected should be visible from the floor and accessible for maintenance.

A.8.5.3.1.2.2 In areas that have cable trays between the signal-processing or MDF equipment and the ceiling, and the cable tray obstructions are such that the free flow of smoke will be inhibited to the ceiling, sampling ports or sensors should be located both at the ceiling level and below

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the cable trays to overcome this stratification. *(Refer to NFPA 72.)* In general, where stratification could be a concern, one high and one low sensor or port should be installed per building bay. See Figure A.8.5.3.1.2.2 for clarification.

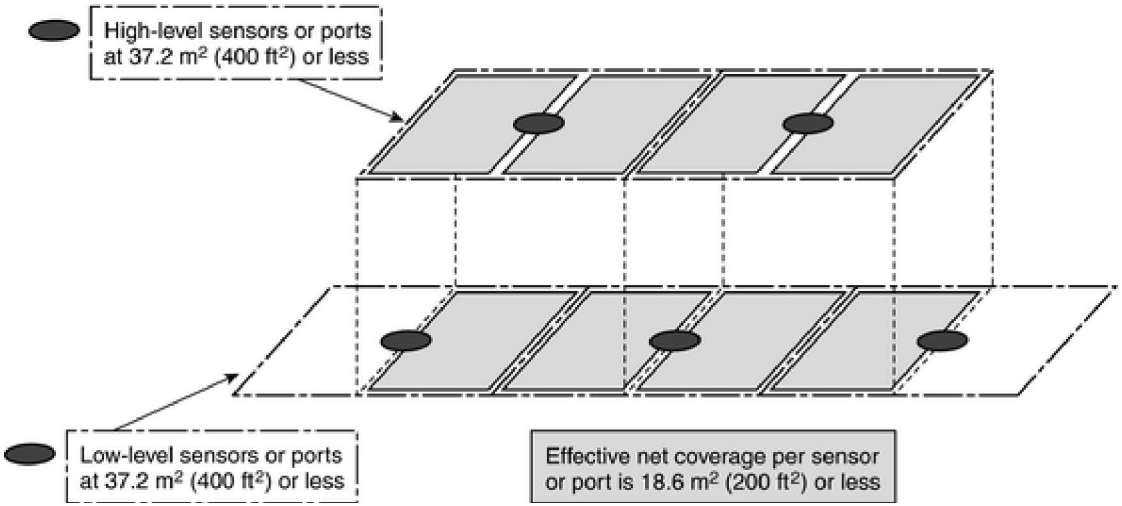

FIGURE A.8.5.3.1.2.2 Staggered Layout of Sample Ports/Sensors.

A.8.5.3.1.2.3 To increase performance, additional sensors or ports should be provided in accordance with manufacturer's requirements. *(Also see NFPA 72 for guidance on port and sensor placement.)*

A.8.5.3.1.2.4 The listed criteria at each sampling port should include the pipe air pressure, the airflow rate through that sampling port, the percentage of the total pipe flow through the sampling port, and the time needed for a smoke sample to be drawn from that sampling port to the detector.

A.8.5.3.1.2.5 Because the listed sensitivity for an air-sampling smoke detection system is that measured at the detector rather than that at each individual sampling port on its piping network, the entire piping network should be evaluated to determine the effective sensitivity at a sampling ports.

Sampling ports that draw in clean air will dilute smoke-laden air being drawn in by other ports. The accumulative effect of clean air being drawn

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through some ports causes dilution that reduces the effective sensitivity of other ports on the same pipe network. Conversely, the accumulative effect of smoke being drawn into multiple sampling ports causes the overall effective sensitivity of the air-sampling system to increase beyond the sensitivity expected at a single sampling port.

The effective sensitivity of a sampling port is a function of the total number of ports on a piping network and the percentage of those sampling smoke-laden air. As the number of ports sampling clean air increases, the effective sensitivity at individual ports on an air-sampling smoke detection system is reduced to less than the listed sensitivity of the detector unit.

The following two examples show a best and a worst credible scenario:

(1) Assuming all sampling ports will sample smoke-laden air, with all the ports in one common interior area with the smoke being uniformly mixed throughout the space by an HVAC system, the effective sensitivity of each sampling port is approximately equal to the listed sensitivity of the detector unit.

(2) Assuming that only one sampling port will sample smoke-laden air, and assuming a balanced piping network design where there is equal airflow, and thus equal sensitivity, at each sampling port, the effective sensitivity of each sampling port is the listed sensitivity of the detector unit multiplied by the total number of sampling ports.

A.8.5.3.2.1.2 In general, one sensor or port per 6.1 m × 6.1 m (20 ft × 20 ft) building bay will be necessary. This size bay is typical but not universal. The sensors or ports do not need to be located directly in the center of the bay but should be located so that they are exposed to the movement of smoke. The sensor or port should not be located within 0.9 m (3 ft) of supply duct registers. Locations selected should be visible from the floor and accessible for maintenance.

A.8.5.3.2.1.5 The listed criteria at each sampling port should include the pipe air pressure, the airflow rate through that sampling port, the percentage of the total pipe flow through the sampling port, and the time needed for a smoke sample to be drawn from that sampling port to the detector.

A.8.5.3.2.2.2 See *NFPA 72* for flame detector selection considerations.

A.8.6.1 This section provides for the use of automatic or manual fire suppression equipment as tools available to be used as fire safety elements in a fire protection plan for a telecommunications facility. Telecommunications facilities have achieved an excellent fire loss record due to the high standards of construction, compartmentation of hazards, and high quality of telecommunications equipment. This high record of reliability has been achieved mostly without the use of automatic extinguishing systems. Automatic suppression should be considered when other fire

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protection elements cannot be employed. Careful consideration should be made to recognize the impact the agent could have on the energized telecommunications equipment.

A.8.6.2.1.1 Automatic fire suppression systems provided in telecommunications facilities should be selected with due consideration of the hazards being protected and the impact of the agent on energized telecommunications equipment or on unprotected emergency responders performing depowering functions. Detection and actuation systems should be periodically reviewed in order to avoid unwanted discharges of the automatic fire suppression systems. Accidental discharge of extinguishing agents can cause damage to equipment or danger to personnel. Fire suppression agents should not cause severe damage to the telecommunications equipment. Suppression agents such as those containing dry chemical agents or corrosive wet agents in fixed systems should not be used in any area containing telecommunications equipment.

A.8.6.2.2.1 Wet pipe, dry pipe, and pre-action systems are acceptable for use in the protection of telecommunications facilities.

The introduction of wet pipe sprinkler systems in telecommunications equipment areas should be carefully controlled. In addition to the recommendations for pipe pitch in 8.6.2.2.2, galvanized steel pipe could be necessary to prevent failure of the piping system and resultant leakage of water on telecommunications equipment. Consideration should also be given to the use of dry pendent sprinklers to prevent water from residing in pipe drops, where pendent sprinklers are utilized.

The use of pre-action, double-interlocked sprinklers will minimize the risk of inadvertent water discharge.

A.8.6.2.3.1 Piping systems installed to deliver clean agents into telecommunications equipment areas should have particular attention paid to internal cleaning of the piping. Any debris discharged into the telecommunications equipment area can cause catastrophic damage to the telecommunications equipment. All piping systems should be cleaned internally after fabrication to prevent discharge of debris. Cleaning should be in accordance with the requirements of NFPA 2001 and manufacturer's recommended guidelines.

A.8.6.2.4.1 Piping systems installed to deliver halon systems into telecommunications equipment areas should have particular attention paid to internal cleaning of the piping. Any debris discharged into the telecommunications equipment areas can cause catastrophic damage to the telecommunications equipment. All piping systems should be cleaned internally after fabrication to prevent discharge of debris. Cleaning should be in accordance with the requirements of NFPA 12A and manufacturer's recommended guidelines.

A.8.6.3.1.3 Dry chemical agents and corrosive liquid agents will contaminate the signal-processing equipment and cause damage to the terminals and connectors. Experience has shown that such contamination and damage can be catastrophic to the equipment. It is recommended that any occupancy near or adjacent to telecommunications equipment areas not have dry chemical or corrosive liquid extinguishers installed.

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A.8.6.3.2 All pipes carrying water in or around telecommunications equipment should be monitored for waterflow to prevent catastrophic water damage and loss of network reliability. All hose connections should be installed outside telecommunications areas.

A.8.7.1 Where properly designed, installed, tested, and maintained, smoke management systems, including smoke control systems and smoke removal systems, should be recognized as an effective means to prevent smoke from spreading to noninvolved areas in low heat release rate fires, to minimize damage, and to facilitate search, manual fire fighting, and cleanup operations.

A system designed, installed, and maintained to provide one level of protection will not, in every case, also provide another level of protection that could be necessary for a hazard area.

Where smoke or combination fire/smoke dampers are installed in separations between hazard areas with varying smoke detection performance, additional review should be performed and/or operational strategy provided to ensure that the selected smoke control sequence is correct. While it is not recommended, it is possible that two compartments share an HVAC system. The more important area will have a smoke detection system with higher detection performance. It is possible that smoke can drift between compartments from a fire in the compartment with less sensitive smoke detection and be detected by the more sensitive smoke detection in the adjacent compartment. This should result in the dampers closing. The smoke exhaust system should start only when the smoke condition is verified in the compartment experiencing fire conditions. The improper smoke exhaust operation can result in unintended damage.

A.8.7.2 For guidance on smoke management systems, see NFPA 92A, NFPA 92B, and NFPA 204.

A.8.7.2.2 Makeup air inlets should be designed so that the velocity of the supplied air does not exceed 61 m/min (200 ft/min) and to take maximum use of the mixing and diluting effects created. If air enters the smoke layer above the interface, it should be accounted for in the exhaust calculations. Where outside air is used, consideration should be given to conditioning the outside air to provide an environment that would be similar during regular operations, to avoid temperature shocks to electronic telecommunications equipment.

A.8.7.2.3 Consideration should be given to using exhaust point(s) to reduce the possibility of smoke being drawn into noninvolved telecommunications equipment. Exhaust openings should be designed and positioned to take maximum use of the mixing and dilution effects created by the airflow in the room.

A.8.7.2.5 Periodic testing and maintenance is essential to ensure operation of the smoke management systems. For guidance, see NFPA 92A, NFPA 92B, and NFPA 204. Periodic testing frequency should be based on criticality of the smoke management system to service continuity and life safety.

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A.8.7.3 The design of the power supply and controls of the smoke management system should preclude unintentional shutdown of the smoke management system *(see Section 6.5)*.

To prevent smoke migration into telecommunications areas during fire department overhaul and to facilitate cleanup, means for smoke removal should be provided. Examples are provisions of special openings for use by fire department smoke ejectors, access panels in walls, and roof vents for gravity venting.

A.8.7.4.2 The design of the power supply and controls of the smoke management system should preclude unintentional shutdown of the smoke management system *(see Section 6.5)*.

A.8.8.1 Section 8.8 describes the procedures and test methods used to quantify ignition and fire resistance in telecommunications equipment.

Provision of telecommunications equipment that is resistant to ignition and subsequent fire spread has a direct impact on the frequency and severity of fires in telecommunications facilities.

A.8.8.2.8.4 UL 568 does not currently have any requirements for nonmetallic cable trays in plenums.

A.8.8.3 UL 60950 specifies the fire resistance of the materials used in making the equipment and therefore provides a level of protection. However, UL 60950 does not require fire safety performance testing of the final equipment configuration as Telcordia-GR-63 CORE does and does not provide assurances that the fire will not continue to propagate past a single piece of equipment as required by GR-63.

A.9.1 Inadequate housekeeping provides a potential fuel for an ignition source and allows combustibles to be closer to potential ignition sources. The basic prevention is prompt disposal of combustible materials or safe storage of these materials and periodic inspections to verify this is being done.

Telecommunications facilities should implement a level of fire prevention measures and should be constructed, maintained, and occupied in a way that reduces the likelihood of ignition and the spread of a fire by minimizing the ignition potential and reducing the fire load.

A.9.1.1 All combustibles should be kept to a minimum. Fire prevention recommendations apply to both owned and leased structures.

A.9.1.2 Such combustibles within unprotected areas and having a heat release rate greater than 500 kW represents a potential hazard even for noncritical areas of telecommunications facilities *(see annex material within NFPA 72 for various examples of heat release rates and see guidance within NFPA 1 and NFPA 241 concerning such storage)*. If such combustibles cannot practically be stored within protected areas,

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other prevention measures within this standard should be implemented to ensure that the buildup of or the amount of combustibles is limited or otherwise kept to a minimum. Areas near the ventilation system intake, or any openings (e.g., equipment doors and egress routes), are areas of greatest concern because these are places a fire could enter a building.

A.9.1.3 If the primary heating source is inadequate, the building management should take appropriate permanent action to correct the heating deficiencies.

Where portable space heaters are necessary for work activities or due to extraordinary problems with the HVAC system, they should include the following features:

(1) Electrically powered

(2) Listed

(3) De-energized upon tilt or tipover

(4) Illuminated 損 ower-on? pilot light

(5) Variable temperature control

(6) Building management approval

(7) Limited to temporary use of no more than 30 consecutive days

A.9.1.4 Heat-producing appliances can be located in an established break or food services area within a facility. Examples of portable heat-producing appliances not related to the support of telecommunications equipment include heaters, mug warmers, coffee pots, hot plates, microwave units, and refrigerators. These and other unnecessary sources of ignition should not be located in any telecommunications equipment area, computer room, individual office spaces, individual cubicles, storage areas, or shipping areas.

A.9.1.5 Smoking is defined as the carrying or use of a lighted pipe, cigar, cigarette, tobacco, or any other type of smoking substance. Examples of telecommunications equipment areas and support buildings include signal-processing areas, power and battery areas, standby engine areas, warehouse/combustible storage/staging areas, and computer rooms.

A.9.1.5.1 The fire risk analysis should include consideration of the following criteria to protect the network:

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(1) Noncombustible ash trays

(2) Noncombustible waste receptacles

(3) Ignition-resistant furnishings

(4) Commensurate detection and/or suppression

(5) Minimum 1-hour fire separation of the area

A.9.1.6 The objectives of these actions should be to reduce ignition risks and to provide appropriate fire prevention intervention strategies. Where soldering irons, heat guns, glue guns, and other similar heat-producing tools are used, they should be attended at all times when in use. Additionally, these tools should be de-energized and safely stored when not in use.

A.9.1.7 Flammable and combustible liquids such as paints, solvents, and other lubricants generally should not be permitted in telecommunications equipment facilities.

A.9.1.7.3 Noncombustible compressed gases within telecommunications equipment areas should follow the Compressed Gas Association guide for safe handling, CGA P-1.

A.9.2 Electrical powering of telecommunications equipment is exempt from the requirements of *NFPA 70. [See Section 90.2(B)(4) of NFPA 70.]*

A.9.2.2 A temporary connection is considered to be one that is less than 30 days in duration. An example of a flexible electric cord is an extension cord. If additional electrical demand is needed, the local management should be consulted.

A.9.3 Construction and alteration projects should be carefully reviewed by management to ensure conformance with all codes, regulations, and company standards. The delivery, storage, installation, testing, and cleanup associated with the installation of telecommunications equipment should be performed in a manner that exhibits the highest degree of fire safety procedures. The vendors, installers, and contractors associated with the installation of telecommunications equipment should comply with the safety standards of the telephone company during the installation of such equipment.

A.9.3.3 Where tarps are used to cover combustible construction, alteration, and installation materials, they should be listed as fire-resistive tarps.

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A.9.3.4 NFPA 25, NFPA 1, and other appropriate standards can be referenced for additional information. The delivery, storage, construction, and cleanup associated with building construction and alteration work should also be performed in a manner that complies with the telecommunications company policies. The activities of building construction contractors should be regulated by policies of the telecommunications company.

A.9.3.6 Building maintenance and janitorial staff should consider all the activities that would increase the fire load or ignition probability and should take appropriate steps to limit or remove these potential hazards.

Examples of potential hazards include flammable cleaning solvents, aerosol products, worn or frayed extension cords, improperly sized extension cords, worn-out motors, and improperly grounded equipment.

A.9.5 A review of the security procedures and compliance to internal practices should be conducted to identify any potential exposures and corrective actions that should be implemented. Access should be controlled to the building or to areas containing critical telecommunications equipment to reduce the possibility of arson. Security is a deterrent to potential arson, both from interior and external parties.

A.9.8 See NFPA 10 for selection of an appropriate portable fire extinguisher(s). Otherwise, open flames should not be permitted.

A.9.9 For new cabling installations, ac, dc, and telecommunications cables should be run in separate paths and not mixed. Where practical, unused or dead cables should be mined (removed) and discarded. Care should be taken during the removal process so as to protect the existing live cables from damage.

Infrared thermography or other like technology can be used to detect hot spots in telecommunications operations. Thermography scanning should be conducted for power boards, rectifiers, batteries, power room bus connectors, switchgear, ac/dc, and primary power supply.

A.9.9.1 The intent is to separate major cable distribution systems. In-bay or in-cabinet wiring should be installed in accordance with manufacturer's instructions.

A.9.9.3 Care should be taken during the removal process so as to protect the existing live cables from damage.

A.9.10 The review is conducted to ensure that the areas or spaces do not add an additional risk.

A.10.1.1.3 The plan is intended to ensure the safety of employees and all occupants of the facility.

A.10.3 The telecommunications company should ensure that employees receive periodic and regular orientation pertinent to their assigned

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responsibilities involving the following:

(1) Facility evacuation

(2) Facility fire prevention measures

(3) Facility fire detection systems

(4) Alarm processing

(5) Fire suppression or response to fire incidents

Fire drills should be conducted annually at the facility for all employees.

See NFPA *101* for exemptions for number of occupants.

A.10.4 Figure A.10.4 is an example of a pre-fire plan drawing.

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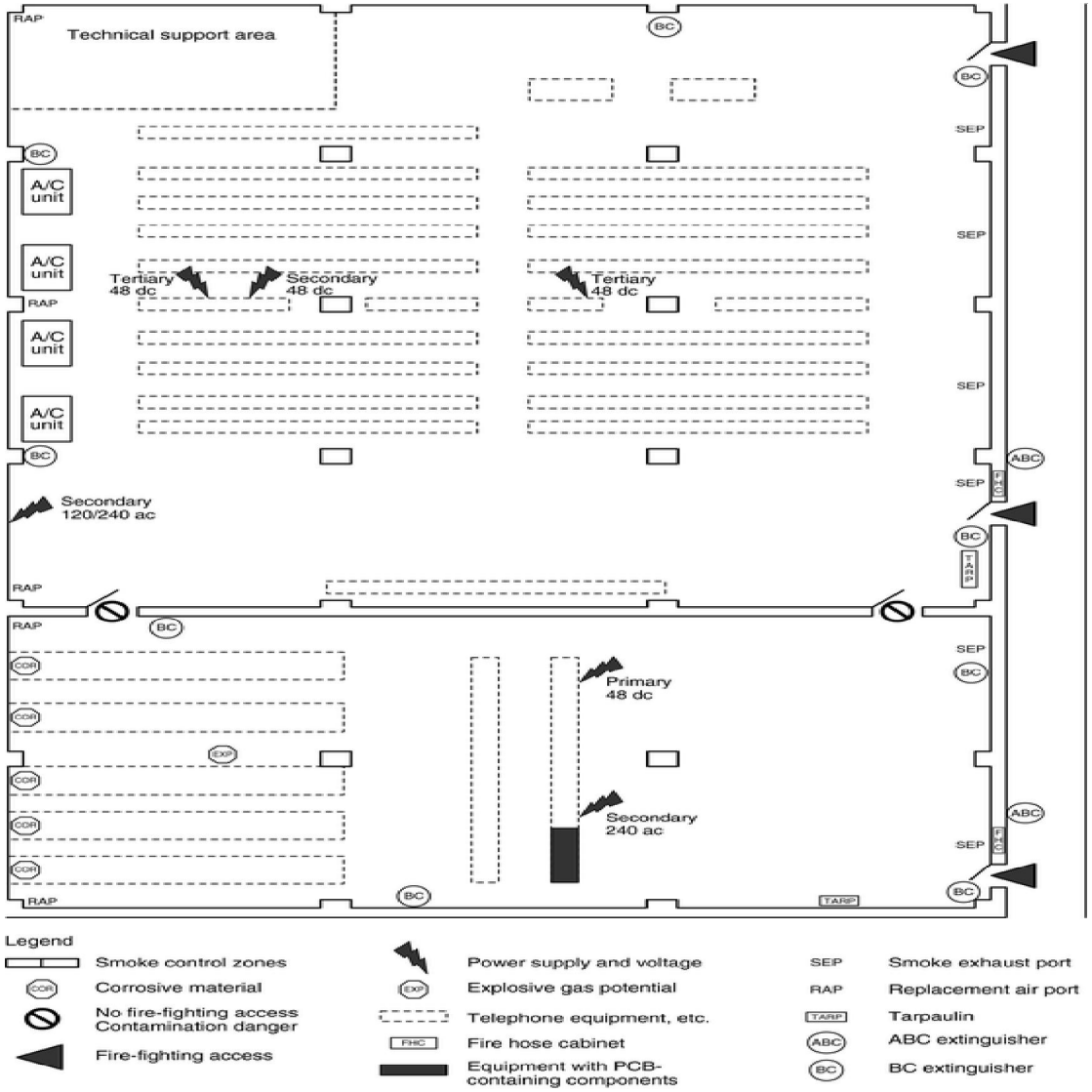
Technical support area
RAP
BC
SEP
A/C unit
Tertiary 48 dc
Secondary 48 dc
Secondary 120/240 ac
ABC
TARP
COR
EXP
Primary 48 dc
Secondary 240 ac
Legend
Smoke control zones
Corrosive material
No fire-fighting access Contamination danger
Fire-fighting access
Power supply and voltage
Explosive gas potential
Telephone equipment, etc.
FHC
Fire hose cabinet
Equipment with PCB-containing components
SEP
Smoke exhaust port
RAP
Replacement air port
Tarpaulin
ABC extinguisher
BC extinguisher

FIGURE A.10.4 Example of a Pre-Fire Plan Drawing.

A.10.4.2 Fire service orientation and information might include the review of the telecommunications equipment placement, the depowering issues, and how to perform them.

A.10.5 The purpose of this procedure, which can be a subset of the pre-fire plan, is to address methods by which damage to the telecommunications equipment can be minimized and timely restored to operation.

A damage control procedure should provide a means for the following:

(1) Preventing or minimizing damage to operations and telecommunications equipment (Whenever electronic equipment or any type of record is wet, smoke damaged, or otherwise affected by the results of a fire or other emergency, it is vital that immediate action be taken to clean and dry the electronic equipment. If the water, smoke, or other contaminants are permitted to remain in the equipment longer than absolutely necessary, the damage could be grossly increased.)

(2) A means for preventing water damage to electronic telecommunications equipment (The proper method of doing this varies according to the individual equipment design. Consideration should be given to the provision of waterproof covers, which should be stored in easily accessible locations.)

A.10.6 When developing the procedure for depowering, the possible effects of depowering on the continuity of communications services should be considered.

A.10.7 The purpose of the procedure is to ensure that if a major fire loss occurs within a telecommunications facility that affects its service, provisions have been addressed to identify critical service, alternative site locations, replacement telecommunications equipment, emergency callback of employees, temporary rerouting of services, and other functions. Further, the procedure is intended to ensure that the downtime of the telecommunications facility is kept to a minimum and that service is restored promptly. This procedure should be updated annually.

The procedure should include the following:

(1) Procedures to identify and prioritize types and levels of service affected

(2) A list of salvage telecommunications equipment suppliers, vendors, and tradespeople

(3) A current contact list of telecommunications disaster recovery specialists

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(4) A list of internal and external people or agencies assigned to assist with recovery

(5) Operations, including staff to deal with the press, fire authorities, police, and authorities that can restrict entry following a fire of suspicious origin

(6) Measures to maintain up-to-date copies of important documents in a secure off-site location (Examples of such records include but are not limited to essential business records, insurance records, building plans, and system documentation.)

(7) Procedures to identify and handle hazardous materials that can cause a health hazard or contaminate the structure or telecommunications equipment

Annex B Performance Test Procedures for Very Early Warning and Early Warning Fire Detection Systems

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Introduction.

B.1.1 Scope. Performance of the tests described in this annex can result in the release of noxious fumes, the presence of localized heat, and the introduction of a fire hazard to the tested area. Precautions should be taken to protect personnel from these potential hazards. It is the responsibility of the testing personnel to conduct testing in a manner that complies with federal, state, and local health and safety regulations.

B.1.1.1 These tests are intended to simulate the small amounts of smoke that would be created in the early stages of a fire in a telecommunications equipment area. If an actual fire were to produce the amounts of smoke produced by these tests, telecommunications companies would want to be alerted by the fire alarm system.

B.1.1.2 The tests represent a good balance between the desire to use smoke sources that are representative of the types of fires that have occurred in telecommunications equipment areas and the desire to minimize the introduction of smoke that can cause damage to operating telecommunications equipment in the area.

B.1.2 Objectives. These tests are also intended to meet the general objectives listed in B.1.2.1 through B.1.2.4.

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B.1.2.1 The tests are intended to be repeatable, in that a consistent quantity, temperature, and color of smoke is produced each time the test is performed.

B.1.2.2 The tests are intended to use test equipment that can be set up quickly in actual telecommunications facilities (i.e., in situ).

B.1.2.3 The tests are intended to prevent or minimize the potential for smoke damage to the telecommunications equipment in the room under test. They should create little or no corrosive products of combustion.

B.1.2.4 The tests are intended to avoid the creation of large amounts of smoke and gas that could pose a health threat to personnel in the test area.

B.2 Heated Wire Test.

B.2.1 This test uses an electrically overloaded PVC-coated wire to simulate the early stages of a fire. Although a PVC wire is used, hydrogen chloride vapor is unlikely to be produced in quantities significant enough to be of concern, if the test procedures herein are followed, due to the relatively low temperatures reached. If the current is applied for a longer time, or if the wire sample is shorter than stated, small quantities of hydrogen chloride can be generated. In either event, a clearly perceptible odor that should dissipate in short time is produced by the test.

The tests are based on the test specified in Section A.3 of BS 6266. The principal differences for some tests include the use of a regulated dc power supply and different wire, electrical load, and wire length.

Users are directed to Table B.2.1 to select the parameters to be used during the testing.

Table B.2.1 Heated Wire Test Parameters

	BS 6266 Test (1992)			
Parameter	**2 m Wire Test**	**1 m Wire Test**	**Modified BS 6266 Test: Two 1 m Wires in Parallel**	**North American Wire Test: North American Wire**

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Table B.2.1 Heated Wire Test Parameters

Parameter	BS 6266 Test (1992)		Modified BS 6266 Test: Two 1 m Wires in Parallel	North American Wire Test: North American Wire
	2 m Wire Test	1 m Wire Test		
Wire Specs	10 strands of 0.1 mm diameter tinned copper wire.	Total cross-sectional area of conductor is 0.078 mm^2. Insulated with PVC to a radial thickness of 0.3 mm.	Wire is very flexible due to stranded construction and highly plasticized insulation.	A single strand of 22 (twenty-two) AWG copper wire, insulated with PVC to a radial thickness of 1.1 mm (0.041 in.). This wire is stiffer than the BSI wire due to the single-strand construction and the minimally plasticized PVC insulation.
Smoke Characterization	Smoke is very light (barely visible). HCl vapor is unlikely to be produced due to the low temperature achieved in the wire. The primary constituent of the smoke is plasticizer.	More visible smoke than the 2 m test, but still very light smoke. Due to the higher temperature in the wire, a very small amount of HCl vapor will be produced.	More visible smoke than the 2 m test or the single wire 1 m test but still very light smoke. Due to the higher temperature in the wires, a small amount of HCl vapor will be produced.	More visible smoke than the BSI wire tests but still very light. A minor amount of HCl is produced but for a shorter duration than the BSI wire tests.
Test Period	180 seconds	60 seconds	60 seconds	30 seconds
Electrical Load	Constant voltage ? 6.0 volts dc, current varies from 0 to 15 amperes during the test due to changing resistance in the wire.	Constant voltage ? 6.0 volts dc, current varies from 0 to 15 amperes during the test due to changing resistance in the wire.	Constant voltage ? 6.0 volts dc, current varies from 0 to 30 amperes during the test due to changing resistance in the wire.	Constant current of 28 amperes. Voltage varies from 0 to 18 volts dc during test due to changing resistance in the wire.
Pass/Fail Criteria	Fire detection system should 揹espond? within 120 seconds of the end of the test period.		揹 lert? or 損 re-alarm? signal within 120 seconds of the end of the test period.	

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The test parameters to be used should be selected based on the detection system performance levels dictated by the performance-based analysis.

B.2.2 Test Apparatus. The test apparatus consists of the items listed in B.2.2.1 through B.2.2.4.

B.2.2.1 Wire. Table B.2.1 lists four options for wire selection and test parameters for the users to select. Test wire should be cut cleanly to the length specified in Table B.2.1.

B.2.2.2 Wire Mounting. The wire should be arranged by placing it on a noncombustible, nonconductive board, or suspending it on a noncombustible, nonconductive support. The wire should be arranged so that there are no kinks or crossovers where localized higher temperature heating can occur.

B.2.2.3 Power Supply and Leads. A regulated dc power supply should be capable of supplying a current of 0 to 30 amperes at 0 to 18 volts dc (i.e., Kenwood Model XL6524E-D). The lead wires between the power supply and the test wire(s) should be 10 AWG, 3.25 m (10.66 ft) long to avoid unacceptable voltage drop.

B.2.2.4 Stopwatch. A stopwatch or clock accurate to 1 second should be used.

B.2.3 Test Procedure.

B.2.3.1 The test should be performed in the room in which the detection system is installed, with all normal ventilation fans (e.g., fans internal to equipment, room ventilation fans) operating. Testing should also be performed with the fans turned off to simulate the potential for fan cycling and/or a power failure. This does not preclude testing required by *NFPA 72*.

B.2.3.2 Detector Programming. The detector alarm sensitivity setting (i.e., pre-alarm or alarm) used during the test should be identical to those used during normal operation of the system. Alarm verification or time delay features should be disabled during the test to permit the detector response to be annunciated immediately upon activation.

This testing is intended to verify that the detectors 捞ee? smoke in sufficient concentrations to reach the specified alarm levels. Because the test produces a small amount of smoke for a brief period of time (i.e., a puff of smoke), the use of the alarm verification or time delay features would likely result in the detector not reaching the specified alarm levels. In a 掑eal-world? fire, the smoke would continue to be produced as the fire grows, permitting the detector to reach alarm. If these features are disabled during the testing, they should be enabled at the conclusion of the

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testing before leaving the room.

B.2.3.3 Test Locations. Test locations should be selected by considering the airflow patterns in the room and choosing challenging locations for the tests (i.e., both low airflow and high airflow can be challenging). If possible, the locations and elevations of the test apparatus should be varied to simulate the range of possible fire locations in the room. Locations where the smoke would be drawn directly into the telecommunications equipment cooling ports or fans should be avoided. Locations where the smoke would be entrained into the air exhausting from an equipment cabinet are acceptable.

B.2.3.4 Positioning. The test apparatus should be positioned at the test location, and the test equipment should be secured to prevent damage.

B.2.3.5 Preparation. The test wire should be prepared by carefully removing not more than 12 mm (? in.) of the insulation from each end of the sample so that the conductor(s) is not nicked.

B.2.3.6 Mounting. The wire should be mounted on the insulating material so that there are no kinks or crossovers in the wire.

B.2.3.7 Setting. The power supply should be set to supply either a constant voltage or constant current as shown in Table B.2.3.7.

Table B.2.3.7 Heated Wire Test Electrical Specifications

Test	Voltage Setting	Current Setting	Current Application Time
2 m BSI Wire Test	6.0 volts dc	0 to 15 amperes (varies)	180 seconds
1 m BSI Wire Test	6.0 volts dc	0 to 15 amperes (varies)	60 seconds
Two BSI 6266 Wires in Parallel	6.0 volts dc	Current varies from 0 to 30 amperes during the test due to changing resistance in the wire	60 seconds
One North American Wire	Voltage varies from 0 to 18 volts dc during the test due to changing resistance in the wire	0.28 ampere	30 seconds

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B.2.3.8 Connection. The ends of the test wire(s) should be connected to the power supply leads.

B.2.3.9 Test. When all other preparations are complete, the power supply should be switched on for a period shown in Table B.2.3.7. After the appropriate current application time, the power supply should be turned off, and the test results should be observed and recorded.

To avoid burns, the wire should not be touched during the test, or for 3 minutes after turning off the power supply. If the wire is located close to HVAC registers or equipment exhaust ports, the airflow can cool the wire and result in inadequate production of smoke. In this event, either the apparatus should be repositioned or the wire should be shielded from the airflow.

B.2.3.10 Test Sequence. The test should be repeated at least three times for each HVAC condition, with the test apparatus placed in a different location in the room each time. If possible, the elevation of the test apparatus should be varied.

B.2.3.11 Pass/Fail Criteria. The pass or fail criteria for the VEWFD system should be as indicated in Table B.2.1.

B.3 Lactose膜 otassium Chlorate Test.

B.3.1 Description. The lactose杙 otassium chlorate test is one of the test methods specified in BS 6266 with modifications to the mass of mixture used for North American conditions. A mixture of 50 percent by weight of lactose and 50 percent by weight of potassium chlorate is ignited by a long-handled butane lighter to produce a small, vigorous flame and clean white smoke.

B.3.2 Test Apparatus. The test apparatus should consist of the items listed in B.3.2.1 through B.3.2.6.

B.3.2.1 Crucible or Open Cup. A noncombustible (i.e., metal, silica, or porcelain) crucible or similar cup-shaped item should be used to hold the mixture of lactose and potassium chlorate during combustion.

B.3.2.2 Support. A noncombustible surface should be used to hold the crucible upright and to insulate it from the supporting surface below.

B.3.2.3 Scale. A scale accurate to 0.1 g should be used for weighing the required mass of lactose and potassium chlorate.

B.3.2.4 Stopwatch. A stopwatch or clock accurate to 1 second should be used.

B.3.2.5 Ignitor. A long-handled butane lighter (i.e., one used to light a barbecue grill) should be used.

CAUTION:

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DO NOT USE AN ORDINARY
CIGARETTE LIGHTER ?
BURNS COULD RESULT!

B.3.2.6 Ignition Mixture. A mixture composed of equal masses of lactose and potassium chlorate should be used. (This mixture is approximately 1.4 volumes of lactose to 1 volume of potassium chlorate.) For testing EWFD systems, the mass of lactose/chlorate mixture should be 4.0 g.

B.3.3 Procedure.

B.3.3.1 Detector Programming. The detector alarm sensitivity setting (i.e., pre-alarm or alarm) used during the test should be identical to those used during normal operation of the system. Alarm verification or time delay features should be disabled during the test to permit the detector response to be annunciated immediately upon activation.

This testing is intended to verify that the detectors will 捞ee? smoke in sufficient concentrations to reach the specified alarm levels. Because the test produces a small amount of smoke for a brief period of time (i.e., a puff of smoke), the use of the alarm verification or time delay features would likely result in the detector not reaching the specified alarm levels. In a 揖eal-world? fire, the smoke would continue to be produced as the fire grows, permitting the detector to reach alarm. If these features are disabled during the testing, they should be enabled at the conclusion of the testing before leaving the room.

B.3.3.2 Test Locations. Test locations should be selected by considering the airflow patterns in the room and choosing challenging locations for the tests (i.e., both low airflow and high airflow can be challenging). If possible, the locations and elevations of the test apparatus should be varied to simulate the range of possible fire locations in the room. Locations where the smoke will be drawn directly into the telecommunications equipment cooling ports or fans should be avoided. Locations where the smoke will be entrained into the air exhausting from an equipment cabinet are acceptable.

B.3.3.3 Preparation. The required mass of lactose and potassium chlorate should be weighed into a mixing container, and mixed well by shaking or stirring to break up all lumps or clumps. The mixing container should be sealed tightly until ready to conduct the test.

B.3.3.4 Placement. The crucible should be placed on the support in the test location.

B.3.3.5 Test. When all other test preparations are complete, the required amount of mixture should be poured into the crucible, keeping it in a

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compact mound (without packing it down). The mixture should be ignited with the long-handled butane lighter.

This mixture is essentially the formula for a match head. When ignited, it burns vigorously like a match (and smells the same). Be sure to use a long lighter to avoid being burned when the mixture ignites.

B.3.4 Test Sequence. The test should be repeated at least three times for each HVAC condition, with the test apparatus placed in a different location in the room each time. If possible, the elevation of the test apparatus should be varied.

B.3.5 Pass/Fail Criteria. The EWFD system should produce an 挈 lert? or 損 re-alarm? signal within 120 seconds of the cessation of ignition.

Annex C Hazard Areas and Other Issues of Concern

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1

The hazard areas or issues that should be known when visiting a telecommunications facility are covered in C.1.1 through C.1.22.

C.1.1 Familiarizing with Hazard Areas. When visiting a telecommunications facility to determine the conditions or familiarize oneself with the nature of telecommunications hazard areas, it is wise to be aware of characteristics of the areas and hazards or issues that can be associated with them.

C.1.2 Standby Engine Area. Standby power generators are located within these areas and are used as a power source during commercial power failures. The generators are driven by engines and or turbines that are fueled using a variety of fuels including diesel, propane, natural gas, or #2 fuel oil. Fire hazards associated with liquid and gaseous fuels should be considered. Electrical hazards should also be considered, including the power generated and the starting circuit for the engine. Technicians should wear hearing protection while the engine is running. They might not hear audible fire alarm signals while the engine is running or when they are wearing hearing protection.

C.1.3 Main Distribution Frame (MDF) Area. The wiring associated with distribution frames could be combustible due to the type of wire insulation used in the past and the large surface area created by the separation of wires. The wires forming the individual telecommunications circuits are usually protected against externally induced over-voltage conditions at the main distribution frame. Cables typically enter the frame area from a cable entrance facility area below through a floor or wall. Sealing of cable penetrations and ongoing maintenance of the seals are

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necessary for integrity of the MDF area floor fire separation.

C.1.4 Cable Entrance Facility Area. An unventilated cable entrance facility area could have natural gas or methane gas accumulations having explosion potential if not properly ventilated. There is also the possibility of flammable liquids leaking into the cable entrance facility area from external fuel spills. Cable entering from outside the telecommunications facility could be combustible. Cables entering the cable entrance facility area often have metallic sheaths grounded within the vault to protect against accidental exposure of the sheath to external current sources.

C.1.5 Power Areas. Alternating current (ac) power is converted to direct current (dc) power by rectifiers and is stored in batteries to power the telecommunications equipment. The batteries provide power during commercial ac power failures. The batteries can be expected to provide power to the signal-processing equipment for several hours. Visitors should act as if the batteries are fully charged at all times. This should be a consideration even when working in or around a 揹 epowered? power area. Direct current bus bars are often not insulated, presenting a danger to personnel using metal tools or wearing metallic jewelry or watches in proximity to the bus bars. Hydrogen gas could be present and should be vented to prevent the buildup to explosive levels. Many types of batteries contain sulfuric acid.

Hydrogen gas can be produced during battery use for both flooded cell and valve regulated lead acid (VRLA) batteries. Battery areas require proper ventilation. VRLA batteries minimize acid spill potential, because the electrolyte is immobilized. The VRLA batteries do have the potential for thermal runaway. VRLA batteries need to be maintained in a properly conditioned environment and should be monitored for signs of thermal runaway, increases in charging voltage, charging current, or battery temperature, so that proper action can be taken.

C.1.6 Uninterruptible Power Systems (UPS). UPS could be present in various areas to power certain ac-powered telecommunications equipment. These are not generally considered to be power areas unless they are large and, therefore, similar to power areas.

C.1.7 Signal-Processing Equipment Areas. Signal-processing equipment provides paths and switching for data, voice, video, broadband signals, packets, and streams. Circuit boards and wiring insulation are combustible, but much of the telecommunications equipment and cables in use in North America are designed and manufactured with fire-resistant components and treatments. Many of the requirements of this standard anticipate that the signal-processing equipment, wire, and cable in use has fire resistance characteristics and ratings. The signal-processing equipment could contain both ac and dc power circuits from more than one source. The signal-processing equipment is very sensitive to products of combustion, including acid gases and soot, and is sensitive to rapid changes in conditions, including ambient temperature and humidity.

C.1.8 Security Requirements. Access to the telecommunications facility as well as to vital areas within the facility should be controlled and

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limited.

C.1.9 Environmental Equipment Concerns. Telecommunications equipment requires a controlled environment to operate properly. Abrupt changes to the environment should be avoided.

C.1.10 Multiple Power Sources. Expect voltages of 120, 208, and 240 volts ac and possibly 600 volts ac. The dc power commonly used is 48 volts, 24 volts, and even lower for some circuits.

C.1.11 External Exposures. Telecommunications equipment should not be exposed to explosion, dust, electromagnetic fields, and high-intensity radio frequency signals and should not be located adjacent to high hazard occupancies.

C.1.12 Effects of Water. Water on energized telecommunications equipment could cause permanent damage.

C.1.13 Building Support Equipment. When building support equipment is installed on floors over telecommunications equipment areas, there is the potential for liquid releases from any source (e.g., plumbing systems, water piping) to penetrate through openings in the floor and damage telecommunications equipment below. Floors should be sealed to prevent the entry of liquids. Building support equipment should not be installed over signal-processing equipment, main distribution frames, power areas, generator rooms, or cable entrance areas.

C.1.14 Nonthermal Threat. Smoke from all types of fires, in any combustible materials, poses a significant hazard to electronic telecommunications equipment and should be minimized or exhausted.

C.1.15 Limited Combustibility. Limited combustibility has typically been used for telecommunications facility construction. Much of the telecommunications equipment and cable contents could exceed the potential heat value given in NFPA 220 of 8141 kJ/kg (3500 Btu/lb) when tested in accordance with NFPA 259. The committee has cited acceptable industry standards that have been used by telecommunications service providers to limit the fire loading, flame spread, and heat release rates of combustibles in telecommunications facilities.

C.1.16 Removing Power from Telecommunications Equipment. Familiarization with the proper procedures to shut down power to telecommunications equipment should be done in concert with the telecommunications personnel who are responsible for the facility.

C.1.17 Compartmentation. Separation of sensitive electronic telecommunications equipment from other hazard areas, such as administrative office and storage areas, is important.

C.1.18 Installation Precautions. During installation of fire protection systems, protection against dust and falling objects on

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telecommunications equipment should be considered. Contact with exposed conductors and battery terminals should be prevented.

C.1.19 Alternating Current and Direct Current Power Panels and Lines. Care should be taken not to touch any electrical connections or exposed conductors to prevent electric shock hazards.

C.1.20 Static Electricity. Some signal-processing equipment is extremely sensitive to static electricity discharge. People entering telecommunications equipment areas should take care to avoid static discharge on equipment.

C.1.21 Combustible Packaging Material. Excess packaging material should be limited to a few days' supply. Typically, boxed new electronic telecommunications equipment is brought in and staged in preparation for change out of older electronic equipment. *(See Chapter 9 for guidance.)*

C.1.22 People. Telecommunications equipment areas in most facilities have a very low density of people. However, in some larger facilities, a growing number of administrative office areas can contain people in densities that are more typical of commercial office buildings.

Annex D Smoke Management

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

D.1

The following information is adapted from 揑 etwork Reliability: A Report to the Nation,? Federal Communication Commission's Network Reliability Council.

Although smoke management is applicable to all areas of a building, it is most important in the signal-processing equipment areas, main distribution frame areas, and power areas. It is estimated that 95 percent of the fire damage in telephone central offices is attributed to the smoke products and only 5 percent is caused by the thermal effect of fires. In any fire accident there is a quantity of combustion products generated before the complete suppression of the fire that can cause short- or long-term damage to sensitive telecommunications equipment. The objective of smoke management systems is the rapid confinement and elimination of the products of combustion. Therefore, the design parameters of smoke management systems are driven by telecommunications equipment vulnerability criteria and the respective smoke generation rate and transport patterns.

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The hazards associated with materials involved in fires can be defined and quantified by the heat release rate during their combustion, the rate of generation of fire products (gases, liquids, and solids), and the total amount of heat and fire products generated. In addition it is necessary to know the amount of cooling air (forced and convection) passing through equipment that will enter the smoke layer. This fire source information is necessary input to smoke movement and transport models. Information about the heat release rates and smoke yields of materials and commodities is catalogued, and methods for obtaining these values have been reported in the *SFPE Handbook of Fire Protection Engineering*. Pyrolysis and combustion models that simulate fire spread and growth have also been developed. They could be used in combination with computer models that predict the smoke movement (e.g., models for smoke detection and models predicting the descent of smoke from the ceiling to the floor, or the transport of smoke to adjacent areas). The cumulative quantity of the collected smoke, and the rate of deposition on the surfaces exposed to the combustion products as a function of time and source intensity, is used to assess the damage inflicted on sensitive telecommunications equipment.

Research and field experience have suggested a casual relationship between zinc chloride accumulation on electronic components and telecommunications equipment damage. The success of post-fire recovery and restoration of equipment exposed to smoke containing halogenated gases was found to depend strongly on the amount of zinc chloride accumulated on equipment surfaces. For electronic signal-processing equipment, levels of 30 to 60 μmg/in.^{2} were observed to accumulate over greater than 20 years of normal environmental exposure and pose no special problem. Signal-processing equipment exposed to fire gases and attaining accumulations of below 200 μmg/in.^{2} were easily restorable with little loss of reliability. Accumulation levels up to 600 μmg/in.^{2} were restorable as long as strict environmental controls were implemented soon after the fire. The cost of restoration of telecommunications equipment with accumulations above 600 μmg/in.^{2} approached the cost of the telecommunications equipment itself, with no guarantee of long-term reliability.

The goal of any smoke management solution in a telecommunications facility is the mitigation of possible service interruption consequences by reducing smoke damage to acceptable levels. The following steps are necessary to evaluate the potential damage caused by a fire and to establish quantitative criteria and objectives for any engineered solution averting smoke damage:

(1) Determination of detection time

(2) Determination of smoke control system activation

(3) Determination of the distribution of smoke spatial concentration

(4) Calculation of deposition rate of smoke products on vulnerable surfaces

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(5) Calculation of total deposition of smoke products from fire initiation until final smoke control

Currently available tools and methods provide the vehicle for the computation of these five parameters.

The next step is the selection of the most appropriate and feasible smoke management strategy that minimizes the total smoke deposition and reflects the realistic conditions of the facility.

The most appropriate considerations for telecommunications facilities are as follows:

(1) Compartmentation

(2) Early and reliable detection of smoke from flaming and nonflaming fires

(3) Automatic and reliable activation of smoke removal systems at the early stages of the fire (small flame size)

(4) Measures limiting migration of smoke into connecting areas in combination with passive smoke barriers, opposing airflow, and pressurization of surrounding area

The most attractive smoke strategy for existing facilities that are not scheduled for any other retrofit is the early smoke detection with automatic activation of smoke exhaust system. For systems that will undergo planned equipment changes, compartmentation combined with early detection and automatic exhaust system actuation could be a desirable and feasible smoke control strategy. For new facilities (new designs) ? in particular multistory, multioccupant buildings ? compartmentalization on passive or active and automatic pressurization of adjacent areas connected with the room of the fire origin would be a recommended strategy.

Annex E Pre-Fire Planning

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

E.1

Pre-fire planning for telecommunications facilities covered by this standard is an essential component for life safety considerations of its occupants and for the fire fighters providing protection for the facility. Telecommunications facilities vary both in size and complexity of

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operation. Further, the critical nature of the communications service provided by the facility might not be reflected by the variables of size and complexity of operation. In any event, achieving the objective of this section, pre-fire plans would be expected to vary significantly in details from those for a small facility and those for a large facility, as described within this standard. The plan can incorporate actions, including investigation, evaluation and mitigation of the incident, fire suppression activities, and evacuation/relocation guidelines and assignments.

A fundamental concept of effective fire protection of a telecommunications facility is the recognition that there should be a good relationship or interaction or both between the telecommunications industry provider and the emergency services provider (normally the local fire department).

Telecommunications facilities are unique occupancies that normally provide vital links for the community for emergency services through 911-type communications links and other vital government-type circuits in addition to routine communication services expected of their customers.

It is recognized that sensitivity to this and other unique services provided to the community by the facility are brought to the awareness level of the emergency services provider through pre-fire planning. Pre-fire planning for the facility by the fire officials along with the necessary interface with representatives of the facility can ensure that objectives during actual fire emergencies are accomplished effectively and efficiently with as little interruption to the service as possible.

It is recognized that as the magnitude of a fire within a facility increases, issues of depowering parts of the facility become critical to controlling the fire and minimizing life safety exposure to fire suppression officers.

Decisions regarding depowering a facility should be carefully weighed, having been considered during pre-fire planning and given full consideration to the loss of the vital community communication links. When it is deemed necessary to depower a facility or part of a facility, the pre-fire planning done for the facility will help ensure the safe and efficient accomplishment of this objective with the minimum amount of service interruption for the facility as is possible.

The pre-fire plan can also include the following:

(1) Location of all pre-fire plan documents.

(2) Location of facility's alarm panel.

(3) Completed building fact sheet including a list of emergency contacts.

(4) Specific responsibilities assigned to designated personnel, including the use of a guard service (where provided). The telecommunications

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management should ensure that guards are knowledgeable of fire emergency systems in the facility and the pre-fire plan.

(5) Depowering procedures to enable continuity of service in a fire situation by identifying the locations of electrical depowering devices. This procedure should include the following:

(a) Coded floor prints located in the pre-fire plan document and facility signage to direct fire personnel to depowering locations

(b) The method of turning off power to the following:

i. Alternating current power board (This is the primary source of electric power for a telecommunications office and is supplied by the local power company.)

ii. Standby power generator (This unit, usually a turbine or diesel generator, provides standby ac power that is transferred manually or automatically whenever a loss of ac power is experienced.)

iii. Direct current primary disconnect fuse bay (This unit distributes dc power to the secondary fuse panels throughout the central office. The secondary fuse panels feed all the operating voltages to the central office branch circuits.)

iv. Uninterruptible power supply (UPS)

v. HVAC systems serving the area

Annex F Assumptions Related to Specific Hazard Areas

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

F.1

Sections F.2 through F.9 address typical areas in telecommunications facilities and provides information that should be considered in the development of assumptions. Additional considerations can be required for specific scenarios or design situations.

F.2 Telecommunications Equipment Areas.

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Telecommunications equipment areas extending to fire safe compartmentation (either fire-rated walls or exterior walls of the facility in small facilities) could contain associated signal processing, power, main distribution frame, communications cables, and related support equipment. Telecommunications equipment areas, if occupied, are normally occupied only by employees directly supporting the equipment. The occupants are assumed to be trained, alert, and capable of self-rescue. The occupant load is assumed to be low from an egress standpoint. These areas have a low probability of fire ignition and sustainability because of the limited quantity of combustible products. If a fire does start, the items in the area that could burn include cables that when burning will produce highly corrosive products of combustion.

F.3 Signal-Processing Equipment Areas.

A signal-processing equipment area is an area in which the signal-processing equipment is located. Signal-processing equipment areas, if occupied, are normally occupied only by employees directly supporting the equipment. The occupants are assumed to be trained, alert, and capable of self-rescue. The occupant load is assumed to be low from an egress standpoint. These areas have a low probability of fire ignition and sustainability because of the limited quantity of combustible products. If a fire does start, the items in the area that could burn include cables that when burning will produce highly corrosive products of combustion.

F.4 Cable Entrance Facilities.

A cable entrance facility is the interface point between the outside plant cabling and the telecommunications equipment. These areas are normally unoccupied. Where these areas are occupied during cable alterations, it is assumed that the occupants within these areas are trained, alert, and capable of self-rescue. The occupant load is assumed to be low from an egress standpoint. These areas have the potential for accumulating combustible gases and liquids, such as methane, that enter the facility through underground cable openings.

Fires within cable entrance facilities, whether of high or low heat release rate, are a concern due to the corrosivity of the products of combustion. Combustion products generally contain acid gases and solid particulates. Effects on the reliability of electronic equipment range from degradation of performance and reduction in the expected service life to complete failure of the telecommunications equipment. Recovery methods such as reduced levels of relative humidity within the space and cleaning of the equipment have shown to minimize the detrimental effects of exposure to combustion products.

F.5 Power Areas.

These areas typically include the batteries, rectifiers, inverters, and related bus bars and cables. It is assumed that the thermal effects of a fire in

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the power equipment will be contained within the equipment. Fires in battery casings and cables are a concern due to the corrosivity of the smoke that is generated. Occupants are assumed to be trained, alert, and capable of self-rescue. The occupant load is relatively low from an egress standpoint. The fire loading of the area is low. Batteries can generate hydrogen during charging that could be an explosion hazard. It is assumed that the possibility of thermal runaway has been mitigated through battery management. Additionally, it is assumed that the hydrogen explosion hazard will be mitigated and localized by adequate ventilation of the area.

F.6 Main Distribution Frame.

The main distribution frame is a wiring frame through which customers' phone lines are physically connected to signal-processing equipment or where cable connections between signal-processing equipment are made. Replacement of a frame damaged as a result of a fire is extremely labor intensive. Occupants in this area are assumed to be trained, alert, and capable of self-rescue. The occupant load is relatively low from an egress standpoint. This area typically includes large amounts of low voltage communication wire.

Fires within main distribution frame areas, whether of high or low heat release rate, are a concern due to the corrosivity of the products of combustion. Combustion products generally contain acid gases and solid particulates. Effects on the reliability of telecommunications equipment range from degradation of performance and reduction in the expected service life to complete failure of the equipment. Recovery methods such as reduced levels of relative humidity within the area and cleaning of the telecommunications have been shown to minimize the detrimental effects of exposure to combustion products.

F.7 Standby Engine Areas.

These areas typically include internal combustion engines, generators, combustible liquids (day tank) or flammable gas, and starting batteries. It is assumed that a fire in the area is a Class B fire or a Class C fire. Occupants are trained, alert, and capable of self-rescue. The occupant load is low from an egress standpoint. Although it could be expected that a fire in this area could be a Class B liquid fuel fire, recent history has shown that fires in these areas have been Class C electrical in nature.

F.8 Technical Support Areas and Ancillary Areas.

The technical support and vendor staging areas that directly support telecommunications equipment are a part of the telecommunications areas. The occupant load is low from an egress standpoint. The typical work location consists of metal furniture with a personal computer workstation. Some amounts of file storage and catalog library are expected.

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F.9 Administrative Areas.

These areas typically include offices (i.e., administrative, accounting, engineering), mail rooms, cafeterias, and customer service operation center types of working environments. The fire loading of these areas varies from low for customer service center to medium for accounting and engineering offices. The occupant load is medium from an egress standpoint.

F.10 Building Services and Support Areas.

These areas typically include utility areas, mechanical equipment areas, the various maintenance shops, loading docks, and associated storage areas. The fire loading of these areas varies from medium for maintenance shops to high for storage areas. It is assumed that combustibles will be in accordance with 9.1.1. Characteristics requiring assumptions include occupant abilities and locations, and the nature of the thermal and nonthermal threats expected in telecommunications facilities (e.g., fuel loading and heat release rate of materials, extent of fire spread, amount and nature of smoke generated). The fuel loading and potential heat release rate of fires are dependent on the materials and equipment that are employed.

Annex G Informational References

G.1 Referenced Publications.

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